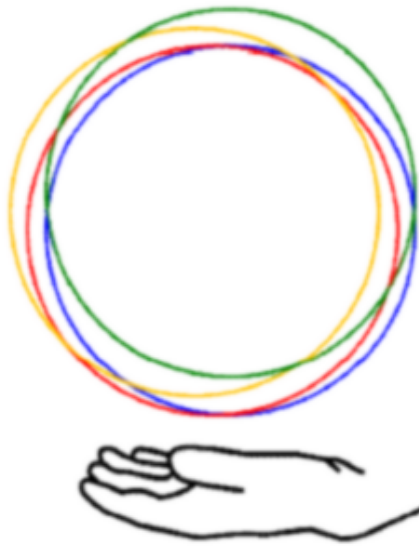


Environment and Health International



Magazine of the International Federation of Environmental Health



Global Environmental Health Faculty Forum

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on Environmental Health

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INTERNATIONAL FEDERATION OF ENVIRONMENTAL HEALTH

The **International Federation of Environmental Health** works to disseminate knowledge concerning environmental health and promote co-operation between countries where environmental health issues are trans-boundary. It promotes the interchange of people working in this sector and the exchange of Member's publications of a scientific and technical nature. Amongst other things, the Federation seeks to provide means of exchanging information and experience on environmental health, to hold Congresses and meetings to discuss subjects relevant to environmental health science and administration, to represent the interests of environmental health to state agencies, national governments and international organisations and to promote field studies of environmental health control.

HENNING HANSEN
President of IFEH



On behalf of the International Federation of Environmental Health, I extend a warm welcome to all delegates participating in this great congress, Global Environmental Health Faculty Forum – IFEH 1st World Academic Congress on Environmental Health. My sincere thanks and gratitude go to Coimbra Health School for hosting this important event and to the organizing Committee, chaired by Prof. Susana Paixao.

For many years, the IFEH has conducted World Congresses on Environmental Health and still is. The World Academic Congress on EH is the first of its kind. It is my vision that this and coming Academic World Congresses will bring the EH Academic Research and Educational Community and the Environmental Health Professionals and EH Practitioners even closer to each other. New research results could more easily be implemented in the general EH practice – as well as experience done by EH officers could more easily be implemented in research activities. In addition, this experience could be a guidance of where more research is needed. I would envisage further specific EH projects engaging IFEH and its member organizations in co-operation with universities being academic members of the IFEH. Such initiatives could as well be tightened up with the WHO, the UN and other organizations. Finally, I would envisage further co-operation between universities – both on research programs as well as educational curricula.

The Global Environmental Health Faculty Forum sets a splendid stage for moving co-operation even further and the congress provides great opportunities for the sharing and exchange of knowledge and skills on Environmental Health. The exceptional program includes keynote speakers, topical presentations and case studies on EH, and the congress will provide all delegates an up to date on the science of Environmental Health and the best available practices, new inputs and knowledge relevant to their work in the field of Environmental Health. The Congress by nature has a global outlook – an outlook that is emphasized with the presence of the World Health Organisation WHO and the United Nations UNISDR together with many more esteemed speakers.

The congress encompasses the celebration of World Environmental Health Day 26 September. The World Environmental Health Day was inaugurated by the IFEH in 2011. All over the Globe many activities are taking place in order to focus on the promotion and implementation of Environmental Health.

On behalf of the IFEH and together with the host, Coimbra Health School, we are pleased in welcoming you all at this unique event on Environmental Health. I feel confident in wishing you all a very successful conference in Coimbra - where you will feel the academic atmosphere of one of the oldest Universities in the World that is also World Heritage.

H. P. Hansen.

COIMBRA HEALTH SCHOOL

ESTeSC – Coimbra Health School is currently an organic unit of the Polytechnic Institute of Coimbra, with a history and culture of its own and presents a concept of differentiating school, looking to combine training and research in the health area. Located in Coimbra, city of knowledge and culture, and which also seeks to assert itself as a capital of health, ESTeSC is an active part in all these paths and it is in accordance with them that it educates its students. On this stroll, ESTeSC is a school that has invested in a functioning certified by quality standards. In order to do more and better, ESTeSC is the first eco-school (green flag) of European higher education, a sign that we practice day-to-day environmental sustainability.

JORGE CONDE

President of Coimbra Health School



Welcome to ESTeSC - Coimbra Health School.

ESTeSC is proud to be the host institution of the Global Environmental Health Faculty Forum. During the last year we have been working to provide the best meeting and, at the same time, add value to science and Environmental Health teaching. We hope that these days are prosperous enough to bring more knowledge, more science, but also to welcome you to Coimbra and to our school, and build the wish to visit us again. In fact, every day we work to build knowledge and to promote Environmental Health within the health sciences, but also in citizenship practices for all of us and those around us.

I thank the organizing committee, especially to Susana Paixão, for all the commitment at the organization of this meeting, that much honor ESTeSC, and the hope that will increase our projection in the world.

A handwritten signature in black ink, appearing to read 'Jorge Conde'.

GLOBAL ENVIRONMENTAL HEALTH FACULTY FORUM

Global Environmental Health Faculty Forum is an event that gather even the academia as the professionals around the world. The programme was prepared in a way to bring the state of art in the science of Environmental Health and the best available practices. Join us and celebrate the World Environmental Health Day with a large network of Environmental Health people and you will feel the academic atmosphere of one of the oldest Universities in the World, that is also World Heritage.

SUSANA PAIXÃO

Chairwoman of GEHFF



The Global Environmental Health Faculty Forum (GEHFF) is the result of a challenge released by the International Federation of Environmental Health (IFEH) to our School. It was not easy to put up the 1st World Academic Congress on Environmental Health in an economic crises scenario. But when we want we can do it...

The main topic of this Forum is Urban Health. According to World Health Organization (WHO), Urbanization is one of the leading global trends of the 21st century that has a significant impact on health. By 2050, over 70% of the world's population will live in cities. To face this challenge, wide-ranging investigation is extremely important as well as the sharing of experiences, approaches and knowledge within the field of environmental health. Over these days we will together examine and reflect upon the changes and new challenges confronting health professionals, researchers and students in the wide area of environmental safety and health.

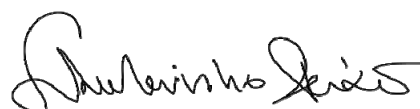
The GEHFF provides an ideal platform for debate concerning health and the environment and the rapid scientific advances which are occurring with a view to increase participation for the construction of proposals and better understanding that may safeguard a better quality of health and life to present and future generations. Therefore, the GEHFF is intended as a space for the entire technical-scientific community and all those interested in environmental health at the national and international level.

During this first Forum we will look to improve several themes developed by national and foreign specialists who have kindly accepted our invitation to participate. We are encouraged by the considerable number of specialists who are participating and take it as a good sign for future initiatives. There will also be workshops, courses, parallel sessions of talks on more diverse themes linked to environmental health as well as discussions of posters related to these issues.

Finally I would like to acknowledge the support received from the Presidency of the College of Health Technology of Coimbra and the Polytechnic Institute of Coimbra, also the International Federation of Environmental Health our scientific sponsors as well as the valuable support from numerous other institutions and organizations, finally all my colleagues from organization committee, especially to Professor João Almeida.

In conclusion, Global Environmental Health Faculty Forum will be an event that will gather even the academia as the professionals around the world. It was prepared a programme that brings the state of art in the science of Environmental Health and the best available practices. Thanks for join us in Coimbra and celebrate the World Environmental Health Day (26th of September) with a large network of Environmental Health people.

As we say in Portuguese "o meu bem haja a todos" (thanks to everyone).

A handwritten signature in black ink, which appears to read "Susana Paixão".

INTERNATIONAL FEDERATION OF ENVIRONMENTAL HEALTH MAGAZINE

KATHRYN YOUNG
Hon Editor of IFEH



This is certainly a landmark edition of the IFEH magazine as it marks the launch of the IFEH 1st World Academic Congress on Environmental Health hosted by Coimbra Health School, Portugal

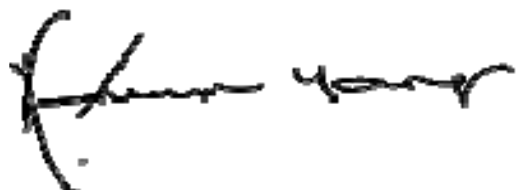
This is the first time that the Global Environmental Health Faculty Forum is presented as a stand alone initiative with the objective of bringing Environmental Health as a profession closer to the academic research community. This will ensure that evidence based research can be implemented in the general practice of Environmental Health worldwide.

An exciting and interesting program will be presented in Coimbra covering such important areas as children's exposure to polychlorinated biphenyls (pcbs) as a significant risk factor in development disorders, parental awareness of safety in the homes of under 5 years and the topic of e-cigarettes as a factor in normalizing smoking.

The Global stage is now a much smaller place than we may have thought a few years ago due to advances in technology. This has made communication at national and global levels so much easier however I feel that technology can never replace the face to face communication that one achieves at a congress such as this where partnerships can be consolidated so readily.

It is hoped that future collaborations can be initiated through these important meetings which form part of President Henning Hansen's leadership vision in promoting Environmental Health on an International Global Stage in the future.

Enjoy the congress and also the historic area of Coimbra, Portugal.

A handwritten signature in black ink, appearing to read 'Kathryn Young', written in a cursive style.

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PHOTOGRAPHS





Representants of Organizing
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Course "Managing Environmental Health in
Disaster and Humanitarian Setting"



Course "Sustainability and Public Health"



Course "Indoor Air Quality"



Environmental Health



Tu Na D'ESTES



Opening ceremony



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Chris Dijkens



Ana Pelerito



Awina Aitsi-Selwi



Bettina Borisch



Rita Sousa



Posters session



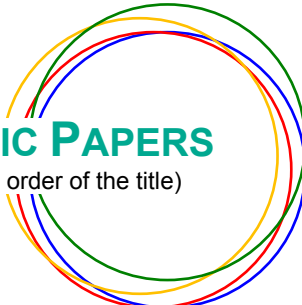
Technical visits



gala dinner



SCIENTIFIC PAPERS
(by alphabetic order of the title)

A decorative graphic consisting of several overlapping circles in various colors (green, yellow, blue, red) arranged in a circular pattern around the text.

A study of the knowledge, attitudes and practices to infectious disease and occupational health of funeral directing in Ireland

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ABSTRACT: How the deceased are handled and commemorated is deeply rooted in all religions and societies. Furthermore, respect for the dead has always been an integral part of Irish culture and heritage. On average, nearly 29,000 people die in the Republic of Ireland each year and for each death the process through burial or cremation generally takes 2-4 days. During this period the body can be handled by a number of people and include emergency workers, health workers, Gardai/Police, pathology staff, mortuary staff and funeral directing workers. Furthermore, loved ones can also handle and view the body. Therefore, the handling of a deceased person involves a number of different individuals and agencies. The process of disposing of a deceased body whether with or without an infectious disease is inevitably carried out by a Funeral Director. The Irish Funeral Industry comprises of 600 Funeral Directors with less than 100 of these being full time. There are no barriers to entry and no licensing. This is a considerable business that affects public and environmental health. Research and study on funeral directing in Ireland indicates far-reaching occupational health concerns among these professional groups.

Keywords: *Funeral Directing, Ireland, Health Protection Surveillance Centre, Infectious Disease, Occupational health and safety, Risk communication, Funeral Directors, Embalmers, Embalming*

INTRODUCTION

Normal circumstances should allow the deceased person to be quickly handled, embalmed, cremated or buried with minimal health risks to those who handle and view them. However, hazards still exist when handling deceased persons. Those handling deceased persons face an array of health and safety hazards. These include occupationally acquired infectious diseases from exposure to biological agents (Crealy, 2004). The Health Protection Surveillance Centre (HSPE) - Ireland's specialist agency for the surveillance of communicable diseases 'Guidelines for the Management of Deceased Individuals Harboring Infectious Disease' was published. (Health Protection Surveillance Centre, 2013). It offers guidelines, develops best practice and makes recommendations primarily aimed at Funeral Directing. Research was undertaken on assessing the knowledge, attitudes, values, and beliefs of the Irish funeral industry workers towards their occupational hazards and infectious disease controls in particular, their degree of compliance to the HPSC guideline document.

METHODS

An electronic questionnaire was sent to the following two professions concerned with disposal of the deceased in Ireland: Funeral Directors and Embalmers. The same questionnaire was also used in a small number of face to face sampling within some of the above groups. The sample specifically analysed responses from members of the Association of Irish Funeral Directors (AIFD) and the two main embalming industry organisations: the British Institute of Embalmers (BIE (Irish section)) and Professional Embalmers Association of Ireland (PEAI)

DISCUSSION AND RESULTS

In assessing strengths of this research and study, there were possible weaknesses in it. The response rate to the study was only 12.4% and does not compare favourably to previous studies of Funeral Directors and Embalmers. The reason for this could include the protracted nature and detail of the survey questionnaire. Added to this, general members including committee members of the three groups surveyed indicated in free conversations that responses would be low because members felt the study would reveal poor practices and were simply unwilling to acknowledge or expose these. Other research weaknesses are attributed by the AIFD participants being drawn from selected members rather than a selection of all Funeral Directors in Ireland and may reflect those who have higher participation in the industry and are more likely to follow accepted standards. The BIE (Irish section) has taken part in previous studies but the PEAI is another embalming group that has a significant presence in embalming services in Ireland.

This study shows that Embalmers have formal qualifications and this is a pre-requisite of being a member of their representative groups. Members of the AIFD are not required as part of their membership criteria to acquire their industry specific accredited qualifications (AIFD, 2014), creating a possible culture of non conformance to standards and above all creating a gap in knowledge. However, some AIFD members are trained Embalmers. Despite the existence of formal qualifications by all group members, there still remains a gap in knowledge relating to their obligation of the Health and Safety at Work Act 2005 and its relationship to other regulations and their amendments. (Government of Ireland, 2005) .

These manifested into risk assessments not being undertaken and consequently result in limited measures to eliminate or mitigate hazards. Control measures of exposure to biological agents were of particular note and included Standard Precautions not being followed, no health surveillance applied to workers, (Government of Ireland, 2003). In addition, there was limited or no hazard notification from Mortuaries to allow Funeral Directors/Embalmers to identify the level of control that is required.

These lack of control measures also extend to respondents not receiving recommended vaccinations relating to their occupational risk exposures and body bags not routinely used to transport deceased persons with confirmed infection. Moreover, most respondents have not established a sharps/splash injury emergency policy and contingency plans, spillage kits are not routinely stocked in premises and vehicles and selection and use of certain disinfectants may be ineffective or less than optimally effective (Health and Safety Executive, 2003). Funeral Directors and Embalmers are using one category of health care waste disposal method for solid waste regardless of its infection status (Health Service Executive, 2010). In addition, there is little or no risk assessment granted to family members by Funeral Directors when laying out their loved ones. Funeral Directors have indicated that embalming permits infection control on deceased persons and may imply that it is permitted to be carried out on deceased persons with Hazard Group 4 classification of Biological Agents.

The HPSC guidelines document (2013) recommends the use of the official Health Service Executive (HSE) – (Ireland’s national provider of health services) “ Notification of Death Form “ to risk communicate or give hazard notification on the infection status of the deceased person to Funeral Directors and Embalmers. Despite this, this form has not been implemented nationwide (except in one southern region hospital) and is not routinely employed in Hospital Mortuaries. This has resulted in a void in risk communication and impacts on the effectiveness of any sharps/splash injury emergency policy and contingency plan. (Health Protection Surveillance Centre, 2012). Despite this, some Mortuary Technicians offer a limited hazard notification to Funeral Directors. Mortuary Technicians have balanced this up against the deceased’s medical confidentiality and argue that limited hazard notification takes precedence over this but at the same time consider Standard Precautions as mitigating risk of infection to handlers. To compound this issue, in a Mortuary Technician’s absence, Hospital Porters release remains but do not have access to deceased person’s medical records and therefore are unable to communicate any infection. Summarily the combination of above survey findings provided support that a disjointed risk communication dynamic exists with limited or no clear risk communication protocols in existence.

Respondents indicated that embalming is carried out at the deceased’s home/domestic premises highlighting risks associated with this practice. Respondents also indicated that embalming is also carried out in Hospital Mortuaries by Mortuary staff. There is some discourse from Embalmers as to whether Mortuary staff undertaking this service are qualified. However, Mortuary Technicians expressed embalming is carried out by qualified Embalmers with the agreement of the Hospital. BIE members in particular indicated that hospitals carrying out embalming services created challenges

when Funeral Directors and Embalmers attended Mortuaries to collect remains. They indicated this was manifested by exerting influence on Funeral Directors to use their embalming services or otherwise experience delays in release of deceased persons. In addition, Embalmers have expressed that remains returned from Mortuaries that have undergone post mortem are released to Funeral Directors/Embalmers in an unsuitable state and pose an infection risk (Tallon. 2014) .

Deficiencies in facilities and building accommodation were indicated by Embalmers and included:

- Inadequate ventilation and no shower facilities
- Wall surfaces not washable or made of durable material that was easily cleaned, no automated washer disinfectant available
- No separate changing facilities, no appropriate laundering facilities and inappropriate clinical waste facilities.
- Floor surfaces are not washable or made of durable material that is easy to clean and disinfect.
- Work top surfaces are not washable or made of durable material that is easy to clean and disinfect, no dedicated wash sink for washing embalming utensils, no cleaning or sanitising facilities and no segregation between embalming Room and other areas.
- Work top surfaces are not washable or made of durable material that is easy to clean and disinfect, no dedicated wash sink for washing embalming utensils, no cleaning or sanitizing facilities and no segregation between embalming room and other areas.

The study findings suggest that Funeral Directors do not have or cannot relate their own premises to that of required specifications and best practices that are prescribed in the HPSC guidelines document (2013) and have not deliberated to this document. Respondents from the AIFD indicated that all wall and floor surfaces permit good hygiene practice in their funeral directing premises and less of these deficiencies indicated by Embalmers possibly reflecting responses from the selected AIFD survey members who participate in the industry more and are deemed to have higher standards in premises facilities. Respondents in this study indicated variable responses to their awareness of the HPSC guidelines document (2013) with Funeral Directors having the lowest cognizance of this.

In addition, previous studies indicated persons in the funeral industry calling for national guidelines on infectious disease, but when available only about 50% of respondents refer to it. This indicates that industry representative organisations, training providers, health services and regulatory occupation health bodies are not acknowledging its presence or not promoting its existence despite it being drafted as a national guideline document on infectious disease for the Irish Funeral Directing industry. Unlike the United Kingdom (UK), guidelines relating to health and safety in funeral directing are available freely and published by the National Health Service (NHS), local authorities and the Health and Safety Executive.(Health and Safety Executive 2005). Except for the HPSC guidelines document (2013), this confirms a limited acknowledgement from vested parties of the infection risks and occupational challenges faced by the Irish funeral industry.

Other occupational hazards exist and these too have been identified to be perceived as less important and centre on use of chemicals and manual handling. These have manifested in not adhering to use of chemicals legislation including codes of practice, associate regulations and amendments and consequently no risk assessments being undertaken thereupon resulting in limited or no control measures to eliminate or mitigate hazards. (Irish State Book, 2011). This has been indicated despite all AIFD members denoting they have a written Health and Safety Policy. Also respondents indicated limited conformance to the Biocides Directive. In addition, not all death care workers have received manual handling training. (Health and Safety Authority, 2013). Funeral Directors are not aware of their obligations to carry out occupational risk assessments when providing exhumation services. (Cork County Council, 2012) .

The study has identified potential pollution effects from embalming chemical and associated waste to drain and therefore suggests additional research on this. (US EPA, 2010). In addition, Enzyme Traps are not routinely used in Funeral Directing businesses. Standard Operating Procedures (SOP's) were identified in some groups but not being established in all groups surveyed. Contaminated work wear is mainly laundered using a domestic type washing machine. Manual cleaning methods are universally undertaken by embalmers and use of automated washer disinfectors is rare in the field despite

being recommended by the HPSC guidelines document (2013). All AIFD members use International Air Transport Association (IATA) guidelines on the transport of human remains.

CONCLUSION

There is a strong desire by Funeral Directors and Embalmers to be advised of infection risk or risk from Hazard Group biological agents when receiving remains from a Mortuary. They favour an identification tag placed on the deceased person's toe to identify the deceased person's infection status without being patient diagnoses specific. Respondents from all groups also favour regulation of their industry but have some concerns that the cost of registration levies to the Funeral Director/Embalming regulator could be passed onto the customer/consumer.

This research and study indicates far-reaching occupational health concerns among these professional groups. It confirms the need for occupational health and safety advice and services from its own representative bodies, funeral directing stakeholders especially health services and the occupational safety regulatory authority. In addition, the study also shows limited perceived risk from Funeral Directors and Embalmers relating to biological agents and risk transmission leading to 'systemic weak control of infection' in the handling of bodies in this regard. Of particular note, this perceived risk may be more common in smaller undertakers therefore possibly instigating a worst case scenario where a deceased person harbours a Category 3 or 4 infection, is released by a Hospital Porter and is waked at home and several people occupationally or family are exposed to and contract serious infection. There is a need for stronger guidelines in this area and for increasing the level of regulation within the profession in Ireland. These may include delaying burial/cremation until the release of the deceased's Death Certificate (shows cause of death) to permit informed risk assessment. Increasing the level of regulation can be achieved by the implementation of a funeral directing/embalming regulatory authority into Irish Statute and based on regulatory models in the United States of America. (New Hampshire Government 2014). Ebola is one of the Hazard Group 4 biological agents mentioned in the HPSC guidelines document (2013) and reminds the reader of risks to workers handling deceased persons. This further highlights the need for infection control management and better standards overall within the funeral directing industry in Ireland.

RECOMMENDATIONS

The following recommendations were prescribed in the research paper and include:

- More undertaking towards Health and Safety Legislation by all groups in funeral directing and embalming.
- Stronger commitment by Embalmers to occupational safety with regard to Biological Agents.
- Additional understanding and awareness of infectious disease legislation by all groups.
- Promotion and use of key guidance: (HPSC guidelines document 2013) in infection control in funeral directing and embalming by all groups and stakeholders.
- Acknowledgement of presence of embalming organisations in Ireland and determine their future roles in training.
- Acknowledge the presence of occupational risks in funeral directing by all vested parties including local authorities and especially health services and the regulatory occupational health authority and promotion of occupational safety within this industry.
- Inclusion of embalming representative/training groups in any consultation process when drafting any future funeral directing guidelines.

- Urgent reforms should be implemented in risk communication procedures in funeral directing especially when deceased persons are released from Mortuaries to funeral Directors/Embalmers.
- Where additional risk communication protocols cannot be invoked, delay burial/cremation until release of Death Certificate to permit informed risk assessment by Funeral Directors/Embalmers.
- HSE official Notification of the Death Form should be revised and re-drafted to include indications of possible routes of infection based on United Kingdom's 'Infection Notification Sheet'.
- Cessation of embalming in domestic premises (deceased's home).
- Ensure design of premises and its significance to health and safety and containment measures of infectious agents meets specifications in HPSC guidelines document (2013).
- Where embalming is undertaken in hospital mortuaries, develop protocols based on best practice and incorporate this service into the Hospital health service framework.
- Establish routine use of Body Bags by all groups in all circumstances.
- Address all deficiencies commonly found in funeral home premises and embalming rooms.
- Implementation of Standard Operating Procedures (SOPs) in funeral directing and embalming.
- Adherence to all components in Standard Precautions.
- No embalming and hygienic preparation on persons diagnosed with Hazard Group 4 infection status.
- Re-evaluation of current funeral directing and embalming waste disposal methods especially for infectious waste.
- Dedicated vehicles for removal of remains without shared reared accommodation for passengers with deceased persons.
- Comprehensive risk assessment offered to families by funeral directors if permitted to lay out their loved one.
- Provision of spillage kits in premises and funeral vehicles
- Undertaking of compliance in all legislative requirements including occupational safety in use of chemicals.
- Correct selection and use of disinfectants.
- Provide laundering facilities or laundering services for contaminated work wear at work premises.
- Install adequate ventilation in premises and particularly in embalming rooms.
- Undertake research on liquid waste management in funeral directing.
- Provision of vaccination for workers handling deceased persons and those potentially harbouring infectious disease.
- Undertake research on effectiveness of enzyme traps in funeral directing.
- Assign health surveillance for workers handling deceased persons harbouring infectious disease.
- All groups should establish emergency policy and contingency plans.
- Establish provision for manual handling training for transporting deceased persons to workers handling deceased persons
- Ensure occupational safety legislation is adhered to when carrying out exhumations.
- Compulsory vocational and accredited training by all members of the AIFD.

- Funeral Directors and Embalmers representative groups should lobby and educate regulatory bodies about the benefits of regulation of their industry.
- Funeral Directors and Embalmers representative groups should lobby health services for better risk communication.
- Implement funeral directing regulatory authority based on regulation models in the United States of America.

REFERENCES

- AIFD (2014). AIFD Committee member telephone interview with author- 19th December 2014.
- British Institute of Embalmers (Irish Section), (2014). Presentation: Design and Dignity Project, addressing issues on the removals from nursing homes and hospitals. November 2014.
- Cork County Council (2012) Occupational Safety, Health and Welfare Requirements for Contractors, Grave Diggers, Masons, Undertakers and Funeral Directors carrying out Works in Cork County Local Authority Cemeteries. [Internet] available at: <http://www.corkcoco.ie/co/pdf/124262049.pdf> [Accessed 26th November 2014].
- Creely.K.S. (2004).Infection Risks in Embalming. Institute of Occupational Medicine. Scotland. lomhq publishing.
- Environment, Heritage and Local Government (2007). Application for Licence to Discharge to water. Guidance applicant. Water Services Training Group. Roscrea. EHLG publishing.
- Environmental Protection Agency (USA). (2007). Guidance for Preparing Standard Operating Procedures (SOPs) [Internet] available at: <http://www.epa.gov/quality/qs-docs/g6-final.pdf> [Accessed 29th August 2014].
- Fingal County Council (2010). Water Pollution Licences and Parameters. Dublin. Fingal County Council publishing.
- Gomez F, Kabadi. CJ, Smith. CR III. (2013). Potential Pathogen Transmission on Medical Student Anatomy Laboratory Clothing. Medical Student Research Journal. 2013; 2(Spring) pp: 30-35.
- Government of Ireland (2003) S.I. No. 707/2003: Infectious Diseases (Amendment) (No. 3) Regulations, 2003. Stationery Office, Dublin.
- Government of Ireland. (2005).Safety, Health and Welfare at Work Act. Stationery Office, Dublin.
- Government of Ireland (2007). No 30 of 2007.Local Government (Water Pollution) Act, 2007. Stationery Office, Dublin.
- Grady, C.P, Lim, L and Lim, H.C (1980). Biological Wastewater Treatment. New York. Marcel Decker Inc..
- Health and Safety Authority. (2014) (A). Hazard and Risk. [Internet] available at: <http://www.hsa.ie/eng/Topics/Hazards/> [Accessed 16th May 2014].
- Health and Safety Authority. (2014) (B). REACH, Key Duties of Downstream Users. Internet] available at: http://www.hsa.ie/eng/Your_Industry/Chemicals/REACH/Downstream_users/ [Accessed 25th November 2014].
- Health and Safety Authority (2013). Guidance on the Prevention and Management of Musculoskeletal Disorders (MSDs) at http://www.hsa.ie/eng/Publications_and_Forms/Publications/Manual_Handling_and_Musculoskeletal_Disorders/Guide_on_Prevention_and_Management_of_Musculoskeletal_Disorders_MSDs_.pdf [Accessed 20th November 2014].
- Health and Safety Executive (UK) (2003). Safe Working and the prevention of infection in the Post Mortuary Room. United Kingdom. Crown Copyright.
- Health and Safety Executive (UK) (2005). Controlling the risks of infection at work from human remains. A guide for those involved in funeral services (including embalmers) and those involved in exhumation. United Kingdom. Crown Copyright.
- Health Service Executive (2010). Healthcare Risk Waste Management Segregation Packaging and Storage Guidelines for Healthcare Risk Waste. HSE.
- Hogan, J., Dolan, P., Donnelly, P. (2009) 'Introduction', in J. Hogan, P. Dolan and P. Donnelly (eds) Approaches to Qualitative Research: Theory and Its Practical Application. Cork: Oak Tree Press.
- Health Protection Surveillance Centre (2013). Guidelines for the Management of Deceased Individuals Harboured Infectious Diseases. Dublin. Health Service Executive Publications.
- Health Protection Surveillance Centre (2010). Guidelines on the Prevention and Control of Tuberculosis in Ireland. HPSC, Dublin, Ireland

- Health Protection Surveillance Centre (2011). Notifying Infectious Diseases. [Internet] <http://www.hpsc.ie/NotifiableDiseases/NotifyingInfectiousDiseases/> [Accessed 29th August 2014].
- Health Protection Surveillance Centre (2012). Guidelines for the Emergency Management of Injuries. Dublin. HPSC Publishing.
- Health and Safety Authority (2008) Guidelines on First-Aid at Places of Work. Health and Safety Authority, Dublin.
- Health and Safety Executive (2003). Safe Working and the Prevention of Infection in the Mortuary and Post-mortem room. Crown publishing.
- Health and Safety Executive (2005). Controlling the risks of infection at work from human remains: A guide for those involved in funeral services (including embalmers) and those involved in exhumation. Health and Safety Executive, UK
- Health Service Executive (2006) Infection Prevention & Control Guidelines. HSE North-East.
- Health Service Executive. (2010). Healthcare risk management segregation packaging and storage guidelines for healthcare risk waste. Dublin. HSE publishing.
- Health Service Executive (2013). Guidelines for vaccination in General Practice, 2013. [Internet] available at: <http://www.immunisation.ie/en/HealthcareProfessionals/ImmunisationGuidelines/> [Accessed 16th May 2014].
- Irish Statute Book (2003). Safety Statutory Instrument No 707 of 2003 Infectious Disease (Amendment) (no 3) Regulations 2003. Published by Office of the Attorney General. Dublin 2003.
- Irish Statute Book (2005). Safety, Health and Welfare at Work Act (2005). Published by Office of the Attorney General. Dublin 2005.
- Irish Statute Book (2007). Safety, Health and Welfare at Work (General Application) Regulations 2007. Published by Office of the Attorney General. Dublin 2007.
- Irish Statute Book (2011). 2011 Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001). Published by Office of the Attorney General. Dublin 2011.
- Irish Statute Book (2013). Statutory Instruments 572 of 2013. Safety, health and welfare at work (Biological Agents) Regulations 2013. . [Internet] available at: <http://www.irishstatutebook.ie/about.html> [accessed on 16th May 2014].
- New Hampshire Government (2014). Funeral Directors and Embalmers, State Board of Registration. CHAPTER Frl 700 Preparation Room. Statutory Authority: RSA 325:16. Part Frl 701 Requirements and Equipment.
- Tallon.G (2014). BIE Education Officer Interview with author on the 7th November 2014.
- The Irish Hospice Foundation. (2011). National Council of the Forum of end of life. The Funeral Industry in Ireland. The case for reform and regulation. Dublin. Irish hospice Foundation publications. The Royal College of Pathologists (2002). Guidelines on autopsy practice, Report of a working group of The Royal College of Pathologists. The Royal College of Pathologists, London, UK.
- United States Environment Protection Agency (2010). Funeral Home waste disposal. [Internet] available at: <http://www.epa.gov/region2/water/compliance/more.html> [Accessed 6th September 2014].
- World Health Organisation. (2006). infection control standard precautions in health care. . [Internet] available at: http://www.who.int/csr/resources/publications/4EPR_AM2.pdf [accessed 20th November 2014].
- World Health Organisation (2014). Ebola virus disease outbreak – West Africa. [Internet] available at: http://www.who.int/csr/don/2014_09_04_ebola/en/ [accessed on September 2014].
- World Health Organisation. (2014). Infectious Disease. [Internet] available at: http://www.who.int/topics/infectious_diseases/en/ [Accessed 29th August 2014]
- Young, SEJ, Healing TD. (1995) Infection in the deceased: a survey of management. CDR Review, 5, R69-73

Assessment of DNA damage on a group of firefighters

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ABSTRACT: Portugal is a country at high risk for forest fires. Firefighters are exposed to many toxic combustion products that may lead to deleterious health effects. Epidemiological studies have shown positive associations between firefighting and the development of several chronic diseases, including cancer. Results from human biomonitoring studies, particularly regarding genotoxicity are limited and inconsistent. Genotoxicity evaluation constitutes a valuable tool for studying the most important occupational hazards. The aim of the present study is to evaluate both DNA damage and oxidative stress in blood of a group of firefighters compared to the general population. Data obtained provides preliminary information on human health effects of wildland firefighting exposure at genetic and molecular level. These findings may also provide new important data to serve as public awareness to the long-term health risks involving firefighting. Implementation of security and hygiene measures in this sector as well as good practices campaigns may be crucial to decrease risk.

Keywords: *Firefighters, Occupational exposure, DNA damage, oxidative stress, comet assay*

INTRODUCTION

Firefighters are exposed to many toxic combustion products, including many known, probable or possible carcinogens, such as respirable particulate matter, benzene, benzo [a]pyrene and formaldehyde. Portugal is a country at high risk for forest fires with an annual average of 23.068 fires and a “fighting force” of about 29.703 firefighters (INE, 2013). The worst year recorded was 2005 with a total of 35.823 fires. In the summer of 2013, 16.717 fires occurred with 152.758 hectares of burn area (ICNF, 2013). Epidemiological studies strongly suggest that firefighters are at an increased risk of developing cardiovascular diseases, respiratory impairment and various types of cancer (IARC, 2010). There are a limited number of studies evaluating genotoxic effects in firefighters, the results reported are inconsistent and inconclusive (Reisen, F. & Brown, 2009). Genotoxicity evaluation constitutes a valuable tool for studying the most important occupational hazards it also allows a reasonable epidemiological evaluation of cancer predictivity.

Over the years, the Comet Assay (single-cell gel electrophoresis) has become one of the standard methods for assessing DNA damage, with applications in genotoxicity testing, human biomonitoring and molecular epidemiology, as well as fundamental research in DNA damage and repair. The comet assay is a quick, simple and sensitive assay for measuring DNA damage, at the individual cell level, that occurs in response to a genotoxic agent. It combines the simplicity of biochemical techniques with the single-cell approach typical of cytogenetic assays. The comet assay is based on the principle that strand breakage of supercoiled duplex DNA reduces the size of the large genomic DNA molecule from which these strands are separated or stretched out by electrophoresis. The high pH of the alkaline lysis step causes denaturation, unwinding of the duplex DNA and the release of DNA lesions as strand breaks (SB). These become “comets” as the broken ends of the negatively charged DNA molecule migrate towards the anode during electrophoresis (Collins *et al.*, 2014). DNA glycosylases can be added to the alkaline comet assay to measure specific DNA lesions. DNA glycosylases recognises and removes the damaged bases on the DNA chain. The resulting abasic site leads to a strand break either by the enzyme’s associated lyase activity or by the subsequent alkaline treatment. Glycosylases are either monofunctional, i.e. they remove the damaged base by cutting the glycosidic bond between the base and the sugar, or bifunctional, i.e., in addition to removing the damaged base by cutting the glycosidic bond, it also cut the DNA backbone (Ersson C., 2011). The enzyme most frequently used in

the comet assay is formamidopyrimidine glycosylase (FPG) that detects oxidized purines (e.g., 8-oxoguanine) as well as other lesions. Thus, incubation with this lesion-specific enzyme enables an estimation of net enzyme-sensitive sites related to oxidative stress. It has been demonstrated that oxidative stress may play an important role in cardiovascular disease, metabolic syndrome and on the early steps of carcinogenesis (Baur *et al.*, 2012; Khana *et al.*, 2014). This damage can be induced by reactive oxygen species (ROS) produced during metabolising processes and/or as a consequence of exposure to exogenous agents (Halliwell B., 2007). ROS may react with different biomolecules, e.g. DNA, inducing oxidative damage that may disturb the cell genomic integrity. Wood fires produce smoke with abundant particles that contain free radicals and other substances capable of generating ROS (Adetona *et al.*, 2013). In this context, the main objective of this preliminary study is to evaluate the DNA damage and oxidative stress in a group of wildland firefighters compared to controls.

MATERIALS AND METHODS

Study Population

Study population consisted of a total of 61 non-smoking male subjects, 30 firefighters (mean age \pm standard deviation (sd): 35.60 \pm 1.80; range: 22-55) and 31 controls (mean age \pm sd: 33.97 \pm 1.70; range: 19-53) ($P=0.512$; t - Student test). For each subject's relevant information on personal and medical history was assessed by questionnaire. Only participants with similar socio-demographic characteristics, without known history of chronic disease and with no history of occupational exposure to known carcinogens were chosen for this study. Subjects of the exposed group were limited to volunteer firefighters that had at least one year experience in firefighting (mean duration \pm sd: 13.53 \pm 8.39; range:1-30). Firefighters also gave specific information related to working practices, including the use of personal protective equipment (PPE) which comprise of a protective helmet, flash hood, gloves, boots and protective clothing designed to protect against fires. All subjects were fully informed about the procedures and informed consent was signed.

Genotoxicity Assessment

Alkaline Comet assay. The classical comet assay version was performed as described by Singh (1988) with minor modifications (Costa *et al.*, 2008). A medium-throughput version of the comet assay, 12-Gel Comet Assay Unit™ (Severn Biotech Ltd) was used. Briefly 5 μ L of peripheral blood was dispersed in 0.6% (w/v) low-melting point agarose and dropped onto a frosted slide pre-coated with 1% layer of normal melting point agarose. Slides were immersed into cold (4°C) lysis solution (2.5 M NaCl, 100 mM Na₂EDTA, 10 mM Tris-base, 0.25 M NaOH, pH 10; 1% Triton X100) for at least 1h at 4°C in the dark. Slides were then removed from lysis solution and incubated with electrophoresis solution (1 mM Na₂EDTA, 300 mM NaOH) for 20 min at 4°C before electrophoresis, carried out for 20 min at 30V (1.1 V/cm). Slides were then washed in PBS for 10 min and rinsed in distilled water for a further 10 min. DNA was fixed by immersing the slides in 70% ethanol for 15 min and in absolute ethanol for a further 15 min, before letting them to dry overnight. Dried slides were stained with SYBR®Gold and 150 cells (75 cells per gel) were scored using the semi-automated image analysis system Comet Assay IV (Perceptive Instruments, UK). Microscopic analyses were performed on a Nikon Eclipse E400 Epi-fluorescence microscope. The percentage of DNA in the comet tail (%TDNA) was the DNA damage parameter evaluated to describe comet formation, and represents de basal DNA damage of each subject.

Enzyme-Comet Assay. The comet assay enzyme version was performed as described by Costa *et al.* (2014). For measurement of oxidized purines, after lysis, slides were washed three times (5 min each time) with buffer F (0.1 M KCl, 0.5 mM Na₂EDTA, 40 mM HEPES, 0.2 mg/mL BSA, pH 8.0) and incubated for 30 min at 37 °C with FPG in buffer F, or with buffer F alone. The next steps were performed accordingly to the comet assay classical version described above. The percentage of DNA in the comet tail (%TDNA) was the DNA damage parameter evaluated to describe comet formation. Net FPG-sensitive sites, for each subject, were calculated by subtracting the %TDNA values obtained for buffer and for FPG.

Data analysis

All analyses were conducted using the IBM SPSS for Windows statistical package 21.0. The statistical differences between means and the relationship between categorical variables in the characteristics of the study population were assessed by Student's t -test. All results were assessed for normal

distribution using the Kolmogorov–Smirnov goodness-of-fit test and graphic evaluation (histograms, Q–Q plots, P–P plots). Net-FPG was the only parameter that departed significantly from normality and therefore the analysis of this variable was performed using non-parametric test (Mann-Whitney test); Basal DNA damage analysis was performed by Student’s t-test (parametric test). The influence of factors such as age and occupational exposure related variables (duration and hours of exposure) on the endpoints studied were evaluated by non-parametric and parametric tests (Kruskal-Wallis and ANOVA one-way analysis of variance). Associations between variables were analysed by Spearman’s rank correlation. The level of significance considered was 0.05.

RESULTS

Univariate comparisons of effect biomarkers by study group are reported in Table 1. Genotoxicity endpoints were increased in firefighters compared to control subjects.

Table 1: Results of basal DNA damage (TDNA) and oxidative damage measured by FPG (NetFPG)

	Controls		Exposed	
	N	Mean ± SE	N	Mean ± SE
Basal damage	31	7.05±0.54	30	11.73±0.50*
NetFPG	31	0.93±0.03	30	1.70±0.71

* P <0,001

SE- standard error deviation

Basal DNA damage was significantly higher in peripheral blood of firefighters compared to controls. Regarding the evaluation of the oxidative damage measured by NetFPG no statistical significance was found; a rise was observed but it did not reach significance. In order to examine the effect of age, exposed and control individuals were divided in three groups: <29 years, 29–38 years and >38 years. No significant influence of age was observed. Concerning the effect of work-related factors such as the number of hours exposed in the last two days and duration of exposure (years as firefighters) no statistical significant differences were observed on the studied genotoxic endpoints.

DISCUSSION

Each year in Portugal a high number of wildfires occur, involving numerous firefighters across the country, a great percentage are volunteers. During the high fire-season months between June and August there activity is of paramount importance. In these periods firefighters are regularly exposed to extremely high levels of smoke. Woodsmoke is a complex mixture of air contaminates, many of which have known deleterious health effects. Woodsmoke genotoxicity was mostly studied in animal and *in vitro* experiments focusing on singular components, which is considered to be a weak and inexact model of interaction between smoke pollutants and humans (Adetona O.T., 2011). In addition, woodsmoke is a mixture of air contaminants that differs in composition and quantity, making it extremely difficult to study.

Our results showed a significant increase in firefighter’s basal DNA damage compared to population controls. Net-FPG was also higher in the exposed group, but did not reach significance. FPG is a DNA glycosylase that allows the identification and measurement of oxidised purine bases including 8-oxo-dG (8-oxoguanine) (Danielsen *et al.*, 2008).

There are very few human biomonitoring studies evaluating the health outcomes related to wildland firefighting exposures (Rothman *et al.* 1993; Adetona *et al.* 2013; Gaughan *et al.* 2014). Our findings are in accordance with the available published data. Two recent studies have assessed the influence of wildland firefighting exposure on different biological endpoints. Adetona *et al.* (2013) investigated the work shift changes in oxidative stress biomarkers among firefighters. Although no significant change was observed, an increased on overall unadjusted geometric mean of 8-oxo-dG level in urine was found compared to levels reported on general population studies. A similar result was observed by Gaughan *et al.* (2014) in two groups of wildland firefighters from the US Interagency Hotshot Crews, urinary levoglucosan concentration (smoke exposure marker) was positively associated with oxidative

stress scores (average z-scores for urinary 8-isoprostane and 8-hydroxy-2'-deoxyguanosine). Additionally, in two controlled human exposure studies, acute exposure to woodsmoke was found to increase the levels of malondialdehyde (biomarker of oxidative stress and lipid peroxidation) in exhaled breath condensate (Barregard *et al.* 2006; 2008), confirming the biologic results obtained in real settings.

In human biomonitoring studies it is important to assess the influence of major confounding factors such as gender, age and smoking habits in the endpoints studied. Our study population only consisted of non-smoking males. Between age groups no significant differences were found on the levels of the endpoints studied.

Concerning firefighting-related factors such as hours of exposure in the last two days and years as firefighters, no significant effect was observed. Adetona *et al.* (2013) found that subjects who had worked as wildland firefighters for longer than two years had higher but steady levels of urinary 8-oxo-dG. The average years as firefighters in our population was 13.5 years, furthermore 93% of the studied subjects worked for more than 2 years, which agrees with Adetona *et al.* (2013). One possible explanation for this fact is adaptation due to the up-regulation of antioxidant enzymes (Pilger and Rüdiger, 2006). Our study has a few limitations: a) population size was limited; b) self-reporting questionnaire; and c) sample collection timing, due to firefighting activity, rest periods and logistic contingencies samples were collected a period after wildland fires, that may allowed a small window to DNA repair.

CONCLUSIONS

To our knowledge, the present study is the first in Portugal to report preliminary data on the genotoxic effect in wildland firefighters related to woodsmoke. Data obtained in this work indicate that wildland firefighting exposure is associated to an increase level of DNA damage suggesting a potential health risk situation. Additionally, firefighters showed higher oxidative damage compared to controls namely oxidised purines (8-oxo-dG). However, these results need to be carefully interpreted, mostly due to the limited size of our population. Hence, further studies with larger populations are needed to confirm herein results. Nevertheless, data from this study may offer the support needed to implement effective measures in order to protect firefighter's health, including regular monitoring and surveillance activities, such as medical surveillance, good practice campaigns, training programs and implementation of written policies and procedures.

REFERENCES

- Adetona, O., Zhang, J. J., Hall, D. B., Wang, J. S., Vena, J. E., & Naehler, L. P. (2013). Occupational exposure to woodsmoke and oxidative stress in wildland firefighters. *Science of the Total Environment*, 449, 269-275.
- Adetona, O. T. (2011). *Occupational exposure to woodsmoke and associated changes in lung function and biomarkers of oxidative stress among wildland firefighters* (Doctoral dissertation, University of Georgia).
- Barregard, L., Sällsten, G., Gustafson, P., Andersson, L., Johansson, L., Basu, S., & Stigendal, L. (2006). Experimental exposure to wood-smoke particles in healthy humans: effects on markers of inflammation, coagulation, and lipid peroxidation. *Inhalation toxicology*, 18(11), 845-853.
- Barregard, L., Sällsten, G., Andersson, L., Almstrand, A. C., Gustafson, P., Andersson, M., & Olin, A. C. (2008). Experimental exposure to wood smoke: effects on airway inflammation and oxidative stress. *Occupational and environmental medicine*, 65(5), 319-324.
- Baur, D. M., Christophi, C. A., & Kales, S. N. (2012). Metabolic syndrome is inversely related to cardiorespiratory fitness in male career firefighters. *The Journal of Strength & Conditioning Research*, 26(9), 2331-2337.
- Collins, A., Anderson, D., Coskun, E., Dhawan, A., Dusinska, M., Koppen, G., Kruszewski, M., Moretti, M., Rojas, E., Speit, G., Valverde, M., & Bonassi, S. (2012). Launch of the ComNet (comet network) project on the comet assay in human population studies during the International Comet Assay Workshop meeting in Kusadasi, Turkey (September 13–16, 2011). *Mutagenesis*, 27(4), 385-386.
- Costa, S., Coelho, P., Costa, C., Silva, S., Mayan, O., Santos, L.S, Gaspar, J.and Teixeira, J.P. (2008). Genotoxic damage in pathology anatomy laboratory workers exposed to formaldehyde. *Toxicology*, 252(1), 40-48.
- Danielsen, P. H., Loft, S., Kocbach, A., Schwarze, P. E., & Møller, P. (2009). Oxidative damage to DNA and repair induced by Norwegian wood smoke particles in human A549 and THP-1 cell lines. *Mutation Research/Genetic Toxicology and Environmental Mutagenesis*, 674(1), 116-122.

- Danielsen, P. H., Loft, S., Jacobsen, N. R., Jensen, K. A., Autrup, H., Ravanat, J. L., Wallin H., & Møller, P. (2010). Oxidative stress, inflammation and DNA damage in rats after intratracheal instillation or oral exposure to ambient air and wood smoke particulate matter. *Toxicological Sciences*, kfq290.
- Danielsen, P. H., Møller, P., Jensen, K. A., Sharma, A. K., Wallin, H., Bossi, R., Autrup, H., Mølhave, L., Ravanat, J.L., Briedé, J.J., Kok, T.M., & Loft, S. (2011). Oxidative stress, DNA damage, and inflammation induced by ambient air and wood smoke particulate matter in human A549 and THP-1 cell lines. *Chemical research in toxicology*, 24(2), 168-184..
- Ersson, C. (2011). *International validation of the comet assay and a human intervention study*. Inst för biovetenskaper och näringslära/Dept of Biosciences and Nutrition.
- Gaughan, D. M., Siegel, P. D., Hughes, M. D., Chang, C. Y., Law, B. F., Campbell, C. R., & Christiani, D. C. (2014). Arterial stiffness, oxidative stress, and smoke exposure in wildland firefighters. *American journal of industrial medicine*, 57(7), 748-756.
- Halliwell, B. (2011). Free radicals and antioxidants—quo vadis?. *Trends in pharmacological sciences*, 32(3), 125-130.
- Instituto da Conservação da Natureza e das Florestas. (2013). Relatório provisório de incêndios florestais 01 de janeiro a 15 de outubro 1/15. , pp.1–15.
- Instituto Nacional de Estatística. (2013). Bombeiros (Nº) por localização geográfica (NUTS - 2002), Sexo e Nível de escolaridade; Anual
- International Agency for Research on Cancer. (2010). Painting, firefighting, and shiftwork: IARC monographs on the evaluation of carcinogenic risks to humans, v. 98. *World Health Organization (WHO) Lyon, France*, 764.
- Khanna, R., Karki, K., Pande, D., Negi, R., & Khanna, R. (2014). Inflammation, free radical damage, oxidative stress and cancer. *Interdiscip J Microinflammation*, 1(109), 2.
- Pilger, A., & Rüdiger, H. W. (2006). 8-Hydroxy-2'-deoxyguanosine as a marker of oxidative DNA damage related to occupational and environmental exposures. *International archives of occupational and environmental health*, 80(1), 1-15.
- Rothman, N., Correa-Villasenor, A., Ford, D. P., Poirier, M. C., Haas, R., Hansen, J. A., Toole, T.O., & Strickland, P. T. (1993). Contribution of occupation and diet to white blood cell polycyclic aromatic hydrocarbon-DNA adducts in wildland firefighters. *Cancer Epidemiology Biomarkers & Prevention*, 2(4), 341-347.
- Reisen, F. & Brown, S.K.. (2009). Australian firefighters' exposure to air toxics during bushfire burns of autumn 2005 and 2006. *Environment international*, 35(2), pp.342–52.

Bangkok Myanmar migrant workers' knowledge about analgesic use

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ABSTRACT: Many people take medication without a doctor's prescription or reading the medication instructions typed on the label or any attached information leaflet. There may be several reasons for this including unregulated access to drugs, lack of awareness, lack of literacy, - and lower socio economic status. The purpose of the study is to investigate how Myanmar migrant workers, who now live and work in Bangkok, Thailand, respond about their knowledge on analgesic use, one of the most commonly used drugs for pain relief, since little is known about this issue among Myanmar migrant workers. Data was collected using a convenience sampling technique through self-administered questionnaires that assessed two key aspects with 9 items using a three Likert scale, measuring knowledge about analgesic use and the signs and symptoms of overdose. The responses (N=75) were analyzed by using both descriptive and inferential statistics. The Independent sample t-test indicated that those Myanmar workers with a higher socio-economic status were more likely to think that overdosing with analgesics would not be harmful while those with a lower socio-economic status are more likely to be aware that an overdose of analgesics can cause organ bleeding. A one way ANOVA test also suggested that Myanmar migrant workers who completed their high school education are more likely to understand that analgesics can be taken 3 days continuously while those with a lower or no formal education are more likely to perceive that an overdose of analgesic can cause fits/seizures or even unconsciousness. This independent study can be applied to design education programs to help prevent the side effects of analgesic overdose among not only Myanmar but also other migrant workers in Thailand.

Keywords: Myanmar migrant workers, knowledge, Analgesic use

INTRODUCTION

People used medication to prevent and cure- illness as well as to lead a healthy life style. Since, drugs have both benefits and adverse side effects, it is necessary they are taken following a specific regimen and in accordance with instructions otherwise they may be ineffective or harmful. However, there are many common drugs which may be taken without a doctor's consultation e.g. analgesics (El Ezz & Ez-Elarab, 2011). There may be several reasons for this such as poor regulation, lack of health education, and socio economic status, etc.

Analgesics are the most commonly consumed drugs in the world, and it is estimated that millions of people in the United States, Australia, and Europe use OTC analgesics on a daily basis. A Spanish study using data from the 2003 Spanish National Health Survey showed that, among individuals consuming analgesics, 39.4% were self-medicating (Carrasco-Garrido et al., 2014). Though the use of analgesics is widespread worldwide, the side-effects experienced may vary with different people, and overuse can be harmful (Ibrahim et al., 2015). For example, for headache and other minor painful conditions, analgesics may cause gastritis and even peptic ulcers in the long run, and antibiotic abuse can result in resistant organisms etc (El Ezz & Ez-Elarab, 2011). These problems can be minimized by raising people's awareness of the indications, contraindications and side-effects of these drugs (Sarahroodi et al., 2012).

"Though exact figures are unavailable, some observers estimate there may be as many as 3 million Myanmar migrant workers in Thailand, many of them undocumented" (www.mmmtimes.com). Moreover, by observation, many Myanmar migrant workers in Bangkok are taking self-medicated analgesics for a variety of health problems. Many of these workers are reluctant to seek out health professionals for advice. To understand this, the purpose of the study is to investigate Bangkok Myanmar migrant workers' knowledge on analgesics, since little is known on this issue. The main goal is to study how

such workers, respond to the medical instructions on analgesics, in order to manage their illness and lead a healthy life.

MATERIAL & METHODS

A total of 100 Myanmar migrant workers, who now live and work in Bangkok, Thailand participated in this study. Through the convenience sampling technique, 75 Myanmar migrant workers, a 75 percent response rate, returned completed self-administered questionnaires. Myanmar migrant workers' responses were assessed on two key aspects with 9 items using a three Likert scale measuring their level of knowledge of analgesic usage and the signs and symptoms of overdose of analgesics as the initial assessment. The data collected was analyzed by using both descriptive and inferential statistics. The inferential statistics were compiled using an Independent sample t- tests and a one-way ANOVA test that measured significant mean differences among the above-stated two key aspects of analgesic use classified by participant's social economic status and education. We applied the following criteria of class interval in this study (Table 1).

Table 1 – Criteria of class interval mean range for this study

1.00-1.66	1	Low
1.67-2.33	2	Moderate
2.34-3.00	3	High

Table 2 – Overall descriptive statistics on knowledge of analgesic use

Key aspects of analgesic use	Mean	Std. deviation	Conclusion
Analgesic usage	1.5289	.6532	Low (1.00-1.66)
Sings & symptoms	1.1822	.3052	Low (1.00-1.66)

Table 2 shows the overall mean for the two different key aspects of knowledgeability of analgesic use stating the range of the mean score. Both key aspects showed a mean score range of (1.00-1.66). However, it indicates that the higher the mean, the more likely participants know about analgesic use.

Table 3 – Independent sample t-test on knowledgeability of Analgesic use by SES

Knowledge on analgesic use	SES	Mean	Std. deviation	t-statistic (p value)
not more than 4 tablets per day	1	2.0000	1.0000	.388(.700)
	2	1.7971	.8842	
3 days continuously	1	1.6667	1.1547	.413(.681)
	2	1.4783	.75943	
too much analgesic will not be harmful	1	1.0000	.0000	-3.891(.000)
	2	1.2985	.62801	
Headache/Dizziness	1	1.6667	1.15470	1.509(.136)
	2	1.1940	.4997	
Sickness/Vomiting	1	1.3333	.5774	.555(.580)
	2	1.1739	.4838	
Sleepiness/Sedation	1	1.6667	1.1547	.506(.614)
	2	1.4783	.6090	
Fits/Seizures	1	1.3333	.5774	1.714(.091)
	2	1.0448	.2715	
Unconsciousness	1	1.3333	.5774	1.508(.136)
	2	1.0597	.2955	
Organ Bleeding	1	1.6667	1.1547	2.166(.034)
	2	1.0882	.4138	

Table 3 shows the mean differences between the level of knowledge about analgesic use by socio-economic status. The highest mean score is related to people who take analgesics not more than 4 tablets per day while the lowest mean score is related to those taking too many analgesics will not be harmful for low socio-economic status of Myanmar migrant workers. It is also shows that both for low and high socio-economic status Myanmar migrant workers have the highest mean score for people who take analgesic not more than 4 tablets per day. However, the independent sample t-test indicated that those of higher socio-economic status of Myanmar migrant workers are more likely to believe taking too much analgesic is not harmful while those of a lower socio-economic status are more likely to understand that to overdose on analgesics can cause organ bleeding ($p < .05$).

Table 4 – ANOVA test for knowledgeability on Analgesic use by education

Knowledge on analgesic use	Edu	Mean	Std. deviation	F-statistic (p-value)
not more than 4 tablets per day	1	1.7143	.9512	.453(.716)
	2	1.9024	.9435	
	3	1.6923	.7511	
	4	2.1250	.9910	
3 days continuously	1	1.4286	.7868	3.203(.029)
	2	1.5366	.8396	
	3	1.0000	.0000	
	4	2.0000	.7559	
too much analgesic will not be harmful	1	1.4286	.7868	.925(.434)
	2	1.3250	.6155	
	3	1.0769	.2774	
	4	1.5000	.9258	
Headache/Dizziness	1	1.5714	.9759	1.661(.185)
	2	1.2000	.4641	
	3	1.0000	.0000	
	4	1.2500	.7071	
Sickness/ Vomiting	1	1.2857	.4880	1.874(.143)
	2	1.1707	.4417	
	3	1.0000	.0000	
	4	1.5000	.9258	
Sleepiness/Sedation	1	1.7143	.9512	.429(.733)
	2	1.4390	.6344	
	3	1.4615	.5189	
	4	1.3750	.5176	
Fits/Seizures	1	1.5000	.8367	6.036(.001)
	2	1.0250	.1581	
	3	1.0000	.0000	
	4	1.0000	.0000	
Unconsciousness	1	1.5000	.8367	4.771(.005)
	2	1.0500	.2207	
	3	1.0000	.0000	
	4	1.0000	.0000	
Organ Bleeding	1	1.3333	.8165	.891(.451)
	2	1.1463	.5273	
	3	1.0000	.0000	
	4	1.0000	.0000	

Note: 1=lack of formal education
 2= primary school
 3= secondary school
 4= high school

Table 4 shows Myanmar migrant workers' different levels of education and their responses on their knowledge about analgesic use. The highest mean score was related to people who take analgesic not more than 4 tablets per day while the lowest mean score was related to those who overdose on analgesics with five different signs and symptoms including headache/dizziness, sickness/ vomiting, fits/seizures, unconsciousness and organ bleeding for each level of education. However, the one way ANOVA test showed a significant relationship between Myanmar migrant workers' level of education and the three different items of knowledge about analgesic use. It suggests that Myanmar migrant workers who completed high school are more likely to be informed that analgesics can be taken 3 days continuously while those who lack formal education are more likely to perceive an overdose of analgesics can cause fits/seizures and unconsciousness ($p < .05$).

DISCUSSION

This study investigated how Myanmar migrant workers, who now live and work in Bangkok respond about their knowledge of using analgesics. Two key aspects were measured as the initial assessment; their level of knowledge on analgesic usage and knowledge of the signs and symptoms of incorrect usage. Comparing the level of knowledge on analgesic usage and signs and symptoms by different socio-economic status, the independent sample t-test indicated that those workers of a higher socio-economic status were more likely to believe that taking too much analgesic would not be harmful while those workers of a lower socio-economic status are more likely to know that an overdose of analgesic can cause organ bleeding. For the different responses on participant's knowledge about analgesic usage and signs and symptoms of incorrect usage and their different education background, a one way ANOVA test was used. It indicated that Myanmar migrant workers who completed high school are more likely to understand that analgesics can be taken 3 days continuously while those with a lack of formal education are more likely to know that an overdose of analgesic can cause fits/seizures and even unconsciousness. Surprisingly, Bangkok Myanmar migrant workers with a lack of formal education and of a lower socioeconomic status are more knowledgeable than those who have completed high school and also of a higher socioeconomic status. It maybe because they are more likely to be aware than others.

CONCLUSIONS & RECOMMENDATION

Recent newspaper reports highlighted that legal foreign migrant workers in Thailand can now buy health insurance to be used at any state hospital to improve their access to health care services. However, most Myanmar migrant workers are still unable to take out health insurance due to their undocumented status or low social economic status or the language barrier with health providers in Thailand. As a result, they may face adverse effects from their medication usage due to their lack of prior consultation with doctors or pharmacists. The purpose of the study was to investigate how Myanmar migrant workers, who now live and work in Bangkok, Thailand, respond about their knowledge of using analgesics, one of the most commonly used drugs for pain relief, since little is known on this issue among Myanmar migrant workers. For safety reasons and to understand analgesic use, the workers should consult with doctors and/or pharmacists as common practice prior to taking any medication. Beneficially this independent study would be helpful in designing future education programs about analgesic use which can contribute to better health and reducing any adverse effects from incorrect analgesic drug use among not only Myanmar migrant workers but also other migrant workers in Thailand.

REFERENCES

- EI-Ezz NFA, Ez-Elarab HS. (2011). Knowledge, attitude and practice of medical students towards self medication at Ain Shams University, Egypt. *Journal of Preventive Medicine and Hygiene*, 52(4), 196-200.
- Government changes plan on IDs for migrant workers in Thailand (2015). Retrieved from [http://www.mmtimes.com/...](http://www.mmtimes.com/)
- Nahla Khamis Ibrahim, Banan Mohammad Alamoudi, Wejdan Omar Baamer, and Rajaa Mohammad Al-Raddadi. (2015). Self-medication with analgesics among medical students and interns in King Abdulziz University, Jeddah, Saudi Arabia. *Pakistan Journal of Medical Sciences*, 31(1): 14-18
- Pilar Carrasco-Garrido, Ana López de Andrés, Valentín Hernández Barrera, Isabel Jiménez-Trujillo, César Fernandez-de-las-Peñas, Domingo Palacios-Ceña, Soledad García-Gómez-Heras and Rodrigo Jiménez-

García.(2014). Predictive factors of self-medicated analgesic use in Spanish adults: a cross-sectional national study. *BMC Pharmacology and Toxicology*. 15:36.

Sarahroodi S, Maleki-Jamshid A, Sawalha AF, Mikaili P, Safaeian L. (2012). Pattern of self-medication with analgesics among Iranian University students in central Iran. *Journal of Family Community Medicine*, 19(2):125–129.

Building ventilation as a risk factor for sick building syndrome

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ABSTRACT: Background: Improperly designed and poorly maintained ventilation systems presents one of the main causes for Sick Building Syndrome (SBS). The aim of this study is to identify and classify risk factors for SBS related to building ventilation. **Material and methods:** Comprehensive literature review was carried out studying risk factors for SBS related to building ventilation. We searched two bibliographic databases (Pub Med and Science Direct) for peer-reviewed publications from 1983 to May 2015. **Results and discussion:** Based on the results of the comprehensive literature review, the health risk factors for SBS related to building ventilation are: risk factors related to the type of ventilation system (natural, mechanical), maintenance status and functioning, qualitative and quantitative parameters of building ventilation (ventilation rate, microclimate parameters). Results indicated that occupants of naturally ventilated buildings had fewer SBS symptoms than occupants of air-conditioned ones. The reviewed studies reported that high ventilation rates resulted in lower relative risks for respiratory diseases and for SBS symptoms compared to low ventilation rates. **Conclusions:** Identification of risk factors related to building ventilation presents a first step towards integral prevention and control of SBS. Based on the results of our study the priority actions are: identification of health risk factors for SBS and their relevant parameters and also to determine the interactions between them; defining standardized methods for identifying health risk factors with sampling procedures and analysis.

Keywords: *building ventilation, health risk factors, sick building syndrome*

INTRODUCTION

Current design of energy-efficient buildings is mainly focused on the solving of energy problems. Solutions are defined in the direction of improved thermal insulation, increased air tightness of the building envelope as well as in the installation of energy-efficient ventilation systems (Krainer et al., 2008). Such partial solutions often results in unhealthy and uncomfortable conditions and may be related to the occurrence of a Sick Building Syndrome (SBS). Environmental Protection Agency (EPA) (EPA, 1991) describes SBS as situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building. The characteristic symptoms of SBS that may occur singly or in combination with each other are often headache, eye, nose, or throat irritation, dry cough, dry or itchy skin, dizziness and nausea, difficulty in concentrating and fatigue (ECA, 1989; Redlich et al., 1997; Burge, 2004).

The World Health Organization (WHO) (WHO, 1983) estimated that up to 30% of new and renovated buildings worldwide may be related to SBS. Comprehensive research (Burge et al., 1997) performed in the UK on 4373 office workers in 42 public buildings revealed that 29% of those studied experienced five or more of the characteristic SBS symptoms. Study carried out by Woods et al. (1987) on 600 office workers in the USA concluded that 20% of the employees experience SBS symptoms and most of them were convinced that this reduces their working efficiency. Additionally, a study on 1390 workers in 5 public buildings in Quebec, Canada (Bourbeau et al., 1997) showed that 50% of workers experienced SBS symptoms. SBS may also occur in other environments such as schools, kindergartens and residential buildings (Scheel et al., 2001; Sahlberg et al., 2013).

Study by Kupec and Dovjak (2014) emphasised that SBS is often related to the exposure of various health risk factors, such as physical, chemical, biological, psychosocial, personal and others. Improperly designed and poorly maintained ventilation systems present one of the main causes for

SBS (ECA, 1989; Seppänen et al., 1999). Identification of risk factors related to building ventilation, main parameters and their interactions are important for integral prevention and control of SBS.

AIMS

According to the purpose of our paper, the research aims are:

1. to prepare systematically comprehensive literature review studying risk factors for SBS related to building ventilation,
2. to prepare a priority actions for future improvements.

METHODS

Comprehensive literature review was carried out studying risk factors for SBS related to building ventilation. We searched two bibliographic databases (Pub Med and Science Direct) for peer-reviewed publications from 1983 to May 2015. The key-words were written in English: "sick building syndrome", together with "air temperature", "surface temperature", "relative humidity", "air velocity", "heating", "cooling", "ventilation", "air-conditioning". Titles, abstracts or both, of all articles, were reviewed to assess their relevance.

We also reviewed reports, guidelines, legislative and other documents of the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), Environmental Protection Agency (EPA), Health Protection Agency (HPA), Occupational Safety and Health Administration (OSHA), International Labour Organization (ILO), National Institute for Occupational Safety and Health (NIOSH), National Institute of Public Health of the Republic of Slovenia (NIPH), European Commission (EC), Eurostat, Official Journal of RS, EUR-Lex, Ministry of Health of the Republic of Slovenia (MZ GOV SI); ISO standards; manuals and handbooks of the American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

On the basis of the literature review, the list of priority actions was defined.

RESULTS AND DISCUSSION

Parameters related to building ventilation

The main causes for SBS symptoms related to building ventilation and defined by studies were:

- type of ventilation system (natural, mechanical),
- maintenance status and functioning and
- qualitative and quantitative parameters of building ventilation (ventilation rate, microclimate parameters).

Mechanical vs. natural ventilation system:

Numerous researchers examined the prevalence of SBS symptoms in naturally ventilated buildings and air-conditioned buildings (Seppänen et al., 1999; Seppänen & Fisk, 2002; Costa & Brickus, 2000). Literature review on office buildings (Seppänen & Fisk, 2002) indicated that occupants of naturally ventilated offices had fewer SBS symptoms than occupants of air-conditioned offices. Similar study was performed by Costa and Brickus (2000) in a central-air-conditioned dropping centre and in natural-ventilation commercial shops in Rio de Janeiro, Brazil. Air-conditioned building was associated with increased SBS symptoms.

Ventilation rates:

Literature review of 41 studies (Seppänen & Fisk, 2002) showed that ventilation rates below 10 L/s per person in office buildings were associated with statistically significant worsening in one or more health or perceived air quality outcomes. Some studies determined that increases in ventilation rates up to approximately 20 L/s per person, were associated with further significant decreases in the prevalence of SBS symptoms or with further significant improvements in perceived air quality. The reviewed

studies reported relative risks of 1.5-2 for respiratory illnesses and 1.1-6 for SBS symptoms for low compared to high ventilation rates.

Indoor air temperature and relative humidity:

Indoor air temperature (T_{ai}) and relative humidity (RH_{in}) present two of the environmental parameters of thermal comfort (Fanger, 1973; ASHRAE, 1966). Studies show that general dissatisfaction with the T_{ai} and RH_{in} may be related with the increase of SBS symptoms (Valbjorn & Kousgaard, 1986; Valbjorn & Skov, 1987). Jaakkola et al. (1989) carried out a study in a modern eight floor office building in Finland (N=2150 workers) and found out a linear correlation between the amount of SBS symptoms. SBS symptoms increased both when the T_{ai} was considered to be too cold and too warm.

Nordström et al. (1994) performed a study in new and well ventilated geriatric hospital units in southern Sweden (N=104 employees). It was stated that in Scandinavia, the indoor RH_{in} in well ventilated buildings was usually in the range 10-35% in winter that results in increased number of dissatisfied persons. It was concluded that air humidification during the heating season in colder climates can decrease symptoms of SBS and perception of dry air among employees.

High RH_{in} usually appears in the buildings that are located in a hot-humid climate. However, higher RH_{in} (more than 80%) may also occur in other buildings, especially due to incorrectly designed building envelopes, systems and installations, processes of increased steam production, water damage and flooding. These conditions may lead to dampness, stuffy odour, visible mould and adverse health effects. Dampness may be a strong predictor of SBS symptoms. Li et al. (1997) evaluated the association between measures of dampness in 56 day care centers in the Taipei area and symptoms of respiratory illness in 612 employees. Dampness was found in 75.3% of the centers, visible mould in 25.8%, stuffy odour in 50.0%, water damage in 49.3%, and flooding in 57.2%. Prevalence of SBS symptoms in the day care workers was statistically significant among those who worked in centers that had mould or dampness.

Surface temperatures:

Beside air temperature and humidity, surface temperatures also have to be considered due to their large influence on perceived temperature. Additionally, lower surface temperatures may result in local discomfort, radiative asymmetry and water condensation. Studies (Barna & Bánhidi, 2012) showed that low surface temperatures often result in thermally uncomfortable conditions and higher prevalence of SBS symptoms.

Interactive influences:

Study by Kukec and Dovjak (2014) revealed that for complete control and prevention against SBS, interactive influences among health risk factors and their parameters are important.

There exist important interactive influences between parameters related to building ventilation as well other risk factors. The type of building ventilation system (i.e. natural-ventilation vs. mechanical systems) was related to indoor air quality (IAQ) and SBS as it was presented in the comparative study by Costa and Brickus (2000) in Niteroi, Rio de Janeiro, Brazil. Occupants in naturally ventilated offices have fewer SBS symptoms than occupants of air-conditioned offices. Inadequate functioning, obsolete and unmaintained heating, ventilating, and air conditioning (HVAC) system, decreased number of air changes, decreased volume of clean air may lead to increased concentrations of indoor air pollutants and may result in the occurrence of SBS symptoms (ECA, 1989; Redlich et al., 1997; Seppänen et al., 1999). Moreover, ventilation rates strongly influence the emission rates from indoor sources, such as di-(2-ethylhexyl) phthalate (DEHP) emission rate from polyvinyl chloride (PVC) flooring. Similar findings were reported in the study by Hodgson et al., (2000) in houses in Florida, where volatile organic compounds (VOCs) emission rates at the low and high ventilation rates decreased with decreasing compound volatility. Additionally, ventilation system itself can be a source of air pollutants. Unsealed fibreglass and other insulation material lining the ventilation ducts can release particulate material into the air. Such material can also become wet, creating an ideal and often concealed site for the growth of microorganisms (Redlich et al., 1997).

CONCLUSIONS

Identification of risk factors for SBS related to building ventilation and their relevant parameters presents an important step towards effective prevention and control of SBS symptoms.

The priority actions for control and prevention of health risk factors related to building ventilation are:

1. identification of health risk factors for SBS and their relevant parameters and also to determine the interactions between them,
2. defining standardized methods for identifying health risk factors with sampling procedures and analysis.

For integral prevention and control of risk factors of SBS, additional research is needed. Future research should be focused on defining standardized methods for identifying risk factors with sampling procedures and analysis. This should be based on interdisciplinary cooperation of various experts. The occurrence of SBS symptoms may be a result of interactive influences among risk factors and their parameters.

REFERENCES

- Andersen, I., Lundqvist, GR., Jensen, PL. & Proctor, DF. (1974). Human response to 78-hour exposure to dry air. *Archives of Environmental Health*, 29 (6), 319-324.
- ASHRAE (1966). Thermal Comfort Conditions. New York: ASHRAE Standard 55.66.
- Barna, E. & Bánhidi, L. (2012). Combined effect of two local discomfort parameters studied with a thermal manikin and human subjects. *Energy and Buildings*, 51, 234-241.
- Bourbeau, J., Brisson, C. & Allaire, S. (1997). Prevalence of the sick building syndrome symptoms in office workers before and six months and three years after being exposed to a building with an improved ventilation system. *Occupational and Environmental Medicine*, 54 (1), 49-53.
- Burge, PS. (2004). Sick building syndrome. *Occupational and Environmental Medicine*, 61, 185-190.
- Burge, S., Hedge, A., Wilson, S., Bass, JH. & Robertson, A. (1987). Sick Building Syndrome: A study of 4373 office workers. *Annals of Occupational Hygiene*, 31 (4a), 493-504.
- Costa, MF. & Brickus, LS. (2000). Effects of ventilation systems on prevalence of symptoms associated with sick buildings in Brazilian commercial establishments. *Archives of Environmental Health*, 55, 279-283.
- ECA. European concerted action indoor air quality & its impact on man. (1989). COST Project. Environment and Quality of Life Report No. 4. Sick Building Syndrome. A Practical Guide. Luxembourg: Commission of the European Communities. Directorate General for Science. Research and Development. Joint Research Centre - Institute for the Environment. Commission of the European Communities.
- EPA. US Environmental Protection Agency. (1991). Indoor Air Facts No. 4 (revised). Sick Building Syndrome. Air and Radiation. Available: http://www.epa.gov/iaq/pdfs/sick_building_factsheet.pdf (12. 2. 2014).
- Fanger P. O. (1973). Assessment of man's thermal comfort in practice. *Br J Ind Med.*, 30, 4, 313-324.
- Hodgson MJ., Permar, E., Squire, G., Cagney, W., Aller, A. & Parkinson, DK. (1987). Vibrations as a cause of "tight-building syndrome" symptoms. *A Student History Journal*, 2, 449-453.
- Jaakkola, JJK., Heinonen, OP. & Seppänen, O. (1989). Sick building syndrome, sensation of dryness and thermal comfort in relation to room temperature in an office building: need for individual control of temperature. *Environmental International*, 15, 163-168.
- Krainer, A., Košir, M., Kristl, Ž. & Dovjak, M. (2008). Passive house versus bioclimatic house. *Gradbeni vestnik*, 57 (3), 58-68.
- Kukec, A. & Dovjak, M. (2014). Prevention and control of Sick Building Syndrome (SBS). Part 1: Identification of risk factors. *Sanitarno inženirstvo*, 8 (1), 16-40.
- Li, CS., Hsu, CW. & Lu, CH. (1997). Dampness and respiratory symptoms among workers in day-care centers in a subtropical climate. *Archives of Environmental Health*, 52, 68-71.
- Nordström, K., Norbäck, D. & Aksešson, R. (1994). Effect of air humidification on the sick building syndrome and perceived indoor air quality in hospitals: a four month longitudinal study. *Occupational and Environmental Medicine*, 51(10), 683-688.
- Redlich, CA., Sparer, J. & Cullen, MR. (1997). Sick-building syndrome. *Lancet*, 349, 1013-1016.
- Sahlberg, B., Gunnbjörnsdóttir, M., Soon, A., Jogi, R., Gislason, T., Wieslander, G., Janson, C. & Norback D. (2013). Airborne molds and bacteria, microbial volatile organic compounds (MVOC), plasticizers and formaldehyde in dwellings in three North European cities in relation to sick building syndrome (SBS). *Science of the Total Environment*, 444 (1), 433-440.

Scheel, CM., Rosing, WC. & Farone, AL. (2001). Possible sources of sick building syndrome in a Tennessee middle school. *Archives of Environmental Health*, 56 (5), 413-417.

Seppänen, O. & Fisk, WJ. (2002). Association of ventilation system type with SBS symptoms in office workers. *Indoor Air*, 12, 98-112.

Seppänen, OA., Fisk, WJ. & Mendell, MJ. (1999). Association of ventilation rates and CO₂ concentrations with health and other responses in commercial and industrial buildings. *Indoor Air*, 9, 226-252.

Valbjorn, O. & Kousgaard, N. (1986). Headache and mucous membrane irritation at home and at work. Report 175. Harsholm: Statens Byggeforsknings Institut.

Valbjorn, O. & Skov, P. (1987). The Danish Indoor Climate Study Group. Influence of indoor climate on the sick building syndrome prevalence, *Proceedings from the 4th international Conference on Indoor Air Quality and Climate*. Berlin: Institut für Wasser-, Boden- und Lufthygiene.

WHO. World Health Organization. (1983). Indoor air pollutants: exposure and health effects. EURO Reports and Studies No. 78. Copenhagen: WHO Regional Office for Europe.

Woods, JE., Drewry, GM. & Morey, P. (1987). Office worker perceptions of indoor air quality effects on discomfort and performance, *Proceedings from the 4th international Conference on Indoor Air Quality and Climate*. Berlin: Institut für Wasser-, Boden- und Lufthygiene.

Children's play paints safety – What is the reality in Portuguese schools and at retail stores?

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ABSTRACT: Children's play paints, an attractive tool for preschool activities, can be classified in artist paints (gouaches, acrylics, watercolors, fingerpaints) and face paints. These products composition is not always known since not all are required to bear their ingredients in the label packaging. The present study aimed to characterize the children's play paints available in schools and retail stores and also to assess the practices involved in the acquisition, handling and storage of these products by schools and that may have impact on the product quality and safety. For this purpose were studied paints from 8 schools and 7 retail stores from Porto (Portugal), in a total of 17 popular brands. The results shows that the label information differs from product type, taking into account the legal requirements applied to each one (artist paints or face paints). The main hazards stated in the products label are related with the possibility of ingestion of small pieces that are part of the product. Only brands of face paints (60%) mentioned the potential risk to develop allergic reactions or skin irritation problems arising from their application. As regards to school practices, they are aware to the importance in purchasing products suitable for children use however, some of the behaviors during storage and handling of these products may affect their quality and safety.

Keywords: Children, Toys, Cosmetics, Artist paints, Face paints, Safety product

INTRODUCTION

Children's play paints are an attractive tool for preschool activities, being widely used as didactic products. These paints can be divided into two main groups "artist paints" (e.g., gouaches, watercolors, acrylic paints, fingerpaints) and "face paints".

Given its purpose, artist paints fall within the concept of a toy "a product designed or intended, whether or not exclusively, for use in play by children under 14 years of age", and therefore their safety in the European Union is regulated under the Toy Safety Directive (EU, 2009a). As regards to face paints (cosmetic toys), they have to be considered as cosmetics products, "any substance or mixture intended to be placed in contact with external parts of the human...with a view exclusively or mainly to...changing their appearance", and so they shall comply with the compositional and labelling requirements laid down, in European Union, in the Cosmetics Regulation (EU, 2009b).

The composition of these products is not always known, since only the cosmetic products must state on its label the list of its ingredients. However, the basic composition of a paint typically includes pigments or dyes, solvents, resins and additives.

The paints used for didactic purposes are mostly water-based, having a high percentage of this component, as well as pigments and dyes, essential to obtain the diversity and attractiveness of the colors. The pigments used in these paints are typically inorganic pigments (Barata, 2002; Smith, 2003), generally comprised by oxides, chromates and metal sulfates, which may contribute to the presence of potentially toxic elements in their composition, such as heavy metals [e.g., lead (Pb), cadmium (Cd) and chromium (Cr)] (Godoi et al., 2009). Furthermore, due to their ubiquitous and persistent nature, the presence of metals as impurities in all products is recognized as unavoidable (trace amounts arising from both the ingredients and manufacturing practices) (Al-Saleh et al., 2009).

The major concerns related to children's exposure to toxic elements present in paints were made clear in summer 2007 when media worldwide reported about toys being recalled from the market because of the discovery of high Pb levels in them (Baer et al., 2011) and more recently with the presence of some heavy metals in children's face paints reported in the Campaign for Safe Cosmetics (CSC) (2009).

In addition to potential toxic elements (i.e., heavy metals), the presence and growth of microorganisms is another condition susceptible to occur in these products. The effect is not only the deterioration of the product, but the presence of opportunistic microorganisms, representing a risk to children's health (Flores et al., 1997). The main microorganisms commonly isolated from cosmetics, with weak preservative capacity, include the genera *Klebsiella*, *Enterobacter*, *Staphylococcus*, *Bacillus*, *Pseudomonas*, *Penicillium* and *Candida* that are normally introduced in the product through the water used in its formulation (Perry, 2001).

Despite most of these products being specifically designed for children, there is always some concern regarding to their safety, particularly to the chemical ingredients used in its formulation, as also to their microbiological quality, since they are more susceptible to biodegradation (La Rosa et. al., 2008).

The most significantly health impacts to which children can be exposed when using these products are related with the risk of allergy due to the added of fragrances, preservatives or coloring agents (The Danish Environmental Protection Agency, 2007). Additionally, when children play with paints, skin contact and potential absorption through the skin of some ingredients are almost unavoidable. These products are also susceptible of easy ingestion in significant quantities, and they should comply with maximum acceptable levels for the migration of toxic elements (ISO, 2010).

The aim of this study was to characterize the children's play paints used in schools establishments and also available in retail stores, by analyzing the label content (e.g. ingredients, potential hazards, emergency first aid, handling and storage conditions and toxicological information). It was also aimed to know which practices are involved in the acquisition, storage and handling of these products by schools establishments in order to understand whether they can have an impact on product quality and safety.

MATERIAL AND METHODS

Sample selection and collection

The information about the products available in schools were obtained by contact and visit 8 preschool establishments located in Porto (Portugal). It was also purchased some products available in 7 retail stores of the same area. This study was conducted between the period of 2011 and 2014.

In total 66 products belonging to artist paints (n=54) and face paints (n=12), representing 17 popular brands were studied. The general information about the samples (brand and country of manufacture) and the local of acquisition are represented in Table 1.

Table 2 – General information about the samples

Category of Paint	Brand	Country of Manufacture	Collected/ Purchased in
Artist paints	B1 (n=11)	Italy	School/Store
	B2 (n=4)	France	School
	B3 (n=1)	Italy	School
	B4 (n=1)	Spain	School
	B5 (n=6)	Italy	School
	B6 (n=1)	Italy	Store
	B7 (n=1)	China	Store
	B8 (n=5)	France	Store
	B9 (n=3)	China	Store
	B10 (n=5)	China	Store
	B11 (n=4)	China	Store
	B12 (n=12)	China	Store
Face paints	B13 (n=1)	France	School
	B14 (n=1)	Spain	School
	B15 (n=1)	China	School
	B16 (n=2)	China	Store
	B17 (n=7)	U.K	Store

Sample and school practices characterization

The 66 products identified were characterized according to the information available on the product label as regards to ingredients, potential hazards, emergency first aid, handling and storage conditions and toxicological information. This information was then analyzed in accordance with the legal requirements [Directive 2009/48/EC and Regulation (EC) n.º1223/2009] of each category of product (toy or cosmetic).

In order to assess the practices involved in the acquisition, storage and handling of these products by schools establishments it was applied a short questionnaire, as an interview, to kindergarten teachers or school leaders.

RESULTS

All the studied products had a package label providing information about the product and country of manufacture. China was the predominant country of origin (42.4%), followed by Italy (28.8%), France (15.2%), UK (10.6%) and Spain (3.0%). The products purchased in retail stores were mostly from China (58.7%). Watercolors were the most available artist paint, representing the highest percentage of the samples identified (34.8%), followed by gouaches (30.3%), face paints (18.2%), fingerpaints (9.1%) and acrylics (7.6%).

The Figure 1 shows the package label information by product type (face paints and artist paints) and main practices adopted by the schools in the acquisition, storage and handling of these products.

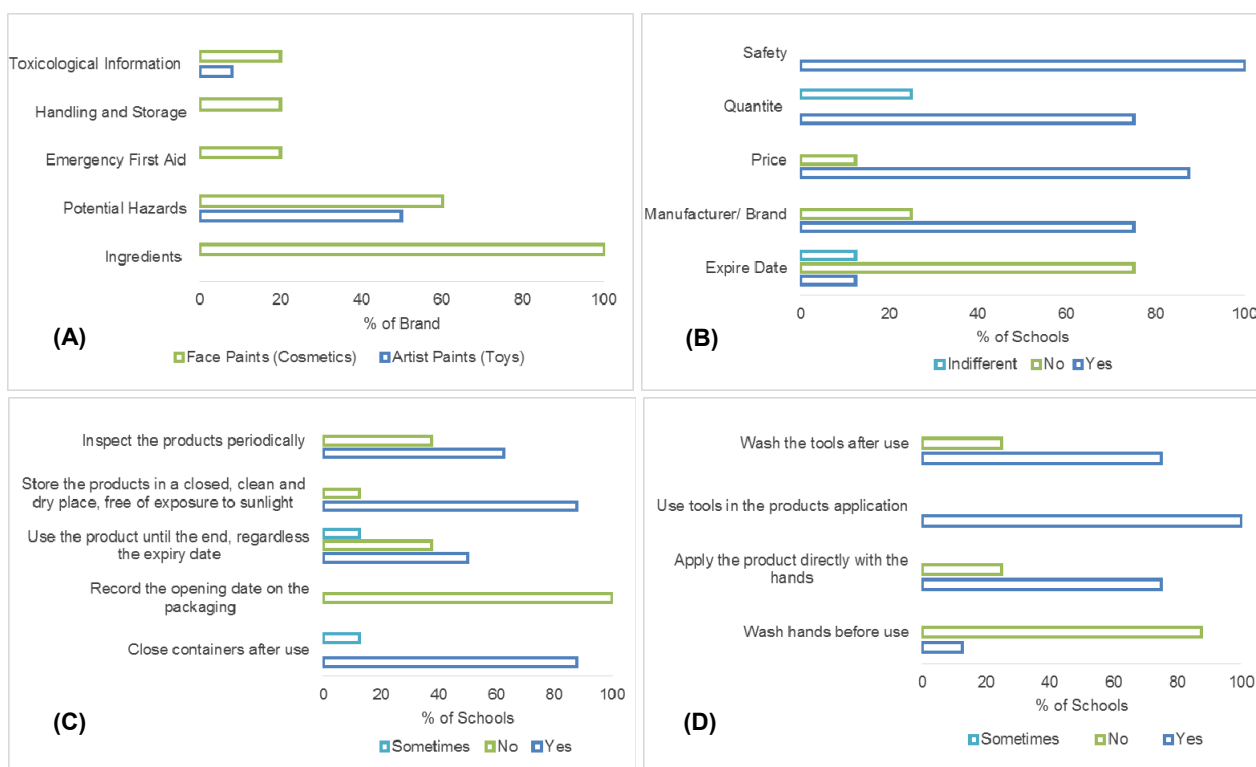


Figure 1 – Label information provided by brands of face paints (cosmetics) and artist paints (toys) (A); Schools practices involved in the acquisition (B), storage (C) and handling (D) of the products. In the acquisition process “indifferent” meant that it is an important factor but is not taking into account. In the storage and handling of the products “sometimes” meant that is not always considered by schools as an important factor to control.

DISCUSSION

Through the analysis of Figure 1 (A) it is possible to emphasize that the label information differs in function on the product type (i.e. face paints or artist paints), a fact easily explained by the different legal requirements applied to each product. However, a similarity found in all the products was the presence of a graphic/information on the label indicating ‘the product is not suitable for children under

36 months' and the CE marking that indicates the product is in conformity with the Community harmonization legislation.

As regards particularly to face paints (cosmetics), they must specify on the label, among other information, the data of minimum durability and the list of ingredients used in its composition (EU, 2009b). All the products identified were in accordance with these requirements. Carrying out a more detailed survey of the pigments and dyes indicated in the label shows that all of them are listed as colorants allowed in cosmetic products by the European Regulation. The precautions to be observed during the use (handling and storage) were only observed in 20% of the brands and were related with the importance to handle the product with the hands washed, not ingest or apply near the eyes and mouth (mainly the colors red, yellow and green) and guarantee the storage in a cool and dry place. The potential hazards identified in these products (60%) are related with the risk to develop allergic reactions or skin irritation problems arising from their application. The CSC (2009) study concluded that more than half of Children's face paints tested contained Cr, Ni and Co, common causes of allergic contact dermatitis, at levels exceeding 1 ppm, a recommended limit value to minimize the risk for very sensitive individuals (Basketter, et. al. 1993).

Concerning to artist paints (toys), the Toy Safety Directive, states that a toy in the form of a substance or mixture containing inherently dangerous substances or mixtures must indicate, without prejudice to the application of the provisions laid down in applicable Community legislation, as regards to the classification, packaging and labelling of certain substances or mixtures, the instruction for use indicating a warning of the dangerous nature of these substances and an the precautions to be taken by the user (EU, 2009a). However, the main warnings identified in the studied products are related with physical hazards, more specifically with the possibility of ingestion of small pieces that are part of the product and the specification of the minimum and maximum ages for users. No mention to chemical hazards were identified in these paints. As respect specifically to fingerpaints, the new toy safety standard EN 71-7:2014 for fingerpaints, requires that the primary packaging indicates in the label the preservatives and embittering agent used (CEN, 2014). The only brand (B1) of finger paint identifies in this study had not this information on the label.

Analyzing the practices involved in the acquisition of children's paints in schools [Fig. 1 (B)] is possible to verify that the safety of the product is a major factor in its acquisition, looking for products suitable for the children's age, despite the price also be crucial. Although schools are aware to the importance of the expiry date, particularly in cosmetic products, this is not a determinant factor since the "product's life" is considered short at these establishments and, therefore, is not taken into account in their acquisition [Fig. 1 (B)]. For the same reason the use of the products until the end, regardless the expiry date, is not always an important factor to control [Fig. 1 (C)]. As regards the registration of the opening date on the product packaging, during the storage period, none of the inquired schools applies this practice [Fig. 1 (C)], which may contribute to the use of a product with a durability date already expired. Concerning to the handling procedures it is noted that hand washing prior to product use is not a common practice and that the product is, in most cases, applied directly with the hands [Fig. 1 (D)]. This scenario may not only contribute to the microbial contamination of the paints, and consequently to their biodegradation, but also to increase the exposure to some potential hazards substances, including the microorganisms itself and harmful microbial metabolites (US FDA, 1995). Additionally, the exposure through dermal contact or ingestion to other potential toxic elements present in these products is also greater. A study conducted recently by Rebelo, et. al. (2015) that analyzed the samples here characterized in this work shows the presence of some heavy metals, mainly copper (Cu) and zinc (Zn) in concentrations above the migration limits, imposed by Toys Safety Directive, in artist paints, which reinforce the need to ensure the effective monitoring of the quality and safety of these products.

CONCLUSIONS

This study provide useful information about the children's play paints used in school establishments and available in retail stores. By analyzing the label content, was possible to characterize generically these products, especially as regards to the main hazards that may be involved in their use. As regards to the practices adopted in schools, it is perceptible that they are aware to the importance of acquire suitable products for children. However, some behaviors used in the application of these products may increase the exposure to some potential toxic elements and to their deterioration. In this sense, it is important to rethink some of these practices in order to ensure a high level of protection of children and also to guarantee the quality of these products.

REFERENCES

- Al-Saleh, I., Al-Enazi, S. & Shinwari, N. (2009). Assessment of lead in cosmetic products, *Regulatory Toxicology and Pharmacology*, 54, 105–113.
- Baer, I. Van de Kreeke, J. Linsinger, T.P.J. Robouch, P. Raposo, F.C. & Calle, B. (2011). IMEP-24 analysis of eight trace elements in toys. *Trends Analytical Chemistry*, 30, 313-323.
- Barata, E.A.F. (Eds.). (2002). *Cosméticos: Arte e Ciência*. Lisboa: Lidel, Edições Técnicas, Lda.
- Basketter D.A., Briatico-Vangosa, G. Kaestner, W. Lally, C. Bontinck, W.J. (1993). Nickel, cobalt and chromium in consumer products: a role in allergic contact dermatitis? *Contact Dermatitis*, 28, 15–25.
- CEN, the European Committee for Standardization (2014). EN 71- 7:2014 Safety of Toys – Part 7: Requirements and Test Methods, ICS 97.200.50
- CSC, the Campaign for safe Cosmetics (2009). Pretty scary: could Halloween face paint cause lifelong health problems? Available from: <http://www.safecosmetics.org/wp-content/uploads/2015/02/Pretty-Scary.pdf>.
- Danish Environmental Protection Agency, Danish Ministry of the Environment (2007). A survey and health assessment of cosmetic products for children, Survey of chemical substances in consumer products 88. Available from: <http://www2.mst.dk/Udgiv/publications/2007/978-87-7052-638-8/pdf/978-87-7052-639-5.pdf>.
- EU, European Union (2009a). Directive 2009/48/EC of the European Parliament and of the Council of 18 June 2009 on the safety of toys, *Off. J. Eur. Communities L 170 (06.30.2009)* 1–37.
- EU, European Union (2009b). Regulation (EC) no. 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products, *Off. J. Eur. Communities L 342 (12.22.2009)*.
- Flores, M., Morillo, M. & Crespo, M. (1997). Deterioration of Raw Materials and Cosmetic Products by Preservative Resistant Microorganisms. *International Biodeterioration and Biodegradation*, 40, 157-160.
- Godoi, Q., Santos Jr., D., Nunes, L.C., Leme, F.O., Rufini, I.A., Agnelli, J.A.M., Trevizan, L.C. & Krug, F.J. (2009). Preliminary studies of laser-induced breakdown spectrometry for the determination of Ba, Cd, Cr and Pb in toys, *Spectrochimica Acta Part B*, 64, 573-581.
- ISO, International Standard Organization (2010). *Safety of toys — part 3: migration of certain ingredients*, ISO 8124–3:2010(E). Geneva: International Standard Organization.
- La Rosa, F., Giese, E., Dekker, R., Pelayo, J. & Barbosa, A. (2008). Contaminação microbiológica de tintas à base d'água de uma indústria do estado do Paraná, Brasil. *Ciências Exatas e da Terra, Londrina*, 29 (1), 85-92;
- Perry, B. (2001). Cosmetic microbiology. *Microbiology Today - Society for general microbiology* Vol28/Nov01;
- Rebelo, A., Pinto, E., Silva, M.V. & Almeida, A.A. (2015). Chemical safety of children's play paints: Focus on selected heavy metals. *Microchemical Journal*, 118, 203-210.
- Smith, R. (Eds.). (2003). *New Artist's Handbook*. London: Dorling Kindersley Limited.
- US FDA, Food and Drug Administration (1995). Guide to inspections of cosmetic product manufacturers. Available from: <http://www.gmp-compliance.org/guidemgr/files/1-2-22.PDF>.

Determination of T2 and HT2 mycotoxins in cereals and cereal-based products using ELISA technique

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ABSTRACT: The aim of this study was to determine the levels of T-2 and HT-2 mycotoxins in grain, mill products and cereal-based products from samples obtained for testing at the Teaching Institute of Public Health Dr. “Andrija Štampar” in Croatia. Twenty-nine samples of grain, mill products and cereal-based products, collected using random sampling method from trade turnover in Croatia, were tested for T2 and HT2 mycotoxins. Samples were prepared according to the manufacturer's kit Romer Labs, and after preparation, the amount of T2 and HT2 mycotoxins was determined by immuno-enzymatic method (ELISA). The absorbance of the prepared samples was recorded at 450nm. The limit of detection LOD is 29 ppb for corn and 57 ppb for barley. The applied method proved to be a quick and effective for the analyzed group of samples. The results ranged from 24.00 µg/kg to 104.50 µg/kg for cereal, and from 24.00 µg/kg to 333.10 µg/kg for products based on cereals, indicating considerable contamination. The results indicated the presence of studied mycotoxins in the Republic of Croatia, therefore, to get better and more accurate results, it is necessary to analyze a larger number of various types of samples, both grains and their products, all in order to protect human health.

Keywords: T2 and HT2, mycotoxins, ELISA

INTRODUCTION

Mycotoxins are toxic secondary metabolites of toxigenic molds with chemically very different structures and variety of biological effects. The variety of structures is the result of biological methylation, halogenation and enzyme-catalyzed oxido-reduction that allows mycotoxins to have different effects on living organisms (Puntarić et al, 2012). People and animals introduce them through contaminated food, inhalation or through the skin, and can be dangerous to health in small amounts. They are very persistent and stable compounds whose accumulation results diseases called mycotoxicoses. Acute effects require high amounts and such incidents are usually restricted to less developed parts of the world where food controls are limited. Chronical effect occur when mycotoxins are present in much lower amounts leading to long-term health concern world-wide. There are proven hepatotoxic, neurotoxic, nephrotoxic, mutagenic and carcinogenic effects of mycotoxins as well as the effects on reproduction and development. In addition to health problems, they result serious economic consequences like damage to the grain and development of diseases of livestock (eg. reproductive and developmental toxicity). The optimum conditions for mold growth depends on the type and include appropriate moisture content, suitable temperature and presence of oxygen. Physical damage to crops and the presence of other microorganisms also facilitate breakthrough and development of molds and their metabolites. Due to their persistence and stability in the environment, once formed, cannot be destroyed by high temperature and known fungicides have little or no impact. Prevention is the best protection against mycotoxins, and protective measures are necessary to start immediately in the field, in the form of breeding resistant crops, rotation of crops, application of antifungal, insecticide and herbicide treatments and agro-technical measures which include testing of moisture and soil type. Harvest is recommended in dry seasons, when the humidity, which favors the development of molds, is at minimum. Purification, drying and separation of damaged grains reduces the possibility of development of mold during transport and storage of crops.

The most common mycotoxins are aflatoxins (B1, B2, G1, G2 and M1), ochratoxin, fumonisins (B1, B2 and B3), patulin, zearalenone and trichothecenes produced by different types of mold such as *Aspergillus sp.*, *Penicillium sp.* and *Fusarium sp.*

Trichothecenes

Trichothecenes are a large group of compounds with similar chemical structures that produce molds from families *Fusarium*, *Trichoderma*, *Stachybotrys*, *Verticimonosporium*, *Cephalosporium* and *Myrothecium*. Often, we can find them on cereals (eg. wheat, barley, corn, oats, rice) and cereal products (eg. flour, corn flakes, food for infants, malt and beer), in fruits (eg. bananas, mangoes), mustard seeds and sunflower seeds, peanuts, potatoes, etc. Due to the chemical structure are divided into two groups; trichothecenes group A, B, C and D. T2 and HT2 mycotoxins belong to group A and the most known representatives of the group B are deoxynivalenol (DON) and nivalenol. Trichothecenes are acutely cytotoxic and strongly immunosuppressive.

T2 and HT2

T2 and HT2 are belonging to the group A-trichothecenes, produced by various *Fusarium* species which grow and invade crops under moist and cool conditions. This group shares some common structural features, such as a double bond between C9 and C10 and an epoxy group at C12 and C13 (Figure 1) (EFSA, 2010).

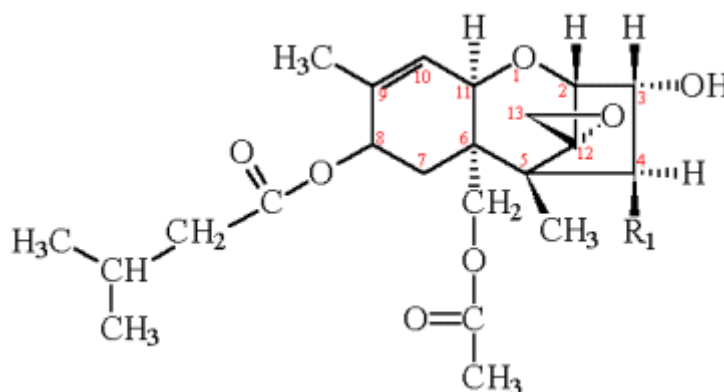


Figure 1: Structure of T-2 (R = OAc) and HT-2 (R = OH) toxin (EMAN)

Type A-trichothecenes are of special interest because they are more toxic than the other food-borne trichothecenes (Miller, 2002). Although T2 is produced primarily by *Fusarium* sp. (eg. *F. acuminatum*, *F. nivale*, *F. oxysporum*, *F. sporotrichoides*), toxin was also found in molds belonging to other genera such as *Trichoderma* sp. and *Myrothecium* sp. which means it's present worldwide and not only in northern temperature regions. Temperature range for T2 toxin production is wide (0°-32°C) with maximum production at temperatures below 15°C (EFSA, 2010). Surveys have revealed the presence of T2 and HT2 toxins in grains such as wheat, maize, oats, barley, rice, beans and soya beans as well as in some cereal-based products (WHO, 2002). T2 and HT2 toxins are not normally found in grains but result from water damage to grains. This may occur when crops remain in the fields for extended periods or become wet during storage.

Absorption, distribution, metabolism and excretion

T2 toxin is rapidly absorbed via oral and inhalation route but absorption through human skin is shown to be slow. It is metabolized by the gut microflora of mammals to several metabolites. HT-2 is one of the major metabolites of T2 toxin and it is generally accepted that HT2 toxin will follow the same pathways as found for T-2 toxin (EFSA, 2010). Therefore, the toxicity of T2 toxin in vivo can be considered to include that of HT2 toxin and the results of studies with T-2 toxin can be used to approximate the effects of HT2 toxin (WHO, 2001). Other metabolites include 3'-hydroxy-HT-2, 3'-hydroxy-T-2, T-2 tetraol, de-epoxy 3'-hydroxy-T-2 triol, de-epoxy 3'-hydroxy-HT-2 and 3'-hydroxy-T-2 triol. Metabolism continues in the liver (with biliary excretion), resulting in a substantial, combined first-pass effect in the gut and liver (WHO, 2002). Biotransformation in vivo is mainly situated in the liver, but also in the intestine or blood plasma of rats, pigs, mice, chickens and cows (EFSA, 2010). Distribution of toxins occurs through blood to target organs. Organs sensitive to T-2 and its metabolites are liver, gastrointestinal tract, kidney and spleen. Phase II metabolism of T2 toxin and its metabolites is

characterized by the formation of glucuronide conjugates which account for the majority of the excreted metabolites (EFSA, 2010).

Toxicology and observations in humans

T-2 toxin is a potent inhibitor of proteins. In cultured mammalian cells low concentrations of T-2 toxin induced DNA strand breaks, unscheduled DNA synthesis, gene mutations, chromosomal aberrations and inhibition of intercellular communication across gap junctions (WHO, 2002). Still, it is unclear if genotoxic effects are a consequence of interaction of T-2 toxin with genetic material or are secondary to inhibition of proteins. Different susceptibility was observed due to species and sex of experimental animals. Short-term studies have shown that cats are more susceptible to T-2 toxin than other species (eg. pigs and mice), probably due to disability to form glucuronide conjugates. Humans would not be expected to be similarly susceptible. As it is mentioned before, biological effects on humans can be acute or chronic. The available studies of adverse health effects in human populations were limited to a few investigations of outbreaks of acute poisoning, in which the reported effects included nausea, vomiting, pharyngeal irritation, abdominal pain and distension, diarrhoea, bloody stools, dizziness and chills (WHO, 2002). There were recorded more cases of food-related poisoning referred to as alimentary toxic aleukia (ATA) in Russia after consumption of grain infected with moulds. The dominant pathological changes were necrotic lesions of the oral cavity, oesophagus and stomach and, in particular, pronounced leukopenia consisting primarily of bone-marrow hypoplasia and aplasia (WHO, 2002). Data for chronic effects are not yet available.

GOALS

The purpose of this study was to determine the levels of T-2 and HT-2 mycotoxins in grain, mill products and cereal-based products from samples obtained for testing at the Department of Public Health Andrija Štampar, Croatia.

MATERIALS AND METHODS

A total of twenty-nine different samples of cereals and cereal-based products were used in this study. All samples were collected using random sampling method from trade turnover in Croatia and delivered for analysis to the Teaching Institute of Public Health "Dr. Andrija Štampar". Sampling was conducted in accordance with Regulation 401/2006, i.e., the amount of samples was taken regard to the amount of the lot, sub-lot and aggregate sample as well as the sampling frequency. Samples were divided into two groups according to the type. First group was consisted of eight grain samples and second group was consisted of twenty-one sample of cereal-based products. For identification and quantification of T2 + HT2 analyts was used immuno-enzymatic method for the determination of mycotoxins - ELISA technique. This technique is based on reaction between antigens and antibodies. Coloration strength is inversely proportional to the concentration of trichothecenes, which is measured at 450 nm. Sample preparation includes mixing 20.0 g of sample and 100 ml of 70% methanol in an Erlenmeyer flask and placing on a shaker for approximately 3 minutes until layers are separated. After separation of layers the solution is filtered through the filter paper. Using automatic pipetting system Precision-Biotek, to each well is added 50 µL of conjugate and 50 µL of each standard as well as 50 µL of antibody solution. Prepared sample, with occasional stirring, was incubated at room temperature for 10 min. After incubation, the content of wells was discarded and rinsed with distilled water dispenser. This process was repeated four more times (total of five). Between each wash the wells were completely dried using paper. To each well was added 100 µL of substrate and incubated for 5 minutes at room temperature, followed by addition of 100 µL of stop solution. Spectrophotometer recording was performed at 450 nm.

Internal quality control of results is performed before each testing and is done by injecting standard each time before measuring sample; calibration lines accompany test results whose absorbance must be within the limits of tolerances. For each analysis the coefficient of variation between two standards and sample provided by manufacturer is calculated. The laboratory also have external quality control of results by participating in inter-laboratory comparisons organized by FAPAS.

Table 1: Validation parameters

PARAMETERS	ELIGIBILITY CRITERIA
Linearity	$k \geq 0,985$ (1)
Precision	
- the reproducibility of the measured samples	RSD \leq 20%
- the reproducibility of the measured standards.	RSD \leq 20%
- intermediate precision	RSD \leq 20%
Utilization rate	70 -110 %
Stability of measured solution	information
The limit of detection	$< 1,0 \mu\text{g}/\text{kg}$
The limit of quantification	$< 2,0 \mu\text{g}/\text{kg}$

RESULTS AND DISCUSSION

This study researched the presence of a mycotoxin T2 and HT2 as products of mold from *Fusarium tricinctum*. They belong to group A-trichotecene mycotoxins, and produced by *Fusarium* in a very wide temperature range of 0-32 ° C (Creppy, 2002). It is known that the toxin T2 is non-volatile compound, insoluble in water and petroleum ether, but soluble in ethyl acetate, acetone, chloroform, dimethyl sulfoxide, ethanol, methanol and propylene glycol. It is thermally stable and is difficult to suppress it in the food production. If it is ingested, in animal kidney T2 toxin is metabolized in less toxic HT-acetyl-2 and HT2 toxin. Remains of T2 toxin and its metabolites were found in milk (Whitlow et al., 2006). The mentioned toxins have strong cytotoxic and immunosuppressive properties that may cause acute intoxication and chronic diseases in humans and in animals. The symptoms of acute intoxication are: nausea, chills, abdominal pain, diarrhea and weight loss, and symptoms in animals include intestinal bleeding, reduced milk production and even death of cattle (Whitlow et al., 2006 & Gremmels, 2008). It was also proved that the T2 toxin inhibits protein synthesis causing secondary disorder in the synthesis of DNA and RNA (Richard, 2007). It also adversely affects the immune system which leads to change in the number of leukocytes and increased hypersensitivity (Creppy, 2002). Because of the lack of existence of relevant evidence about carcinogenicity in humans and animals IARC classify T-2 toxin as category 3, i.e. a group of substances that are not carcinogenic to humans. For T2 and HT2 mycotoxins is not yet established maximum permitted quantity for food and feed, but European Union gather data from member states, and the data is collected by the European Food Safety Authority EFSA. Because of their toxic properties to the target organ, both animals and people, are in focus of control and monitoring of their presence in different types of food.

During this study, a total of twenty-nine samples of cereals and cereal-based products was processed. Samples were analyzed for the presence of T2 and HT2 mycotoxins in the laboratory of Teaching Institute of Public Health. The samples were collected randomly from the area of Republic of Croatia. Samples were taken regard to the amount of the lot, sub-lot and aggregate sample as well as the sampling frequency according to Regulation of the European Union, which prescribes the sampling method, as well as the number of samples due to the amount of the series. Analytical method used in this study is based on the principle of binding antigens and antibodies, i.e. immuno-enzymatic method - ELISA technique - was applied. It is a fast and simple screening method that requires additional checks on affirmative sophisticated analytical techniques, but is applicable to routine analysis which confirms the fact that is used in the analysis of other types of mycotoxins (Tangni et al, 2010). The available literature mentions high of efficiency liquid chromatography mass spectrometry (LC-MS-MS) (Ates et al, 2012). Equally, there are different principles used during the sample preparation preceding the LC-MS-MS technique, which is based on a multi-mycotoxin determination appropriate to determine a number of different mycotoxins in cereals (Queslati et al, 2012). Results obtained in this study were divided into two groups. The first group includes the results of the analyzed grains, and in second group are samples of products based on cereals. Table 2 shows the results of analyzed samples of cereals and grain mill products. Table shows clearly that the analyzed samples were wheat, wheat products and corn.

Table 2: Concentration of T2 and HT2 toxins in grain and mill products

No.	Sample	T2 and HT2 ($\mu\text{g}/\text{kg}$)
1.	Wheat flour from whole grain	32,28
2.	Corn grits	24,00
3.	Durum wheat flour	24,00
4.	Mixed cereals	24,00
5.	Pop corn	27,94
6.	Corn	29,35
7.	Mercantile corn	24,00
8.	Corn	333,10
9.	Wheat	24,00
Average value		60,3
Minimum value		24,00
Maximum value		333,10

The range of results was from 24.00 $\mu\text{g}/\text{kg}$ to 333.10 $\mu\text{g}/\text{kg}$, while the average value for nine analyzed products was 60.30 $\mu\text{g}/\text{kg}$ of the sum T2 and HT2 toxins.

Table 3 shows the results of cereal-based products. It was analyzed a total of 20 different samples, and obtained values are between the range of 24.00 $\mu\text{g}/\text{kg}$ and 104.50 $\mu\text{g}/\text{kg}$.

Table 3: Concentration of T2 and HT2 toxins in cereal-based products

No.	Sample	T2 and HT2 ($\mu\text{g}/\text{kg}$)
1.	Wheat flakes	24,00
2.	Macaroni	29,56
3.	Cornflakes	24,00
4.	Pasta	27,55
5.	Muesli	24,00
6.	Buckwheat porridge with fruit	24,00
7.	Cereal porridge	25,07
8.	Cereal porridge	28,56
9.	Cereal porridge	31,02
10.	Buckwheat porridge with fruit	27,57
11.	Banana and lemon balm	27,07
12.	Buckwheat porridge	24,00
13.	Oatmeal porridge	24,00
14.	Integral spaghetti with vegetable sauce	26,33
15.	Pasta with vegetable sauce	28,10
16.	Cereal porridge	104,50
17.	Tea biscuit	32,90
18.	Cereal porridge "gris"	24,00
19.	Cereal porridge "čokolino"	38,70
20.	Cereal porridge "vanilino"	24,00
Average value		30,85
Minimum value		24,00
Maximum value		104,50

Average value of analyzed mycotoxins was 30.85 $\mu\text{g}/\text{kg}$. Higher values of sum T2 and HT2 toxins can be observed in the group of grains and grain mill products while cereal-based coproducts contain a

slightly lower value. Comparing the obtained values with values from available literature, we can say that similar values were obtained in a study "Multi-mycotoxin determination in cereals and derived products marketed in Tunisia using ultra-high performance liquid chromatography coupled to triple quadrupole mass spectrometry" conducted by Queslati et al who found that values of these toxins in wheat have range from 5.2 µg/kg to 52.4 µg/kg, with highest value of 120 µg/kg.

The results undoubtedly showed the presence of *Fusarium* molds in the analyzed foods. It is evident that some type of products contain relatively high values of studied mycotoxins, such as corn in which the amount of the determined sum of T2+HT2 toxins is 333.10 µg/kg, indicating a considerable contamination. Equally, when it comes to products based on cereals, it is evident that the amount of 104.50 µg/kg was determined in Cereal porridge. The results show that there are products contaminated with T2 and HT2 toxins, therefore it is necessary to continue to carry out research, especially when we know that food is not always the only source of these mycotoxins.

CONCLUSION

Considering the determined toxic properties of T2 and HT2 mycotoxins, in order to make the maximum contaminant level (MCL) of T2 and HT2 mycotoxins, it is important to participate in the monitoring prescribed by the EFSA, with the aim of collecting as much as possible the results from the whole of the European Union. Based on the risk assessment of the results, also taking into account the diet, acceptable daily intake and MCL will be determined.

The results indicated the presence of studied mycotoxins in the Republic of Croatia, therefore, to get better and more accurate results, it is necessary to analyze a larger number of various types of samples, both grains and their products, all in order to protect human health.

REFERENCES

- Ates E., Mittendorf K., Stroka J., Senyuva H. (2013). Determination of fusarium mycotoxins in wheat, maize and animal feed using on-line clean-up with high resolution mass spectrometry. *Food additives & contaminants. Part A, Chemistry, analysis, control, exposure & risk assessment*; 30(1):156-65.
- Creppy E.E. (2002). Update of survey, regulation and toxic effects of mycotoxins in Europe. *Toxicology Letters*, 127, 19-28.
- European Mycotoxins Awareness Network
Available from: <http://services.leatherheadfood.com/eman/FactSheet.aspx?ID=13>
- Lattanzio V.M., Ciasca B., Haidukowski M., Infantino A., Visconti A., Pascale M. (2013). Mycotoxin profile of *Fusarium langsethiae* isolated from wheat in Italy: production of type-A trichothecenes and relevant glucosyl derivatives. *Journal of mass spectrometry*; 48(12):1291-8.
- Miller J.D. (2002). Aspects of the ecology of fusarium toxins in cereals. In: De Vries J., Trucksess M. and Jackson L. *Mycotoxins and Food Safety*. Kluwer Academic/Plenum Publishers, New York. 19-27.
- Queslati S., Romero-Gonzalez R., Lasram S., Frenich A.G., Vidal J.L. (2012). Multi-mycotoxin determination in cereals and derived products marketed in Tunisia using ultra-high performance liquid chromatography coupled to triple quadrupole mass spectrometry. *Food & chemical toxicology: an international journal published for the British Industrial Biological Research Association*; 50(7):2376-81.
- Puntariæ D., Miškulin M., Bošnjir J. et al (2012). Environmental health. Zagreb: Medical edition.
- Schuhmacher-Wolz U., Heine K., Schneider K. (2010). Scientific report submitted to EFSA. Report on toxicity data on trichothecene mycotoxins HT-2 and T-2 toxins. Available from: <http://www.efsa.europa.eu/en/supporting/doc/65e.pdf>
- Tangni E.K., Motte J.C., Callebaut A., Pussemier L. (2010). Cross-reactivity of antibodies in some commercial deoxynivalenol test kits against some fusariotoxins. *Journal of agricultural and food chemistry*; 58(24):12625-33.
- Whitlow L. W., Diaz D. E., Hopkins B. A., Hagler W. M., (2006). Mycotoxins and milk safety: the potential to block transfer to milk
- WHO, World Health Organization (2001a). WHO Food Additives Series: 47. Safety evaluation of certain mycotoxins in food.
Available from: <http://www.inchem.org/documents/jecfa/jecmono/v47je01.htm>
- WHO, World Health Organization (2002b). Evaluation of certain mycotoxins in food. Available from: http://whqlibdoc.who.int/trs/WHO_TRS_906.pdf

Xu X., Madden L.V., Edwards S.G. (2014). Modeling the effects of environmental conditions on HT2 and T2 toxin accumulation in field oat grains. *Phytopathology*; 104(1):57-66.

Differentiation of prostate cancer (C61) morbidity and mortality in the Silesian Province in Poland

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ABSTRACT: Introduction: In 2012 prostate cancer was the second most common cancer in men, mainly in the more developed countries. This type of cancer is characterized by high growth rates of morbidity, with the persistent mortality level. **Aim:** The aim of the study was to present the differentiation of morbidity and mortality of prostate cancer in the male population of Poland and in the cities and counties of the Silesian Province, the most polluted part of Poland. **Material and methods:** The incidence and mortality rates were calculated on the basis of statistical data collected from the National Cancer Registry and the Central Statistical Office of Poland. **Results:** During the analyzed period of time the morbidity and mortality of prostate cancer increased in all analyzed provinces of Poland and cities and counties of Silesian Province. Between all analyzed places the differentiation is very significant; reaching 80% between the provinces and even 600% in the Silesian Province. **Discussion:** The rapid growth of prostate cancer cases enforces the need for comprehensive preventive measures. Taking effective preventive action will only be possible if the relevant factors which have the influence on the process of carcinogenesis will be identify. **Conclusions:** The data analysis presents high dynamics of morbidity and mortality from prostate cancer in all provinces of Poland and in the Silesian Province, territorially differentiated, which may indicate the significant role of environmental risk factors in the occurrence of this type of cancer.

Keywords: *environmental risk factors, prostate cancer, incidence and mortality rates*

INSTRUCTION

Statistics of prostate cancer

Neoplastic disease characterized by high growth rates of morbidity, with the persistent mortality level, is prostate cancer in men, classified by the International Classification of Diseases and Related Health Problems (ICD-10) as the C61. In 2012, prostate cancer was the second, after lung cancer (16.7%), the most common cancer in men, acting in 15% of all cases, of which 70% (759,000) occurred in the more developed countries (WHO,2014 & WHO,2012).In 1985, the lifetime risk of being diagnosed with prostate cancer in the average American was 8.7% and the risk of dying from this cancer was 2.5%. In 2005, these figures have changed, increasing the risk of being diagnosed with C61 to 17% and the risk of death to 3% (WHO,2008). The highest incidence rates for the C61, for over two decades, are recorded in countries such as the United States, Canada and the Scandinavian countries, while the lowest in China and the other Asian countries. Turning to the mortality rates, the highest are recorded in Scandinavia and the Caribbean, while the lowest in China and Japan (Crawford E, 2003). In 2011, in Poland prostate malignancy was responsible for 14.4% of all cancer incidences and 7.9% of cancer deaths in total (Didkowska, Wojciechowska & Zatoński, 2013).

Etiology of prostate cancer

The etiology of prostate cancer is not fully understood. In addition to such endogenous risk factors of prostate cancer as age, genetic load, ethnicity or oxidative stress, the researchers also draw attention to the exogenous factors including diet, occupation, and environmental factors (Bostwick et al,2004 & Grönberg, 2003 & Goyer, Liu & Waalkes , 2004). The incidence of prostate cancer increases with age (especially in men over 65 years of age). The probability of this cancer is almost forty times higher in men older than 65 years than in men below this age. Only about 1% of prostate cancer is detected in men younger than 50 years. For most cancers, both men and women in the younger age groups (<45 years old) have a much better chance of 5-year survival from the time of diagnosis than those in the oldest age groups (>65 years) (WHO,2014). Prostate cancer is an exception, because it is

characterized by a worse prognosis in men in the youngest age groups (<44 years), when more aggressive types of this cancer are developed (WHO,2012 & Wojciechowska, Didkowska & Zatoński, 2010). Genetic factors also play a significant role in the development of this cancer. The man, whose father or brother was diagnosed with C61, has from 2 to 3 times greater risk of developing this type of cancer than a genetically unloaded person (WHO,2014). Genetic factors clearly increase the susceptibility of developing this type of cancer. African-Americans are an ethnicity who has 1.6 times higher risk of developing C61 than Caucasians (WHO,2014 & Bostwick et al.,2004 & Grönberg, 2003 & Quinn & Babb, 2002). Significant geographical differences in morbidity and mortality of prostate cancer may indicate the role of the environmental risk factors in the habitat and the workplace. An increasing number of studies shows that significant risk factors, in this case, can be heavy metals, including cadmium (World Cancer Research Fund, 2007 & Strumylaite, 2011 & Zemła et al., 2012). Other environmental pollutions, which are potentially associated with the development of prostate cancer, are: dioxins, polychlorinated biphenyls and other chlorinated compounds which are a component of plant protection products (Matés et al., 2010 & Aronson et al., 1996 & Belpomme et al., 2009 & Dich & Wiklund, 1998 & Prins, 2008).

Prostate Cancer in the Silesian Province

The Silesian Province is one of the particularly contaminated regions in Poland. It is characterized by the highest concentration of cadmium in all environmental compartments (water, air and soil). Silesia Region is historically associated with intensive industrial activities, especially with non-ferrous metal ores mining industry, where environmental pollution with heavy metals, such as cadmium and lead, remains a serious problem. In this region, prostate cancer, was responsible in 2010 for 14.2% of new cancer cases and for 7.6% of cancer deaths. Each of these values exceeded the mean values for Poland (morbidity-13.2%, mortality-7.2%) at the same time (The Silesian Voivodeship Office, Department for Health Care System Supervision, Branch of Analysis and Medical Statistics, 2013).

AIM

The aim of the study was to present an increase and differentiation of the incidence of morbidity and mortality of prostate cancer in the male population of Poland and in the cities and counties of the Silesian Province in the years 1999 - 2011.

MATERIAL AND METHODS

In the epidemiological analysis crude incidences and mortality rates (per 100 000 men) for provinces of Poland, collected from the National Cancer Registry, were used. For cities and counties of Silesian Province crude rates (incidence and mortality) were calculated using the number of prostate cancer cases and the number of inhabitants. The analysis included a period of 13 years, between 1999 and 2011, and it was made for 16 provinces of Poland and all counties and cities located in the Silesian Province in order to show the spatial differentiation. In addition, to present a dynamics of growth of morbidity the average values of incidence rate for the three two-year intervals for provinces and Silesian Province were calculated.

RESULTS

The morbidity of prostate cancer during analyzed period varies significantly in different provinces. In extreme cases, the difference is over 80% (Warmińsko-mazurskie Province and Swietokrzyskie Province). Mortality from prostate cancer, during analyzed period, was the highest in the Podlaskie Province and the smallest in the Opolskie Province, and the difference between them was close to 50% (Tab.2).

Table 2 - The crude incidence and mortality rate of prostate cancer (C61) in the provinces of Poland (per 100 000 men). The average values obtained for the period 1999-2011

The average rate value for the years 1999-2011

Province	Incidence	Mortality
dolnoslaskie	36,12	18,21
kujawsko-pomorskie	35,81	19,23
lubelskie	40,23	20,24
lubuskie	26,98	17,24
lodzkie	32,34	21,98
malopolskie	37,16	18,47
mazowieckie	40,43	21,51
opolskie	30,69	16,25
podkarpackie	37,64	18,98
podlaskie	37,68	23,66
pomorskie	43,71	18,88
slaskie	40,00	17,95
swietokrzyskie	48,52	22,69
warminsko-mazurskie	26,77	16,97
wielkopolskie	42,92	20,57
zachodniopomorskie	29,05	17,30
Poland	37,78	19,51

The epidemiological analysis of calculated data (Tab.3) showed the increasing incidence and mortality rates in all regions. The highest growth dynamics of incidence of prostate cancer occurred in Lubuskie Province, where during 13 years the average morbidity increased 5-fold. The highest increase of mortality of prostate cancer took place in Opolskie Province (over 84%), while the lowest occurred in Pomorskie Province (11%).

Table 3 - The crude incidence and mortality rate of prostate cancer (C61) in the provinces of Poland (per 100 000 men). The average values for three time intervals: 1999-2000, 2004-2005, 2010-2011

The average rate value for the years:

Province	1999-2000		2004-2005		2010-2011	
	Incidence	Mortality	Incidence	Mortality	Incidence	Mortality
dolnoslaskie	28,4	13,4	32,5	18,1	47,5	20,6
kujawsko-pomorskie	25,1	16,4	27,5	18,0	52,7	23,7
lubelskie	24,7	17,1	44,4	19,6	56,9	22,7
lubuskie	10,9	11,7	28,4	17,3	55,4	19,0
lodzkie	22,1	18,8	30,0	23,1	58,3	22,9
malopolskie	26,1	14,4	32,1	19,2	50,2	21,0
mazowieckie	24,7	18,7	43,1	21,4	51,8	22,1
opolskie	24,8	11,6	27,1	16,2	41,2	21,4
podkarpackie	26,0	16,1	39,5	19,6	52,1	20,3
podlaskie	28,1	18,4	40,0	23,7	56,9	26,4
pomorskie	31,4	18,2	28,4	17,2	72,2	20,2
slaskie	25,0	13,9	39,7	17,5	55,4	21,1
swietokrzyskie	42,6	19,5	52,2	23,7	46,8	23,3
warminsko-mazurskie	13,8	13,4	30,3	16,8	34,6	18,2
wielkopolskie	25,5	18,4	40,1	20,1	53,3	21,9
zachodniopomorskie	19,2	14,4	27,2	18,1	40,7	20,0
Poland	25,2	16,2	36,2	19,5	52,5	21,5

Table 4 presents data about morbidity and mortality of prostate cancer in the counties and cities of Silesian Province. The increase in the incidence of prostate cancer, during analyzed period, occurred in 15 of 17 counties of Silesia. The exceptions were two counties – czestochowski and myszkowski, in which the value of incidence rates were decreased. The highest, almost 5-fold, increase in incidence occurred in cieszynski county. The highest mortality growth dynamics was characterized by a district raciborski, in which mortality increased 3-fold. In the three counties – gliwicki, wodzislawski, zywiecki, the value of mortality rate was doubled. The decrease of mortality took place only in two counties (bedzinski, czestochowski).

Table 4 - The crude incidence and mortality rate of prostate cancer (C61) in the counties and cities of Silesian Province (per 100 000 men). The average values for three time intervals: 1999-2000, 2004-2005, 2010-2011

COUNTY	Incidence of C61			Mortality of C61		
	The average rate value for the years:					
	1999 - 2000	2004 - 2005	2010 - 2011	1999 - 2000	2004 - 2005	2010 - 2011
bedzinski	33,1	51,2	61,3	23,2	24,9	20,7
bielski	25,9	56,7	37,2	14,7	15,2	17,0
cieszynski	12,2	26,4	60,6	10,3	13,5	19,4
czestochowski	33,9	13,0	30,8	21,9	22,1	16,6
gliwicki	17,9	24,0	48,3	8,1	13,3	17,9
klobucki	15,0	16,6	23,7	18,5	17,8	20,1
lubliniecki	26,4	18,6	52,5	7,5	10,6	10,5
mikolowski	35,5	59,2	73,1	15,5	12,5	16,4
myszkowski	34,8	37,2	25,8	18,1	10,0	31,5
pszczyński	31,4	27,3	43,5	7,8	15,6	14,2
raciborski	14,5	23,1	39,6	6,0	10,2	17,9
rybnicki	24,4	29,1	42,8	10,9	13,9	20,1
tarnogorski	24,8	28,9	61,0	11,3	17,1	14,9
tyski	33,7	31,1	38,5	10,2	12,8	15,8
wodzislawski	41,7	26,5	52,6	12,2	13,3	26,6
zawierciański	34,1	37,8	59,6	23,0	31,2	28,5
zywiecki	14,1	40,9	34,7	9,4	18,4	22,1
CITY						
Bielsko-Biala	39,3	96,2	45,6	18,2	17,3	21,9
Bytom	20,7	24,4	41,8	17,6	15,7	24,1
Chorzow	30,2	98,2	80,8	20,7	15,4	20,7
Czestochowa	23,6	23,3	38,7	13,2	16,8	20,2
Dabrowa Gornicza	16,9	39,6	70,1	13,7	18,2	28,1
Gliwice	25,5	40,6	68,5	11,0	16,9	26,0
Jastrzebie-Zdroj	19,4	28,1	83,5	6,8	14,5	7,7
Jaworzno	15,7	24,4	44,5	10,4	19,1	23,9
Katowice	38,4	72,6	101,1	19,5	25,8	27,0
Myslowice	29,9	36,7	58,6	9,1	13,6	17,7
Piekary Slaskie	17,2	51,8	53,9	11,0	31,1	18,0
Ruda Slaska	15,0	25,6	53,8	11,8	15,2	31,6
Rybnik	24,8	27,2	52,3	13,4	14,3	16,7
Siemianowice Slaskie	17,6	55,2	62,4	9,5	14,2	20,8
Sosnowiec	12,5	39,5	73,3	13,4	21,6	22,9
Swietochlowice	20,9	50,0	64,5	8,7	18,5	13,6
Tychy	25,8	39,7	62,3	17,2	19,5	26,3
Zabrze	26,4	32,7	39,4	13,4	15,5	20,6
Zory	9,0	30,0	40,9	6,0	15,8	4,9
Silesian Province	25,0	39,7	55,4	13,8	17,5	21,1

The increase of prostate cancer morbidity, in the years 1999-2011, was observed in all cities of the Silesian Province. The highest, over 6-fold increase, occurred in Sosnowiec. The increase of mortality occurred in 18 of 19 cities. In Ruda Slaska was observed the highest, 3-fold increase of mortality caused by C61. Furthermore, the value of mortality rate was doubled in Gliwice, Jaworzno, Siemianowice Slaskie and Dabrowa Gornicza.

DISCUSSION

Malignant neoplasm of the prostate is now the second most commonly diagnosed cancer in men in the world and is the fifth leading cause of death due to cancer. The value of incidence rate of prostate cancer varies between countries, in extreme cases the difference is over 25-fold (WHO,2014). Besides unmodified risk factors such as age, gene load and ethnicity, more and more research shows that significant risk factors in the development of prostate malignancy may be environmental factors such as heavy metals, dioxins, polychlorinated biphenyls and other halogenated compounds (Bostwick et al,2004 & Grönberg, 2003 & Goyer, Liu & Waalkes , 2004 & Quinn & Babb, 2002, Wojciechowska, Didkowska & Zatoński, 2010 & World Cancer Research Fund, 2007 & Strumylaite, 2011 & Zemła, Banasik & Kołosza, 2012). The differentiation in dynamic of morbidity and mortality between the provinces and all cities and counties of the Silesian Province (in extreme cases the difference is 6-fold) indicate the close relation between the prostate cancer occurrence and the

environmental risk factors. The relation is more visible in the Silesian Province which is the most contaminated part of the country with heavy metals. The rapid growth of new cases of prostate cancer enforces the need for comprehensive preventive measures. The effective preventive action is only possible if the relevant factors activating the process of carcinogenesis is indicated.

CONCLUSIONS

The data analysis presents high dynamics of morbidity and mortality from prostate cancer in all provinces of Poland and in the Silesian Province, territorially differentiated, which may indicate the significant role of environmental risk factors in the occurrence of this type of cancer.

REFERENCES

- Aronson K.J., Siemiatycki J., Dewar R., Gerin M., (1996), Occupational Risk Factors for Prostate Cancer Results from a Case-Control Study in Montreal, Quebec, Canada, *American Journal of Epidemiology*, Vol. 143, No. 4;
- Belpomme D., Irigaray P., Ossondo M., Vacque D., Martin M., (2009), Prostate cancer as an environmental disease: An ecological study in the French Caribbean islands, Martinique and Guadeloupe, *International Journal of Oncology* 34: 1037-1044;
- Bostwick D.G., Burke H.B., Djakiew D., Euling S., Ho S., Landolph J., Morrison H., Sonawane B., Shifflett T., Waters D.J. & Timms B., (2004) Human Prostate Cancer Risk Factors, *Cancer Supplement*, American Cancer Society, November 15, 2004 / Volume 101 / Number 10;
- Crawford E.D., (2003) Epidemiology of prostate cancer, *Urology*, Volume 62, Issue 6, Supplement 1, Pages 3–12;
- Dich J., Wiklund K., (1998), Prostate Cancer in Pesticide Applicators in Swedish Agriculture, *The Prostate* 34:100–112;
- Didkowska J., Wojciechowska U. & Zatoński W. (2013), Cancer in Poland in 2011, Polish National Cancer Registry, Department of Epidemiology and Cancer Prevention, ISSN 0867–8251, Warszawa; [URL:] http://onkologia.org.pl/wp-content/uploads/COI_Nowotwory2013_web.pdf [available: 02.09.2014];
- Goyer R.A., Liu J., Waalkes M.P., (2004) Cadmium and cancer of prostate and testis, *BioMetals* 17: 555–558;
- Grönberg H., (2003) Prostate cancer epidemiology, *The Lancet*; Vol 361: 859–64;
- Matés J.M., Segura J.A., Alonso F.J., Márquez J., (2010), Roles of dioxins and heavy metals in cancer and neurological diseases using ROS-mediated mechanisms, *Free Radical Biology & Medicine* 49 (2010) 1328–1341;
- Prins G.S., (2008), Endocrine disruptors and prostate cancer risk, *Endocrine-Related Cancer* 15 649–656;
- Quinn M., Babb P., (2002) Patterns and trends in prostate cancer incidence, survival, prevalence and mortality. Part I: international comparisons, *BJU International*, 90, 162–173;
- The Silesian Voivodeship Office, Department for Health Care System Supervision, Branch of Analysis and Medical Statistics, (2013) Malignant tumors in the Silesian Province (selected data for the year 2010), Katowice;
- Strumylaite L., (2011) Cancer risk in relation to exposure to trace elements, *Environmental Medicine*, 14 (1), 7-10;
- Wojciechowska U., Didkowska J., Zatoński W., (2010) Five year survival rates of cancer patients in Poland, *Journal of Oncology*, Vol 60, Number 2, 122–128;
- World Cancer Research Fund, American Institute for Cancer Research, (2007) *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective*, Washington DC: AICR, , ISBN: 978-0-9722522-2-5;
- World Health Organization, International Agency for Research on Cancer, (2014) *World Cancer Report 2014*, IARC Press, Lyon;
- World Health Organization, International Agency for Research on Cancer, (2008) *World Cancer Report 2008*, IARC Press, Lyon;
- World Health Organization, International Agency for Research on Cancer, (2012) *Fact Sheets by Cancer*; [URL:] http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx [available: 29.09.2014];
- World Health Organization, International Agency for Research on Cancer, (2012), *World Cancer Factsheet*, World cancer burden, *Cancer Research UK* 2014; [URL:] www.cruk.org/cancerstats [available: 29.09.2014];
- Zemła B., Banasik T.R. & Kołosza Z., (2012) An endemic areas of the biggest and smallest mortality cancer rates for all sites combined within Silesia Voivodeship, *Environmental Medicine*, Vol. 15, No. 4, 95-103.

Environmental exposure to polychlorinated biphenyls as a significant risk factor on the incidence of developmental disorders in children

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ABSTRACT: Introduction. Some studies indicate that the exposure of children to polychlorinated biphenyls (PCBs) in the environment may cause negative effects on the development of cognitive and somatic functions of young organisms. Recently, sudden increase in the number of developmental disorders in children is noticed. In the same time an increase of concentration of PCB, very neurotoxic chemical, has been observed in the environment. **Aim.** The study was undertaken to investigate the hypothesis that the high coefficients of developmental disorders (R62) and psychomotor developmental disorders (R62.0) in the population of children are associated with polychlorinated biphenyls, which contaminate their place of living. **Material and Methods.** On the basis of the raw R62 and R62.0 data connected with children in selected Silesian cities, the coefficients were calculated (per 100 000 children) for the years 2009-2010. The environmental burden was estimated on the basis of annual average concentrations of PCBs in the air of 19 Silesian cities. The relationships between the incidences of R62 and R62.0 in children and environmental burden by PCBs were performed. **Results.** Significant differences in the R62 and R62.0 coefficients between the cities were indicated. The significant correlation between R62 and R62.0 and the average concentrations of PCBs in the respirable dust PM10 has been found. **Discussion.** The important role of PCB as a factor affecting the incidence of developmental disorders in children was indicated also by other authors but mostly they pointed out food as a main source of PCB in health risks. **Conclusions.** One of significant environmental factor affecting the incidence of developmental disorders in children is exposure to PCBs in the respirable dust PM10.

Keywords: *developmental disorders, psychomotor developmental disorders, polychlorinated biphenyls, environmental exposure*

INSTRUCTION

Environmental pollution by polychlorinated biphenyls are considered to be the causative agent of many different health irregularities, including developmental disorders in children (Gerc et al., 2012). Frequently diagnosed nervous system deficits in children and adolescents are developmental disorders, classified according to the International Classification of Diseases and Related Health Problems (ICD-10) as the R62, which include the psychomotor developmental disorders (classified as R62.0) and physical developmental disorders (classified as R62.8) (WHO, 2010). Previous studies indicate that exposure of children to some neurotoxic substances in the environment, such as polychlorinated biphenyls (PCBs) and Pb, may cause negative effects on the development of cognitive and somatic functions of young organisms (Grandjean & Landrigan, 2006 & Moore, 2009). The U.S. National Academy of Sciences estimate that the simultaneous action of environmental factors, including exposure to toxic chemicals in the environment, such as lead and polychlorinated biphenyls, and genetic susceptibility, may contribute to rise of at least 25% of the diagnosed development disorder in a population of children (SFDTRA, 2000). The exposure of children, both prenatal and postnatal, to such factors like polychlorinated biphenyls, may lead to the psychomotor developmental disorders, which are manifested by a low intelligence quotient (IQ), irritability excessive, impulsivity, problems with concentration, attention and memory, leading to reduced ability to learn, worse psychomotor efficiency, including impaired visual-motor coordination and difficulty social contacts (Aguiar et al., 2010 & Kimura-Kuroda et al., 2007). These symptoms are also typical in autism (ASD) and in attention deficit hyperactivity disorders (ADHD) (Eubig et al., 2010). The etiology of these disorders is not well understood, but the literature suggests increasing of the interaction of genetic and environmental factors (Benarjee et al., 2007 & Swanson et al., 2007). In both case, ASD and ADHD, the number of diagnosed cases in children is increasing rapidly in time. According to the U.S. Centers

for Disease Control and Prevention (CDC), in 2010, in the population of American children, one child on 68 was detected for some form of autism. [28] This rate is the highest in history; about 62% higher than in 2006 (1 on 110 children) and about 121% higher than the number estimated in 2002 (1 on 150 children) (CDC, 2014). ADHD is another of the most common neurobehavioral disorders, diagnosed in children around the world (Eubig et al., 2010 & Landrigan et al., 2012). According to the latest data currently recorded incidences of ADHD in the population of children in the United States exceeded 14% (Landrigan et al., 2012). Increasing number of diagnosed developmental disorders in children at such a rate exacts the need to take immediately preventive actions what is very difficult because of limited studies relating identification of the neurotoxins responsible for this, as well as ways of exposure of children. Without a better understanding of when, where, how and why the neurotoxin affects the health of children, reliable protection is impossible (Barrett, 2009). Sudden increase the number of developmental disorders in children in recent years, is adequate to increase, at the same time, environmental burden of persistent organic pollutants such as PCBs, characterized by high neurotoxicity, which are increasingly seen as the most important risk factors in developmental disorders in children. Polychlorinated biphenyls (PCBs) are synthetic chemical compounds belonging to the group of persistent organic pollutants (POPs). PCBs were used primarily as electric insulators in transformers and capacitors of average and high power, in hydraulic systems, in heat exchangers, as components of lubricants, oils, plasticizers, printing inks as well as incombustible substances and media of pesticides (Carpenter, 2006 & WHO, 2003). Wide application of PCB in the environment as well as their durability, resistance to biodegradation and the ability to accumulate in a food chain are the reason of their presence in the human body and breast milk (Grandjean & Landrigan, 2006). Exposure to PCBs can disrupt the normal development of neurons in children and cause abnormal development of the brain (Kimura-Kuroda, 2007). The results indicating of an association of polychlorinated biphenyls with the amount of developmental disorders in children are part of the priority objectives of the research work conducted by research centers in the world for which the aim is to protect the public health from harmful effects of these compounds and reducing social inequalities in health (Marek et al., 2006 & Grandjean & Landrigan, 2006).

AIM OF THE STUDY

The study was undertaken to investigate the hypothesis that the high coefficients of developmental disorders and psychomotor developmental disorders in the population of children are associated with polychlorinated biphenyls, which contaminate their place of living.

MATERIAL AND METHODS

The data on the state of health of children and adolescents aged 0-18 who are under care of a primary care physician were acquired from the Center for Health Information Systems. The standardized coefficients of developmental disorders and neurodevelopmental disorders were calculated (the number of diagnosed cases per 100 000 children) on the basis of the total number of developmental disorders (R62) as well as of neurodevelopmental disorders (R62.0) and the size of the children's population (data from the Central Statistical Office). It was done for each of 19 selected Silesian cities for the years 2009-2010. For estimation of environmental exposure to PCBs in the cities of Silesian province, the concentrations of PCBs in the air were analyzed. Environmental burden of PCBs was calculated using the results of the concentrations of PCBs in the air of three different location of the city. The relationships between the incidences of developmental disorders and psychomotor developmental disorders in children and environmental burden by PCBs were performed using Statistica 10.0 program.

RESULTS

The analysis of average coefficient of developmental disorders and psychomotor developmental disorders in the population of children under the age of 18, calculated for the years 2009 to 2010, revealed significant differences in the prevalence of this disorders between 19 selected Silesian cities. In this cities the socio-economic conditions and access to medical care are comparable, but the differentiating factor for each of them is air pollution, especially when is considered in long term. The highest coefficients of developmental disorders (R62) in children, were recorded in Ruda Slaska, Gliwice, Dabrowa Gornicza and Jaworzno (Fig. 1). Psychomotor developmental disorders in children

(R62.0) occurred the most often in Dabrowa Gornicza, Gliwice, Jaworzno, Piekary Slaskie and Czestochowa (Fig. 2).

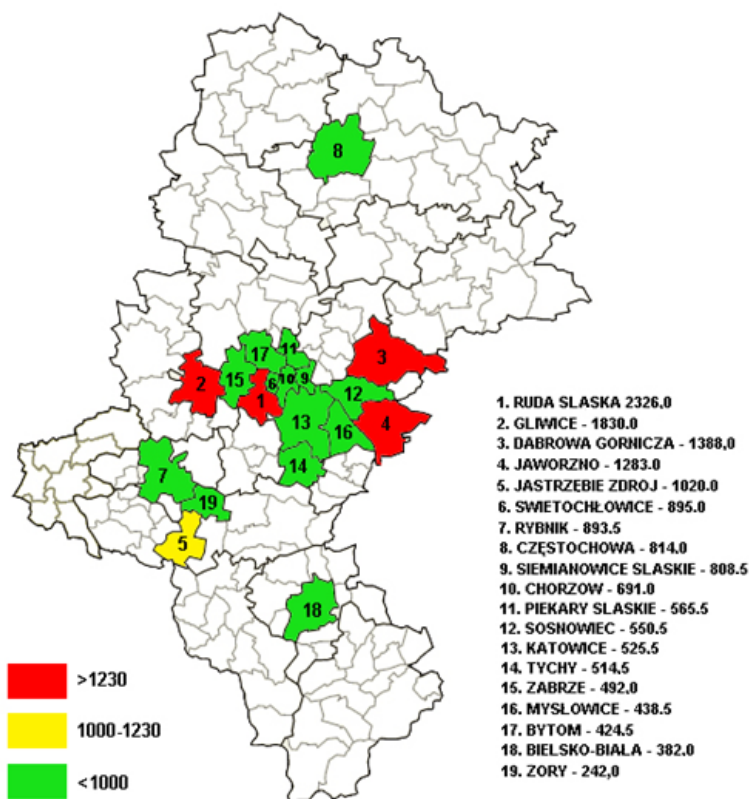


Figure 1 – The average coefficients of developmental disorders in children (number of cases per 100000 children) in selected cities of Silesian province (mean value for 2009-2010)

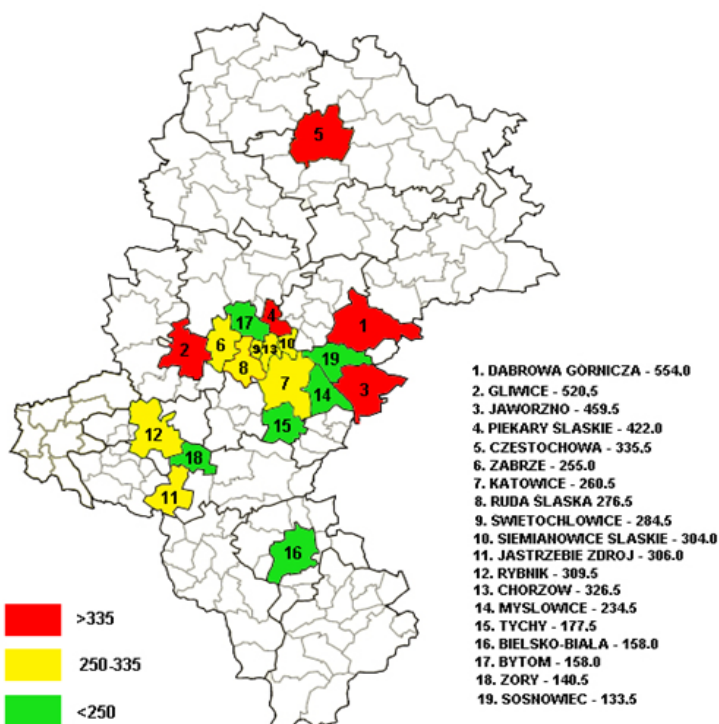


Figure 2 – The average coefficients of psychomotor developmental disorders in children (number of cases per 100000 children) in selected cities of Silesian province (mean for 2009-2010)

In both cases the highest coefficients were reported in the cities where lead pollution is not dominant, but in the cities (Dabrowa Gornicza, Gliwice, Ruda Slaska, Chorzow, Jaworzno) where chemical plants or waste incineration plants exist with significant PCBs emissions to the environment (Fig. 1, 2).

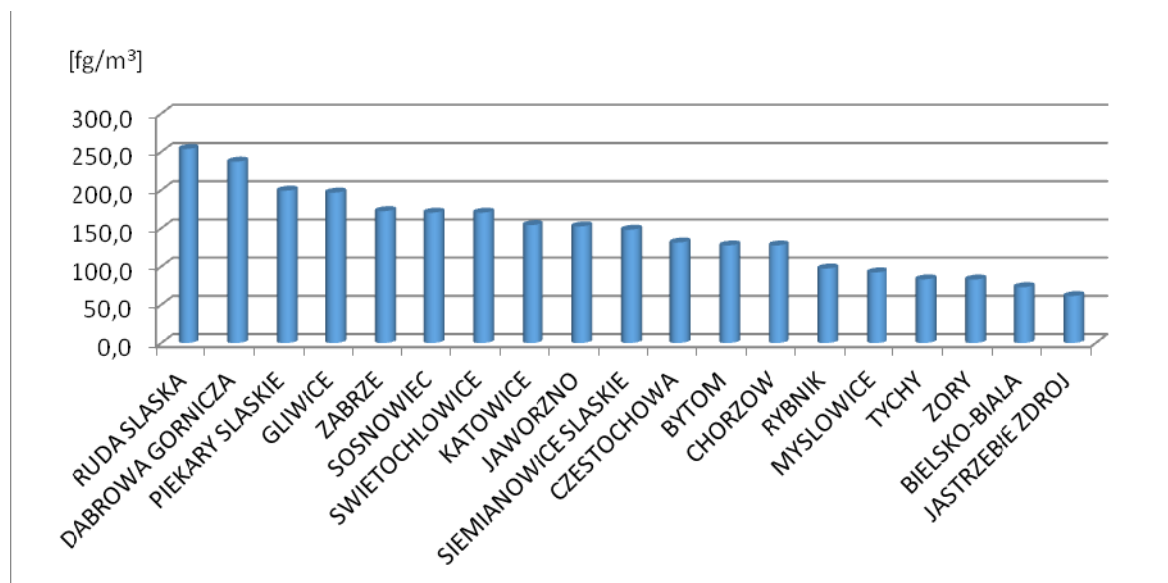


Figure 3 – The average concentration of PCBs in respirable dust PM₁₀ in selected cities of Silesian province in 2012 year [fg/m³]

The highest concentration of polychlorinated biphenyls in respirable dust PM₁₀ were estimated in Ruda Slaska, Dabrowa Gornicza, Piekary Slaskie and Gliwice, while the lowest in Jastrzebie Zdroj, Bielsko-Biala, Zory and Tychy. In the cities with the highest coefficients of developmental disorders and psychomotor developmental disorders in children, also the highest average concentrations of PCBs were indicated. In order to verify the hypothesis on association between the incidence of developmental disorders in general and psychomotor development disorders in children and concentration of PCBs in the air, the relationships between these factors were investigated. Correlation coefficients, confirming a strong relationship between the studied variables were obtained in case of both types of disorders in children and the average concentration of PCBs, recorded in the cities of the Silesian province ($r = 0.5$). The results are statistically significant ($p < 0.05$).

DISCUSSION

Accumulation of PCBs in the fat tissue, their slow elimination and a long-lasting interaction makes that the effects of exposure may appear in the offspring (Aguiar et al., 2010 & Cao et al., 2008 & Mocarelli et al., 2008 & EPA, 2007). Our study shows the association between the incidence of developmental disorders in general and psychomotor development disorders in children and concentration of PCBs in the air. Other studies from Europe and the USA clearly indicate the association between environmental exposure to PCBs and developmental disorders in infants (Eubig et al., 2010 & Arisawa et al., 2005). The international research shows that the main source of human exposure to these pollutants is food, which can provide to human body as much as 95% of the acceptable daily dose of PCBs (EFSA, 2010). In the assessment of exposure to these compounds, often the respiratory system role is omitted because it is considered as marginal - less than 2% of the total dose (EFSA, 2010 & Fiedler, 2007 & Parzefall, 2002). Our results indicate a significant role of PCBs present in the air in the induction of developmental disorders in children and pointed out on the respiratory system as an important source of exposure. Number of scientific work in this area is still insignificant, which results from both the new, interdisciplinary field of knowledge that is the environmental health, as well as from insufficient information about the concentrations of persistent organic compounds in the environment, which are necessary to estimate exposure of the population and identification the sources of exposure. A limited number of measurements of concentrations of PCBs is caused primarily by high cost of chemical analyses. The important role of PCBs in air as a factor affecting the incidence of psychomotor disorders in children exposure would be of great importance for environmental health by identifying modified, other than food, sources of health risks.

CONCLUSIONS

1. Significant differences in the incidence of developmental disorders in general and psychomotor development disorders in children between selected cities in the Silesia province were found which indicate their environmental connections.
2. Research indicate a statistically significant correlation between the coefficients of the total developmental disorders and impaired psychomotor development in children, and the average annual concentrations of polychlorinated biphenyls in the respirable dust PM10.

REFERENCES

- Aguiar A., Eubig P.A. & Schantz S.L. (2010): Attention deficit/hyperactivity disorder: a focused overview for children's environmental health researchers. *Environ. Health Perspect*, 118:1646–1653.
- Arisawa K., Takeda H. & Mikasa H. (2005): Background exposure to PCDDs/PCDFs/PCBs and its potential health effects: a review of epidemiologic studies. *J Med Invest*. 52(1-2):10-21.
- Banerjee T.D., Middleton F. & Faraone S.V. (2007): Environmental risk factors for attention-deficit hyperactivity disorder. *Acta. Paediatr.*, 96(9):1269–1274.
- Barrett J.R. (2009): Double Protection: Reaching Accord on the Ethical Conduct of Child Observational Research. *Environ. Health Perspect*, 117(8):A354-A357.
- Cao Y., Winneke G., Wilhelm M., Wittsiepe J., Lemm F., Fürst P., Ranft U., Imöhl M., Kraft M., Oesch-Bartlomowicz B. & Krämer U. (2008): Environmental exposure to dioxins and polychlorinated biphenyls reduce levels of gonadal hormones in newborns: Results from the Duisburg cohort study. *Int. J. Hyg. Environ. Health*, 211, 30-39.
- Carpenter D.O. (2006): Polychlorinated biphenyls (PCBs) routes of exposure and effects on human health. *Rev. Environ. Health*, 21(1):1-23.
- Centers for Disease Control and Prevention (CDC, 2014): Developmental Disabilities Monitoring Network Surveillance Year 2010 MMWR Surveill Summ, 63 (2), pp. 1–21.
- Environmental Protection Agency (EPA, 2007): A Decade of Children's Environmental Health Research. Highlights from EPA's Science to Achieve Results Program. Summary Report. U.S. Environmental Protection Agency Office of Research and Development; EPA/600/S-07/038; December 2007.
- Eubig P.A., Aguiar A. & Schantz S.L. (2010): Lead and PCBs as Risk Factors for Attention Deficit/Hyperactivity Disorder. *Environ. Health Perspect*, 118:1654-1667.
- European Food Safety Authority (EFSA, 2010): Results of the monitoring of dioxin levels in food and feed. *EFSA Journal*, 8(3), 1385-1419.
- Fiedler H. (2007): National PCDD/PCDF release inventories under the Stockholm Convention on Persistent Organic Pollutants. *Chemosphere*, 67, 96-108.
- Gerc K., Piasecka B. & Sikorska I. (2012): Environmental pollution in residential area and its influence on child's psychomotor development disorders. *Probl. Hig. Epidemiol.*, 93(1): 55-61 [in polish].
- Grandjean P. & Landrigan P.J. (2006): Developmental neurotoxicity of industrial chemicals. *Lancet*; 369:2167-2178.
- Kimura-Kuroda J., Nagatal. & Kuroda Y. (2007): Disrupting effects of hydroxy-polychlorinated biphenyl (PCB) congeners on neuronal development of cerebellar Purkinje cells: A possible causal factor for developmental brain disorders?. *Chemosphere*, 67(9):412-420.
- Landrigan P, et al. (2012): A research strategy to discover the environmental causes of autism and neurodevelopmental disabilities. *Environ. Health Perspect.*, 120:a258- a 260.
- Marek M., Kaleta D. & Miskiewicz P., et al. (2012): Social inequalities in health in Poland. Regional Office for Europe; World Health Organization. WHO.
- Mocarelli P., Gerthoux P.M., Paterson Jr. D.G., Milani S., Limonta G., Bertona M., Signorini S., Tramacere P., Colombo L., Crespi C., Brambilla P., Sarto C., Carreri V., Sampson E.J., Turner W.E. & Needham L.L. (2008): Dioxin exposure, from infancy through puberty, produces endocrine disruption and affects human semen quality. *Environ. Health Perspect.*, 116, 70-77.
- Moore C.F. (2009): *Children and Pollution. Why Scientists Disagree*. Oxford University Press. Oxford.
- Parzefall W. (2002): Risk assessment of dioxin contamination in human food. *Food Chem. Toxicol.*, 40, 1185-1189.

Scientific Frontiers in Developmental Toxicology and Risk Assessment (SFDTRA, 2000) Washington, DC: National Academy of Sciences Committee on Developmental Toxicology; [cited 2000] Available from: [http://www.nap.edu/openbook.php?record_id=9871 &page=R1](http://www.nap.edu/openbook.php?record_id=9871&page=R1).

Swanson J.M., Kinsbourne M., Nigg J., Lanphear B., Stefanatos G.A., Volkow N., et al.: Etiologic subtypes of attention-deficit/hyperactivity disorder: brain imaging, molecular genetic and environmental factors and the dopamine hypothesis. *Neuropsychol. Rev.* 2007; 17(1):39–59.

World Health Organization (WHO, 2010): *International Statistical Classification of Diseases and Related Health Problems- 10th revision, edition 2010*. ISBN: 9789241548342.

World Health Organization (WHO, 2003): *Polychlorinated Biphenyls: Human Health Aspects. Concise International Chemical Assessment Document 55*. Geneva 2003.

Environmental Pledge Assignment: Connecting classroom lessons to behavioral changes with calculable impacts

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ABSTRACT: Since its inception in January of 2008 the Environmental Health Science Pledge Project has made an impact on the local, state, and environment of our nation. More than 600 students have participated as part of an upper level introduction to environmental health science course where they pledge to spend one week committed to being as sustainable as possible with a special focus of their choice (water use, meat reduction, fossil fuels, agriculture, plastics etc.). Students collected environmental impact and footprint data from a typical week and compared that to data obtained during a pledge week. Class data is collected and pooled at the semester end so that students can see the impact made as a group. Students are also asked to calculate the impact they would have if they imparted their behavioral changes in part or wholly for a lifetime. Many students commit to making permanent lifestyle changes as a result of this experience. Here, data that shows the impact a class can make over the course of one semester is presented in addition to post class survey data that shows that the majority of the students who participated in the environmental pledge assignment continued to modify their behavior after the class ended.

Keywords: *environmental assignment, sustainability, calculating impacts, environmental education*

INTRODUCTION

The discipline of environmental health science is tasked with educating its students on the basics of preservation of the environmental for the sake of public health as well as giving students tools to implement changes in their own lives that lessen their personal environmental impact. These changes, once imparted at the student level, may soon become a part of persons outside of environmental health science if they are roommates or family members of the students who have imparted the desired behavior. Previous work has suggested that imploring a sense of responsibility has been an effective way to impart behavioral change. This is of utmost importance because poor lifestyle choice are responsible for a variety of environmental related illnesses as shown in several studies performed with medical students (Vargas & Zelis, 2014) (Phillips, Pojednic, Polak, Bush, & Trilk, 2015). Responsibility is difficult to convey with classroom lectures alone even when students are offered concrete advice and solutions that will increase their personal responsibility. In addition, it is difficult to overcome negative portrayal of conservation efforts in the media, which may affect undergraduate behavior (Geraee, Kaveh, Shojaeizadeh, & Tabatabaee, 2015), especially when it comes to climate change (Swim, Clayton, & Howard, 2011). It has been previously shown that role playing has had a positive impact on increasing social responsibility because it gives students a taste of a "real life" conversation or situation (Doorn & Kroesen, 2013).

Active environmental student learning by participation and community involvement lends itself not only to the immediate benefit to the environment, but also the potential to exact long term changes once students 1) try an activity and realize that it may not be as difficult to change their behavior as previously thought and 2) begin to feel a sense of community and responsibility about sustainability as they transition into adulthood and make the types of household decisions that can alter the course of environmental degradation at the local, state, national, and global level. With this in mind, a project was developed for undergraduate students that promotes environmental stewardship and sustainability that yields direct benefits to the environment during the course of the semester and holds the potential to alter their behavior such that changes will be imparted in the long term.

Presented here is an assignment that was developed in part by the instructor, but given to the students each semester for full development during a classroom activity.

METHODS

The assignment began by organizing students into groups to discuss changes that they could make in their lives now to lower their environmental impact. Each group of 5-6 students was charged to come up with three ideas. Ideas were discussed in class and listed for students on the class assignment web page. The following week, again on a mandatory attendance day, students were put into groups based on which pledge they selected. Each group had to have a minimum of 3 students; otherwise that option would be eliminated. Student groups were tasked with researching the impacts of their choice and unifying at least 3 data points that they would collect (and the units). For example, frequently in the group that selected to reduce or eliminate meat intake, students tracked the type of meat they ate, in ounces, and at which meals, and how much water was used to bring their meal from farm to table. They also weighed themselves and frequently had a daily energy scale of 1 to 5 to track how they felt during the pledge week. By agreeing as a group on their assignment development, students took ownership of the process, the assignment, and made it easier to compile their data at the end of the semester in a group report. The assignment dates could be selected by the groups as well. Groups could collect their pre-pledge week data, pledge week data during the same weeks or varying weeks during the semester. They were asked to find two sequential weeks that would be similar. Thirty minutes of class time at the end of the semester was set aside to compile group data and discuss experiences.

RESULTS

Surveys were sent to 445 students who were enrolled in and completed the course from Fall of 2012 through Summer of 2013. Of the 94 respondents, 25 were from spring 2012, 33 were from fall 2012, 24 were from spring 2013, and 10 were from summer 2013. This pool of students was mostly juniors (48%) and seniors (31%), with almost equivalent small representation from freshman (9%) and sophomores (12%). Because the assignment was based on student's making independent decisions in their daily lives, they were asked to report age and living arrangements. Most students were 20 years or older and lived off campus with roommates.

Data for living arrangements during the assignment semester and current living arrangements were taken because students who live off campus have more control over several of the pledge options. For example, students who live in the dormitories do not have access to the thermostat to save electricity nor can they change shower heads to low flow. Students were also asked what grade they earned in the course and the grade profile was representative of total grade profiles for each of the semesters represented to be sure that a representative sample of students responded to the survey.

Pledge assignment selection was typically distributed among eight pledge choices. The majority of the students selected the pledge to become a vegetarian or vegan (29%) for a week or the pledge to conserve water (23%) for a week. Students were also asked whether they submitted an accurate report of their experience in order to find out if the students were exhibiting academic honesty during the pledge week data collection. Only 5% answered 'no' to the survey question, "Did you submit an accurate report of your experience".

Data from the pledge week demonstrated to students that already, as college students, they could make life choices that would lessen their impact on the environment. In addition, the pledge assignment required that they make a calculation that would give the long term impact they would make if they continued the pledge in full or in part (it was their choice as to which calculation to make). Two questions were asked to the pool of survey recipients to determine whether they continued their pledge behavior beyond the class. Students were first asked if they continued their pledge behavior beyond the pledge week at all. To this question 72% answered "yes". A later question in the survey asked if students were currently imparting some of the behavioral changes from their pledge assignment to which 69% answered "yes". To determine the extent to which students continued pledge behavior, they were asked to assess their continuous pledge behavior based on percent. The highest response was that students (26) continued their pledge behavior 50% of the time, followed by a group who continued with 75% of this time.

To determine, in general, why students did or did not continue the pledge assignment behaviors after the semester, they were given a series of options from which to choose a response that best fit their reason. The options were determined from several conversations with students outside of class through the years regarding pledge continuance. For those who did continue, 52% selected the following option: I feel better for participating in a change to better the environment for the sake of society and future generations. The next most popular reason (24%) was as follows: I was unaware of

the impact of the changes that individual actions could have prior to the pledge, but was compelled to continue once I saw the impact that I could make. The other two options had similar numbers of students who selected them: I always wanted to make a change, but needed a reason to get started (8%), and I feel (physically) better for having made the change based on my pledge (15%).

For those students who did not continue the pledge 80% chose the following option: I did feel that the pledge made a significant change in the environment but it was too difficult to continue. The remaining 20% of respondents split equally between the following two options: 1) I did not feel that the pledge made a significant change in the environment and it was too difficult to continue, 2) I do not feel compelled to reduce my environmental impact.

Environmental impact results from the pledge assignments themselves were compiled from the section of students who were enrolled one of two sections of the Introduction to Environmental Health Sciences course in the spring semester 2013. Data from the two most commonly chosen pledges 'reduction in meat (vegetarian or vegan)' and 'water conservation' are shown in Figures 1 and 2.

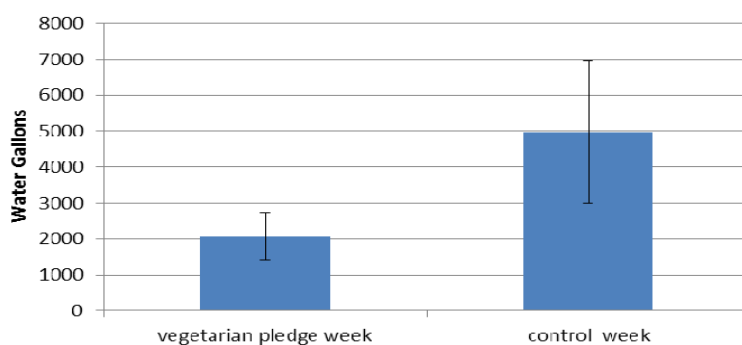


Figure 1 - Spring 2013 Meat reduction/elimination groups data on water conserved during a typical week vs. during the week of their pledge work.

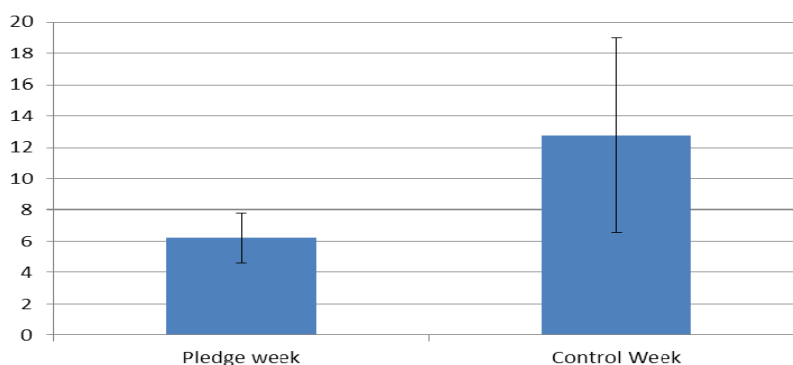


Figure 2 - Shower group measured water output by reducing their shower time (in minutes).

The group that chose to reduce meat consumption tracked their meat consumption by weight in ounces and by type. Students categorized, in addition to meat, all the food they consumed that week in order to calculate the potable water that it takes to bring food from farm to table. Non-meat categories included: chocolate, butter, cheese, rice, pasta, bread, pizza, nuts, lettuce (salad items), vegetables, cereals, milk, eggs, wine and beer, tea and coffee. Students used a variety of online tools and literature to come to a consensus for how much water (in gallons) to assign to each food. During the non-pledge week, the students calculated that the required water consumption for their group of 13 was 60,358 gallons, and the pledge week consumption was 26,873 gallons. The group saved 33,485 gallons of water and dropped their per person consumption on average by more than half. The same group added a semi-quantitative twist to their assignment where they rated, on a scale of 1 to 10, their energy level for the day. The average energy per student for the week was not statistically different between the two weeks which put to rest some student concerns that without meat they would feel week or tired. Students also estimated food miles and CO2 saved as part of their data collection (data not shown).

The water conservation group focused on two ways in which they could reduce water consumption in their daily routine (other than changing their eating habits): time and frequency of showering and time running water while brushing their teeth and shaving. This particular group aimed for each member to

cut shower time in half as one of their goals. They were able to go from an average shower time of more than 12 minutes to an average time of little over 6 minutes.

CONCLUSIONS

The environmental pledge assignment is a new approach to teaching environmental health because it allows students to craft an assignment that they design, implement on an individual basis, recruit friends and family (in some cases), and work in groups to gain knowledge of how to live more sustainably in the future using basic EH knowledge from an Introduction to Environmental Health Science course. By partnering with students to design the options in the pledge assignment as well as the type of data to collect, students take ownership of the assignment and begin to make independent, adult behaviors that are less degrading to the environment and in many cases, sustainable.

By implementing a week of behavioral changes, tracking the environmental impact of such changes, and making adult, household decisions, students are empowered to continue with their environmentally responsible and more sustainable choices. Students are asked to calculate the impact they would have if they continued their pledge in full or in part, in the future, and asked whether they would continue with their behavior. Many of the students' narratives include pledges to continue their new behavior and they often remark a feeling of social gratification, and delight in how easy the pledge was to implement.

This experiential learning assignment conveyed environmental knowledge but had students participate such that long-term impacts were achieved.

REFERENCES

- Doorn, N., & Kroesen, J. O. (2013). Using and developing role plays in teaching aimed at preparing for social responsibility. *Sci Eng Ethics, 19*(4), 1513-1527. doi: 10.1007/s11948-011-9335-6.
- Geraee, N., Kaveh, M. H., Shojaeizadeh, D., & Tabatabaee, H. R. (2015). Impact of media literacy education on knowledge and behavioral intention of adolescents in dealing with media messages according to Stages of Change. *J Adv Med Educ Prof, 3*(1), 9-14.
- Phillips, E., Pojednic, R., Polak, R., Bush, J., & Trilk, J. (2015). Including lifestyle medicine in undergraduate medical curricula. *Med Educ Online, 20*, 26150. doi: 10.3402/meo.v20.26150.
- Swim, J. K., Clayton, S., & Howard, G. S. (2011). Human behavioral contributions to climate change: psychological and contextual drivers. *Am Psychol, 66*(4), 251-264. doi: 10.1037/a0023472.
- Vargas, E. J., & Zelis, R. (2014). Integrating nutrition education into the cardiovascular curriculum changes eating habits of second-year medical students. *J Clin Lipidol, 8*(2), 199-205. doi: 10.1016/j.jacl.2013.11.006.

Ergonomic analysis to workstations of passenger transport company

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ABSTRACT: Ergonomics is the science that allows you to adjust the workplace to man, in order to ensure efficiency and welfare directly. It was aimed the relationship between man and his environment, to optimize the work conditions. The objective of this study was to conduct an ergonomic analysis to the official sector, working out some measures to improve the quality of jobs. Ergonomic analyses imply maintaining and preventing the welfare of workers and thus allow a lack of what the improvements to be undertaken for a better execution of tasks. The study was carried out through an ergonomic analysis on site, using the methodology REBA to analyze the tasks of existing activities in the official sector. It was administered questionnaires to the employees with issues relating to personal data, historical process of progressive scale and local discomfort or pain. Finally, it was conducted an evaluation of lighting in the workplace. After collecting the data, the same have been worked in the software Ergofellow 3.0 (ergonomic risk assessment), Microsoft Excel (evaluation of illuminance) and IBM SPSS Statistics software SPSS version 22.0 (questionnaires). The results obtained indicate that a large part of the tasks of each activity, were an assessment of high risk and very high, requiring implementation of preventive measures (ex: more lightning points). It is relevant to implement measures, in order to give comfort and well-being for workers to feel ill or uncomfortable, become more vulnerable and likely to be committed in drafting failures of their tasks.

Keywords: *ergonomics; ergonomic risk assessment; postures; musculoskeletal disorder.*

INTRODUCTION

With the progress of time, technology has been introduced and improved in the labor world, in order to help the workers to perform their tasks. Stress factors and musculoskeletal lesions are the main diseases that are related to work (Carneiro, 2005), therefore the ergonomomy it's introduced as an interdisciplinary science with the main objective to improve the work conditions.

It has been developed over the past few years, studies regarding the ergonomic analysis in workplaces putting research one set of parameters such as inadequate furniture dimensions, disrespect for feeding times or even perform many hours of work without a break, evidencing the musculoskeletal system disorders as well as derogatory effects the cognitive level and low productivity (Sousa, 2013). Concerning the automobile industry this is referred to as having ergonomic issues due to unfavorable postures and repetitive work (Lick, 2003). To avoid musculoskeletal lesions, stress and work-related symptoms (Tozzi, 1999), should be thoroughly examined working conditions and their activities because of the risks that presents itself (Marziale & Carvalho, 1998).

Therefore, it can be performed an ergonomic analysis consisting of various stages of intervention, such as field observation as well as understanding and studying complains about the work conditions and finally as implementing new methods learned from new studies involving ergonomic postures, to improve the physical and psychosocial conditions to the worker (Marziale & Carvalho, 1998). Some of variables that must be studied are the worker, machine and the surrounding environment (Pinto, 2009).

The objective of this study consisted in carrying out an evaluation at the level of ergonomic postures to passenger transport shops, featuring some corrective measures to be implemented in the workplace.

MATERIAL AND METHODS

The location of the study for the current work was a public transport company, headquartered in the region of Coimbra, having as target population workers employed on the company. This sector consists of mechanics, auto electricians, lubricators, tires managers, locksmiths, lathe operator,

warehouse technicians and painters. The type of sampling was probabilistic, not once the technique is used for convenience. The sample was composed of 33 workers and by 46 tasks.

We used a retrospective cohort study through observational drawing. The nature of the study consists in the identification of ergonomic risks to which workers in the workshop of a passenger transportation company are exposed during the various carried out activities. In order to cover all these activities it was performed a set of ergonomic evaluations.

For collecting data, it was defined two types of tools: questionnaires and semi structured ergonomic assessment (risk assessment and evaluation of luminance).

The questionnaire, was based on questionnaires of other authors (Fonseca, 2009), to support ergonomic analysis, included, historical issues in the workplace and a progressive scale of discomfort or pain where the worker stated to 1 the 5 (no pain to a pain intolerable) the intensity you feel in every part of the body (Lima, et al., 2014).

This research was carried out between September (2013) and June (2014) and the data was collected during the months of January to March. Ergonomic analysis was performed by the investigator and each worker observed twice considering workers switching shifts.

Regarding the ergonomic evaluation, has been a risk assessment using the methodology REBA (Rapid Entire Body Assessment), since this has as main objective the determination of the effect caused by inadequate postures and attitudes of workers. On the end of the analysis the levels of risks and the necessary interventions were evaluated according to the following interpretation: Level 1 - Negligible risk; Level 2 - Low risk (need to some preventative measures); Level 3 - Medium risk (the risk must be investigated in depth; create preventive measures); Level 4 - High risk (investigate the risk and implement corrective measures); Level 5 - Very high risk (implement corrective measures) (Junior, 2006).

For the evaluation of luminance, it was used the following instrument: Luximeter HD model 9221, brand OHM. For this evaluation it was performed various measurements on workplaces, and the average calculated. The values were subsequently compared with the standard EN 12464-1: 2011-06 to verify its compliance.

After collecting the data, the same have been worked in the software Ergofellow 3.0, Microsoft Excel and IBM SPSS statistics software SPSS version 22.0. The test applied to this study was the Fisher exact test.

RESULTS

In order to deepen the study, a descriptive analysis was carried out to characterize the sample. The activities belonging to the workshop were grouped into warehouse technician; technical assistant; auto electrician; Oiler; mechanic; locksmith and other activities (painter, lathe operator and tire manager) to better characterize the Group of respondents.

Of the 33 respondents, it was found that 19 have suffered accidents at work, being the vast majority belonging to the mechanical activity (42,1%). One of the issues of the investigation "During the course of his business, in the last year, have you ever felt discomfort or pain?" 23 of 33 respondents answered affirmatively, being the most hit, mechanics (30,4%). It was noticed that, of the 23 respondents who answered "Yes" to the previous question, 17 reported that the pains were applicants. Since it is important to rest during the labor period it was found that 69,7% of respondents breaks are at least 5 minutes.

Asked about work accidents, pain or discomfort, there has been a tendency in the affirmative answers for the presence of pain. This tends to focus on the region of the "upper back", "medium" and "back-bottom", The "neck" had a statistically significant difference ($p\text{-value} \leq 0,05$), that is the difference in responses about whether suffered accidents at work or not.

In table 1 it is possible to verify that the activities of the mechanical activity evident with high risk and very high are those indicated in the table. It should be noted that the task "disk change" is an activity that takes more than 12:0 am running). The remaining tasks were medium risk of ergonomic assessment. In relation to reference values for lighting in this activity the Rank 1 registered much lower values to admitted, being the average of 32.2 lux with fixed bar lighting. However, the stand 2 to introduce portable Chinning bar lighting showed an average of 411 lux with values permitted for the workstation (300 lux).

Table 1 – risk assessment concerning the mechanical activity

Activity: mechanical Tasks	N	Time (hours)	Neck (1-3)	Trunk (1-5)	Legs (1-4)	Arms (1-6)	Forearm (1-2)	Hand (1-3)	Weight (0-2)	Take ((0-3)	Activity (1-3)	Total (1-15)
Eliminate diesel leak	1	[4-8[	2	3	2	4	2	2	0	0	1	9
Repair of motor	1	> 8 *	2	3	2	2	1	3	1	0	2	8
Compressor repair	1	[2-4[	3	4	2	4	2	1	0	0	1	10
Disk change	1	> 8 *	3	4	4	3	2	3	0	0	1	12
Water leak repair	1	[1-2[	1	2	1	3	2	2	0	0	1	5
Brave shims	1	< 1	3	3	3	2	1	1	1	0	1	9
Maintenance of motor	1	< 1	3	4	4	3	2	2	0	0	2	12
Placement of rim	1	< 1	3	3	2	3	2	2	0	0	1	9
Placement of suspension	1	[2-4[	3	3	4	4	2	1	0	0	1	11
Detect oil leak	1	[2-4[	3	3	3	4	2	2	0	0	0	10
Disassembly of arm extension	1	[1-2[	3	5	4	3	1	2	0	0	1	11
Placing the extension arm	1	[1-2[	2	2	1	3	2	2	0	0	1	5
Removing the windshield brushes	1	[1-2[	3	3	3	4	2	2	0	0	1	11
Fitting the windshield brushes	1	[1-2[	2	3	1	3	2	1	0	0	1	6

* > work 12 hours

In table 2 can verify that all tasks related to the tires managers are among the very high risk and high risk. It Shows the tasks of "dismount" and "mount wheel", with a possible 15. The levels of luminance of this activity, shows the rank 2 with an average of 15.3 lux in a location without lighting and conducive to shadow situations corresponding to values well below the reference value (300 lux).

Table 2: risk assessment concerning the activity of tire manager

Activity: tire managers Tasks	N	Time (hours)	Neck (1-3)	Trunk (1-5)	Legs (1-4)	Arms (1-6)	Forearm (1-2)	Hand (1-3)	Weight (0-2)	Take (0-3)	Activity (1-3)	Total (1-15)
Taking out the screws	2	< 1	3	4	2	2	3	1	3	0	2	13
dismount wheel	2	< 1	3	5	3	3	1	2	3	0	2	14
Scroll wheel	1	< 1	1	2	2	2	1	2	3	0	2	8
mount wheel	1	< 1	3	4	2	3	2	2	3	0	2	14
Tighten wheel	1	< 1	2	3	3	3	1	2	3	0	2	12

For the lathe operator, the tasks under consideration, was the task of cutting pipe bars "presented a very high level of ergonomic risk (table 3). As for the luminance on jobs, both posts are below the reference value, and the rank 1 is close to the reference value.

Table 3: risk assessment concerning the activity of lathe

Activity: lathe operator Tasks	N	Time (hours)	Neck (1-3)	Trunk (1-5)	Legs (1-4)	Arms (1-6)	Forearm (1-2)	Hand (1-3)	Weight (0-2)	Take (0-3)	Activity (1-3)	Total (1-15)
Cut tubing bars	1	[2-4[	3	4	3	0	4	2	2	0	1	11
Cut material at roulette	1	[1-2[	1	3	3	0	3	1	2	0	1	6

Regarding auto electrician activity, it was found that there are tasks with a level of medium and high ergonomic risk (table 4), highlighting tasks such as "repair of suspension", with the high level of risk. As for the lighting level, this registers an average of 153.8 lux, value below the reference value (300 lux) having fixed bars fixtures.

Table 4: risk assessment concerning the activity of auto electrician

Activity: auto electrician	N	Time	Neck	Trunk	Legs	Arms	Forearm	Hand	Weight	Take	Activity	Total
Tasks	(hours)	(1-3)	(1-5)	(1-4)	(1-6)	(1-2)	(1-3)	(0-2)	(0-3)	(1-3)	(1-15)	
Placement of electrical part	1	[1-2[	1	2	3	0	4	1	3	0	2	7
Placement of wiring in the engine	1	> 8 *	3	4	3	0	2	1	2	0	1	9
Repair of electrical system of lights	1	< 1	1	4	1	0	2	2	3	0	2	5
Change light bulbs	1	< 1	2	5	2	0	3	2	2	0	1	10
Generator mounting	1	> 8 *	2	3	1	0	3	2	2	0	2	7
New installation of gearbox	1	[2-4[	2	2	2	0	2	1	2	0	1	5
Suspension repair	1	> 8 *	2	3	3	1	4	1	2	0	1	10
Machine repair	1	> 8 *	3	2	2	0	1	2	2	0	2	6

* > work 12 hours

Regarding the activity of lubricator it was found that the level of risk of most tasks is average with the exception of the task "checking oils on the wheels" in which the level of ergonomic risk is very high, IE is situated on 12 points.

Concerning the activity of painter, it turns out that the task "polishing and painting" meets an ergonomic risk level of 8, i.e. high.

In the activity of locksmith (table 5), reached levels of high risk and very high, demonstrating the task of cementing cracks in the roof. The remaining tasks were medium risk level and low risk. All jobs have lower values of luminance, in relation to the reference value (500 lux), distinguishing the rank 3 with an average of 158.5 lux

Table 5: evaluation of risks related to the activity of locksmith

Activity: locksmith	N	Time	Neck	Trunk	Legs	Arms	Forearm	Hand	Weight	Take	Activity	Total
Tasks	(hours)	(1-3)	(1-5)	(1-4)	(1-6)	(1-2)	(1-3)	(0-2)	(0-3)	(1-3)	(1-15)	
Repairing cracks on the roof	1	[2-4[	2	5	4	3	3	1	2	0	1	11
Repair sticks	1	> 8 *	2	3	2	3	3	2	2	0	2	8
Axis preparation	1	[2-4[	3	4	2	3	3	1	3	1	2	10
Grinding lathe parts	1	[2-4[	3	4	4	2	1	3	0	0	1	10
Get the edge to parts	1	[2-4[	2	1	2	1	1	1	0	0	2	3
Fillingpieces	1	[2-4[	2	3	1	4	1	3	0	0	1	6

In relation to the activity of warehouse, the task of "customer service" was the one that presented a high level of risk with 8 points. The task of "gathering material" presented medium risk, IE 7 points. Both points of measurement of luminance values were below the reference value by highlighting the area of the counter with an average value of 185.1 lux.

Regarding to ergonomic analysis of the tasks it is an established fact that 2.17% feature low risk, medium risk level 33.33%, 35.71% high level of risk and very high risk level 28.57.

According to EN 12464-1: 2011-06, the luminance values showed in most jobs values under intended showing the jobs of mechanic working in the pit to register tire operator and lux 32.2 in place of shadow with 15.3 lux.

DISCUSSION

Musculoskeletal problems are injuries that may be a consequence of an accident at work. Therefore, this study revealed that the vast majority of workers at the shop (23 to 33 respondents), shown more symptoms of pain or discomfort in the area of the back and cervical region. In many work tasks performed daily, the column is maintained in stress (axial rotation) which becomes a conductive factor

to situations of low back pain and degenerative lesions of the disks (Bolonha, et al., 2012). This statement comes against the workers complaints, which was considered that the column was the more sacrificed during their activities.

Workers in the present study are considered as risk group, because there are based on manual tasks and most of these contain repetitive movements. Only 23 of the 33 workers perform breaks, while during working 8:0, only 13 workers perform more than three breaks per day. It was found, during the application of the questionnaire, the auto electricians and mechanics are those who perform the largest number of breaks by excess effort that comes of tasks. In the course of the study it was found that the workers are not performing enough breaks compared to the tasks carried out, besides of the enough breaks they should perform stretching exercises for decompression of the muscles.

In the course of study was performed an assessment a few ergonomic tasks, in order to analyze, diagnose and correct certain situations on workstation (Concicovski, et al., 2010). It turns out that the vast majority of the activities were a high level of ergonomic risk (35.71). Focusing the tire manager with 14 log points on ergonomic risk assessment (very high risk), although they complete works of periodicity less than 1:0. Show also the mechanics, with a risk of 12 (very high risk), and auto-electricians, with a risk of 10 (very high), for tasks whose period of time for the respective implementation is superior to 12:0 am. It should be noted that, despite the tire managers conduct of short duration tasks are tasks that are held several times a day, so the overhead is too high.

In this way should be urgently implemented corrective action/preventive for reducing the risk level of jobs. Should be placed more points of enlightenment or change some tiles for transparent tiles; equipment and tools for easy handling; auxiliary equipment for removal and installation of wheels on the bus; transport system of wheels, other tools and heavy equipment, training, information and awareness of employees with regard to the risks to which they are exposed.

With the ergonomic assessment method, you can verify that the trunk and neck area in all activities are those that hit mainly the maximum values, respectively 3 level value for the neck and 5 level value for the trunk, relating the effort made during the task corresponding to areas of discomfort or pain for workers (Serranheira & Uva, 2006). Overall upper limbs do not correspond to high levels of assessment, however the lower limbs showed values of level 3 and 4 in the evaluation but are not registered negative information regarding parameter of discomfort and pain. Some activities carry small loads manual transport (ex: tires managers) as the transport wheels of 80 kg and the postures in all sectors, repetitive motions, applying excessive force in hands and exposure to vibration (Veiga & Cabral, 2005), indicate that all tasks show high levels of risk.

An assessment of luminance was conducted, once in the course of the study many workers complained of the lack of visibility, In fact all the locations shown values below the stipulated under legislation. Therefore, it is important to implement new measures to correct this situation (Nunes, et al., 2013).

It is possible to verify that this activity can be placed as a group of workers with high risk.

CONCLUSION

In the course of the work it has been observed that many workers complain of pain or discomfort in the neck and back, due to the physical effort made during the performance of the tasks and consequently may arise musculoskeletal injuries. The perception of pain/discomfort is related to the results of the evaluation of ergonomic risk. These state that most workers are exposed to high and very high levels of risk, and the variable that influences the level of risk is spine and neck. It was concluded that some of the jobs are conditioned by reduced visibility, this factor can be one of the causes of incorrect postures, especially when, in itself, the tasks require the postures. That's how important being carried out measures of correction/implementation to reduce risk levels.

The present study had minor limitations, since the sample could be more representative to check how is the high level of risk and very high in many tasks. Sometimes, on different days the worker's attitude can be changed. But as the period of evaluation was small, it was not possible the repetition of many tasks. For best results we suggest the continuity of this study, in order to apply methodologies relating to the manual handling of loads, new risk assessments of proposed measures and draw up measures to prevent listing more exhaustive. It's still important that they are made available to workers, training actions in relation to workplace attitudes and methods getting better.

REFERENCES

- Bolonha, T., Almeida, J., Figueiredo, J., & Ferreira, A. (2012). "Ergonomics in construction. (In International Symposium on Occupational Safety and Hygiene" (pp. 72-79)). Guimarães.
- Carneiro, P. (2005). "Análise ergonómica da postura e dos movimentos na profissão de médico dentista". Universidade do Minho.
- Concicovski, D., Moreira, H., Serozini, L., Schafer, G., Yumikiara, P., & Kessler, E. (2010). "Análise das posturas compensatórias através do método da análise postural OWAS em Berçarista de creche".
- Fonseca, N. (2009). "Distúrbios músculo-esqueléticos em trabalhadoras de enfermagem". Salvador (Bahia): Universidade federal da Bahia.
- Junior, M. (2006). "Avaliação Ergonômica: Revisão dos Métodos para Avaliação Postural". Revista Produção Online, 133-154.
- Lick, V. L. (2003). "Melhoria das condições de trabalho através da acção ergonómica participativa e de lógica do PDCA no setor automotivo". Porto Alegre: Universidade Federal do Rio Grande do Sul.
- Lima, F., Almeida, J., Figueiredo, J., & Ferreira, A. (2014). "Scholar ergonomics - primary schools in Tartu (Estonia) study case". s.l. Occupational Safety and Hygiene 2014, pp. 175-179.
- Marziale, M., & Carvalho, E. (1998, janeiro). "Condições Ergonómicas do Trabalho da Equipa de Enfermagem em Unidade de Internação de Cardiologia". 99 - 115.
- Nunes, G., Sousa, J. & Figueira, L. (Junho de 2013). Campanha de informação - "Semana Europeia 2000". 13 - 20. Lisboa: IDICT.
- Sousa, L. (2013). "Análise Ergonómica das Salas de Aula e de Informática da FEUP para os alunos". Porto: Faculdade de Engenharia da Universidade do Porto.
- Tozzi, G. (1999). "Musculoskeletal disorders in Europe: unions show a lead". TUTB Newsletter nº11-12, 12-21.
- Veiga, R., & Cabral, F. (2005, Abril). "Higiene, Segurança, Saúde e Prevenção dos Acidentes de Trabalho".

Exploring the future role of environmental health in mitigating the impact of disasters on people with non-communicable diseases

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ABSTRACT: Worldwide there has been a ‘disease transition’ from communicable diseases to non-communicable diseases (NCDs). Prominent among these are cardiovascular diseases, cancers, diabetes, asthma, arthritis and kidney diseases. This ‘disease transition’ highlights the need to consider refocusing disaster management for the 21st Century. NCDs are reliant on public health infrastructure such as medications, equipment, services, housing, water, food, waste and sanitation. Damage to this infrastructure places the health and well-being of people with NCDs at great risk. To identify options for mitigating this risk, focus groups were conducted with environmental health professionals in Queensland, Australia. The aim was to explore the future role of the environmental health profession in mitigating the impact of disasters on the treatment management and care for people with NCDs. The research found environmental health professionals are well-placed to have an integral role in helping mitigate the impact of disasters on people with NCDs.

Keywords: *Disaster, environmental health, non-communicable diseases*

INTRODUCTION

Worldwide improvements in life expectancy along with changes in lifestyle and diet have contributed to a ‘disease transition’ from communicable diseases to non-communicable diseases (NCDs) (The Sphere Project 2011, World Health Organization 2011, Demaio, Jamieson et al. 2013, World Health Organization 2014). Prominent among the NCDs are cardiovascular diseases, cancers, diabetes, asthma, arthritis and kidney diseases (AIHW 2014, CDC 2014, Department of Health 2014, World Health Organization 2014). NCDs impose major burdens on health care resources, they are costly and time exhaustive to treat, which has implications for health systems and disaster management systems (Connell and Lea 2002, Murray, Vos et al. 2013).

This ‘disease transition’ highlights the need to consider refocusing disaster management for the 21st Century. NCDs are reliant on public health infrastructure (PHI) such as medications, equipment, services, housing, water, food, waste and sanitation (Ryan, Franklin et al. 2014). Damage to this infrastructure due to a disaster places the vulnerable population with NCDs at great risk. For example, one year after Hurricane Katrina there was a 47 per cent increase in mortality, which can be attributed to NCDs (Burkle Jr 2007).

This challenge has been recognised globally by the United Nations in the Sendai Framework for Disaster Risk Reduction: 2015-2030 (Sendai Framework). Item 30(k) relates to chronic diseases (interchangeable with NCDs) and requests this issue be included in the design of policies and plans to manage disaster risks, including having access to life-saving services (UNISDR 2015). This call to action builds on and compliments the World Health Organization *Global Action Plan for the Prevention and Control of Noncommunicable Diseases – 2013-2020* (World Health Organization 2013).

The environmental health profession is well-placed to help address this challenge due to its population-based focus that encompasses the assessment and control of the factors that affect health (Degutis 2008, Australian Government 2015, WHO 2015). This includes: disease control; drinking

water quality; education; hazardous waste (e.g. asbestos); housing conditions; immunization programed; investigations; general waste management; sanitation; food safety and vector issues.(LGAQ 2013, Ryan, Milligan et al. 2013, Queensland Health 2014, Ryan, Davey et al. 2014, Australian Government 2015, WHO 2015). All of which are vital to protect the health and well-being of the vulnerable population with NCDs.

To identify options for mitigating this risk, focus groups were conducted with environmental health professionals in Queensland, Australia. The aim was to explore the future role of the environmental health profession in mitigating the impact of disasters on the treatment management and care for people with NCDs.

METHODS

Five focus groups were conducted with 55 environmental health professionals across Queensland, Australia. The focus groups were held in the towns of Roma (n=2), Malanda (n=2) and Townsville (n=1). These locations were selected due to recent cyclone, flood and storm related disasters. The focus groups explored the impact of disasters on PHI; how a breakdown of PHI can impact on people with NCDs; and identified mitigation strategies. The data was thematically analyzed through the phases of: organizing data; data description; classification; and interpretation. This occurred via a combination of manual analysis and with the assistance of N-VIVO Qualitative Data Analysis Software. Ethics approval was obtained from James Cook University, Australia, (H4871) and Queensland Health, Australia, (HREC/13/QTHS/251).

RESULTS

The research identified disasters can disrupt treatment and care for people with NCDs through damage to PHI such as essential treatment, care, equipment, water supplies and access to nutritious food. This disruption and even breakdown of PHI can increase the risk of exacerbation of illness (including death). The level of PHI resilience was found to be an influencing factor in the impact on treatment management and care for people with NCDs.

Mitigation strategies identified include: a focus on strengthening PHI (e.g. multiple options for providing treatment, care and safe water); ongoing assessments and control of the factors that affect public health; improving communication and education across the health system (e.g. consistent messages and preparations tailored to individual patient needs); basing disaster plans on community priorities (e.g. reflect local burden of disease); and ensuring the presence of health professionals at evacuation centers.

Overall, the findings demonstrate that the environmental health profession is well placed to have an integral role in mitigating the impact of disasters on people with NCDs. It is therefore recommended that local, provincial/state and international bodies recognize the leading role environmental health should have in mitigating the impact of disasters on people with NCDs.

CONCLUSION

Environmental health professionals are in a good position to help mitigate the impact of disasters on the treatment management and care for people with NCDs. The profession has a population-based focus, which includes creating health-supportive environments to influence the health and well-being of people with NCDs. Before, during and after disasters this includes ongoing assessments and control of the public health factors that affect treatment management and care of people with NCDs. It is recommended that local, provincial/state and international bodies recognize the leading role environmental health should have in mitigating the impact of disasters on people with NCDs. If achieved, this would be a significant step towards implementing the Sendai Framework item 30(k) and most importantly helping protect the health and well-being of people with NCDs.

REFERENCES

- AIHW (2014). Australia's health 2014. Canberra, Australia, Australian Institute of Health and Welfare.
- Australian Government. (2015). "Overview of environmental health." Retrieved 24 June 2015, 2015, from <http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-envhlth-index.htm>.

- Burkle Jr, F. M. (2007). "Public health emergencies, cancer, and the legacy of Katrina." *Prehosp Disaster Med* **22**(4): 291-292.
- CDC. (2014). "Chronic Diseases and Health Promotion." Retrieved 25 October, 2014, from <http://www.cdc.gov/chronicdisease/overview/index.htm>.
- Connell, J. and J. P. Lea (2002). *Urbanisation in the Island Pacific: towards sustainable development*, Psychology Press.
- Degutis, L. (2008). *Public health systems and public health preparedness*. New Haven, Connecticut., Yale Centre for Public Health Preparedness.
- Demaio, A., J. Jamieson, R. Horn, M. de Courten and S. Tellier (2013). "Non-communicable diseases in emergencies: a call to action." *PLoS currents* **5**.
- Department of Health. (2014). "Chronic Disease." Retrieved 24 June, 2015, from <http://www.health.gov.au/internet/main/publishing.nsf/Content/chronic-disease>.
- LGAQ. (2013). "What type of jobs to Councils offer?" Retrieved 24 June, 2015, from <https://lgaq.asn.au/council-jobs>.
- Murray, C. J., T. Vos, R. Lozano, M. Naghavi, A. D. Flaxman, C. Michaud, M. Ezzati, K. Shibuya, J. A. Salomon and S. Abdalla (2013). "Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010." *The Lancet* **380**(9859): 2197-2223.
- Queensland Health. (2014). "Environmental Health Branch." Retrieved 24 June, 2015, from <https://www.health.qld.gov.au/ph/ehu/>.
- Ryan, B., P. Davey, N. Fabian, M. A. Kalis and M. D. Miller (2014). "Capacity Building for Environmental Health Disaster Management." *Proceeding ISEE 2013* **1**(1).
- Ryan, B., B. Milligan, A. Preston-Thomas and G. Wilson (2013). "Environmental health disaster management: A new approach." *Australian Journal of Emergency Management, The* **28**(1): 35.
- Ryan, B. J., R. C. Franklin, F. M. Burkle, K. Watt, P. Aitken, E. C. Smith and P. Leggat (2014). "Analyzing the impact of severe tropical Cyclone Yasi on public health infrastructure and the management of noncommunicable diseases." *Prehospital and disaster medicine*: 1-10.
- The Sphere Project, Ed. (2011). *The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response*. Geneva, The Sphere Project.
- UNISDR (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030*. Sendai, Japan.
- WHO. (2015). "Environmental Health." Retrieved 24 June, 2015, from http://www.who.int/topics/environmental_health/en/.
- World Health Organization (2011). "Global health and ageing."
- World Health Organization (2013). "Global action plan for the prevention and control of noncommunicable diseases 2013-2020."
- World Health Organization. (2014). "Noncommunicable diseases." Retrieved 25 October 2014, from http://www.who.int/topics/noncommunicable_diseases/en/.

Food poisoning from oysters contaminated by sewage in south east Australia

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ABSTRACT: South East Australia is an ideal place to grow oysters. Following a major outbreak of Hepatitis A in 1997 in New South Wales, State Governments in Australia tightened up on controls to manage any future such outbreaks. In Tasmania, the industry is regulated under the Tasmanian Quality Assurance Program and appeared to be managed well. Then in 2013 another incident of food poisoning occurred, this time by the Rotavirus. The incident led to 500 cases of food poisoning and was another major setback to the oyster industry and a dent in the confidence of the State Government jurisdictions in managing food safety. The work of local Environmental Health Officers assisted greatly in identifying the source of sewage contamination and a year later the industry has only just fully recovered. The lessons of the importance of rigorous food safety remain ever vigilant.

Keywords: *oysters, food poisoning, sewage contamination* (3 to 5 keyword in italic)

INTRODUCTION

The Game Changer

In Australia in 1997 there was a major spike in cases of Hepatitis A particularly in the State of New South Wales (NSW). There were 444 cases linked to the consumption of oysters from Wallis Lake in the Great Lakes Council, north of Sydney, NSW.

The cause of the contamination was attributed to failing septic tank systems of holiday houses situated along the shore of Wallis Lake. There was considerable debate at the time as to which level of Government authority was the responsible body for managing the incident. The Great Lakes Council, had the statutory power to regulate the onsite wastewater systems under legislation (Local Government Act, 1989 & Clean Waters Act, 1991). There was documented evidence that the Council and its Environmental Health Officers were aware of the failing systems. However the Council failed to address the issue. The reason was that they had a lack of resources to consider options for wastewater management. The case concluded that the Council failed to take full responsibility and there was competing jurisdictional parties involved (*Ryan v Great Lakes Council*, 1999). The State NSW Government had power through fisheries legislation to regulate the growing of oysters and had not acted to deal the issues at Wallis Lake. It appeared to be at the time an issue too complex to resolve.

Under Commonwealth of Australia Trade Practices Act consumers took out a class action for breach of statutory duties and failure to use powers to regulate and prevent such contamination from occurring in the first place.

In hearing the class action case, the Federal Court Judge found all parties to be equally liable “if any one of them had fulfilled its duty to consumers, the epidemic would not have occurred” (*Graham Barclay Oysters Pty Ltd v Ryan*, 2000). The Council was found to be at fault for failing to address the failing septic tank systems. The NSW State Government was also found at fault for failing to implement Land Use Planning laws and approving the operation of oyster farms near un-sewered residential areas. The oyster industry was found to be at fault for failing to adequately monitor the safety of their products.

The findings were overturned after a long and complicated legal case involving an appeal to the Full Court against the Great Lakes Council and to the High Court against the State Government. A very large amount of time and money was invested in defending the case (EnHealth, 2012).

Following the incident, the State Government introduced legislation requiring all bivalve and mollusc growers to implement rigorous food safety standards. Growers are now required to prepare and implement a Food Safety Plan based on HACCP principles. Growers were also required to have their Food Safety Plan audited annually by an accredited third party auditor. Other states of Australia have since introduced similar regulatory requirements for the farming of bivalves and molluscs.

The Problem Arises Again

In 2009, the Tasmanian State Government as part of the Tasmanian Quality Assurance Program (TASQAP) introduced legislation requiring all oyster and mussel growers to prepare a Food Safety Plan and undertake mandatory third party auditing to ensure that the plan was being implemented. The program was complimented by a number of State Government initiatives including:

- Product monitoring for quality and diseases prevention. An emerging disease to be managed is Pacific Oyster Mortality Syndrome, known as POMS
- Water quality testing program and
- Assistance to the industry in providing materials for the development of the Food Safety Plans.

Despite these measures, in 2013 there was another major outbreak of food poisoning in South East Australia. The oysters had been grown in Tasmania and consumed in other areas. In this case there were approximately 500 cases of food poisoning from the consumption of oysters in many different parts of Australia. Tasmania's reputation as a quality producer of fine foods was tarnished. Tasmania is an island state with the clearest air in the world and 30% of the island under National Park or World Heritage Area protection.

TASQAP notified that the norovirus outbreak was linked to oysters grown from a grower with a lease in Dunalley Bay, Tasmania. The Tasmanian Government requested that an investigation and sanitary survey of the area be undertaken. This paper details this recent investigation and draws lessons to prevent this from occurring again.

ASSESSING THE CAUSE OF THE RECENT OUTBREAK

Potential Sources of Contamination

The oyster grower in question had two different leases, one at Barilla Bay near Hobart, Tasmania's capital and another lease on the edge of a country town known as Dunalley, on Tasmania's east coast¹. The incident occurred a few months after a major bushfire destroyed much of the town of Dunalley. Co-incidentally the Barilla lease had been closed due to another sewer spill and so oysters were being harvested from the Dunalley lease.

The investigation into the cause of the food poisoning commenced with a desk top literature search (Robinson & Mason 2013). At the time of the outbreak, Dunalley was on a Combined Effluent Drainage sewer scheme. Septic tanks were in place and effluent was reticulated to sewage lagoons, before discharging into a bay. So the possible causes of the contamination from the Dunalley Sewerage scheme included:

- Pump stations
- Leaking sewage lagoons
- Overflow outfall from absorption pit
- Sewer leak into stormwater
- Individual connections
- Septic tanks that were connected to the sewer being damaged in the bushfire site clean up

Other potential sources of sewage contamination included the illegal disposal of portable toilets from people living on properties burnt down in the bushfire or the possible dumping of waste tanks from boats near the oyster lease.

¹ This region is surrounded by some of Tasmania's pristine white beaches and situated on the East Coast with direct access to the crystal clear, most pure oceanic waters of the Pacific Ocean. The product from this bay has a white flesh, clean shells and a subtle combination flavour of sweetness and saltiness which leaves a clean, crisp taste on the pallet.

Figure 1 is a location plan including marine farm leases shown in green. Figure 2 shows the main features in Dunalley and the major possible sources of sewage contamination.



Figure 1 – Location Map

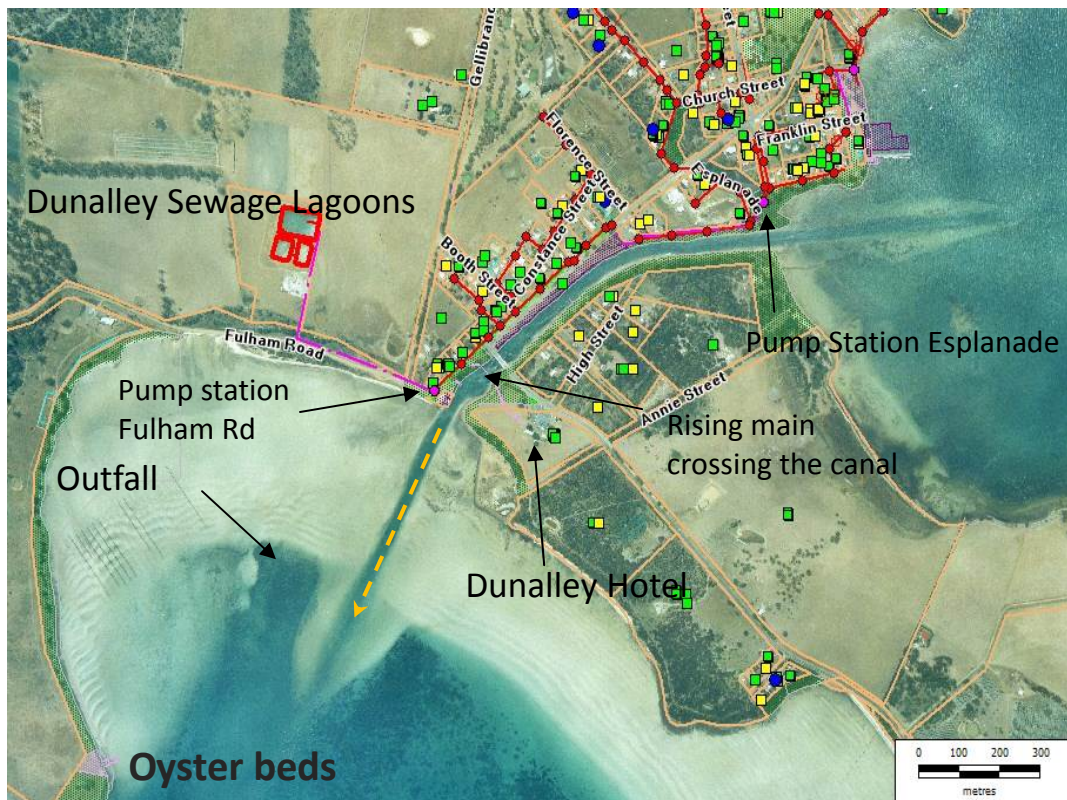


Figure 2 – Dunalley & Major Sources of Sewage Contamination

The investigation involved the collection of water samples from the oyster lease. Staff at the farm were interviewed to ascertain if they or family members had consumed oysters or if they had gastro or vomiting symptoms. Observations were made of possible waste dumping from boats, and other faecal sources near the lease were also investigated.

The investigation also revealed that the pump station at Fulham Road had storage capacity and was working. There had been no reports of recent sewer overflows. If the high level alarm activates, the telemetry automatically notifies a monitoring company that calls the infrastructure on call staff. It was revealed that the pump stations were working.

The Fulham Road sewage rising main showed no signs of leaks. It was found to cross under a canal which runs into Dunalley Bay. The sewage lagoons was not overflowing and the outfall hadn't discharged for several months. The inlet to the lagoons was clear and not blocked, and there were no signs of overflow. The lagoons showed had no signs of leakage from the walls. The absorption pit for the outfall was dry. The Dunalley public toilets near the canal and pump chamber hadn't overflowed. A report of a sewage smell near the new Dunalley Bakery which had recently installed new plumbing had been inspected and showed no signs of failure. Another unlikely source was sewage being cross connected into the stormwater.

RESULTS OF INVESTIGATION

Sewage Pump Station

The investigation revealed that a private sewer line existed at the local Dunalley Hotel. The hotel had survived the bush fires and became a safe haven for those that had lost their homes. A fundraising concert attended by over 3000 people was held at the hotel two months after the fire in 2013. This event added considerable load to the sewage system following the decimation of the town from the bushfires.

The sewer manhole on the other side of the canal from the hotel was identified as the location of the sewer pipe from the Dunalley Hotel. No water was flowing from the hotel and there was no obvious signs of sewage overflow or discharge back into the canal. The local EHO decided to dye test the hotel to see if there were signs of leakage.

The Dunalley Bushfire clean up contractor advised that the septic tanks that were removed from properties in the Fulham Rd area had been pumped out. The last clean up in this area was about 6 weeks earlier.

There was only a light flow in the stormwater system which was consistent with previous light rainfall.

The sewage pump station in Fulham Road was dye tested. The pump chamber was pumped dry and the investigation didn't reveal any signs of leakage so this source was eliminated.

The infrastructure provider was contacted and advised that dye had discharged into the sewage lagoons and there were no signs of the dye discharging into the creek.

More water samples were collected for the Dunalley Canal and results showed <10 Total coliforms suggesting no obvious contamination.

Hotel Discharge

Dye testing at the Dunalley Hotel involved the use of a fluorescein dye used to test the outlet of the septic tank. An inspection of the manhole from the septic tank where the Hotel connected to the sewer showed no water discharging into the sewer initially, however eventually a bright green dye (fluorescein) was observed into the Dunalley canal which conclusively proved the discharge pipe from the septic tank at the Dunalley Hotel was discharging effluent into the canal (Figure 3).



Figure 3 – Dye in the Dunalley Canal

The Problem Abated

There was still some fluorescein near the inlet to the sewage lagoon from the completed dye test. However the testing had confirmed that the sewage leak was from a damaged pipe running along the floor of the canal, probably damaged by either a passing yacht, stress from wear and tear or as a result of the heavy loading from the funding raising concert.

To confirm the Dunalley Hotel as the source of contamination, the septic tank was pumped out. The pump truck operator estimated that the septic tank would hold around 4500L. A civil contractor located the pipe from the septic tank and installed another temporary holding tank to prevent any further sewage from leaking in the canal. The holding tank was connected to the outfall pipe from the septic tank to block off the canal discharge.

Upon confirming the source of the contamination, an Abatement notice under the *Local Government Act 1993* was issued on the Dunalley Hotel advising them to install regular pump outs of the septic tank and the temporary septic tank. This was continued until the leaking sewer line was repaired.

A new sewer line has since been constructed and the hotel has been connected to the sewer. The sewer line was installed by directional drilling and the new pipe line pressure tested.

The whole investigation was jointly funded by the concerned parties namely the Sorell Council, the water and sewage authority and the Dunalley Hotel. This was an example of shared responsibility for the incident, unlike what had occurred 20 years earlier at Wallis Lake.

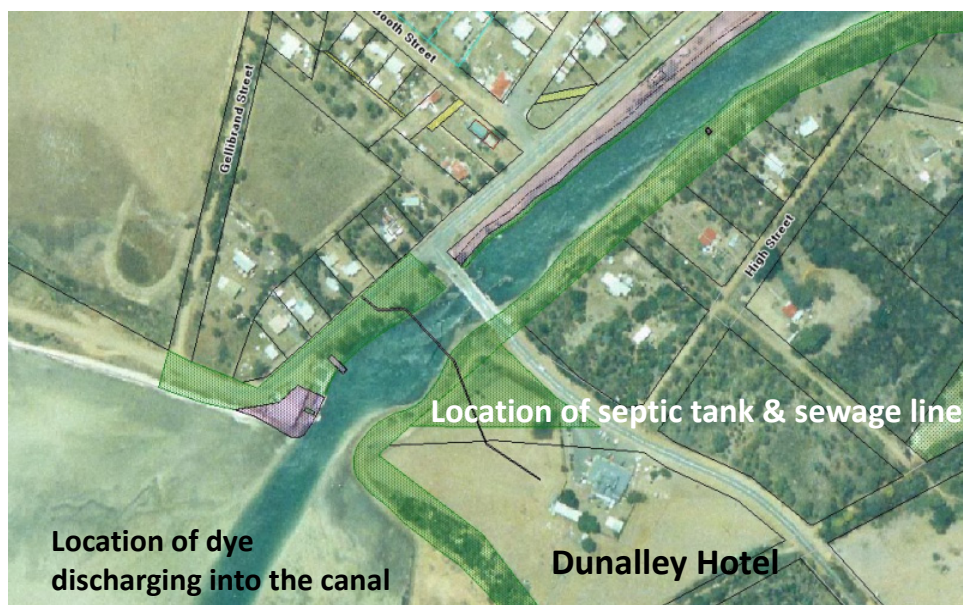


Figure 4 – Sources of Contamination at Dunalley

CONCLUSIONS AND RECOMMENDATIONS

The major incident in 1993 in New South Wales was not dealt for variety of reasons and can best be summarised as a lack of accountability by jurisdictions in managing potential pollution sources adjacent to oyster farms. If Environmental Health Officers had been diligent in their duties and had been supported by their Council, the incident could have been avoided. The result was a major shift in management of oyster farms in Australia so as to protect food safety of consumers.

Twenty years later a similar incident occurred in Tasmania. In this incident a significant food poisoning event occurred despite a rigorous food safety program being implemented. The long term damage was resolved by the diligent investigations of local Environmental Health Officers.

It is concluded that despite rigorous food safety procedures being put in place, the juxtaposition of competing land use activities means there needs to be a constant vigilance of externalities that may lead to food product contamination and subsequent food poisoning. Clearly the role of Environmental Health Officers is critical in preventing such incidents.

REFERENCES

Clean Water Act of NSW (1991); Government Printer, Sydney, New South Wales, Australia

EnHealth (2012); Risky Business – A source to Help Local Government Manage Environmental Health Risks, 2012; ISBN 978-1-74241-839-1,

Graham Barclay Oysters Pty Ltd v Ryan (2000); Full Court of Australia 1099 – Appeal from 1999 decision – High Court of Australia 54

Local Government Act of NSW (1989); Government Printer Hobart, Tasmania, Australia

Robinson & Mason (2013); Investigation of Pollution Sources Dunalley Township Norovirus Outbreak; Tasmanian State Conference of EHA

Ryan v Great Lakes Council (1999) FCA 177 – original case heard in the Federal Court.

Food safety education in primary school: The impact of home economics teacher

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ABSTRACT: Focused on educating pupils in food and nutrition, the home economics teacher plays a vital role in the educational system on primary level. The main purpose of this study is to investigate teachers' understating of food safety concepts, the importance of food hygiene and food safety with regards to individuals' later lives, teaching methods and barriers to teach food safety topics. The results among 168 respondents reveal positive differences compared to the general population regarding understanding of food safety concepts; however, the situation remains far from ideal. Teachers' experience, educational background and their personal preferences towards food safety topics were identified as the crucial factors, not only influencing teachers' attitude, but also in enabling the overcoming of barriers identified. Among these, deficiencies in teachers' formal education and the technical facilities necessary to teach home economics on a practical level were identified. Discrepancies between policy makers and teachers were also detected.

Keywords: Food safety, Food hygiene, Education, Teachers, Home economics

INTRODUCTION

Considering the organization of everyday life, there is an increased prevalence of eating away from home and the use of partly or fully cooked food, which is more a reaction to daily time constraints than a result of any increasing popularity (Tivadar, 2003; Byrd-Bredbenner et al., 2007). Consequently, opportunities for children to observe their parents preparing meals at home or even their collaboration are limited. Despite that, parents are indispensable, supported by findings that young people are looking for role models, and citing their parents as a source of information or even as their first contact with concepts of food hygiene (Coulson, 2002; Byrd-Bredbenner et al., 2007). However, parents may be unreliable sources of information, as many claim that their handling with food is in accordance with the principles of food hygiene practice, although different studies among the general population (Redmond and Griffith, 2003; Terpstra et al., 2005, McCarthy et al., 2007) disprove this self-assurance regarding their knowledge and skills. Also previous studies among the Slovenian general population (Jevšnik et al., 2008a) and its sub-groups, including pregnant women (Jevšnik et al., 2008b), the elderly (Jevšnik et al., 2013) and food handlers (Jevšnik et al., 2008c), revealed gaps in knowledge and practices, prompting a continuation of research in the school-based education system, starting with teachers of home economics on primary level.

From their qualitative findings, McCarthy et al. (2005) suggested that (beside gender and work status) formal home economics training plays a determining role in domestic food safety behaviour among adult consumers, confirmed later by Brennan et al. (2007) as one of crucial factors. Teaching food hygiene at the primary level is crucial, because behaviour is more easily influenced at that stage. Learning about food hygiene and food safety in schools makes it possible to influence children's behaviour with systemic measures; school-based education (on the primary level) in developed countries generally reaches all social classes. Children educated in an effective way can act also as facilitators at home through messages conveyed to family members (Egan et al., 2008), and will develop into adults who continue to implement proper behaviour at home as caregivers for family members or as employees in the food business sector. Therefore, schools are recognized as essential institutions influencing this kind of behaviour (Moon et al., 1999); however, qualified teachers and quality curriculum are key elements. Unfortunately, as reported by others (Griffith and Redmond, 2001; Byrd-Bredbenner et al., 2007), food safety content has been somewhat restricted in national curriculums or moved from compulsory to elective courses and is no longer mandatory for all. A combination of problems regarding the organization of everyday life in families and restrictions or even the withdrawal of food hygiene content in schools could lead to extreme situations in which children

will not be included at all or in an incorrect manner in food preparation, either at home or school, and will therefore not grant any particular credit to these topics in their future life.

In spite of the important issues addressed above, there is little research on school based education about food safety and food hygiene. Research is mostly orientated towards pupils' knowledge, self-reported behaviour and practices (Coulson, 2002; Haapala and Probart, 2004; Byrd-Bredbenner et al., 2007, Eves et al., 2010), while research among teachers is rare (Bielby et al. 2006; Egan et al., 2008), particularly among distinct groups of teachers, e.g. teachers of home economics. The purpose of this study is to investigate teachers' attitudes towards food safety related topics, their understating of food safety concept in relation to food hygiene, their own educational background and interests with on-going inquiries in food safety, their opinions about the importance of food safety considering an individual's latter life, teaching methods and barriers to teaching food hygiene topics.

MATERIALS AND METHODS

Data were collected using a questionnaire sent by post. A total of 450 questionnaires were sent to all primary schools throughout the Slovenia. Questionnaire was developed especially for this study by experts from the Faculty for Health Sciences, University of Ljubljana. In addition to course curriculum and the findings of the aforementioned studies (Bielby et al., 2006; Egan et al., 2008), teachers among whom the questionnaire was pilot tested and their opinions were also considered, resulting in additional response options included in the formation of the questionnaire. The questionnaire took approximately 10 minutes to complete. Except for the first question, in which respondents had to explain in their own words what they understood by the term "food safety", a quantitative approach was used. Other questions contained evaluation scales or offered statements.

For analyzing the open question "How do you interpret the term food safety?", we used the description method based on qualitative content analysis, based upon grounded theory (Strauss, 1996) and previously validated (Jevšnik et al., 2008d). The quantitative results were evaluated and analysed using the SPSS 20.0 program package. To examine the relationship among and between the variables, cross tabulations and the χ^2 test, correlation coefficient, an independent sample t-test and one-way ANOVA (confidence interval 95%) were used considering the question type. In addition to demographic factors, teachers' personal interest was also used as an independent variable.

RESULTS AND DISCUSSION

A total of 168 questionnaires were returned, representing a response rate of 37.3%. The lower response rate is probably due to voluntary response, the time of the survey's execution (at the end of the school year) and related demanding work activities resulting questionnaire being considered non-essential. However all age groups are represented, and different years in teaching experiences are covered; furthermore, the group of respondents is homogeneous regarding gender (Table 1).

Table 1: Demographic characteristics of respondents

Factor	Level	Description	%
Gender	1	Male	6.0
	2	Female	94.0
Age	1	≤ 30	7.4
	2	31–35	16.0
	3	36–40	15.3
	4	41–45	18.4
	5	46–50	16.6
	6	51–55	19.6
	7	> 55	6.7
Years of teaching experience	1	≤ 4	26.8
	2	5–14	26.2
	3	15–24	21.3
	4	25–35	25.6
Education	1	PHE	59.3
	2	FS	5.6
	3	Others	35.1

PHE – Professor of home economics; FS – Education in food science

Respondents with education in food science are those with degrees in food technology or agronomy, combined with additional two-year pedagogical-andragogical courses. In the group “others”, teachers of primary education, teachers of native language, sociology, history, geography, ethics, mathematics and physics only, biology and chemistry only or the arts are included.

Comprehension of the term “food safety”

“Food safety” is a term that is used in different fields such as agriculture, food production, nutrition and medicine. Röhr et al. (2005) reported that food quality and food safety are abstract terms that can be interpreted in various ways. They also emphasise that it is necessary to take subjective interpretations into consideration. Several studies reviewed by Parker and Heywood (2000) demonstrated that primary teachers have gaps or lacks in their background knowledge on which to draw and that they often misunderstand some current scientific ideas. Among 168 respondents, 151 (89.9%) answered the open question: “How do you interpret the term food safety?”. Respondents in this study describe the term “food safety” in a more complex manner, with 54% using it in more meaningful statements in comparison to 24% among the general population as reported by Jevšnik et al. (2008d). The health impact is the most emphasized one, showing a strong connection of the term “food safety” with hazards arising from technological procedure, production methods or food supply chain itself. A total of 11.3% define all three types (biological, chemical, physical) of hazards. Nevertheless, exceedingly few (1.3%) explicitly differentiate safe food from healthy food. In comparison to the general population, “food chain” (8.7%) is also more clearly expressed.

Methods used to teach food safety topics

According to Rivero et al. (2011), the methodology of teaching is an essential element effectively helping pupils to learn. According to the Slovenian curriculum of home economics, methods of practical work and skills, case analysis, project work and excursions are recommended (Simčič et al. 2011). Curriculum implementation differs with teachers’ content area backgrounds, while other teacher-related factors, such as years of teaching experience and mobility, were not found to be predictive (Probart et al., 1997). Teachers’ backgrounds in the content area as well as their backgrounds and opinions of interdisciplinary teaching may be critical concerns affecting curriculum implementation. When teaching food safety topics, 50.0% report a combination of teachers’ explanation with his/her demonstration and pupils’ practical work. The rest combine teachers’ explanation and pupils’ practical work (44.0%), teachers’ explanation with his/her demonstration (4.2%) or applies teachers’ explanation only (0.6%). Differences with regard to years of teaching experience of respondents were revealed, in which a combination of all three techniques is more prevalent among the least (≤ 4 years in teaching home economics) or the most (25–35 years in teaching home economics) experienced teachers ($p = 0.013$). Younger teachers (up to 42 years old) evaluate workshops higher (average score 7.4) in comparison with their older colleagues (average score 6.4). A detailed comparison revealed that with the increasing age the average score of workshop and demonstration drops (from 7.6 to 4.5 and from 6.3 to 4.8, respectively), while the average score of seminar work increases (from 3.2 to 4.9). However, respondents with more years of experience (15 or more) in teaching home economics evaluate case analysis higher (average score 5.6) in comparison to those with less experience (average score 4.5). Furthermore, teachers in the UK suggested that demonstrations and activities involving pupils preparing food are most effective for teaching food hygiene (Egan et al., 2008). However, both need careful preparation; otherwise pupils will not produce good work on their own. Nevertheless, caution is necessary, as studies reviewed by Rivero et al. (2011) gave evidence that contradictions between what teachers say about their approaches and what they designed for their classrooms often appeared. Teachers, therefore, often end up teaching as they were taught and are in practice fairly resistant to innovative ideas. Respondents were also asked if they included any experts in the field of food hygiene. A minority (23.4%) invite experts from institutes of public health, different health workers from health centers, school kitchen staff, school food suppliers and members of different associations. However, the large majority (76.6%) reports that this is not possible because of an overcrowded curriculum, costs related to the experts’ visits, a lack of offers, problems considering organization, their doubting the effectiveness of a single visit, or because they had not yet thought about it. Nevertheless, those respondents whose interest in food hygiene is higher in comparison to other topics (48.8%) also more frequently invite different experts in comparison to the group of teachers who have the same or even lower interest (51.6%) ($p = 0.001$).

Table 2: Teachers evaluation of single teaching method regarding expected efficiency

Teaching technique	Score*		Determinative factor	Statistical significance
	μ	STD		
Workshop / practical work	6.7	2.1	Age	($p = 0.005$)
Demonstration	5.6	1.8	Age	($p = 0.027$)
Case analysis	5.1	1.9	Years of teaching experience	($p = 0.000$)
Project work	4.9	1.8	Age	($p = 0.014$)
Play	4.8	2.1	/	N.S.
Group discussion	4.5	1.8	/	N.S.
Seminar work / poster	3.9	1.9	Age	($p = 0.005$)
Lecture	3.1	2.3	/	N.S.

Legend: * 1 – the least efficient; 8 – the most efficient; N.S.: Not significant

Teachers' personal interest in food safety and trustworthy sources.

Half of the respondents (50.6%) are personally equally interested in the food safety topics as in all the other topics at home economics. The rest are personally less (0.6%), more (20.8%) or especially interested (28.0%) and therefore put particular emphasis on these topics. Teachers' personal preferences could come from their awareness acquired during their own period of growing up or from their intrinsic motivation as an individual inherent inclination to particular areas of life regardless of the presence of external circumstances (Ryan & Deci 2000). Although a high proportion of respondents are educated in home economics or in food science (Tab. 1), only 55.2% of them, more often older than 42 years ($p = 0.049$), report that their knowledge in food safety was acquired during their formal education. The rest report reliance on their own practical experience and their self-initiative to inform themselves about food safety, which is still significantly less ($p = 0.000$) than that of the respondents whose formal education is not in the field of home economics or food science. The differences among respondents whose formal education should provide food safety knowledge indicate different comprehension of their formal education and/or changes of teachers' education program during the years. In comparison to other sources, web pages are more frequently used among younger respondents, especially among those aged 30 or less for whom web pages are the leading source, in addition to professional guidelines and recommendations ($p = 0.006$). The respondents aged 55 or more do not use the internet at all. Moreover, respondents not looking for additional information belong to the group that reports that their knowledge about food hygiene relies on common sense and their practical experience. This could be probably related, to the fact that they consider themselves sufficiently competent. Although most of sources reported are relevant, they are either meant for other professional audience (e.g. food handlers) or general consumers, or are related to healthy nutrition with no food hygiene elements. The results also indicate teachers' needs with regard to lifelong learning in the field of food safety.

Barriers for teaching food safety topics and teachers suggestions

A total of 56.9% of respondents do not report any barriers at all to teach food safety topics. The rest report a lack of time, lack of equipment and/or unsuitable classrooms (29.3%) also combined with pupils' lack of discipline, lack of knowledge and interest (9.0%) or problems with the number of pupils in the class (4.8%). Although teachers encounter barriers regardless of their education, those with education in home economics report significantly fewer barriers in comparison to others ($p = 0.007$), indicating that the education of teachers is a key factor for achieving prescribed learning objectives. The lack of technical facilities, the shortage of additional staff to supervise practical activities, the lack of curriculum time and food safety teaching materials are also limitations for teachers across the UK (Bielby et al., 2006). According to the last question (optional), answered by 47.6% respondents, in addition to the aforementioned barriers there were also problems in timetable organization. Respondents also report that home economics as a course is undervalued by their colleagues and that more hours should be intended for food preparation (during the reform of the school system, total hours for home economics were reduced); this is comparable to their UK colleagues who feel that food safety is overlooked within the formal curriculum (Bielby et al., 2006). Respondents also suggest that course of home economics should be moved back to upper grades, where it was before the reform of primary school system, in which linkage with other courses is easier and when pupils were more familiar working with food. Some also report lacking confidence and competence. One of the respondents explained that her formal education is in the fields of biology and chemistry, and that she does not feel sufficiently competent to teach topics of food hygiene; however, it is necessary in order to have a full salary, as there are not enough teaching hours available at her basic teaching field. Respondents notice pupils' joy when working with food and therefore suggested the re-introduction of

cooking clubs, which were cancelled by school leadership in some schools to avoid potential law suits considering risk for food poisoning after the introduction of the HACCP system.

CONCLUSIONS

The results in this study reveal positive differences compared to the general population with regard to the understanding of food safety concept among teachers, though still far from ideal, with miscomprehensions of basic terms; differences and deficiencies in teachers' formal education; teachers' formal education and their personal interest towards food hygiene topics as a means of overcoming barriers identified; teachers' needs with regard to lifelong learning in the field of food safety, expressed in seeking information in various sources often meant for other professional audiences; teachers' focus on skill-orientated teaching methods supporting the course curriculum content, though often without their demonstration serving as an example; deficiencies in technical facilities necessary for teaching at a practical level. The results additionally expose a discrepancy in employment policy leading to teachers with different formal education (also inappropriate) teaching home economics, and a discrepancy between policy makers' reform goals and teachers' capacity to implement innovations, when reforming the educational system. Focused on educating pupils in food and nutrition, the teacher of home economics plays a vital role in the educational system. Therefore, more care should be given to their education. Additionally, policy makers have to set minimum standards regarding who is qualified to teach food and nutrition topics on all educational levels. However, we should not forget the unavoidable fact that food safety is the result of several factors, not only the effective education of potential food handlers, although it is essential.

REFERENCES

- Bielby, G., Egan, B., Eves, A., Lumbers, M., Raats, M., Adams, M. (2006), "Teaching food hygiene in UK primary schools: A nationwide survey of teachers' views", *British Food Journal*, Vol. 108, pp. 721–731.
- Brennan, M., McCarthy, M., Ritson, C. (2007), "Why do consumers deviate from best microbiological food safety advice? An examination of 'high-risk' consumers on the island of Ireland", *Appetite*, Vol. 49 No. 2, pp. 405–418.
- Byrd-Bredbenner, C., Maurer, J., Wheatley, V., Schaffner, D., Bruhn, C., Blalock, L. (2007), "Food safety self-reported behaviors and cognitions of young adults: results of a national study", *Journal of Food Protection*, Vol. 70, pp. 1917–1926.
- Coulson, N.S. (2002), "Source of food safety information: whom do adolescents trust?", *Appetite*, Vol. 38, pp. 199–200.
- Eves, A., Bielby, G., Egan, B., Lumbers, M., Raats, M., Adams, M. (2010), "Food safety knowledge and behaviours of Children (5-7 years)", *Health Education Journal*, Vol. 69 No. 1, pp. 21–30.
- Egan, M.B., Bielby, G., Eves, A., Lumbers, M.L., Raats, M.M., Adams, M.R. (2008), "Food hygiene education in UK secondary schools: A nationwide survey of teachers' views", *Health Education Journal*, Vol. 67 No. 2, pp. 110–120.
- Griffith, C. and Redmond, E. (2001), "Evaluating hygiene behaviour in the domestic setting and the impact of food hygiene education", *Journal of Infection*, Vol. 43, pp. 70–74
- Haapala, I. and Probart, C. (2004), "Food safety, perceptions and behaviours among middle school students", *Journal of Nutrition Education and Behavior*, Vol. 36, pp. 71–76
- Jevšnik, M., Hlebec, V., Raspor, P. (2008a), "Consumers' awareness of food safety from shopping to eating", *Food Control*, Vol. 19 No. 8, pp. 737–745.
- Jevšnik, M., Hoyer, S., Raspor, P. (2008b), "Food safety knowledge and practices among pregnant and non-pregnant women in Slovenia" *Food Control*, Vol. 19 No. 5, pp. 526–534.
- Jevšnik, M., Hlebec, V., Raspor, P. (2008c), "Food safety knowledge and practices among food handlers in Slovenia", *Food Control*, Vol. 19 No. 12, pp. 1107–1118.
- Jevšnik, M., Hlebec, V., Raspor, P. (2008d), "Consumer interpretation of the term food safety. *Acta alimentaria*, 37(4), 437–448.
- Jevšnik, M., Ovca, A., Bauer, M., Fink, R., Oder, M., Sevšek, F. (2013), "Food safety knowledge and practices among elderly in Slovenia", *Food Control*, Vol. 31 No. 2, pp.284-290.
- McCarthy, M., Brennan, M., Ritson, C., Kelly, A., De Boer, M., Thompson, N. (2005), "Novel food risk communication strategies. Final Project Report Prepared for Safefood" available at:

<http://www.safefood.eu/SafeFood/media/SafeFoodLibrary/Documents/Professional/Ref-02-RESR-018.pdf>
(accessed 2 July, 2012).

McCarthy, M., Brennan, M., Kelly, A. L., Ritson, C., De Boer, M., Thompson, N. (2007), "Who is at risk and what do they know? Segmenting a population on their food safety", *Food Quality and Preference*, Vol. 18 No. 2, pp. 205–217.

Moon, A.M., Mullee, M.A., Thompson, R.L., Speller, V., Roderick, P. (1999), "Health related research and evaluation in schools", *Health Education*, Vol. 99 No. 1, pp. 27–34.

Parker, J. and Heywood, D. (2000), "Exploring the relationship between subject knowledge and pedagogic content knowledge in primary teachers' learning about forces", *International Journal of Science Education*, Vol. 22 No. 1, pp. 89–111.

Redmond, E.C. and Griffith, C.J. (2003), "Consumer food handling in the home: A review of food safety studies", *Journal of Food Protection*, Vol. 66 No. 1, pp. 130–161.

Röhr, A., Luddecke, K., Drusch, S., Muller, M.J., Alvensleben, R.V. (2005), "Food quality and safety – consumer perception and public health concern", *Food Control*, Vol. 16 No. 8, pp. 649–655.

Ryan, R.M. and Deci, E.L. (2000), "Intrinsic and extrinsic motivation: Classic definitions and new directions", *Contemporary Educational Psychology*, Vol. 25, pp. 54–67.

Strauss, L.A. (1996), *Qualitative analysis for social scientists*, Cambridge University Press, Cambridge, New York, Melbourne.

Simčič, I., Koch, V., Gjerek, M., Mencigar, M., Nerad, A., Veg, I. (2011), "Curriculum. Elementary school program. Home economics", available at: http://www.mss.gov.si/fileadmin/mss.gov.si/pageuploads/podrocje/os/devetletka/predmeti_obvezni/Gospodinjstvo_obvezni.pdf (accessed 8 June 2012).

Terpstra, M.J., Steenbekkers, L.P.A., de Maetelaere N.C.M., Nijhuis, S. (2005), "Food storage and disposal: Consumer practices and knowledge" *British Food Journal*, Vol. 107 No. 7, pp. 526–533.

Tivadar, B. (2003), "Save money, waste love: Ambivalence toward purchased convenience food", *Annales Series Historia et Sociologia*, Vol. 13 No. 1, pp. 87–102.

Food safety system based on HACCP methodology in a Portuguese sausage industry

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ABSTRACT: Food safety is a growing concern among consumers in developed countries. In this context, food safety occupies a place of increasing importance to the informed consumer, knowledgeable and aware of what they want and especially what they do not want to eat. This is also the social and economic context that is arising in some markets, the opportunity to offer differentiated or specific products to a specific consumer audience, that can (and want) to pay for the difference. Here fits the traditional products, that are associated with the idea of choosing products that are not produced by the mass industry. Traditional products have a strong relation with the art of “know-how”. This study aimed to develop a food safety system in an industry of Portuguese sausages, in Leiria’s district. To do this, we used the methodology based in Hazard Analysis and Critical Control Points (HACCP) to assess hazards and quantify the risks that may affect consumer health. The study was conducted over four steps based on the standards of the HACCP Plan. This work identified a number of gaps in the food safety system of the organization under study, as well as defined the strategies to improve the operation and ensure the safety of meat products marketed.

Keywords: HACCP, food safety, meat products, food industry

INTRODUCTION

The food industry when creates, develops and produces particular food products aims that their final product would be recognized by their quality (organoleptic, safety, etc.). The need and obligation to produce safer food goes to inevitable implementation of effective food safety systems along the entire chain of production, shipping and distribution, namely a system based on principles and HACCP methodology (Baptista et al. 2003).

This preventive system requires a strategic approach of the stages of the production / distribution, based in the identification of inherent hazards such as biological, chemical and physical (Regulation (EC) n.º852 / 2004).

This article aims to clarify the implementation of a food safety system, based in the Hazard Analysis and Critical Points (HACCP), in a Portuguese sausage industry.

Portuguese Sausage Food industry

The sausages and other meat products are products that have a variety of flavors, textures and shapes, dependent on the raw materials used and the manufacturing process (Carvalho, 2010).

The Regulation (EC) No 853/2004, defines that the meat products are processed products resulting from meat or from other processed meat products, so that the cut surface shows that the product is no longer the characteristics of fresh meat. The Portuguese sausages and meat products arose as a result of favorable conditions for the creation of pigs. The need to preserve meat and to enjoy all that this animal could offer, led to products like sausages in natural gut casing.

In the twentieth century this home production has become industrial. In Portugal there are produced a variety of sausages, including: the meat sausage, the salami, the moor sausage, the blood sausage, black pudding, the pepperoni, the fresh sausages, and others. The most appreciated traditional products are the sausage, the salami and smoked sausage of vineyards (Carvalho, 2010). The production of sausages and meat products must follow the law, so that the products can guarantee their safety.

Food Safety System - HACCP

The HACCP system is a preventive system resulting from the application of common sense, scientific and technical principles. It is an essential tool for identification and analysis of critical points (CP) at different stages of the process, while allowing the establishment of the necessary means to control these points and apply preventive monitoring. The HACCP system stands for proactivity instead of reactivity (corrective approach) (Forsythe & Hayes, 2002).

The methodology of HACCP shows the importance of checking the quality of the product in every stage of the business. This approach is very different than the unique approach of control only the final product, this system allows the analysis at all stages of the production, and also the food chain. The vision is that the product is safely controlled and organized based in a proactive methodology, able to control hazards.

HACCP is designed to be applied in all segments of the food industry (production, processing, distribution and marketing the product). There are seven general principles on which that enable them to identify specific hazards and establish preventive measures for their control:

1. Identifying any hazards that must be prevented eliminated or reduced to acceptable levels;
2. Identification of critical control points (CCP - points, operational steps or procedures that must be monitored in order to eliminate a hazard or to decrease the likelihood of its occurrence) at which control is essential to prevent or eliminate a hazard or to reduce it to acceptable levels;
3. Establishing critical limits to the CCP's, limits that can separate acceptability from unacceptability of the product;
4. Establish and implement effective monitoring procedures to CCP's;
5. Establish corrective actions when monitoring indicates that a CCP's are not under control;
6. Establishing procedures to control CCP's;
7. Establishing documents and records, commensurate with the nature and size of the businesses to demonstrate the effective application of the measures referred to above (Reg. (CE) n°852 / 2004).

The development of the HACCP system is performed by twelve sequential preliminary steps (Pinto & Neves, 2010).

Step 1: Training of HACCP team

The HACCP team should be multidisciplinary, with the intervention of members of other areas where your experience is relevant to the case (Surak & Wilson, 2007).

Step 2: Product Description and distribution method

The HACCP team should describe the product in detail, which includes the ingredients, method of distribution and storage conditions (Pinto & Neves, 2010).

Step 3: Identify your specific use and consumers

Identification of specific use of the final product and the intended consumer (Surak & Wilson, 2007).

Step 4: Development of the flow diagram

The process flow diagram should be designed to allow a clear and succinct analysis of product manufacturing steps (Pinto & Neves, 2010).

Step 5: Check the flow diagram

The HACCP team should confirm, in industrial context, the accuracy of the steps listed in flowchart, never forgetting that this is a dynamic scheme that may be changing (Surak & Wilson, 2007).

Step 6 to 12: Application of the seven HACCP principles

In these steps, the application of the seven HACCP principles is made in accordance with the logical sequence thereof.

OBJECTIVES AND CONTEXT OF THE CASE STUDY

This study was prepared in an organization where its main economic activity is the sausage industry, in Leiria’s district. In order to preserve their identity will be considered with the fictitious name of Organization XPTO.

The main objective of this work is the development of a food safety system based in HACCP methodology in a sausage industry in Portugal. In order to eliminate or minimize any potential safety hazards in manufacturing these products.

The implementation of food safety control systems, such as HACCP is recommended by the FDA (Food and Drug Administration - Food Code 1999), especially for the establishments using processes such as smoking, acidification, cooking and the use of food additives. These features are included in a range of Portuguese food products such as sausages and traditional cured meat products (Escola Superior Agraria de Coimbra, 2002).

MATERIALS AND METHODS:

The implementation of a HACCP system inferred a demanding methodology. The action procedure applied to implement the HACCP system in this Portuguese sausage industry is provided in Table 1.

The duration of each step was, between 1st and 2nd stage it took about a month and between 2nd stage and the remaining, three months.

Table 1 – Action procedure applied to implement the HACCP system

Stage	Developed activities
1	Technical and functional survey of infrastructure and HACCP pre-requisites
	Collect data for preparation of the control of temperatures and cleaning operations; HACCP plan; layout; etc...
2	Preparation of the technical-functional report
	HACCP Dossier Preparation
	Training Action "Food Safety and Hygiene - Food Industry"
3	Harvest microbiological hygiene and food analysis
	Auditing
4	Delivery of prior art visit reports and microbiological analysis
	Training Action "Treatment of non-compliance."
	Application of the improvement plan

The steps mentioned in Table 1 will be described below.

Step 1

Prior to HACCP implementation process, there was a technical-functional visit to the industry, to assess / verify the structural conditions of the facilities, equipments and utensils and the existence or not of HACCP pre-requisites.

HACCP prerequisites are the set of all the processes, they ensure the control of the most various operating conditions in a food industry, is directly related to all the surroundings and the process of food products (Decree nº425 / 99, 21 October).

This step was essential in the methodological process, prior to application of the seven principles of HACCP. The following steps were performed:

- Training of the HACCP team;
- Product description and method of distribution (preparation of the technical data sheets of the final products);
- Identification of the specific use and consumers;
- Development of the flow diagram (assess the layout of the facility and determine the flow diagram to respect the principle of "straight line");
- Check in the field the production flow chart;
- Collect all the information on equipments and work areas for the development of control registers (cleaning / temperature / etc.).

Step 2

At this stage, using the technical and functional evidences reported is announced conformities and non-conformities, as well as its legal and scientific framework and corrective and improvement measures to the top management of the organization.

The dossier is elaborated with all HACCP documentation including: corporate data and personal affection; HACCP plan; Good Practice Code; Traceability; Hygiene Plans, Control and Maintenance; Operating records and Analytical Control Plan.

Last, but not least, was developed a training action to the food handlers about food hygiene and safety. This action is in Organization Training Plan.

Step 3

This Step is designed for monitoring the process, is conduct an audit, during the labor period, so it could be evaluated the adoption of good practices/behaviors, the HACCP practices and procedures.

The harvest of microbiological samples is done to assess the standards of hygiene, as well as product analysis to assess food safety. The laboratory analytical process is carried out by an accredited laboratory for this purpose.

Step 4

Step 4 enables the communication of the monitoring results performed in step 3.

The results obtained by microbiological testing and the audit are presented and discussed with the top management of the organization, to develop the improvement of HACCP plan. Subsequently it is given training to handlers of all the evidences and corrective measures.

At the end of step 4 and after three months, the step 3 is repeated and then after again the forth step, alternating this two steps (3 and 4).

RESULTS AND DISCUSSION

At the end of the first stage the evidences in the technical-function report were discussed with the top management, and to think and act about the best form to correct them.

The installations layout as well as the implementation and formalization of the flow diagrams were prepared with the HACCP team.

The description of the final products and their distribution method are fundamental data for the HACCP plan, so it was elaborated data sheets of all the products produced by the industry.

The HACCP analysis identified four critical control points (CCP), including the stages: storage in refrigeration, quilting, smoking and distribution. After the CCP's identification sequence, the control parameters are set for each stage, corrective measures and ways to monitor those (Wallace et al., 2014).

CONCLUSION

The issues addressed by this research show the importance of implementing a food safety system, because even though the company's infrastructure have been designed and built from scratch, were not adequately addressed to the process, "straight line" flow. It's evident that there is no sensitivity by the top management of the dangers and risks that the final product was subject to, or how to avoid them and, ultimately, how to fix ou reduce those.

The implementation of a food safety system, regarding the methodology, faces difficulties. For the most part, the biggest concerns and difficulties relay on the basics, the HACCP pre-requisites. Namely, infrastructure, pest control, water supply, good food handling practices, training, hazard and risk analysis and knowledge, motivation and commitment of top management. (Regulation (CE) No 852/2004).

REFERENCES

- Baptista, P.; Pine, G. & Alves, P.(2003) *Systems Food Safety Management, Forvisão - Consultancy Integrated Training*. Portugal.
- Carvalho, L. (2010) *Identificação e caracterização de isolados de Staphilococcus: sua utilização como culturas de arranque em enchidos fermentados secos e fumados*. Disponível em: www.repository.utl.pt. Acedido a 05 de Maio de 2014.
- Forsythe, et al. (2002) *Higiene de los alimentos, microbiologia y HACCP*. Acribia, Espanha.
- Codex Alimentarius*; CAC/RCP 1-1969 Rev. 4 – 2003; FAO / WHO Food Standards; Versão portuguesa.
- Escola Superior Agrária de Coimbra; (2002) *HACCP; Manual de Formação*; Disponível em:<http://www.esac.pt>; Consultado a 15/02/2014.
- Pinto, J. & Neves, R. (2008) *HACCP – Análise de Riscos no Processamento Alimentar*. Publindustria, Lisboa.
- Surak, JG & Wilson, S. (2007) *The certified HACCP Auditor Handbook*. ASQ Quality Press. MILwaukee, USA.
- Regulation (EC) No 852/2004 of 29 April 2004 on the hygiene of foodstuffs.
- Regulation (EC) No 853/2004 of 29 April 2004 on the hygiene of food of animal origin.
- Wallace, C.A.; Holyoak, L.; Powell, S.C.; Dykes, F.C. (2014) *HACCP - The difficulty with Hazard Analysis*, Food Control, Volume 35, Issue 1, Pages 233-240

Hand hygiene in public toilets – a case study from Slovenia

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ABSTRACT: Hand washing is the simplest and the most important measure to prevent the transmission of infectious diseases. Despite awareness of the importance of hand washing, people do not wash their hands properly or often enough, but mostly not always when it's needed. The purpose of this paper is to present the hygiene habits of Slovenians after using public toilets in major shopping centers in various towns in Slovenia. The results are compared with the results of similar studies conducted in different countries around the world. Discreet observation of hand washing was carried out in public rest rooms in shopping centers in some major cities across Slovenia, including 1,680 survey participants. The users of public toilets were not aware that they were observed. Poor hygiene practices of the survey participants were identified. As many as 12% of observees did not wash their hands after using public toilets, among which 20% were male and 6% female. The comparison of the results to similar studies in Slovenia and abroad shows that poor hygiene practices are prevailing in all the observed countries, indicating that on average more than a third of men and 10% of women do not wash their hands after using the public toilets. Given the importance of hand washing as a basic hygiene measure, the results produced by the study are extremely worrying and necessitate implementation of various programs to raise awareness and knowledge about proper hand hygiene.

Keywords: *hand washing, hygiene, public toilets*

INTRODUCTION

Hand washing as a basic hygiene measure has been known to various cultures in our history. Hygiene rules of our ancestors, which have been preserved in the form of various records, contain the action of hand washing (Jereb and Likar, 2006; Dragaš and Škerl, 2004). Ancient cultures around the world include hand washing in their hygienic and religious rules already for thousands of years. Ancient Indian records, for example prescribe hand washing before and after eating, after touching the cadavers and unclean areas, after touching certain body parts, and for preventing the spread of diseases that are transmitted by touch. Other ancient peoples, like Babylonians, Persians, Greeks, and Romans practiced similar hygienic measures, which also include hand washing (Dragaš and Škerl, 2004).

Even today hand washing is the simplest hygienic measure to prevent the transmission of infectious diseases. Besides resident micro-flora on the skin, consisting of bacteria, viruses and many types of fungi, transient or temporary microbial population is occasionally also present, consists of micro-organisms which "stick" to the hand from contact with other parts of our own body, contacts with other people or the environment (bus handrails or poles, shopping cart handles, etc.). Hand washing is the simplest way to remove transient bacterial population from hands and therefore prevent transmission of pathogens. Several microorganisms among transient microflora are often the cause of various diseases which are due to transmission path usually called "disease of dirty hands".

From an epidemiological point of view, dirty hands can be a vector of transmission of the pathogens not only through direct transfer (by the contact), more importantly, it can be the source of cross-contamination and indirect transfer. Harrison et al. (2003) demonstrated that contaminated hands can contaminate a clean paper towel rack and vice versa. Similar results were obtained by Barker (2004) who proved that contaminated soil with Norovirus virus can be transmitted to clean surfaces and vice versa, and that transmission is possible from contaminated clothing to clean hands and surfaces.

Poor hygiene, which is particularly problematic in the developing countries, is the main reason for the spread of several infectious diseases. Two to three million deaths per year worldwide could be avoided by taking into account and providing the technical conditions for proper hand washing (Jumaa, 2005). Curtis and Cairncross (2003) estimate that only by using soap everywhere in the world

more than million lives a year could be saved. Although hand-washing is a very simple hygienic measure, the neglecting of hand washing is associated with human behavior (and also technical possibilities), which is usually the cause of the infection as a result of dirty hands (Jumaa, 2005).

Even in the developed world proper hand washing had very important role in the transmission of infections in health care facilities as well as in the food industry, but also in public and private life of individuals. With hand washing, this simple highly effective measure, transmission of several infectious diseases can be prevented, and thus the morbidity and mortality reduced. To reach these goals comprehensive hygiene education in terms of proper hand washing is required. Despite the awareness of importance of hand washing, it is not carried out sufficiently, properly, at all times and wherever necessary, or at least, not accurately and efficiently enough.

Beside technical equipment (clean warm water, soap, and clean towel) the implementation of hand washing depends largely on the education and skills that an individual can (and must) acquire during growing up. The results of the hand washing survey in Slovenia (Jereb and Likar, 2006) show that half of older men did not wash their hands after using public toilets and a further quarter wash them very superficially. The study has established a gender difference in hand washing compliance. More women engage in proper hand washing behavior than men. Nevertheless, every tenth woman still does not wash her hands. Similar conclusions were drawn by the researchers in the UK (Hateley and Jumaa, 1999), Australia (Buchtmann, 2002) and in the USA (Sliwa, 2003, American Society for Microbiology, 2005). The authors also stated that most of the adults know when and how they should wash their hands.

The purpose of this paper is to demonstrate the hygiene habits of Slovenians after using public toilets in major shopping centers in various towns in Slovenia.

METHOD

The observation was carried out in major shopping centers in the period from December 2013 to January 2014 in four larger Slovenian cities: Ljubljana, Koper, Kranj and Novo Mesto. The study aimed to establish whether individual users of public toilets washed their hands after using the toilet, how accurately they performed hand washing and whether they dry their hands afterwards. Shopping centers were selected because in recent years they have become also places for socializing and not only for shopping, therefore a large frequency of users were expected. Locations of observation as well as individuals included in the study were not chosen randomly, since main purpose of the study was evaluation of the hygiene habits in general and not comparing individual users, cities or shopping malls as such. Due to time limitation of the study, the sample of 1,680 users of public toilets was included in the study.

The users of public toilets were differed in terms of gender and age. The observers estimated the users' age on the basis of their physical appearance and divided them into the groups over and under 35 years of age.

According to different researchers (Sifat and Nepal, 2013; Aunger et al., 2010; Harris Interactive, 2010; Toshima, 2001) gap between hand washing knowledge and practices is observed. To diminish this gap observation of hand washing was carried out discreetly, so the users of public toilets were not aware they were being watched. The observers tried to be as inconspicuous as possible pretending to be the users of the restroom or observed the hand washing from outside through the open doors. Precondition for the implementation of the observation was general arrangement of the toilets. Initially the selected restrooms were checked for technical and general hygienic conditions; adequate equipment of the sanitary block was available:

- Liquid soap,
- Hot and / or cold clean running water,
- Paper towels or hand dryers.

Observation of hand washing was divided into three categories (i. proper hand washing - washing according to proper technique, ii. inadequate hand washing and iii. no washing). The observation included also the users' drying of hands after washing.

In the group "proper hand washing" were classified those users who soaped all surfaces of hands. Among the "inadequate washing" were classified those users who soaped their hands sloppily or did not use soap at all and only briefly rinsed their hands without rubbing. Those users who did not wash their hands after leaving the toilet or only rinsed the tips of the fingers of one hand were classified as

"no washing". Drying of the hands was divided into two categories: the proper drying and no drying at all.

Since we are stating the frequency distribution only, confidence intervals for these results were not calculated. For that reason Chi square test in order to display statistically significant differences in distribution of the sample according to gender, age, and proper hand washing was included.

The data obtained using discreet observation were compared with the results of similar studies in Slovenia (Mustafić, 2005; Jereb and Likar, 2006) and abroad (Buchtman, 2002; American Society for Microbiology, 2003;; American Society for Microbiology, 2005; Garbutt et al., 2007; Winterman, 2012; Borchgrevink et al., 2013).

RESULTS

Of the total 1,680 random users of public toilets in shopping centers included in the study, 960 were observed in Ljubljana, 193 in Kranj, 192 in Koper and 335 in Novo Mesto. The total of 771 men and 909 women were observed. Number of survey participants by gender and age is shown in Figure 1.

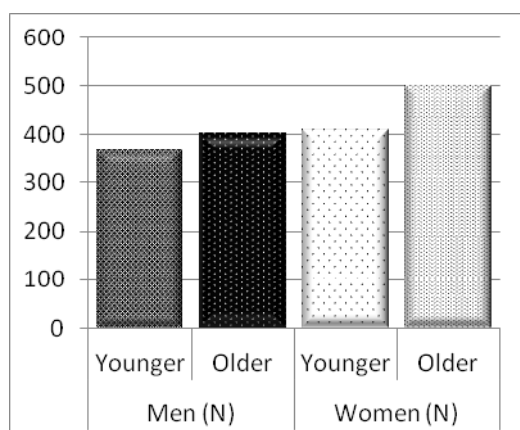


Figure 1 – The number of survey participants presented by gender and age

Of the 1,680 survey participants as many as 205 (12%) did not wash their hands at all, among which there were more men (20%) than women (6%). Only 35% of survey participants followed proper hand washing technique, 42% of women and only 27% of men. We found statistically significant differences in the distribution of proper hand washing according to gender ($X^2 = 98.2$, $df = 2$, $p < 0,001$)

The comparison of different gender/age groups (Table 1) shows that older men have the worst hygienic habits; among man older man have statistically significant worst habits than younger man ($X^2 = 11.2$, $df = 2$, $p = 0,004$) and same applies for women ($X^2 = 11.7$, $df = 2$, $p = 0,003$).

As much as 25% of older men did not wash their hands after using a toilet. On the other hand best hand washing practices were observed in younger women who did not wash their hands only in 3%; additionally almost half of them washed their hands properly and thoroughly.

Table 1 – The effectiveness of hand washing and drying among men and women users of public toilets (expressed as %)

	Proper hand washing (%)	Inadequate washing (%)	No washing (%)	Proper hand drying (%)	No drying at all (%)
Younger men	28	57	15	60	40
Older men	25	50	25	53	47
Younger women	45	52	3	81	19
Older women	39	53	8	71	29

The results of the observation of hand drying show poor hygiene habits as well (Table 1). One third (33%) of survey participants did not dry their hands after washing, among which 44 % were male and 24 % female ($X^2 = 69.0$, $df = 1$, $p < 0,001$).

Comparison of results with previous studies

In the study conducted in 2006 (Jereb and Likar, 2006) similar results were obtained. The worst results regarding hand washing were found among older men, and the best among younger women. Comparison of the results of the previous (Jereb and Likar, 2006) and recent (2014) studies is given in Table 2.

Table 2 – Comparison of hand washing and hand drying results - a comparison of results from the survey 2006* and 2014 (expressed as %)

	Year 2006* (%)	Year 2014(%)
Proper hand washing	44 / 41**	35
Inadequate hand washing	41 / 37**	53
No washing	15 / 22**	12
Proper hand drying	78 / 70**	67
No drying at all	22 / 30**	33

(*Jereb and Likar, 2006; **all results without exclusion of results from city centers and bus/railway stations)

The study conducted in 2006 included the observation of hand washing practices not only in shopping centers but also in public toilets in the city center and at bus and railway stations, while the data from 2014 were obtained only in the public toilets in major shopping centers. In comparing the results of the two studies obtained in shopping centers only (Table 2), significant differences can be identified for hand washing ($X^2 = 42.1$, $df = 2$, $p < 0,001$) and also for hand drying ($X^2 = 41.6$, $df = 1$, $p < 0,001$). Nevertheless, a trend of hand hygiene improvement is observed.

The results were compared also with the results of similar surveys conducted in Slovenia, America, Britain, Australia and New Zealand since 2002. For the purpose of this comparison, the two categories, proper hand washing and inadequate hand washing were grouped together since surveys in New Zealand, the UK and Australia do not include the category “inadequate hand washing”. The comparison of results is shown in Table 3. In all studies researchers came to similar conclusions, men are much worse than women as regards hand washing after using public toilets. The worst results were obtained in a British study by Winterman (2012) who reported that 68% of men and 36 % of women did not wash their hands.

Table 3: Hand washing in different countries – a comparison of results from different surveys (expressed as %)

Year of study	Number of survey participants	Country	Hand washing (%)		No washing (%)	
			Men	Women	Men	Women
2002 (*1)	200	Australia	71	92	29	8
2003 (*2)	7,541	USA	74	83	26	17
2005 (*3)	400	Slovenia	60	85	40	15
2005 (*4)	6,336	USA	75	90	25	10
2006 (*5)	1,617	Slovenia	65	91	35	9
2007 (*6)	1,200	New Zealand	81	92	19	8
2012 (*7)	no information	United Kingdom	32	64	68	36
2013(*8)	3,749	USA	85	93	15	7
2014	1,680	Slovenia	80	94	20	6

(Source: *1 Buchtman, 2002, *2 American Society for Microbiology, 2003, *3 Mustafić, 2005, *4 American Society for Microbiology, 2005, *5 Jereb and Likar, 2006, *6 Garbutt et al., 2007, *7 Winterman, 2012, *8 Borchgrevink et al., 2013)

DISCUSSION

Results of the research show that hygiene habits of Slovenians are poor. The results could be worrying since proper hand washing is practiced by only 35% of users of public toilets. The fact that 25% of older and 15% of younger men fail to wash their hands after using a public toilet is alarming. With dirty hands different micro-organisms can be transmitted to our environment and as such could be the origin of many infectious diseases, such as intestinal diseases, cold and influenza, hepatitis A, parasites diseases and some others.

Hand washing has been known since prehistoric times as the simplest, yet most effective preventive measure to prevent the spread of all kinds of intestinal as well as other diseases, transmitted by dirty hands. Public toilets as place of observation were chosen in order to determine the basic hygienic habits of individuals. These are the places to which everybody has access and are therefore visited by a large number of people with different hygiene practices and habits. Different studies affirmed that most people are familiar with good hand washing techniques, but fail to implement them when necessary and appropriate.

A hand washing improvement trend observed in the survey from 2014 (compared with the results of 2006) can be attributed to the awareness campaigns to educate the general population about the importance of hand washing. Many campaigns to raise awareness and draw attention to the importance of hand hygiene were carried out by the National Institute for Public Health, the Ministry of Health, public television and other stakeholders in last few years, especially during pandemic threats with seasonal flu.

Although survey was conducted in winter, when the occurrence of flu and colds are most common, the users of public toilets were still very superficial regarding hand washing.

According to our results, people are still not sufficiently aware of the importance of proper hand hygiene. Therefore it is essential that the promotion of hygienic awareness through different programs and campaigns will continue in the future.

The results of previous studies (Buchtman, 2002; American Society for Microbiology, 2003; Mustafić, 2005; American Society for Microbiology, 2005; Jereb and Likar, 2006; Garbutt et al., 2007; Winterman, 2012; Borchgrevink et al. 2013) and the results of present research yields a conclusion that the implementation of hand washing, this simple hygiene measure, is remarkably bad. Hand washing is carried out routinely, it is usually not sufficient and thorough, and in particular, people do not wash their hands every time it would be necessary. Therefore it can be concluded that in Slovenia (as well as in other observed countries) hand washing after using public toilets is rather poor. Similar hand washing practices can be assumed for hand washing in general.

One of the probable reasons for the sloppy hand washing may be the modern life style of constant rush and superficiality when we believe (and act like) that for normal everyday tasks there is not enough time. Another explanation could lie in mentality of modern society, namely, that we live in a clean (sterile) environment, free of pathogens and any possible diseases will be resolved by the pharmaceutical industry with a variety of different drugs. The poor results could also be explained by in the time of year the study was conducted and the low outdoor temperatures. It would therefore be reasonable to repeat the study in the summer months and measure also the implication of this parameter. As the study conducted in the year 2014 examined the hand washing practices only in shopping centers, further research should include also public toilets in city centers and bus and railway stations. It is recommended that future observations record the amount of time spent washing hands. Along with the proposed improvements it is also necessary to establish the programs of higher public awareness and propagation of hand washing as well.

REFERENCES

- American Society for Microbiology (2003). http://www.eurekalert.org/pub_releases/2003-09/asfm-uaa091103.php. <24. 2. 2014>
- American society for microbiology (2005). Women better at hand hygiene habits, hands down. <http://www.asm.org/Media/index.asp?bid=38075>; <21.2.2006>
- Aunger R, Schmidt WP, Ranpura A, Coombes Y, Mukiri Maina P, Matiko CN, Curtis V (2010). Three kinds of psychological determinants for hand-washing behaviour in Kenya. *Social Science & Medicine*, 70(3): 383-91
- Barker J, Vipond IB, Bloomfield SF (2004). Effects of cleaning and disinfection in reducing the spread of Norovirus contamination via environmental surfaces. *Journal of Hospital Infection* 58: 42-49.

- Borchgrevink C, Cha J, Kim S (2013). Hand washing practices in a college town environment. *Journal of environmental health* 78: 18-24.
- Buchtman L (2002). <http://www.foodsafety.asn.au/publications/articlesandsurveys/handwashingsurvey.cfm>; <24.2.2006>
- Curtis V, Cairncross S (2003). Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *The Lancet Infectious Diseases* 3: 275-281.
- Dragaš AZ, Škerl M (2004). *Higijena in obvladovanje okužb*. ZRC SAZU, Ljubljana: 16-76.
- Garbutt C, Simmons G, Patrick D, Miller T (2007). The public hand hygiene practices of new Zealanders: a national survey. *The New Zealand medical journal* 120: 4.
- Harris Interactive (2010). Survey on hand washing behavior (trended); prepared for the American Microbiology Society and the American Cleaning Institute. http://www.microbeworld.org/images/stories/washup/2010_handwashing_behavior_survey.pdf <24.2.2015>
- Harrison WA, Griffith CJ, Ayers T, Michaels B (2003). Bacterial transfer and cross-contamination potential associated with paper-towel dispensing. *American Journal of Infection Control* 31: 387-391.
- Hateley PM, Jumaa P (1999). Hand washing is more common among healthcare workers than the public. *BMJ* 319: 519 – 524.
- Jereb G, Likar K (2006). *Umazane roke - grožnja našemu zdravju (Dirty hands - threat to our health)*. V: Zbornik radova. Rijeka: Hrvatska udruga za sanitarno inženjerstvo HUSI
- Jumaa PA (2005). Hand hygiene: simple and complex. *International Journal of Infectious Diseases* 9: 3-14.
- Mustafić A (2005). *Pogostnost umivanja rok po uporabi javnih stranišč (Frequency of wash hands after use of public toilets)*. Graduated thesis. Ljubljana: Visoka šola za zdravstvo.
- Sifat ER, Nepal CD (2013). Exploring the gap between hand washing knowledge and practices in Bangladesh: a cross-sectional comparative study. *BMC Public Health*, 13:89
- Sliwa J (2003). Another US airport travel hazard – dirty hands. http://www.eurekalert.org/pub_releases/2003-09/asfm-uaa091103.php; <21.2.2006>
- Toshima Y, Ojima M, Yamada H, Mori H, Tonomura M, Hioki Y, Koya E (2001). Observation of everyday hand-washing behavior of Japanese, and effects of antibacterial soap, *International Journal of Food Microbiology*, 68(1–2): 83-91.
- Winterman D (2012). *Handwashing: Why are the British so bad at washing their hands?* Poole: BBC News magazine. <http://www.bbc.co.uk/news/magazine-19834975>? <24. 2. 2014>

Management of medical waste: Situation and perspectives in city of Ribeirão Preto, São Paulo, Brazil

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ABSTRACT: The Brazilian legal guidelines Resolution 306/2004 and Resolution 358/2005 defines the management of Medical Waste (MW) as a set of procedures for managing, planned from scientific and technical basis with the objective of minimizing waste production and ensure a safe handling. This study aims to analyse the Plans of Management of Medical Waste of Hospitals of the city of Ribeirão Preto-São Paulo, Brazil. Research descriptive and documental, using quantitative variables. The research was conducted in 11 hospitals of the city of Ribeirão Preto, Brazil. To conduct the analysis of the PMMW was used a check-list and to make the data analysis, for each category was calculated the percentage of positive responses. For this it was necessary to determine a classification by scores: satisfactory (above 70% of positive responses), regular (50% to 70% of positive responses) and unsatisfactory (below 50% of positive responses). This research was conducted after of the approval of the Research Ethics Committee of the University of São Paulo. This results revealed an unsatisfactory situation with regard to the requirements demanded by Resolution 306/2004 of the National Health Surveillance Agency for the elaboration of a PMMW, can infer that in practice there is also an inadequate management of the MW. Highlights that according to the Resolution 306/2004, every establishment generator of MW must elaborate the PMMW, in which must contain all the information about the type of the handling realized in practice, the type of treatment offered to different groups of MW and final disposal. It is emphasized that all the Plans analyzed had some characteristics and/or stages copied in full of the Law and did not describe as were performed in the hospital. This research considers the need for a more efficient and frequent inspection of the health authorities in order to analyze the handling of the MW, especially in hospitals.

Keywords: *public health, environmental health, management of medical waste, medical waste*

INTRODUCTION

Hospitals are responsible for the largest amount produced of Medical Waste (MW) between the different waste generators and increasingly increases the amount generated. There are factors that contribute to the increased generation of MW as the intense appeal for consumption, the continued increase in the complexity of medical and technological development, the high use of disposable materials, coupled with inadequate segregation of waste (Sisinno & Moreira, 2005).

The amount of MW generated in health establishment features is related. For example, in a university hospital is raised from 4.1 to 8.7 kg/bed/day; already in general hospital from 2.1 to 4.2 kg/bed/day, while outpatient generate 0.5 to 1.8 kg/bed/day and primary health care centers 0.05 to 0.2 kg/bed/day of MW, according to the World Health Organization (1999).

It is observed that the amount of RSS generated by a health facility is also related to some important factors such as the number of patients, the number of beds and the type of activity conducted in different sectors of the hospitals (Hamoda, El-Tomi & Bahman, 2005).

The MW generation can also vary according to the economic development of countries as a result of the availability of the complexity of medical care and the increasing use of disposables (Schneider, 2001).

Developed countries have a large number of MW generated by the bed, which can be understood by the availability of advanced technologies. The North America generates 7 to 10 kg/bed/day, Western Europe from 3 to 6 kg/bed/day, Latin America 1 to 4.5 kg/bed/day and 0.3 to Africa 1.5 kg/bed/day.

Asian countries, higher income generate from 2.5 to 4 kg/bed/day and the average income generate from 1.8 to 2.2 kg/bed/day (World Health Organization, 1999).

Proper management of MW requires the generators of this waste facilities, proper management, which includes segregation, packaging, identification, transport internal and external storage, treatment and final disposal. MW generating facilities to meet the legislation, should also have a technician responsible for managing MW and Plan of Management of Medical Waste (PPMW) (Brazil, 2004; 2005).

The PPMW must be prepared according to the norms of legislation, stating the steps for the segregation, packaging, identification, collection and internal transportation, temporary storage, treatment, external storage, collection and external transport and final disposal of waste generated in health services, including continuing education program and workers' health:

- Segregation: is the separation of waste at the time and place of his generation, according to their characteristics physical, chemical and biological;
- Packaging: characterized by the action of the pack segregated waste in bags or containers specific;
- Identification: is the set of measures allowing the identification of the waste contained in bags and containers;
- Internal transport: involves the removal of waste generation points to the location intended for internal or external storage;
- Internal or temporary storage: it consists in temporary custody of containers containing waste, near the site of generation;
- Treatment: refers to the application method, technique or process that changes the characteristics of the waste, thereby minimizing the risk of contamination, it can be made inside or outside of the hospital;
- External storage: consists in the custody of containers with waste to the conduct of the external collection;
- Collection and external transport: consist of the removal of the MW of external storage to the treatment unit or disposal;
- Final disposal: is the final disposal of MW on the soil, previously prepared (Brazil, 2004).

For proper management of MW, hospitals besides performing satisfactorily stages of management of RSS, must also comply with the bio-security standards in order to contribute to the prevention of occupational accidents and the environment.

Ribeiro Filho (2000) states that the MW management should be carried out fully, trying to articulate the normative, operational, financial and planning that a health facility develops, based on health, environmental and economic criteria for collect, treat and dispose of the waste generated.

However, MW is a challenge to hospital administrators, in addition to environmental issues inherent in any type of waste, also incorporate a major concern in regard to control infections in hospitals as well as individual health and occupational and public health.

This research was justified by the need to know the current status of management of MW municipal hospitals, to contribute to evaluating the implementation of the current guidelines to be followed by MW generators establishments, with a view to minimizing the risk of exhibition, mainly to biological, chemical agents and sharps, both for people's health, but also for the environment.

Thus, this research also makes a contribution to the improvement of the MW management condition in Brazil, from knowledge about the care of the MW, in all handling steps, as well as their treatment and disposal in an important city of the State of São Paulo and can also collaborate with public policies for environmental health in the country.

OBJECTIVE

Evaluate the management of MW generated in hospitals in the city of Ribeirão Preto, São Paulo, Brazil.

METHODOLOGY

This is a field research, exploratory, descriptive and documentary, using quantitative variables for data collection on the object of study.

The survey was conducted in Ribeirão Preto, a city in Northeastern of State of São Paulo - Brazil, with approximately 620,000 inhabitants, and that is an important economic center for the State (Brazilian Institute of Geography and Statistics, 2014).

The hospital network of the city has 15 hospitals; however, 4 hospitals refused to participate in the survey; thus, data were collected in 11 hospitals in the city of Ribeirão Preto-SP (Brazil, 2004).

The PMMW analysis was performed by means of a checklist constructed in accordance with the Resolution 306/2004 of the National Agency of Health Surveillance and Resolution 358/2005 of the National Council of the Environment and by Takayanagui Protocol (2004).

The data obtained from the analysis of PMMW were double entered in an Excel database. As a result, the data were analyzed according to the criteria of descriptive statistics.

Whereas the checklist used to survey the PMMW data consisted of a lot of variables, for methodological purposes it was necessary to create categories to undertake analysis of the data.

In this context, the instrument was divided into 10 categories, taking as a basis the items in the Resolution 306/2004 of the National Agency of Health Surveillance, considered in this analysis as variables, the instrument was divided into 10 categories, namely:

- Management;
- Segregation;
- Packaging;
- Identification;
- Internal transport;
- Temporary storage;
- Treatment;
- External storage;
- Collection and external transport;
- Final disposal.

To undertake analysis of such data for each category was calculated the percentage of positive responses, for each alternative the instrument pointed as possible answers alternatives Yes, No and Do not Allows you to frame. For this, we need to determine a score. Thus, the PMMW from hospitals scores were classified into: satisfactory (70% or more of positive responses) Regular (50% to 69.9% of positive responses) and Poor (less than 50% of positive responses).

First carried out a descriptive analysis of each variable checking correspondence with the requirements of legislation taken as a basis; later, the variables were grouped into categories. Then we conducted an analysis of the percentages of each category, and for that the scores are designed to interpret the results.

This research was carried out after the authorization of hospitals and approved by the Research Ethics Committee of the University of São Paulo.

RESULTS AND DISCUSSION

The analysis of PMMW was performed considering the positive responses presented in the Plans of each hospital studied, that is, proceeded to an assessment of PMMW, looking up if these documents had all the items required by Resolution 306/2004, from a categorization created to classify PMMW of each hospital by assigning a percentage to positive responses obtained in each analyzed Plan.

Were analyzed 10 (90.9%) printed PMMW and 1 (9.1%) PMMW that was available in digital file directly into the hospital computer.

The variables relating to the identification, internal transportation, temporary storage, external collection and transportation were classified as unsatisfactory, since the existence of these variables in PMMW did not exceed 50% of positive responses (Table 1).

Also, according to the results shown in Table 1, and the description of the technical handling, packaging, handling, storage and disposal external were evaluated as regular.

This result calls attention for the control and minimization of related risks and problems to inadequate management of MW can be achieved through compliance with the rules that determine the requirements at each stage of the management. It points out that a proper management of MW helps reduce the amount of waste generated and the optimization of financial resources (Sales et al., 2009).

Table 1 - Assessment of the categories that make up the content of PMMW of the hospitals included in this study. Ribeirão Preto, 2013

Items Evaluated	Score		
	Satisfactory (>70%)	Regular (50 a 69,9%)	Unsatisfactory (<50%)
Handling		50,0	
Segregation	75,0		
Packaging		53,4	
Identification			49,0
Internal Transport			35,2
Temporary Storage			30,6
Treatment		57,6	
External Storage		54,6	
Collection and External Transport			18,2
Final Disposal		51,5	

The score obtained in this investigation regarding the segregation (75%) may be related to the fact that the primary stage of the entire management of MW, that is, all handling steps are compromised in the event of an inadequate segregation. Also in this context, highlights the number of establishments that did not obtain a satisfactory score in relation to the segregation; this fact can be inferred that there is still a lack of understanding of the technical and legal requirements existing in the Resolution 306/2004 on the part of managers.

In summary, based on the analysis of PMMW of 11 hospitals in this study, it can be seen from the record of the variables composing this document and which served as the basis for analyzing the MW management, a distancing that's, in fact, is proposed by Law, since it was found in PMMW copies of stretches of specific legislation, without however, describe the reality of the practice of experienced management. This situation requires both empowering of managers of the MW, as well as better monitoring of the agencies responsible.

Thus, questions the effectiveness of PMMW and the actual utility in the same, where health facilities prepare this document as a mere compliance with a legal requirement.

CONCLUSIONS

The results obtained in this study on the analysis of PMMW generate questions about the applicability and efficiency of the Plan, since it in most hospitals, the records contained in PMMW not up to what in fact was realized in practice or stretches were copied in their entirety from the Resolution 306/2004, being short-changed. It is emphasized that these records should be trusted to the existing reality at each hospital, and the need for periodic review of these plans, since it the activities in a hospital are dynamic and need to be reviewed continuously.

In this context, Rushbrook (2005) states that improving the management waste system depends on greater involvement of hospital managers, managers of MW and employees, since it the fulfillment of specific legislation becomes compromised before the deficiency of funds, materials and knowledge.

Still it must be emphasized that some hospitals face problems arising from the lack of infrastructure, such as old buildings and lack of financial resources, but each establishment should try to achieve an appropriate management MW within your reality.

Also highlights the role of regulatory agencies for compliance with the rules on the handling of MW, it is considered that these agencies should work in partnership with managers and managers of MW, aiming to improve the management waste, to be carried out in order safe and appropriate.

Thus, it is considered that the knowledge generated in this study, related to the management waste in hospitals, can support the decision-making process for effective implementation of legal and technical guidelines specific to the management waste, not only in hospitals but also in all health care services.

REFERENCES

Brasil. Agência Nacional de Vigilância Sanitária (ANVISA). (2004). Resolução da Diretoria Colegiada nº 306, de 07 de dezembro de 2004. Dispõe sobre o Regulamento Técnico para o gerenciamento de Resíduos de Serviços de Saúde. Diário Oficial da União, Brasília, DF.

Brasil. Conselho Nacional do Meio Ambiente (CONAMA). (2005). Resolução nº 358, de 29 de abril de 2005. Dispõe sobre o tratamento e a disposição final dos resíduos dos serviços de saúde e dá outras providências. Diário Oficial da União, Brasília, DF, 4 maio 2005.

Hamoda, H.M, El-Tomi, H.N. & Bahamn, Q.Y. (2005). Variations in hospital waste quantities and generation rates. *Journal of Environmental Science and Health, New York*, v. 40, n. 2, p. 467-76.

Instituto Brasileiro de Geografia e Estatística (IBGE). (2013). Cidades. Disponível em: <<http://www.cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=354340&search=sao-paulo|ribeirao-preto>>. Acesso em: 29 abril 2015.

Sales, C.C.L. et al. (2009). Gerenciamento dos resíduos sólidos dos serviços de saúde: aspectos do manejo interno no município de Marituba, Pará, Brasil. *Ciência e Saúde Coletiva*, Rio de Janeiro, 14, 2231-38.

Schneider, V.E. et al. (2001) Manual de gerenciamento de resíduos sólidos de serviços de saúde. São Paulo: Baliero.

Sisinno, C.L.S. & Moreira, J.C. (2005). Ecoeficiência: um instrumento para a redução da geração de resíduos e desperdícios em estabelecimentos de saúde. *Cadernos de Saúde Pública*, Rio de Janeiro, 21, 1893-1900.

Ribeiro Filho, V.O. (2000). Gerenciamento de resíduos de serviços de saúde. In: Fernandes, A. T.; Fernandes, M. O. V.; Ribeiro Filho, N. *Infecção Hospitalar e suas Interfaces na Área da Saúde 2*. São Paulo: Atheneu.

Rushbrook, P. (2005). Better health care waste management: an integral component of health investment. Amman: WHO. Regional Office for the Eastern Mediterranean – Regional Center for Environmental Health Activities, Amman.

Takayanagui, A. M. M. (2004). Risco ambiental e o gerenciamento de resíduos nos espaços de um serviço de saúde no Canadá: um estudo de caso. 2004. 77 f. Tese (Livre Docência) - Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto.

World Organization Health (WHO). (1999). Safe management of wastes from health-care activities. Geneva: WHO.

Opened or closed communication for performance efficiency?

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ABSTRACT: Communication between “shelter” and “outer” space was during human evolution generator of the selection and formation of living environment, of selection of the location, position and geometry of the building and structure of the envelope and as such an interesting manipulation sphere. Communication is needed to trigger physical, physiological and spiritual responses which are a consequence and combination of all senses performance: sight, touch, taste, warmth and coolness and their processing in the brain – control system. Communication needs space it could not perform without the possibility of extension, contraction and movement. Improvement of the communication is man’s apotheosis. Vitruvius presented two thousand years ago bioclimatic design philosophy. From the conceptual point of view until today nothing happened. Of course it is necessary to mention that tradition and its influence on the architecture and building technology cannot be a sample for design of new living and working environment but a model, presentation of the system in the real world, for his understanding, anticipation and feasible management, for the method how to do it. In the dichotomic view we distinguish opened and closed systems. Our earthly problem is the selection between two options: opened, represented by bioclimatic design and closed, represented by so called “pasivhaus standard”. Eventually, wrong decisions are the consequence of manipulated, bad or broken communication, as well as different crises: from apparent crisis in the construction industry to greenwashing with corresponding quality of built environment. In Principle 1 of Rio Declaration 1992, »Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.« Rational energy use, which is more often than not understood as the smallest use of energy is only one of sustainability factors, far from being the most important.

Keywords: communication, *bioclimatic design*, *environmental health*, *role of individual*.

INTRODUCTION

If the living environment is dirty and neglected the soul will keep the body in the same conditions: dirty and neglected. Leonardo Codex Atlanticus 72, 1478-1619.

We will start this essay with the statements of two philosophers Heidegger and Žižek. The term philosophy, a branch of knowledge devoted to systematic examination of basic concepts as truth, existence..., is nowadays often used as metaphor in a pejorative sense. But we can construct our consideration of environmental health position in the design and construction of living and working environment on the following philosopher’s quotations: Heidegger (1927; trans.1962) wrote: “the man is a creature thrown into the world, permanently in a practical relation to the concrete environment, man has not fixed being, he is redefining continuously, depending on possibilities which are used to project our own future and guide and understand our everyday connections with the world (interactivity!)...We are, he said, self-interpreting, deciding entities practically involved along with others in a world that we have not made but that consists of potentially useful things, including cultural as well as natural objects. Thus, a person’s being is inseparable from that of other human beings and things...” (Microsoft Encarta Encyclopaedia 2002) and Žižek: »it is not true that once there was the equilibrium, it is not the right move to live as much as possible in the contact with the nature and in accordance with the nature, but to keep the distance towards her.«

In both cases there is a dynamic equilibrium treated, for interactive communication between man in his environment, as it is understood in bioclimatic concept of design of living and working environment.

The main goal in the design and use of living space is comprehensive performance efficiency of the system; the condition to reach this goal is independence. For efficient system performance is besides clear philosophic orientation and technologic knowledge systematic, transparent and strategically

oriented legislation. Procedures must be stimulating and not punitive, minimal requirements are only a safety fuse in the system. Because of this the individual person and the communication with his environment is the target in the proposed system.

“Two basic starting points lead and direct bioclimatic design strategy of the smart house. The first starting point is the role of the individual: responsiveness to differing and special demands of an individual person. Throughout the history of mankind the value of the individual has been rising. This fact is directly connected with the level of knowledge and access to technology. In each period of development men tried to create the best possible specific living conditions. The influences of technology on the assessment of the individual are evident in historical development and in socio-economic relations. The level of tolerances was always a reflection of technological and social development. The second starting point is common sense. This indicates that a reasonable building is not characterised only by the use of high technology: knowledge well applied has even greater value.” (Krainer 1993).

PROBLEM

Lehto (1996). stated that » intelligent buildings« must be modifiable and flexible, structurally active, capable of structural and functional integration, informative, interactive, secure, comfortable and service-oriented, healthy and therapeutic, economic and productive, based on correct fundamental solutions. It is obvious that “smartness” and/or “intelligibility” are first of all parameters of users’ needs and requirements.

The majority of people are essentially more satisfied if they have direct influence on their conditions and environment, if they have influence on changes in living and working environment, if they can open windows and have influence on temperature and illumination. In case of heating, cooling and ventilation in order to select his own warmer or colder conditions the basic control units must be separate rooms in the building or in the most exacting situations, e.g. hospital rooms more defined spaces sickbeds.

Number of hours spent “inside” is increasing and daylight exposure, genetically evolved through man’s evolution, is decreasing. These changes in the behaviour which are not supported by suitable design interventions cause by rule negative influences on human performance.

While buildings must be designed from the inside out, from individualised active spaces through dynamic envelope to the outer environment, also conditions for living and working must be controlled from the inside, where the needs and demands of concrete user are generators for interventions. It is obvious that the individual person and consequently his performance efficiency is the main goal of interventions and not partial energy efficiency.

Cutting off direct contact with the external environment is viewed as the collateral damage in one-sided energy conservation activities. But the concept of alienating people from the natural environment is according to many studies harmful to health and consequentially to the productivity. The external environment is not by definition hostile to human beings; on the contrary it can have stimulative effects on body and mind. Daylight provides quality lighting, stimulates sense of sight and is important communication mode between the internal and external space. The constant change of light improves concentration and responsiveness. The same holds true for acoustic environment and aural perception and sense of smell.

The important factor which has influence on the selected decisions is financial consequence. Because of this measurement system must be connected to on line monitoring, with visual presentation of financial consequences in real time, to see how Euros are dripping or leaking out of the wallet. The main goal is subjective control of energy use which is connected with financial consequences and not punishment of the state if he will use too much energy. The essence of planning of living and working environment where not only design but also construction, use and removal are included is performance of the individual in the system. Aggregates are only the consequence of sums of decisions of individuals in the system.

The indoor environment in buildings affects energy use and health, productivity and comfort of the occupants. Both energy use and effects on occupants are cost items. But the costs of the poor indoor environment for the society, employer and building owner are often higher than the cost of energy used in the same buildings. Good indoor environment should not be sacrificed for low energy use (Seppänen 2014).

In the opinion of World Health Organisation (WHO) it is possible that up to 30% of new and renovated buildings are linked with Sick building syndrome (SBS), most of them with bad quality of inside air. The main causes are transport of air through the systems for heating, cooling and air-conditioning (HVAC), emission of gases from some building materials, volatile organic compounds (VOC), moulds and inappropriate disposal of light industrial chemicals from premises or inappropriate cleaning and filtering of outside air.

Lack of daylight influences on attack of depression and the cost of depression in EU26 (Sobocki et al. 2008) is: 42.000.000.000 €/direct expenses in health system 76.000.000.000 €/a indirect expenses in economy, together 118 milliards € per year, 253 €/resident, 1% GNP EU28. If correct design of daylighting e.g. optimal dimensions of windows and of structure of glazing diminishes depression only for 1%, this "building" intervention represents 1 milliard € per year.

The total annual financial burden of lung disease in Europe is estimated at 102 milliards €, a figure comparable to the GDP of Ireland. Chronic obstructive pulmonary disease (COPD) is the most costly respiratory disease in Europe, with annual costs estimated at 38.7 milliards €, of which 74%, (28.6 milliards €) result from lost work days. The indirect costs in productivity losses are almost 3 times the costs for direct health care. (European Lung White Book, 2003).

A well known study by Heschong Mahone Group (1999) indicated that students with the most classroom daylight progressed 20% faster in one year on math tests and 26% faster on reading tests than those students who learned in environments that received the least amount of natural light. Another study showed that students who attended daylit schools outperformed the students in non-daylit schools by 5%-14%. They also identify another window related effect: students were found to progress 7-8% faster in classrooms where windows can be opened than those with fixed windows, with or without air conditioning. Despite the importance of natural lighting for learning and achievement, over 20% of the teachers in Washington DC reported that they can't see through the windows in their classroom.

The EnVIE project (2009), reported that EU-27 loses about 2 million disability adjusted life years annually (DALYs) due to the exposure to various pollutants indoors. The potential public health benefits of policies concerning energy efficiency, building materials, products and maintenance huge, ranging from 300000 to nearly one million DALYs, per year - in other words, better health for millions of Europeans.

It looks like that there are still problems with the understanding of importance of daylight in the performance efficiency after 8 centuries!

Maybe it is redundant to mention a companion study in USA which found that sales were 40 percent higher in stores with skylights, compared with almost identical stores in the same chain without skylights.

Problems connected with Sick Building Syndrome (connected with human presence in building) and Building Related Illness (attributed to specific airborne building contaminants) cannot be solved without collective synergetic cooperation of professions dealing with buildings: architecture, civil, mechanical and electro engineering and occupants: health, behaviour, comfort, self actualization

Majority of experts in the field of environmental health engineering will work in SMEs either in health or construction industry or administration. It is necessary to save the problem of their "smallness" with production of experts with broad fan of knowledge which will be able to open communication channels with specialists in order to avoid the problem of lack of resources and skills, of information and contacts.

The existing building stock is more or less the result of the restriction design philosophy. In Europe this philosophy in modern time grow out of *laissez-faire* economies from the middle 19th century and second out of misinterpreted standardization efforts after Second World War. These standards were designed for the protection of users; regulating minimal allowed values in different areas like surfaces of floors and windows, number of air changes etc. Unfortunately this idea have been turned around into maximal allowed values for architects and other experts involved into the design of human living

and working environment. This kind of approach had and still has negative impact not only on the quality of life but also on health.

3. DISCUSSION



Figure 1 – Vitruvius: integral harmonization of influential factors in built environment a guaranty for sustainable development based on high tech – high touch principle.

The logical reaction to this inhuman attitude is the orientation into the stimulative performance design philosophy. Everybody knows Vitruvian's slogan: firmitas, utilitas, venustas. They are connected into the Borromean's knot. If one ring is taken away the system falls apart. While the first two are more or less intelligible the explanation of the third one, venustas, is not so clear. The reason for this is that venustas comprehends more meanings: beauty, attractiveness, charm, loveliness, prettiness, which narrow minded building bureaucracy and technocracy is not able to include into their thinking patterns.

Building used as a shelter must change into building used for production.

Obama (2015) launch the slogan "We are shifting the focus of our country's health care system from sickness and disease to wellness and prevention." Vitruvius is here. He also stated that "America's public health is deeply tied to the health of our environment" and that climate change put individuals with asthma which increase twofold in the past three decades, (according to DG for Health & Consumers in EU in the past 20 years) to greater risk of landing in the hospital. But the main problem is why asthma increased so much. With regard to the fact that we are staying inside for more than 90% of the day the main problem is in the internal environment, with its two main impacts on health and performance: daylight and air quality.

It is very convenient to blame climate change for everything. Without underestimating climate change influences the real problem lies in the indoor environment.

DG Energy in energy efficiency measures reveals the set of four problems which must be addressed in the framework of new curricula (Nuij 2012). The list shows that the problem in the "field" is lack of communication between "collateral" influential factors and classic energy efficient design.

1. Difference between designed and built.
2. Indoor air quality Health and Comfort.
3. Behavioural aspects Health and Comfort individualisation of living and working environment in order to raise living and working conditions (air quality, daylight, aural environment...) and as a result performance efficiency and on the other side the possibility of individual user to follow and control his energy consumption. This means that basic living and working unit is = a room, not house (house is at the end dynamic sum of "rooms").
4. Workforce skills.

From this list it is evident that energy use, energy efficiency and cost in the built environment cannot be treated apart from the user of this environment and without taking into the account possible negative influences of one-sided reduction of energy use which is the main objective of EPBD interventions.

The bioclimatic concept is based on simultaneous adaptation to the external conditions and internal needs and requirements. The closer the building is able to follow these two profiles and the better is the communication between them, the more efficient it is. The adaptive model of the built environment system represents a dynamic structure which performs in real time conditions. Such design and use of philosophy enables optimal exploitation of natural resources, rational adaptation of living patterns, and it is essentially the result of hundreds of years of processes of development of human living environment. The objective of the above described interventions in the framework of bioclimatic design is healthy living and working environment with stimulating performance oriented environment with the

lowest possible energy use and not the lowest energy use based on the physiological minima. (Krainer & Kodama 2010).

Opened communication is precondition for dynamic systems performance which are opposite of the system in equilibrium at absolute zero temperature. Opened communication assures transport of information which triggers necessary activities in the form of movement or energy flow in the system: in our case living and working environment.

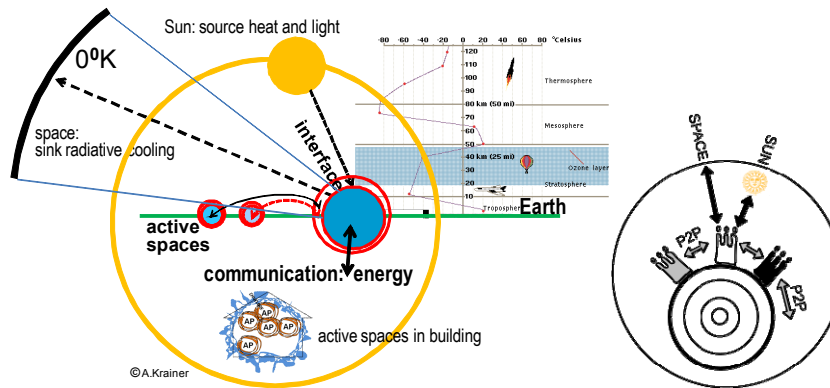


Figure 2 – Energy flow: communication carrier between earth – active individualised spaces in buildings and universe. Horizontal and vertical person to person communication.

The communication goes on on the horizontal level, between individuals and groups and on the vertical level between space and sun. Until there is enough space between individuals and their activities are not in cross section with the activities of other individuals there is also no problem with communication between them. When they want to communicate they move. The communication can be positive “love”, exchange of goods or knowledge, and it can be negative, war. In our modern society, because of the limited space the cross section of interests cannot be avoided. To solve this problem there are two alternatives: sets of agreed rules or conflict. So a person’s being is inseparable from that of the other human beings and things.

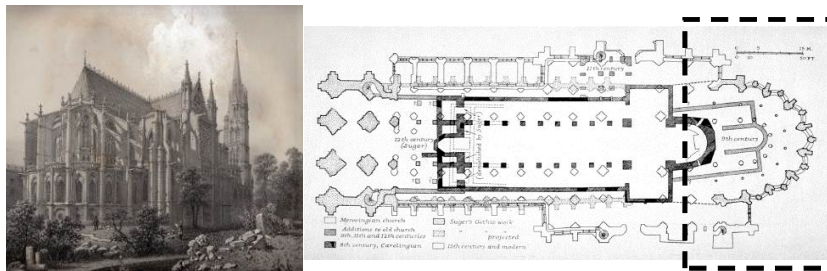


Figure 3 - St. Denis Cathedral, Lithography by Felix Benoit, outside view of ambulatory. http://en.wikipedia.org/wiki/Basilica_of_St_Denis#/media/File:FelixBenoistStDenis.jpg, Plan of Abby Church with Sugar’s ambulatory. <http://www.medart.pitt.edu/image/France/St-denis/plans/plan-felebien-b.jpg>

Abbot Sugar who is believed to be one of the patrons of Gothic architecture meant that access of daylight in the church is necessary to create an atmosphere stimulative for prayer. He carefully planned daylight not only in the function of illumination but also in the function of amplifying subject’s mental performance efficiency when planning the new ambulatory in St. Denis Royal Abbey near Paris in 1140. The generator for development of building construction during men’s history is not load bearing construction which represents today recognition pattern of historic stiles but access of daylight in the interior. The dimension of the opening depends all the times upon daily construction materials and technology, from Parthenon’s oculus, on the ring of light lying Hagia Sophia’s dome to contemporary transparent cupola of designed Eden Project.

Communication is needed to enable triggering of physical and spiritual values accepted with all senses, i.e. sense of sight, sense of hearing, scent or smell, sense of touch, taste, warmth and coolness. Communication needs spaces, it does not work without the possibility of being received and absorbed.

At times they told in Slovenia to people at the spring equinox, to take care how they walk earth so that they will not disturb gods. This was in a figurative sense a warning, a reminder that they must be careful when they intervene into the environment before they start with vernal activities. When man unconsciously or consciously took care when walking the earth it is not difficult to understand and act in such a way that others are not disturbed. This can be taken as the basis for bioclimatic oriented design strategy: to construct the house for god but not to disturb others doing this.

CONCLUSION

Illumination, heating and cooling interventions, ventilation and their consecutive influences on the built living and working environment are not harmonised with natural environment's daylight, visual, thermal, acoustic and ventilation potentials, with peoples requirements considering the individualisation of active space's psycho-physiologic parameters presented by Maslow (1943): self actualization, esteem, love/belonging, safety and physiological (breathing, food, water, sex, sleep, homeostasis, excretion) and with the structure of the building's envelope together with services and installation.

A healthy hedonism can be the keystone which enables to seek our hidden harmonies out of the design. It can serve as cultural instructions for the use, as a system of rules, knowledge, information for learning, what to look for, where to find it, for conceptualization and construction of truly individual and at the same time contiguous intelligent living and working environment. Besides health and comfort, pleasure can represent a value related to the harmonious development of the individuals in the framework of sustainable development. The biggest danger for intelligent house application is to use "market" oil price, which is anything but a real market price, as a comparative value for decisions. Besides health and comfort, pleasure can represent a value related to the harmonious development of individuals in the framework of sustainable development. We know what we want, we can try to find out what we must do, and be prepared how to do it when the technology will be available.

The expected results are harmonisation of comfort and stimulative living and working conditions, i.e. conditions for individual performance efficiency with rational use of energy and material by means of controlled optimisation of influential factors and improved quality of life based on high tech high touch principle development.

REFERENCES

- 'A European strategy for Key Enabling Technologies – A bridge to growth and jobs', COM(2012) 341.
- Energy-efficient Buildings PPP beyond 2013, Convergence of Green and Intelligent Buildings, CABA, 2008.
- EnVIE 2009, Co-ordination Action on Indoor Air Quality and Health Effects, Project no. SSPE-CT-2004-502671.
- European Lung White Book, European Respiratory Society, (ERS9, European Lung Foundation (ELF), 2003. <http://www.erswhitebook.org/about/>
- EUROPE 2020 A strategy for smart, sustainable and inclusive growth, Commission Work Programme 2013, COM(2012) 629.
- Heidegger, M., (1927; trans. 1962), Being and Time.
- Heschong Mahone Group (1999). Daylighting in Schools. An investigation into the relationship between daylight and human performance. Detailed Report. Fair Oaks, CA.
- [http://h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm#Executive Summaries](http://h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm#Executive%20Summaries)
- Krainer, A.,(1993) Toward smart buildings, Building science and environment-conscious design, Module 1: Design principles, 7. AA School of Architecture, London: European Commission.
- Krainer, A., (2010) Reduction of Energy Use or Improvement of Efficiency? EUROSUN2010, V: *Proceedings*. Graz: ISES.
- Krainer, A., Kodama, Y., (2010) White and Quite – Emptiness and Quietness, *Renewable energy 2010: advanced technology paths to global sustainability : joint with 4th International solar energy society conference, Asia Pacific region, Pacifico Yokohama, Yokohama Japan*.
- Lehto, M.,(1996) The intelligent office concept makes the difference, *Nordic Journal of Architectural Research*, Vol. 9, No. 1, pp. 61-72.
- Nuij, R., (2012) DG Energy, MEDBEE forum, Brussels.

Obama, B., (2015) Presidential Proclamation -- National Public Health Week, 2015

Seppänen, O., (2014) Good indoor environment should not be sacrificed for low energy use, Editorial. The REHVA European HVAC Journal, Vol. 51.

Sobocki, P., Jönsson, B., Angst, J., & Rehnberg, C. (2006). Cost of depression in Europe. *Journal of Mental Health Policy and Economics*, 9(2), 87-98.

Vision 2050, The new agenda for business, World Business Council for Sustainable Development, 2010.

Vitruvius, M.P., (27 B.C., 1970) On Architecture, London William Heineman LTD, Cambridge, Massachusetts Harvard University Press.

Parental Awareness of safety in the Homes of children under the age of five

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ABSTRACT: Home safety is the awareness to make your home a safe environment. The task of risk assessing and implementing safety procedures is usually the roll of the parent to ensure a home is without risk or hazard. The home is a complex, interactive environment that operates within a dynamic social setting". In the UK accidental injury to children under 4years of age is a main cause of uptake of emergency health care services. Accidents are the leading cause for loss of life of children with under 5's being most at risk at home It is estimated that the cost to society of home accidents in the UK to be £45billion. This research involved the investigation of interventions aimed at improving home safety for young children. The research found that there remains a need to increase awareness of home safety aimed to protect young children. Interventions (particularly home visits) and provision of free equipment are welcomed. However demand exceeds the capacity to deliver home assessments leading to undue delay and children remaining exposed to unnecessary risks in their own homes. In addition equipment may not be used or installed due to lack of tools and/or skill.

Keywords: *home, safety, children, accident.*

INTRODUCTION

The task of risk assessing and implementing safety procedures in the home is usually the roll of the parent, to ensure a home is without risk or hazard to children. Simpson, et al (2010) says, the home is a complex, interactive environment that operates within a dynamic social setting, and child home safety therefore could be considered, "a wicked problem" meaning it can be difficult to resolve. It exists in a complex environment and is influenced by people and their cultures, economics and politics. Royal society for the prevention of accident (ROSPA) says accidents are the biggest killer of children, post infancy and that accidents are preventable (ROSPA, 2013 pg. 5). Accidents are the leading cause for loss of life of children with under 5's being most at risk at home (PHA, 2014; Shannon et al, 1992). Falls, ingestion and poison, burns, and falling objects are all causes of home accidents and infants are at higher risk due to their size, development, curiosity and inability to anticipate danger (Ramdzans, 2014). ROSPA (2014) have estimated that the cost to society of home accidents in the UK to be £45billion. Effective interventions are required to reduce accidental injury to children. In Northern Ireland (NI), interventions have been put in place funded by government departments as part of a strategy to give children the best start in life. Home accident prevention for under 5's in an area that is often approached in this scheme. This research was to examine how home safety for under 5's was being delivered and its effectiveness.

AIMS AND OBJECTIVES

Aims:

- Assess parental knowledge of home safety for children under five.
- Assess interventions encountered by parents to improve home safety.
- Determine the extent to which home safety is included in home life.

Objectives:

- Measure parents' awareness of home safety.
- Determine if any safety features have been implemented in homes.
- Examine interventions and assess if they result in changes being implemented.
- Identify if there are any barriers to implementing home safety.

LITERATURE REVIEW

Injuries are the most frequent cause of death in children after their first year of life. 4% children and young people suffer from a high rate of accidental deaths compared to the rest of the population. Fatal accidents deprive children and their families of many decades of potential years of life. Due to these years of life lost, accidents have moved up the priority list and prevention has taken a priority role for public health. (ROSPA 2013 pg 8) In children up to 5 years, home accidents are the commonest cause of death on attendance at accident and emergency departments, and on admission to hospital. Of home accidents reaching hospital, cuts, bruises, poisonings, burns, and scalds account for 70% of all A & E visits. A fall has occurred in over half the accidents. (Colver, et al. 1982 pg 1177.) Other common causes include ingestion of medication and poison, burns, injuries due to falling objects and motor vehicle accidents. Infants are at high risk of unintentional injuries due to their body size, stage of development, curiosity and inability to anticipate danger. Shanon, et al (1992 pg. 365.) found of the injuries reviewed in a study of 2239, 619 (21.4%) of accidents occurred in or around the home among children 4 years of age or less. This is not surprising given the amount of time young children spend in their home environment.

Murdock and Joyce, (1974) state, "Boys were more prone to accidents than girls". In 95% of the cases one or both parents were in charge of the child at the time of the accident, reinforcing the realisation that the child is not necessarily left unsupervised.

Alwash, and Mc Carthy, (1988) researched the severity of childhood accidents in the home and discovered a strong trend towards more severe injuries in lower social classes. This finding is in line with other studies that show that social class is strongly associated with the frequency of accidents.. The WHO (2008) has also stated the burden of childhood injuries is greatest in low income countries. However Murdock and Joyce (1974 pg 103) stated, social class had no significant bearing on the accident rate and suggest, that how often accident occurs is more in relation to size of families and age of child rather than social class. So while social class seems to have an effect there is conflicting research as to what the factors are.

The Home Accident Prevention Strategy 2014-2024 (2015) states in Northern Ireland accidents in general cost society more than £4bn each year, with £650m of this burden being carried by the state. ROSPA (2014) have reported the cost to society of UK home accident injuries has been estimated at £45.63billion (£45,630million) annually. The social cost of a home injury includes the costs of loss of life and life quality, medical costs and loss of output, although the costs imposed on society can provide an important motivator for initiating research and programmes to reduce home injury risk. (Keall et al 2010).). Public Health England states serious injury can lead to long term consequences such as disfigurement or disability and it can also impact on a child's education, affecting their attendance and performance at school. Studies have also shown that mothers often have more physical, somatic, and mental problems, including suicide after the loss of a child than do fathers. (Jiong et al 2005 pg 3.) and adds to the total cost to society.

Garling and Garling, (1995); Gralinski and Kopp, (1993) indicates that during the toddler and into the preschool years, safety becomes a major focus in parents' socialization-directed talk with their children. By the time children reach 3 years of age, parents often manage injury risk by teaching their children about hazards and safety practices

Paul,C.L. et al (1992 Pg 22.) discovered evidence that measures devised to prevent or reduce accidental injury are rarely used. Studies in USA found homes had some safety hazards and use of precautions was as low as 20% for fire extinguishers and 40% for power point covers. Even if parents are informed about potential value of safety devices to prevent injury it is still almost unlikely parents will use the device unless they are readily available and inexpensive. Martin, R. et al (1990 Pg 714.) also revealed through research carried out that parents of lower socioeconomic status demonstrated a more limited understanding of child safety. This indicates the importance of passive interventions and the need for programmes to increase parental knowledge of childhood injury and safety.

Interventions providing free, low cost or discounted safety equipment appeared to be more effective in improving some safety practices than those interventions not doing so. Home safety education and modifying the home environment by the provision of safety equipment can only ever be one part of a strategy to reduce home injuries in children. (Kendrick, D et al, 2013). Each serious injury and death is a tragedy, yet many are avoidable. NICE's recommendations are based on evidence about the measures that work to save lives and protect children from serious injuries. (NICE. 2010.) NICE have stated in guidance , "they recommend that help should be offered to parents and carers who may not necessarily have the appropriate information or tools to identify risks in their homes or may not have the money to buy and install the right equipment.

Attention to ensuring children has the best start in life forms part of many governments concerns. In the UK, the government announced the Sure Start initiative in 1998 applying primarily in England with slightly different versions in the UK. The initiative originated with the aim of giving children the best possible start in life through improvement of childcare, early education, health and family support. In addition, public funding is currently provided to most local authority areas in Northern Ireland to deliver home safety. This normally involves the employment of a Home Safety Officer that will carry out home assessments and often will provide limited equipment that can improve home safety.

METHODOLOGY

This study had three parts, a questionnaire, a short presentation including the presenting of a safety tool and leaflet, and a further questionnaire targeting at changes made by parents.

Two different Sure Start programmes were identified. A selection size of 30 mothers was asked to take part. The local authority in the area has a home safety officer who carries out a free home safety assessment and provides the homeowner with any devices/equipment that may be needed to ensure the safety of the child. Items include small corner cushions, cupboard locks, stair gates and fire guards. These items are given on a need only basis and items are limited. On registering with Sure Start all parents were asked if they would like to avail of this service.

The first questionnaire to be completed helped discover how much knowledge the parent has on home safety. A short presentation was then delivered to the groups. Finally, a second questionnaire was given a week later to reveal the interventions added by the parent to reduce the risks in the home.

A mixed method approach was taken with both qualitative and quantitative data collected. The quantitative data collection methods relied on structured data collection designed in the questionnaire into predetermined response categories. The qualitative data played an important role in impact evaluation by providing information useful to understand the reasoning behind results.

Due to ethical issues the research was carried out in a community venue rather than in homes. It was explained to the participant the research is completely anonymous which will also help the respondents to be totally honest

RESULTS

A total of 27 questionnaires were completed on the first visit to the local Sure Start and mother toddler groups targeting the parents with children under 5.

70% reported they knew the term “home safety” and were also aware of the organisations available to complete personal home safety assessments and named the organisation that were carrying out these assessments in the area. 12% of mothers knew the term but did not know any organisation that carried out assessments. 18% of the respondents reported they did not know the term or any organisations that could help them reduce the risk of serious harm or death to their child/children.

46% of respondents had already had a home safety assessment carried out at their home, 31% had not and 23% are currently on the waiting list for a home assessment.

Figure 1 details the range of safety measures that are regularly given as precautionary measures from a home safety officer at an assessment, although some of these candidates have not had an assessment a few have implemented their own devices. It shows how many have and have not implemented the precautionary measures into their homes.

Figure 1 – Safety measures in place at home

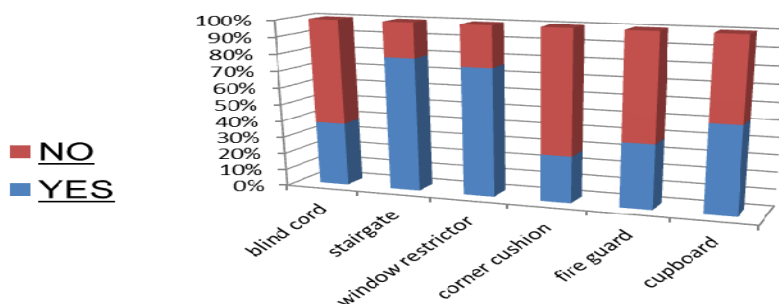


Figure 1 indicates that 80% of the respondents do not have a simple safety measure such as a corner cushion; this would be placed on sharp corners to reduce the impact that could cause a severe gash or bruising but is the least item used, but easiest self-applied device.

65% of respondents stated they do not have blind cord cleats, a device that could reduce the risk for a child if tangled in the blind cord. It has been reported it is because they have to be attached to the wall with the use of a drill, and not all have access to either a drill or a person competent in the use of a drill.

The most widely used item of safety was a stair gate. The stair gates given at a home assessment will require the use of a drill and handyman and is recommended for top of stairs but, stair gates can also be purchased and are easily implemented using no tools. However, these easily fitted stair gates come with their own hazards if they are placed at top of stairs, they become a tripping hazard.

A small proportion of the respondents stated on the questionnaire that they did not have a drill or know how to use one and had no one available to complete the task of fitting blind cord cleats or stair gates for them, they reported this was the reason they had not yet installed devices.

70% of the 27 respondents returned the next week for the follow up questionnaire; 63% of these respondents had declared they have introduced safety measures into the home or have introduced extra measures as a result of the presentation such as;

- moving furniture away from windows;
- emptying buckets of water gathered in gardens;
- Moving cleaning chemicals to higher cupboards.

In relation to blind cord safety 51% of mothers have reported they know the strangulation time of a child is 18 seconds, however of the 51%, 65% of these do not have blind cord cleats installed.

Figure 2 reveals that children aged 2 have the highest amount of fall followed closely by children in the age one category, it also reveals that falls have the highest count of all accidents.

Figure 2 - Comparing age of child/ causes of accident.

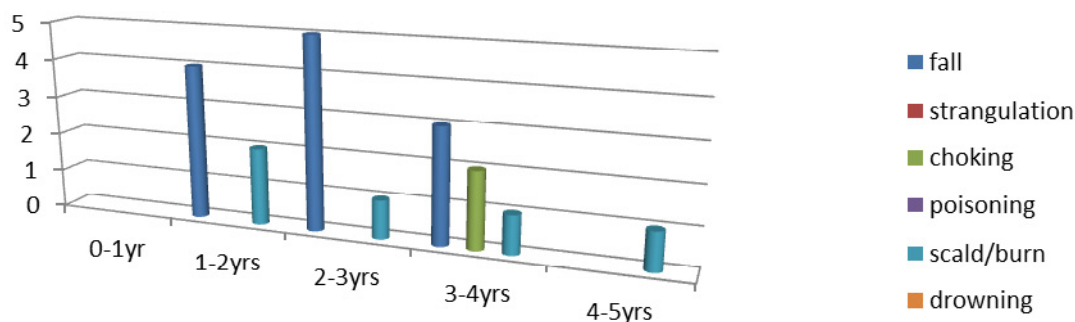
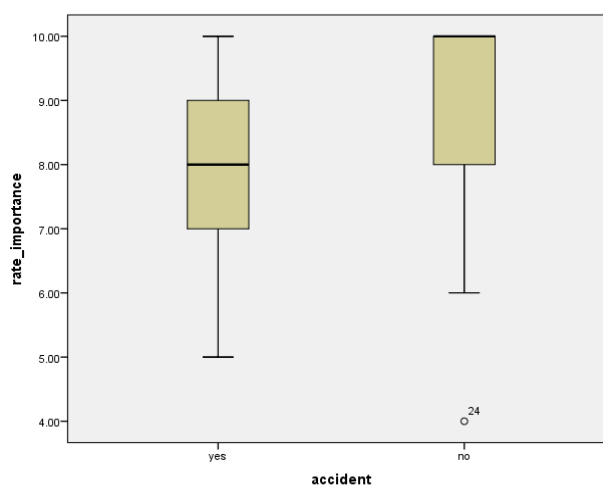


Figure 3 shows that persons who have graded home safety between the 7 to 9 level of importance have had child accidents in the home; and the mothers whose children have never had an accident have given home safety a 10 for very important. This reflects the realisation that securing home safety can reduce accidents.

Figure 3 - Measuring rate of importance of safety/ with accident amount.



DISCUSSION

This research was compiled with measuring parental awareness of home safety in mind. However, the problem is measuring home safety awareness, it relies wholly on the respondent telling the truth when rating importance of home safety and when exposing the preventative measures they have in place in their homes. This new research has revealed that a high number of respondents were aware of the term home safety and the organisations they could contact to have a personal home safety assessment carried out which would be specific to them; this could be as a result of participating in Sure Start groups, however not all mothers attend Sure Start groups. Many mothers work or choose not to go these groups, therefore lose out on the equipment and spread of home safety information. Without this it may increase the risk of a home safety accident occurring in their home. When parents register with Sure Start they are asked if they have had a home safety assessment for the prevention of child accidents at their home. If not, they are registered for this assessment with local council's home safety officer. This question only relates to the term home safety and does not specifically mean they have knowledge of all the issues within the term home safety. It may simply be because it is a pre-registration question asked when enrolling with a sure start group. In the research various questions have been ask to assess if preventative measures have been put in place to reduce accidents. This is a more reliant indicator of home safety awareness and if the information known is implemented into everyday life.

Using a scale chart the parents were asked to rate how important they belief home safety was and this was compared to accidents the child had at home. The parents who had no accidents rated home safety as high priority, however there could be untrue responses given here due to the fact no one wants to be called a 'neglectful' parent. It could also be an indicator that awareness is high and safety precautions are in place in the home. Parents whose child has had an accident also rated home safety as high, but home safety may not be at the top of their list of priorities, this could be as a result of other stressors in everyday life. Sure Start groups were set up to work with parents and children to promote physical, intellectual, social and emotional development of children – particularly in disadvantaged areas. (*Glass, 1999 pg 258.*) Families in disadvantaged areas usually suffer with limited income leading to fuel poverty, food affordability, payment of bills, and lone parenting worries. (*Ghate, Hazel. (2003) pg 29.*)

Supplying home safety equipment is part of the Home safety officer's but it is then the responsibility of the parent to have the equipment installed. The programme's budget does not cover installation costs even though the NICE guidelines for health promotion (2010) states, "where appropriate, supply and install suitable, high quality home safety equipment.

The corner cushions are the least installed item even though they are the easiest to apply, mothers say, "they are unsightly and look ugly on my coffee table". This comment insinuates that look is more important than safety. The corner cushions supplied are white. They do come in other colours that could blend better with furniture but they cost more. Aesthetics in the home is an important issue and can impact on home safety. The effective use of funds should be considered here as equipment is being provided that in reality is not going to be used in people's home.

Cupboard locks are an easily applied safety measure but less than half of respondents claim to have them installed. Cupboard locks are a vital piece of equipment in keeping children away from harmful

chemicals. Gibbs et al (2005 pg 375.) research agrees revealing that although parents in Australia were aware of the need for poison safety strategies and were implementing strategies to various degrees, they were not always comprehensively applied in the homes. The research shows that parents would get frustrated because of the nuisance factor of opening these locks, and if broken safety feature is abandoned. Gibbs (2005 pg 375) research also revealed, parents were unaware of the issues with some products and believed that child proof and child resistant were the same.

The research revealed that after being given a home safety leaflet and a short presentation many mothers went home and looked around to assess were simple safety measures could be completed that have a positive effect on home safety, issues such as emptying containers, and buckets in gardens that have collected rain water, moving furniture away from windows in all rooms and placing cleaning chemicals on higher shelves. These proactive measures show that giving simple information can have a positive effect on home safety.

The research asked if parents knew the time it took for the strangulation of a child. 51% were aware of the time it took and of the 51% only 35% had the blind cord cleat installed. This exposes a reduced concern for the issue, maybe thinking it will never happen to me but it could also be a result of no drill or handyman. It would be more cost effective to have a handyman install the devices for vulnerable persons who have no access to a drill or a handyman, as well as show an urgency to have this safety equipment installed to protect their child.

CONCLUSION

This research shows that

- There is an awareness of home safety
- Provision of simple home safety information can be effective
- Provision of equipment alone may not be effective especially if it requires a tool to be installed. Such equipment should be installed as part of provision.
- Aesthetics and convenience can be important in installing home safety equipment such as corner cushions on tables and cupboard locks.

REFERENCES AND BIBLIOGRAPHY

- Agass, M. Mant, D. Fuller, A. Et al (1990) *childhood accidents: a practice survey using general practioners' records and parental reports. British Journal of General Practice* 40. 202-205.
- Alwash, R. Mc Carthy, M. (1988) *measuring severity of injuries to children from home accidents – Archives of disease in childhood* 63-pg 637.
- Beirens, T.M.J. Brug, J. Van Beeck, E.F. Dekker, R. den Hertog, P. Raat, H. (2007) *Assessing psychosocial correlates of parental safety behaviour using Protection Motivation Theory: stair gate presence and use among parents of toddlers. Health education research. Vol.23 page 731.*
- British blind and shutter association. *Window blind safety. New laws in 2014. Accessed from <http://www.nicma.org/cms/docs/NewsandEvents/BBSA%20-%20Blinds%20and%20regulation%20changes.pdf> accessed on 24th April 2015.*
- Capt. (2015) *Public health commissioning for under 5s. Accessed from <http://www.makingthelink.net/topic-briefings/public-health-commissioning-under-5s> accessed on 31st March 2015.*
- Child accident prevention trust (Capt) (2014) *New standards in blinds 2014. Accessed from: <http://www.capt.org.uk/who-we-are/news/new-standards-blinds> [accessed on 09/12/2014.]*
- Child accident prevention trust (Capt)(2014). *Two recent deaths underline why choking, suffocation and strangulation is a national priority. Accessed from <http://www.capt.org.uk/who-we-are/news/two-recent-deaths-underline-why-choking-suffocation-and-strangulation-national-prior> accessed on 10/12/2014.*
- Colver, A.F., Hutchinson, P. J., Judson, E.C.. (1982) *Promoting children's home safety. British medical journal volume 285 pg 1177.*
- Data collection methods (2014) Accessed from <http://people.uwec.edu/piercech/researchmethods/data%20collection%20methods/data%20collection%20methods.htm> accessed on 08/12/2014.
- DePanfillas, D. (2006). *Child neglect: a guide for prevention, Assessment and Intervention. Chapter 4. Risk and protection factors. Accessed from <https://www.childwelfare.gov/pubs/usermanuals/neglect/chapterfour.cfm> Accessed on 02/12/2014*

Department of Social Development. DSD (2012) *Facing the Future: Housing Strategy for Northern Ireland Action Plan 2012 – 2017* accessed from <http://www.dsdni.gov.uk/facing-the-future-action-plan.pdf> accessed on 15th April 2015.

Dershewitz, R.A. MD, ScM. (1979) *Will Mothers Use Free Household Safety Devices?* *Jama Pediatrics*. Abstract. Vol. 133(1):61-64

Engstrom, K. Diderichson, F. Laflamme, L (2002) *socio economic differences in injury risks in childhood and adolescence: a nationwide and injury prevention.* *Injury prevention* 8:141.

Gaines, J. Schwebel, D.C. (2009) *Recognition of home injury by novice parents of toddlers – department of psychology accident analysis and prevention.* vol; 41 Pg 1070.

Garling and Garling, (1995); Gralinski and Kopp, (1993); Peterson et al., (2002) Morrongiello, B.A. Mc Arthur, B.A. Bell, M. (2014) *Managing children's risk of injury in the home: Does parental teaching about home safety reduce young children's hazard interactions?* *Accident Analysis and Prevention* 71 (2014) Pg. 195

Ghate, D. Hazel, N. (2003) *Parenting in poor environments; stress, support and coping.* Jessica Kingsley Publishers. Pg 29.

Gibbs, L. Waters, E. Sherrard, J. Ozanne-Smith, J. Robinson, J. Young, S. Hutchinson, A. *Understanding parental motivators and barriers to uptake of child poison safety strategies.* *Injury prevention.* Vol.11: 373-377 P375.

Glass, N. (1999) *Sure Start: the development of an early intervention programme for young children in the UK.* *Children and society.* Vol,13, Pg 258.

Healthy Lives, Healthy People: our strategy for public health in England (2010) H.M.Gov. pg.10 accessed from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216096/dh_127424.pdf Accessed on 28th February 2015

Home accident prevention strategy. (2004-2009) accessed from, http://www.dhsspsni.gov.uk/home_accident_prevention_strategy.pdf accessed on 2nd January 2015.

Home accident prevention strategy 2014-2014 (2015) accessed from <http://www.dhsspsni.gov.uk/hapstrategy.pdf> accessed on 10th March 2015.

Jiong Li, M.D., Ph.D., Thomas Munk Laursen, M.Sc., Dorthe Hansen Precht, M.D., Ph.D., Jørn Olsen, M.D., Ph.D., and Preben Bo Mortensen, M.D., Dr.Med.Sc. (2005) *Hospitalization for Mental Illness among Parents after the Death of a Child.*

Keall, M.D. Guria, J. Howden-Chapman, P. Baker, H.G. (2010) *Estimation of social costs of home injury: A comparison with estimates for road injury.* *Accident Analysis & Prevention* Volume 43, Issue 3, May 2011, Pages 998–1002.

Kendrick, D, Young B, Mason-Jones AJ, Ilyas N, Achana FA, Cooper NJ, Hubbard SJ, Sutton AJ, Smith S, Wynn P, Mulvaney C, Watson MC, Coupland C. (2013) *Home safety education and provision of safety equipment for injury prevention (Review) Evidence-based child health: a cochrane review journal* Vol 8:3: 761–939. Published online in Wiley Online Library.

Laflamme L, Eilert-Peterson E. (1998) as cited in Gulliver, P., Dow, N., Simpson, J. (2007) *The epidemiology of home injuries to children under five years in New Zealand.* *Australian and New Zealand Journal of Public Health.* Volume 29, Issue 1, Article first published online: [25 SEP 2007]

Learning and teaching services. (2012). The university of Sheffield. Accessed from <http://www.shef.ac.uk/lets/strategy/resources/evaluate/general/data-analysis/spss> accessed on 08/12/2014.

LeBlanc, J., Pless, I., King, W., Bawden, H., Bernard-Bonnin, A., Klassen, T. and Tenenbein, M. (2006). *Home safety measures and the risk of unintentional injury among young children: a multicentre case-control study.* *Canadian Medical Association Journal.* [online] 175(8), pp.883-887. Available at: <http://dx.doi.org/10.1503/cmaj.050592> [Accessed 30 Sep. 2014].

Martin, R. Eichelberger, MD; Catherine S. Gotschall, MA; Herta B. Feely, MJ; Paul Harstad, JD; Leon M. Bowman (1990) *Parental Attitudes and Knowledge of Child Safety; A National Survey.* *Am J Dis Child.* Vol; 144(6):714-720.

Morrongiello, B.A. Kiriakou, (2004), as cited in Morrongiello, B.A. , Corbett, M. Lasenby, J. Johnston, N. Mc Court, M. (2006) *Factors influencing young children's risk of unintentional injury: Parenting style and strategies for teaching about home safety.*

Murdock, R. Joyce, E. (1974) *Home Accidents to Children under 15 Years: Survey of 910 Cases.* *British Medical Journal.* vol. 3, page 103 accessed from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1611066/pdf/brmedj01986-0045.pdf> [accessed 01/12/2014].

NIFS (2015) *Free Home Fire Safety Check.* Accessed from <http://www.fireservice.co.uk/safety/hfsc> accessed on 23rd April 2015.

NIHE (2011) *district housing plan & local housing strategy 2011/12.* Accessed from http://www.nihe.gov.uk/derry_dhp_2011.pdf accessed on 24th April 2015.

Oxford dictionary definition. (2015) accessed from <http://www.oxforddictionaries.com/definition/english/home> accessed on 27/02/2015.

Oxford dictionary definition. (2015) accessed from <http://www.oxforddictionaries.com/definition/english/safety> accessed on 27/02/2015.

- NICE (2010.) *New NICE guidance to reduce the number of childhood injuries and deaths*. Accessed from <https://www.nice.org.uk/guidance/ph29/resources/new-nice-guidance-to-reduce-number-of-child-injuries-and-deaths> [Accessed on 01/11/2014].
- NISRA (2009) *Hospital Admissions due to Accidents*. Accessed from <http://www.ninis2.nisra.gov.uk/public/pivotgrid.aspx?dataSetVars=ds-2007-lh-37-yn-2004-2009-sk--2-sn-Investing%20for%20Health-yearfilter--> accessed on 15th February 2105.
- Paul, C.L. Redman, S. Evans, D. (1992). *The cost of availability of devices for preventing childhood injuries*. *Journal of Pediatric; child health*. Vol. 28 Pg 22.
- Prosad, P.S. Singh, B.R. (2010) *window blinds; hanging risk*. *Proquest Health and Medical Complete*. Vol. 83 no.2 pg 40.
- Public health.hscni.net*, (2014). *Blind cord safety in spotlight during Family Safety Week | HSC Public Health Agency*. [online] Available at: <http://www.publichealth.hscni.net/news/blind-cord-safety-spotlight-during-family-safety-week> [Accessed 30 October. 2014]
- ROSPA (2013) *Northern Ireland's a big book of accident prevention*. Pg 5.
- Rospa.com, (2014). *Accidents to Children | Child Safety | Advice & Information | Home Safety | RoSPA*. [online] Available at: <http://www.rospa.com/homesafety/adviceandinformation/childsafety/accidents-to-children.aspx#strangulation> [Accessed 30 Sep. 2014].
- Rospa (2014) *blind cord safety campaign*. Accessed from <http://www.rospa.com/HomeSafety/Info/blind-cord-safety.pdf> accessed on 16th February 2015.
- Rospa (2015) *Accidents to children* accessed from <http://www.rospa.com/homesafety/adviceandinformation/childsafety/accidents-to-children.aspx#References> accessed on 16th Feb. 2015.
- Rospa.com (2012). *Home Safety Facts and Figures*. Accessed from <http://www.rospa.com/homesafety/adviceandinformation/general/facts-figures.aspx> [Accessed on 02/12/2012].
- Rospa. Com (2014) *home safety*. Accessed from <http://www.rospa.com/homesafety/> [accessed on 01 December 2014.]
- Shanon, A. Bashaw, B. Bsc. Lewis, J. Bsc. Feldman, W. MD. FRCPC. (1992) *nonfatal childhood injuries: a survey at the children's hospital of Eastern Ontario*. *Canadian Medical Association*. Pg 365.
- Sibert, J.R. (1991) *Accidents to children: the doctor's role. Education or environmental change?* *Archives of Disease in Childhood* 1991; 66: 890- 893
- Simpson, J. McGee, F. Fougere, G. (2010). *Child home safety: are we tackling a wicked problem with tame solutions?* *Injury prevention*. *BMJ* ;volume, 16(Suppl 1):A1–A289 accessed from http://injuryprevention.bmj.com/content/16/Suppl_1/A199.1.full.pdf+html accessed on 03rd December 2014.
- Van Beelen, M., Beirens, T., den Hertog, P., van Beeck, E. and Raat, H. (2013) *First-Time Parents Are Not Well Enough Prepared for the Safety of Their Infant*.
- Westerntrust.hscni.net*, (2014). *Western Trust brings child safety message to Free Derry Corner*. [online] Available at:<Http://www.westerntrust.hscni.net/about.1875.htm> [access 7th October 2014
- Which (2015) *Safety gate reviews; features explained*. Accessed from <http://www.which.co.uk/baby-and-child/child-safety-at-home/reviews/stair-gates/page/features-explained/> accessed on 03rd April 2015.
- WHO. (2005). *World Health Organisation Preventing children accidents and improving home safety in the European region. Identifying means to make dwellings safer*. Pg 3. Pg.12. Pg. 23.
- WHO (2008) *World Health Organization and Unicef. World Report on Child Injury prevention*. Accessed from <http://whqlibdoc.who.int/publications/2008/9789241563574yeng.pdf> [accessed on 29/11/2014].
- Wolfe, I. Macfarlane, A. Donkin, A. Marmot, M. Viner, R. (2014) *Why children die: Death in infants, children and young people in UK*. *Royal college of Paediatric child health*. Pg.2. Accessed from http://www.ncb.org.uk/media/1130496/rcpch_ncb_may_2014_-_why_children_die__part_a.pdf accessed on 28th February 2015.

Perceptions of rock band musicians about the effects of loud music and protective practices

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ABSTRACT: Rock band musicians are an important group in what regards to the exposure to high sound pressure levels. They can be exposed to loud music, which can result in hearing damages. However, there are very few studies focused on this issue. In view of this, this study attempts to analyze the perceptions about musicians in relation to the loud music risks, as well as to characterize their preventive behaviors and health effects. To analyze this issue, a questionnaire was applied to 14 musicians belonging to three garage rock bands. The results showed that group rehearsals and concerts are considered the noisiest activities and the sound pressure levels at individual practices are seen as low. Guitar and drums were identified as the noisiest instruments and the piano was seen as the instrument that produce lower sound levels. The results also showed that only a part of the musicians were concerned with the health effects related to the exposure to high sound levels and the majority of them reported do not use hearing protection. The findings of this study emphasize the need to give more attention to these groups, informing them about the risks and on the need of risk reduction measures.

Keywords: *musicians, risk perception, rock, sound pressure levels*

INSTRUCTION

The importance of musicians' exposure to high sound pressure levels has been emphasized in the last decade. Previous studies have been shown that professional musicians are exposed to loud music in the course of rehearsals and performances (O'Brien *et al.*, 2008; Jansen *et al.*, 2009; Qian *et al.*, 2011; Rodrigues *et al.*, 2013; 2014), and that hearing damages can appear as a result of this exposure (Jansen *et al.*, 2009). Despite the importance of this issue for professional musicians, it is essential to recognize that other musical groups can also be exposed to high sound pressure levels, as is the case of the garage rock bands musicians.

In a previous study the authors showed that rock bands are exposed to dangerous sound pressure levels in the course of rehearsals (Almeida *et al.*, 2014). Values of equivalent continuous sound pressure levels (L_{p,A,eqt}) were higher than 100 dB(A) for all musicians and values of peak sound pressure levels (L_{p,Cpeak}) were higher than 135 dB(C). These results were related by the authors to the poor acoustic conditions of the venues, where most of them were small, with the use of egg cartons as absorption material on the wall and ceiling, which has been referred as inadequate material for this purpose. Furthermore, as no sound reduction material or protection was used to the drums, amplifiers had to be used to the other instruments. The levels of exposure found by the authors can lead to ear pathologies, particularly Music-Induced Hearing Loss (MIHL). In fact, studies with professional musicians, where the sound levels are significantly lower than with rock musicians, have related the exposure levels to MIHL and other other hearing loss-related symptoms such as tinnitus, hyperacusis and diplacusis (Laitinen *et al.*, 2008; Jansen *et al.*, 2009; Schink *et al.*, 2014). Furthermore, most of these musicians are non professional and, accordingly, they can have additional professional activities where they can be also exposed to high sound pressure levels. In view of this, this is a group of musicians with particular interest for environmental health. However, despite the importance of this issue, there are few studies focused on the problem of rock band musicians loud music exposure, particularly about their perceptions and behaviors.

In view of this, this study attempts to analyze the perceptions about musicians in relation to the loud music risks, as well as to characterize their preventive behaviors and health effects.

MATERIALS AND METHODS

Sample

For this study a total of 14 musicians belonging to three garage rock bands were inquired, 2 pop-rock and 1 heavy metal. The majority of the participants were males (93%), and their mean age was 26 years old (SD = 5; interval range 19-35 years old).

Musicians' risk perception analysis

The questionnaire developed by Rodrigues *et al.* (in press) to analyse of students' perceptions about sound pressure levels, the health effects related to the exposure to loud music and preventive behaviours was adapted for this study.

The questionnaire was divided in five parts. In the first part of the questionnaire, musicians were inquired about age and gender. The second part included questions about the instrument played, weekly activities dedicated to music and other noisy activities. The third part of the questionnaire analysed the perception of musicians about the sound pressure levels in what concerns to: (1) practice and concerts; (2) different type of instruments. They were also inquired about the influence of loud music on their own performance. The fourth part was composed of seven questions to gathering musicians' views about health effects on the following: (1) general negative health effects; (2) degree of care about health effects; (3) previous hearing exams; (4) hearing symptoms. In the last part of the questionnaire, musicians were inquired about the usage of hearing protection in different situations. If they answered to use hearing protection, they were queried about the type that they use, and if not, they were asked about the motive to not use it. At the final, they were inquired about additional care to reduce the sound levels at their own practice.

The questions included in the questionnaire were closed, except the last one that was an open question as mentioned above. For the other questions three types of measurement scales were used: ratio scale and nominal scale (are classifications, allowing describe the variables and assign the subject without recourse to quantification), and ordinal scale (are distributed according to a certain order, which can be ascending or descending, allowing the establishment of differentiations). The values were reported in ascending order, according to the seriousness of the situation.

Musicians completed the questionnaires at the end of a group rehearsal. They were notified that their participation was voluntary and confidential and that the results would only used to purpose of this research.

RESULTS

The number of practice hours per week was analysed. Results show that musicians spend on average 7 hours (sd=5.85) practicing alone and 4 hours (sd=1.51) at ensembles.

Table 1 presents the musicians' perceptions about the sound pressure levels in relation to the different activities that they perform and to the different instruments that can be a part of the band. Results show that group rehearsals and concerts are considered the noisiest activities, despite a significant percentage of respondents assess the sound pressure levels at these activities as "Moderate". The sound pressure levels at individual practices are seen by most of musicians as very low (35.7%) or low (21.4%). According the presented results, guitar and drums were identified as the noisiest instruments and the piano was seen as the instrument that produce lower sound pressure levels.

Table 1 - Perception about the sound pressure levels by activity and instrument (%)

		VL	L	M	H	VH
Activity	Individual practice	35.7	21.4	35.7	-	7.1
	Group rehearsals	0.0	0.0	14.3	35.7	50.0
	Concerts	0.0	0.0	21.4	7.1	71.4
Instrument	Guitar	0.0	0.0	35.7	35.7	28.6
	Bass	0.0	28.6	42.9	14.3	14.3
	Drums	0.0	0.0	0.0	28.6	71.4
	Piano	14.3	42.9	21.4	21.4	0.0

VL= "Very Low"; L="Low"; M="Moderate"; H="High"; VH="Very High".

The incidence of hearing loss-related symptoms was analysed and the results are presented in Table 2. Tinnitus was the highest reported disorder (64.3%) followed by diplacusis (50.0%) and hyperacusis (35.7%). Sound distortion was only reported by 14.3% of musicians. Musicians were also asked about the influence of loud music on their own performance and it was observed that 28.6% of respondents identified a high negative effect, 28.6% a moderate negative effect and 42.8% an effect with a certain extent.

Table 2 - Reported hearing disorders (%)

Hearing disorder	Percentage of musicians
Tinnitus	64.3
Hyperacusis	35.7
Diplacusis	50.0
Sound distortion	14.3

Table 3 presents the degree of concern of respondents in relation to some health effects. In general, musicians indicated low concerns in relation to health effects. Higher levels of concerns were identified for hearing loss (42.9% reported "Very High" concerns) and tinnitus (28.6% reported "Very High" concerns).

Table 3 - Degree of concern with health effects (%)

	Secondary School				
	N	L	CD	H	VH
Stress	21.4	14.3	14.3	35.7	7.1
Headache	21.4	21.4	7.1	35.7	14.3
Heart rate	14.3	21.4	42.9	14.3	0.0
Hearing loss	14.3	0.0	21.4	14.3	42.9
Tinnitus	7.1	21.4	21.4	14.3	28.6
Hyperacusis	21.4	28.6	21.4	0.0	21.4
Diplacusis	28.6	28.6	14.3	7.1	14.3
Sound distortion	21.4	21.4	28.6	7.1	21.4

N="None"; L="Low"; CD="To a Certain Degree"; H="High"; VH="Very High".

The usage of hearing protection was also analysed. Results showed that, in general, musicians never wear hearing protection, since 71.5% of respondents reported never wear it at individual practice, 35.7% at the group rehearsals and 57.1% at the concerts. The musicians that wear it reported only use the hearing protection in an occasional way. When they opted to not use it, most of respondents indicated that they are uncomfortable.

DISCUSSION

Results of this study indicated that rock band musicians have a low perception regarding the sound levels in the course of the different activities. According previous studies, they are exposed to dangerous sound pressure levels during ensembles (Mordini, 1994; Almeida et al., 2014). However, some of musicians assessed the sound levels as "Moderate". Furthermore, the majority of musicians classified the sound levels during individual practice as "Low" or "Very Low". Despite lowest sound pressure levels may be found at individual practice once musicians are not exposed to the sound produced by other instruments, previous studies demonstrated that the levels of exposure at these activities are still significant, and in some cases, higher than in ensembles (O'Brien et al., 2013). In fact, in most of the times that rock musicians practice alone, they use amplifiers and reproduce the other instruments and this can lead to similar levels of exposure between individual practice and ensembles. This problem is higher when considered the high number of hours that musicians spend in training per week, increasing the risk of MIHL.

With respect to type of instrument, musicians assessed guitar and drums as the noisier instruments types. For drums these results were not surprising, since Almeida et al. (2014) have previously identified them as the louder instruments. However, bass was identified by the authors as the second noisiest instrument, but the authors in this study identified guitars producing higher sound pressure levels. These results can be related to the timbre and dynamics of the guitars, which can be the source of more discomfort to the other musicians. It is important also to note that a considerable

percentage of musicians indicated the piano as less noisy instrument. However, despite the lower the sound level produced by these instruments in comparison with other instruments as identified in previous studies (Almeida et al., 2014), the sound levels are still significant.

In this study a high prevalence of tinnitus was detected, as well as, a significant prevalence of hyperacusis and diplacusis. Once hearing loss-related symptoms were noted, this suggest that, throughout their exposure time, musicians might develop MIHL (Laitinen et al., 2008; Jansen et al., 2009), which may also have important consequences on their own performance as musicians (Royster et al., 1991).

Despite the identified hearing symptoms, as well as the important results of previous studies that identified that rock musicians are exposed to high sound levels, this study also showed that they are not entirely concerned about this issue. A considerable percentage of musicians did not appear to be worried with the different health effects. Lack of knowledge about the risks of their exposure can justified these results.

This study also showed that rock band musicians are resistant to the use of hearing protection. Only few respondents reported to use it but in an occasional way, emphasizing one more time that rock musicians are not provided with a correct knowledge about the risks that they are exposed, and about the importance to protect themselves.

CONCLUSIONS

The findings of this study showed that rock band musicians are not entirely aware of the risks associated with the exposure to loud music in the course of their practice. A significant number of musicians perceived the sound levels at individual practices as low and very low. Additionally, despite they reported some hearing loss-related symptoms such as tinnitus, hyperacusis and diplacusis, the study showed that not all of them are concerned with this issue.

In view of this, it is important to give more attention to these groups. Musicians should be informed about the risks that they are exposed and about the importance of the risk reduction measures, particularly about the importance of hearing protection and audiological exams.

REFERENCES

- Almeida, J., Silva, S., Carmo, P., Neves, P., & Rodrigues, M. (2014). Sound exposure of garage rock bands musicians. In Silva, M., Oliveira, R., Rodrigues, M., Nunes, M., Santos, J., et al. (Eds). *3th International Congress of Environmental Health: Proceedings Book*. pp. 210. Porto: ESTSP-IPP.
- Jansen, E.J.M., Helleman, H.W., Dreschler, W.A., & de Laat, J.A.P.M. (2009). Noise induced hearing loss and other hearing complaints among musicians of symphony orchestras. *International Achievements Occupational and Environmental Health*, 82, 153–164.
- Laitinen, H., & Poulsen, T. (2008). Questionnaire investigation of musicians' use of hearing protectors, self reported hearing disorders, and their experience of their working environment. *International Journal of Audiology*, 47, 160-168.
- Mordini, C. A., Branco, F. C. A. & Rodrigues, P. F. (1994). Um estudo sobre os efeitos da exposição à música em músicos de rock and roll. São Paulo: Pontifícia Universidade Católica de São Paulo. (in Portuguese).
- O'Brien, I., Wilson, W. & Bradley, A. (2008). Nature of orchestral noise. *Journal of the Acoustical Society of America*, 124(2), 926-939.
- Quian, C., Behar, A., & Wong, W. (2011). Noise exposure of musicians of a ballet orchestra. *Noise & Health*, 13, 59-63.
- Rodrigues, M.A., Alves, P., Ferreira, L., Silva, M.V., Neves, M.P., & Aguiar, L. (2013). Musicians noise exposure in a Portuguese orchestra – a case study. In Arezes, P., Baptista, J.S., Barroso, M., Carneiro, P., Cordeiro, P., Costa, et al. (Eds). *Occupational Safety and Hygiene*. pp. 431-435. Taylor & Francis: London, ISBN 978-1-138-00047-6.
- Rodrigues, M.A., Amorim, M., Silva, M.V., Neves, P., Sousa, A. & Inacio, O. (2015). Sound levels and risk perceptions of music students during classes. *Journal of Toxicology and Environmental Health – Part A*, 78:825–839.
- Rodrigues, M.A., Freitas, M.A., Neves, M.P., & Silva, M.V. (2014). Evaluation of the noise exposure of symphonic orchestra musicians. *Noise & Health*, 16, 40-46.
- Royster, J.D., Royster, L.H. & Killion, M.C. (1991). Sound exposures and hearing thresholds of symphony orchestra musicians. *Journal of the Acoustical Society of America*, 89 (6), 2793-2803.

Schink, T., Kreutz, G., Busch, V., Pigeot, I., & Ahrens, W. (2014). Incidence and relative risk of hearing disorders in professional musicians. *Occupational and Environmental Medicine*, 71(7), 472-476.

Providing access to environment information and its protection in the Polish law - Introduction to subject

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ABSTRACT: For a long time now, we observe an increased activity of legislators of both - European and Polish law system creators in the area of environmental protection, especially in the context of the climate change. Such protection is especially important from the perspective of creating conditions for healthy living, leisure and social development, as well as enjoying the esthetic experience of contact with nature. Environment protection requires not only action from the public authorities, although these are crucial, but also development of environmental awareness represented by societies and creation of mechanisms that might allow a society for an active and effective cooperation with the government, or even taking independent action to obtain the discussed aim. This article presents the basic Polish law sources, which are in force and are concerning providing information about environment and its protection, the rules of such providing, the group of entities authorized to such information and the entities obliged to provide such information. The authors seek to determine the exact definitions of issues mentioned above, its relations with public information and outline the conditions in which the public authority can refuse providing access to such information. In this article the authors also make an attempt to determine the range in which the legislator realizes the constitutional right of every person to access information about environment and its protection

Keywords: *environment, climate change, public information, provide information*

INTRODUCTION

The value that the Polish legislator attaches to the institution of information about the environment and its protection is confirmed by granting everyone the right to it in the Constitution of the Republic of Poland of 1997, hereinafter called "Constitution". The right to information on environment and its protection is a manifestation of making the protection of environment as a social important issue, propitious to mobilizing a society to action to protect and improve the environment (Bukowski, 2002). The protection of environment and the citizens' right to information on the environment is important, regardless of whether humans' activities have impact on climate change or not.

According to Article 8, paragraphs 1,2 and 4 of the Constitution, public authorities should provide a policy of ensuring ecological safety for the present and future generations and supporting the activities undertaken by the society for the protection and improvement of environment's condition. The right of society to participate in this area has been introduced by giving people a right to information about the condition of environment and its protection (Article 74, paragraph 3 of the Constitution) (Skrzydło, 2013). This provision is related with the right of citizens to obtain information on activities of public authorities and also to access documents and to observe sittings of collective organs of public authority, with the possibility of recording audio or video (article 61 paragraph 1-2 Constitution) (Florkiewicz, 2013). The procedure of providing information mentioned above has been determined in many acts of law, among which the key role, from this article's point of view, is played by the Act on access to public information, hereinafter called "a.p.i.", and the Act of 6.09.2001. on providing environment information and its protection, the public participation in environmental protection and environmental impact assessment, hereinafter called "p.e.i."

The Constitution defines both formal and substantive conditions of the limitation of the right to information. In accordance with Article 61, paragraph 3 of the Constitution, such restrictions can be made only by statute (formal requirement), and only because of the constitutional protection of rights and freedoms of other persons and legal entities, public order, security or important economic interests of the state (substantive requirement). The right to access information on environment and its protection is also mentioned in EU law and international organizations' law ratified by Poland, including the Aarhus Convention of 25.06.1998. about information access, society participating in decision making and access to fairness in environment aspect, hereinafter called the "Aarhus Convention" and also in Directive of the European Parliament and of the Council 2004/4/EC from January, 28th, 2003 on public access to environmental information and repealing Council Directive 90/313/EEC, repealing Directive of the Council 90/313/EWG, hereinafter called the "Directive 2003/04".

Both Aarhus Convention and Directive 2003/04 have been implemented into Polish law in 2008 with the Act on providing environment information and its protection, the public participation in environmental protection and environmental impact assessment.

Environment and its protection information and a public information

According to Article 1, paragraph 1 of a.p.i., every information concerning public affairs is public information (Kłaczyński, Szuster, 2013). Article 6, paragraph 1 of p.e.i. shows examples of public information. At the same time, according to Article 9, paragraph 1 of p.e.i., in a range of environment and its protection information one can find information considering:

1. state of environment elements, such as: air, water, land, minerals, climate, landscape and natural sites including wetlands, coastal and marine areas, as well as plants, animals and fungi, and other components of biological diversity, including genetically modified organisms, and the interaction between these elements;
2. emission of (including radioactive waste) pollutants that affect or may affect the elements of an environment as referred in subsection 1 above; should be noted at this moment that while providing this category of information, the administration entity which will be more described further on, is also made to inform, on the appeal of the requesting authority, about the localization of data about methods of taking measurements including processes of the collection and processing of samples and methods of interpretation the data that were used to generate the shared information, or to refer to the appropriate reference methodologies in this field;
3. measures, such as administrative measures, policies, legislation relating to the environment and water management, plans, programs and agreements on environmental protection, and activities affecting or likely to affect the elements of an environment as referred in subsection 1, and on emissions and pollution as referred in subsection 2 above, as well as measures or activities that are designed to protect those elements;
4. reports on the implementation of environmental legislation;
5. cost-benefit analysis and other economic analysis and assumptions used within the framework of the measures and activities as referred in subsection 3 above,
6. state of health, safety and life conditions of people and state of cultural objects and buildings - in the aspect in which they are or may be affected by:
 - a. state of elements of environment, mentioned in subsection 1 above or by
 - b. elements of environment, mentioned in subsection 1 above – emission and pollutants, mentioned in subsection 2 and measures mentioned in subsection 3 above;

With this in mind one must agree with K. Gruszecki, that information on the environment and its protection in many cases may also be considered public information and the provisions of p.e.i should be applied (Gruszecki, 2013).

Entities authorized to require the information on the environment and its protection

The Constitution states that everyone shall have the right to be informed about quality and protection of the environment. A. Barczewska-Dziobek and J. Dziobek-Romański emphasize that having such access is: "irrespective of citizenship or place of residence" (Barczewska-Dziobek, Dziobek-Romański, 2010). The above provision is repeated in art. 4 of p.e.i., according to which everyone is entitled to information about the environment and its protection under the conditions specified therein. Those regulations contain one of the basic rules of environment protection law - a principle of universal access to information on the environment, which guarantees the society participation in any activities undertaken in this area. K. Gruszecki determines the genesis of this rule in the 10th rule of the declaration of Rio de Janeiro of June 14, 1992, adopted at the Plenary Meeting of the United Nations Conference on "Environment and Development", according to which: "Environmental issues are best resolved at the appropriate level, with the participation of all interested citizens. At the national level, each individual shall have access to information concerning the environment held by a public authority" (Gruszecki, 2013). The author justly emphasizes that while the aforementioned act is not directly binding, the 10th rule has been added to Aarhus Convention and is applicable. Article 1 of Aarhus Convention states that in order to contribute to the protection of the right of every person of present and future generations to live in an environment adequate to health and well-being, each party shall ensure, in matters concerning the environment, rights of access to information, public participation in decision making and access to justice in accordance with its terms. A similar solution was introduced in Directive 2003/04. The preamble of this act states that: "Authorities should ensure to any natural or legal person the right of access to environmental information that is held by a public authority or which are intended for those authorities, without the need to demonstrate interest of such person" (Kłaczyński, Szuster, 2013). The public authorities should also make available and popularize environmental information to the general public as far as possible, in particular by means of information and communication technologies. The future development of these technologies should therefore be included in the reporting on the above Directive. The right to the aforementioned information is not restricted by any means (e.g. by requiring actual or legal interest in gaining such information or stating the aim of gaining it) (Barczewska-Dziobek, Dziobek-Romański, 2010).

Providing information about environment and its protection

According to article 8 of p.e.i., the public authorities are obliged to provide all information on the environment and its protection that is in their possession or is intended for them. The rule is that information about the environment and its protection is available on written request, in oral, written, visual, audio, electronic or any other form. Without a written request it is possible to obtain:

1. information that does not require searching;
2. in case of natural disaster, other natural disaster or technical failure, which are listed in the Act of 18.04.2002. on the state of natural disaster, or other immediate threat to human health or the environment caused by human activities or natural causes- the information held by administration authorities or for them, allowing those who may suffer as a result of this threat, take measures to prevent or mitigate harm arising from the threat.

The administrative authority provides an information about the environment and its protection without unnecessary delay and no later than one month from the date of receiving the request.

Providing information about the environment and its protection is managed in a way and form specified in the request, unless the technical means available to the authority, do not allow the provision of information in the way and form therein specified. If an information about the environment and its protection cannot be provided in a way or form determined in a request, the administration authority notifies the applicant in writing within 14 days from the date of receiving the request about reasons of inability to provide the information as requested and indicate how or in what form the information can be accessed. If within 14 days from the date of receiving the notification mentioned above, the applicant doesn't request for information in a way or form indicated in a notification, the

administrative authority issues a decision on the refusal to provide the information in a way and form specified in the request.

A particularly important role in the socialization process and increasing the efficiency of accessing information on the environment and its protection play publicly accessible lists, and publication of information by electronic means. Documents in which such pieces of data are provided are published in the day of requesting for such data.

In lists, that are available for public one can find such data like those about:

1. decision refusing access to information, mentioned in Article 20, paragraph 1 of p.e.i.
2. documents' projects, mentioned in Article 46 and 47 of p.e.i. and about projects of changes in those documents, before public consultations;
3. information on withdrawing from the strategic assessment of impact on environment, mentioned in Article 47 of p.e.i.
4. information stating the need for a strategic environmental assessment, mentioned in Article 47 of p.e.i.
5. opinions, mentioned in Article 54, paragraph 1 of p.e.i.
6. documents, mentioned in Articles 46 and 47 of p.e.i., with the summary mentioned in Article 55, paragraph 3 of p.e.i. after their acceptance;
7. prognosis of impact on environment
8. decisions, mentioned in Article 63, paragraphs 1 and 2 of p.e.i.
9. requests to give decision and about decisions about environmental conditions;
10. requests to give decision and about decisions mentioned in Article 72, paragraph 1 of p.e.i. given for projects likely to significant impact on the environment;
11. decisions, mentioned in Article 24, paragraph 1 of p.e.i.

Refusal of providing information

The p.e.i. states circumstances in which public authorities are obliged to refuse to provide information about environment and its protection. Because of the fact that the main principle is the possibility to gain the information on environment and its protection in its full scope, these circumstances are extraordinary and are specified in p.e.i. exhaustively. It means that the public authority may refuse to provide access to only in specific and clearly defined cases. Grounds for refusal should be interpreted in a restrictive way, and should consider if the public interest served by provision of the information does not outweigh the interest granted by the refusal.

Subject to article 17 of p.e.i., according the article 16 paragraph 1 of p.e.i., public authorities do not provide information about environment and its protection if the data consider:

1. unit data, obtained in public statistical surveys, protected by the statistical confidential, mentioned in an Act of 25.06.1995 on public statistics;
2. cases that are under court proceedings, disciplinary or criminal proceedings, if providing information can interfere with the proceedings;
3. cases of copyright, mentioned in Act of 04.02.1994. on Copyright and Related Rights or patent cases, mentioned in Act of 30.06.2000. on Industrial Property Law, if providing of this information can interfere with those cases;
4. personal data, mentioned in Act of 29.08.1997. on protection of personal data, considering the third persons if providing of this information can violate the rules on the protection of personal data;

5. documents or data provided by the third persons if those persons - not having the obligation to provide those information and couldn't be included by such obligation, provided such information or data and restricted possibility to share them;
6. documents or data which provision could cause a danger for environment and its protection
7. information of commercial value, including technical data, supplied by third parties and secrecy of company, if providing of such information would impair the competitive position of these individuals, and they have made a reasoned request for exemption sharing of such information;
8. projects likely to have significant effects on the environment, carried out in enclosed areas, which are not assumed to be conducted with the participation of the public as mentioned in Article 79 paragraph 2;
9. defense and national security;
10. public safety;
11. data contained in the register mentioned in the Act of 14.12.2012 on waste (considering data on:
 - a. terms of the agreement, the entity introducing the equipment to the market signed with the organization of recovery of electrical and electronic equipment;
 - b. financial security mentioned in Act of 29.07.005 on electrical and electronic equipment waste;
 - c. registration and annual fees;

According to article 17 of p.e.i. the administrative authority can deny an access to information about environment and its protection (the facultative refusal) if:

1. it would require to provide documents or data development;
2. it would require to provide documents or data intended for internal communication process;
3. the request is clearly impossible to realize;
4. the request is formulated too generally.

The administrative authorities, refusing providing information upon article 17 of p.e.i., should give a name of an authority responsible for the development of a document or data and inform about the expected date of the publication. If the request considers information, which is not held by the administrative authority, this authority immediately, but not later than within 14 days from the date of receiving the request:

1. forwards the request to the administrative body, which holds the requested information, and informs about this fact the applicant (according to article 65, paragraph 1, is applies accordingly);
2. returns the application to the applicant, if it is impossible to determine the authority mentioned in above point 1.

If the application is formulated too generally, the administrative authority immediately, but not later than within 14 days from the date of receiving the request, calls the applicant to complete the application, by providing relevant explanations, in particular, informs the applicant about a possibility of using publicly available lists mentioned in art. Paragraph 21 of p.e.i. Completing of the request does not exclude the possibility of a refusal to provide information, according to article 17, paragraph 4 of p.e.i.

The refusal of providing information about environment and its protection takes place by an administrative decision. Obtaining an administrative decision allows the applicant to file a complaint to the administrative court to control legality of acting of the administrative authority that made the decision. Such complaints are carried on according to the Act of August, 30th, 2002 - the Law on Proceedings in administrative courts (16), but:

1. transfer of the file and responding to the complaint takes place within 15 days from the date of receiving the complaint;
2. the complaint shall be considered within 30 days from the date of receipt of the file with the response to the complaint.

It needs clarification, that in case of refusal of providing information on the base of article 16, paragraph 1, points 4,5 or 7, the provisions of article 22 of a.p.i. should be applied.

CONCLUSIONS

Improving the condition of environment, especially because of its possible impact on the climate change, requires continuous progress of environmental awareness. This awareness is shaped also, but not only, by increasing public access to environmental information and spreading of this data. Such projects are a sine qua non for the free exchange of opinions, and laying foundations for more efficient, because knowledge-based, public participation in environmental decision-making. The accession of the European Community to the Aarhus Convention and by mean of further directives, to expand the public's right to information about environment, is thus a consistent, long-term operation of the European legislator aimed to set above goals. Analysis of existing legislation leads to the conclusion that the Polish legislator has created mechanisms to allow anyone to access the information on the environment and its protection. Some doubts may however raise in the context of the rigors of the Directive 2003/04 and giving the administrative authorities a facultative competences to refuse access to information about the environment and its protection, especially because of the discretionary nature of such refusals. De lege ferenda authors propose to consider the possibility of creating a normative act regulating access to information, including information about the environment and its protection. The proposal aims to simplify the public access to information which should be easily accessible for the society and fits in the current reducing bureaucracy in public life at the level of legislation.

REFERENCES

- BARCZEWSKA-DZIOBEK A, DZIOBEK-ROMAŃSKI J. (2010), Dostęp do informacji o środowisku naturalnym człowieka a realizacja prawa do dobrej administracji, „Prawo i Środowisko”;
- BUKOWSKI Z. (2002) Konstytucyjne podstawy obowiązków państwa w zakresie ochrony środowiska, „Prawo i Środowisko”;
- FLORKIEWICZ E. (2013) Dostęp do informacji o środowisku i jego ochronie. Komentarz praktyczny [w:] Prawo ochrony środowiska on-line, stan prawny na 9 listopad 2013 r.;
- GRUSZECKI K. (2013) Komentarz do art. 2 ustawy o udostępnianiu informacji o środowisku i jego ochronie, udziale społeczeństwa w ochronie środowiska oraz o ocenach oddziaływania na środowisko;
- GRUSZECKI K. (2013) Komentarz do art.4 ustawy o udostępnianiu informacji o środowisku i jego ochronie, udziale społeczeństwa w ochronie środowiska oraz o ocenach oddziaływania na środowisko;
- KŁACZYŃSKI M, SZUSTER M. (2013) Komentarz do ustawy z dnia 6 września 2001 r. o dostępie do informacji publicznej. Dz. U. 01.112.1198, Wolters Kluwer Lex Prestige;
- SKRZYDŁO W. (2013) Komentarz do art. 74 Konstytucji RP [w:] W. Skrzydło, Konstytucja Rzeczypospolitej Polskiej. Komentarz, stan na 1 stycznia 2013 r.: Wolters Kluwer, Lex Prestige online,;

Quality, environment, occupational health and safety and food safety management systems - Retrospective evolution of certification

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ABSTRACT: With technological advancement, the global growth and the growing prospects of human life, the concept of industrial development has changed. This change, along with the economic globalization process and increasingly competitive markets, has led many organizations to extend their business area, making it more comprehensive and differentiated in comparison with their competitors. During the last years a new organizational culture in Europe has been arising, concerning the management paradigm. Initially, limited to the industrial sector, but quickly spread to other activity sectors. This spreading resulted essentially from the economic globalization process and progressively competitive markets, which led to a lot of organizations implementing more comprehensive quality, environmental, occupational health and safety and food safety management systems. Being a strategic decision of high importance for the competitiveness and for the survival of the organizations, the diffusion of management systems already hit their values, on December 31 of 2013. About 1.110.000 organizations certified according to ISO 9001, 251.000 according the ISO 14001, 54.000 on the OHSAS 18001 and 26.047 according to ISO 22000. In the present article it will be presented the retrospective evolution of management systems certificates worldwide as well as their evolution process.

Keywords: *management systems, certification, quality, environment, occupational health and safety, food safety*

INSTRUCTION

In a globalized market, any organization that wants to be competitive or a market leader suffers increasingly competitive pressure, as well as, management strategies to enable it to respond adequately to the new challenges (Kondo, 2000; Billig & Camilato, 2008; Ferreira, 2009). Actually it has been found in Europe, the appearance of a new culture in the enterprise level, with regard to the organization management paradigm (Kondo, 2000). Initially limited to the industrial sector, but quickly spread to other sectors (Saizarbitoria et al, 2006).

The implementation of a management system, a set of interrelated business processes, which use resources to achieve the different organizational objectives (Saraiva & Sampaio, 2010), does not require a minimum level of organizational performance, or achieve a result predefined, but must contribute to that. Establishes the need to systemize and formalize a set of business processes related to the different business areas (Seddon, 2000). The emergence and proliferation of management systems meant that the organizations could withstand in basic principles of systematization and formalization of responsibilities (Karapetrociv et al., 2006).

The global phenomenon of diffusion and evolution of management systems is a matter with opportunities and threats. In terms of opportunities, it stands out from the global experience and the accumulated knowledge of various stakeholders to date, enabling it to become increasingly able and easier to perform the implementation and the certification of new normative referential (Franceschini et al, 2004). On the other hand, a potential threat can arise from market saturation, in terms of certification, which is already beginning to be visible around some countries. This matter can affect the image and value of certification, if is not able to implement unregulated competitive mechanisms (Franceschini et al., 2006) (Sampaio et al, 2011).

However, there are currently several possible paths to follow in order to avoid that threat, according to different stakeholders (organizations, certification and accreditation bodies, consultants, etc.). One possible solution is to adopt regulatory frameworks that are important, necessary and able to provide added value for the organizations that implement those (Saraiva & Sampaio, 2010).

The purpose of this study was to perform a retrospective analysis of the evolution of the most common standards in the world, in particular quality, environment, occupational health and safety and food safety management systems.

METHODOLOGY

The information, which served as a support to this retrospective study, and further analysis, was based on the ISO survey with data until 2013 and OHSAS Survey with data until the year of 2009, as well as scientific publications.

For analysis, it was selected the relevant standards most commonly used by organizations, namely ISO 9001 (Quality Management System), ISO 14001 (Environmental Management System), OHSAS 18001 (Occupational Health and Safety Management Systems) and ISO 22000 (Food Safety Management System).

RESULTS AND DISCUSSION

Based on the available data (ISO, 2014) there were, until the end of 2013, 1.129.446 organizations with certifications according to ISO 9001, spread across 187 countries (Figure 1). In terms of quality management system certification, the evolution until 2002 showed a growth, particularly sharp, between 1993 and 2002. The number of certificates issued worldwide increased from 46,571 to 561,766. The downturn in the evolution of the number of certified organizations, in 2003, is mainly due to the fact that the transition to the standard 9001:2000 have not been made by a several number of organizations (ISO 2004). Since 2003, growth retook the previous dynamics, having been a slight deceleration from 2007.

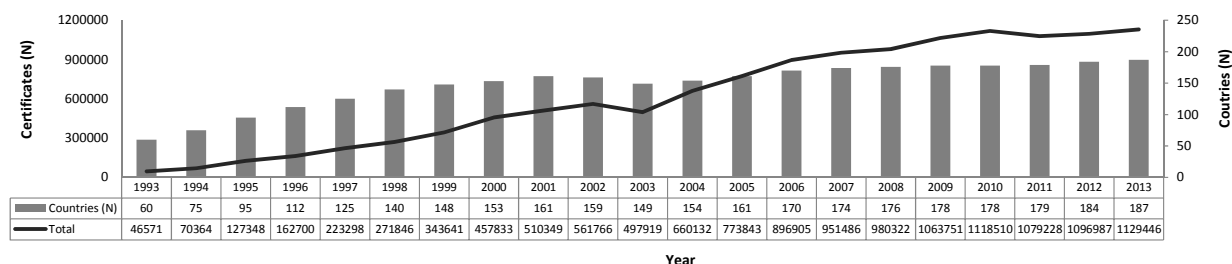


Figure 1 - ISO 9001 certification.

In Figure 2 it can be see an evolution in almost all regions, highlighting the regions "Europe" and "East Asia and Pacific", as those that hold a larger number of certifications in accordance with ISO 9001. The European benchmark level had an increase of 15,815 certificates in the year 2012, and the total certifications in 2013, represents 43% in all certificates worldwide. In the region "East Asia and Pacific" it was found a decrease of 8,786 certifications in 2013, since the year 2012. These two regions represent 84.4% of all certifications, in December 31, 2013.

Although the region "Europe" increased the number of certified according to ISO 9001, this growth has been declining, against the entire number of certifications worldwide. In 1993, Europe held 81.1% of the certificates and by the end of 2013 held only 43%.

The latest numbers, show a decrease in the percentage of certificates comparing to other regions, such as "Africa" and "North America". The remaining regions had an increase in certification percentage, being the region where this increase was more pronounced, the "East Asia and Pacific", going from 10.2% in 1993 to 41.4% in 2013.

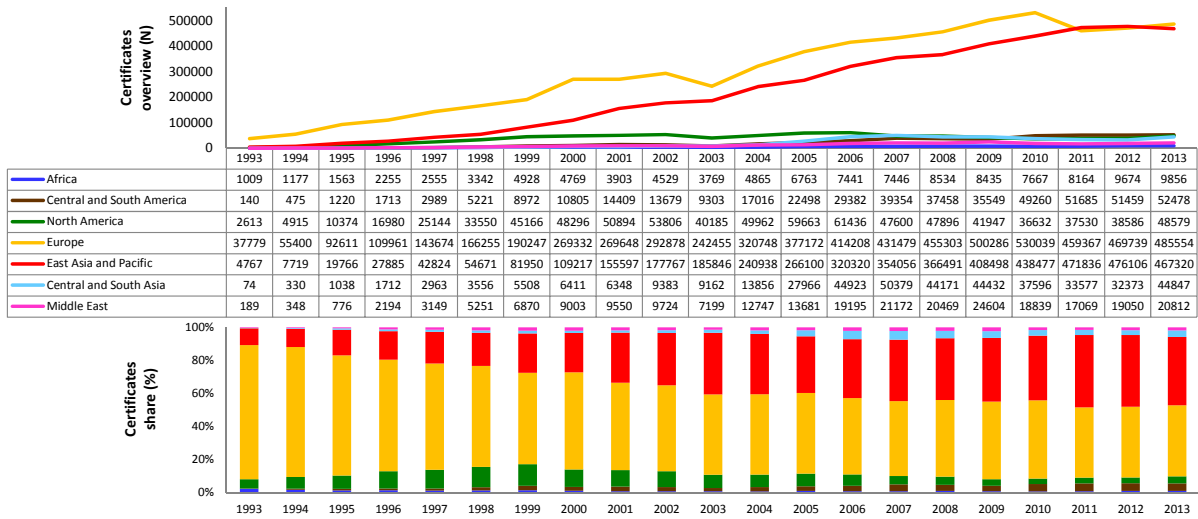


Figure 2 - ISO 9001 worldwide certification, in absolute terms and percentage.

In the environmental management system, there was a similar phenomenon like the certification of quality management systems, although in a different scale (Figure 3). The certification growth rate remains substantially constant since 2001. As mentioned, the evolutionary patterns of both management systems are similar. In spite of their different levels, they have similar evolutionary dynamics of growth, showing a positive association between the evolutions of both systems (Sampaio et al., 2008). There has been a global increase of 16.993 in 2013, compared to 2012, existing 301.647 certificated organizations, spread over 171 countries, in December 31, 2013.

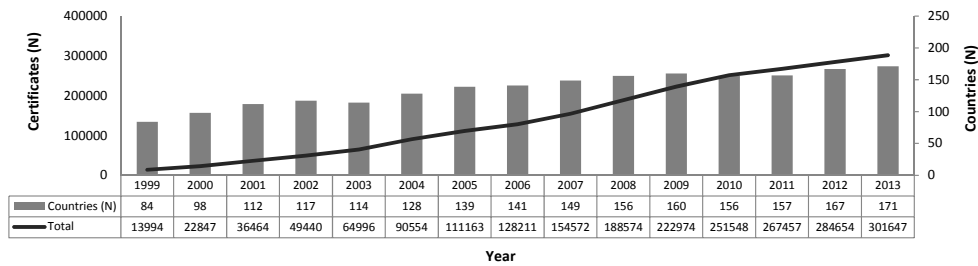


Figure 3 - ISO 14001 certification.

The Figure 4 reflects the development of the certification according to ISO 14001, globally, by region. It can be observed an increase in all regions, in particular the regions of "Europe" and "East Asia and Pacific", as occurred in the data for ISO 9001. In "Europe" there was an increase of 7.197 certificates in 2013, comparing to 2012. The region of "East Asia and Pacific" found an increase of 5.020 certificates, at the end of 2013 in comparison with 2012. These regions together accounted for 89.6% of worldwide certificates, in December 31, 2013.

Regarding the percentage of growth, it can be seen that, the trend already observed in ISO 9001, is reflected in this standard. Thus, it can be observed, that "Europe", despite the growing number of certificates, has been declining against the total of certificates. In 1999, this region boasted 51.8% of certificates and by the end of 2013, just 39.5%. The region with the highest percentage growth was the "East Asia and Pacific", growing from 36.6% in 1999, to 50.1% by the end of 2013.

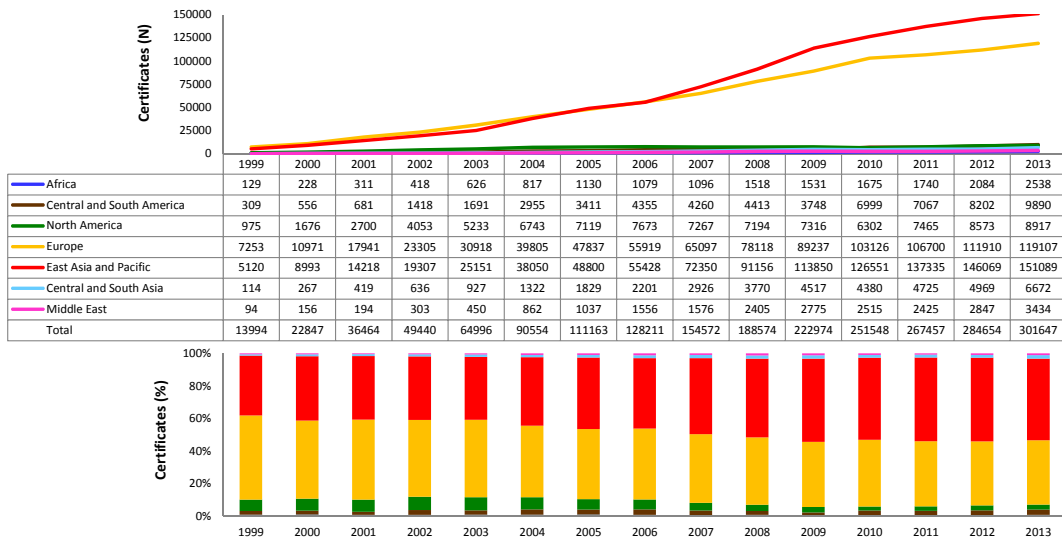


Figure 4 - ISO 14001 worldwide certification, in absolute terms and percentage

Regarding the certification in occupational health and safety management system, according to OHSAS 18001, a survey was carried out by the OHSAS Project Group. However, for various reasons, OHSAS Project Group was unable to receive input from a number of entities that contribute to the 2008 survey (OHSAS, 2010). Nevertheless, it can be seen in Figure 5 that existed in December 31 of 2009, 54,357 certified entities, spread over 116 countries, reflecting an increase of 390%, between 2003 and 2009.

With regard to the management system certification in occupational health and safety, it has been shown, over the last few years, a significant increase in the number of certifications, higher than the growth of other standards. This management system, however, shows a dynamic growth similar to the other systems presented.

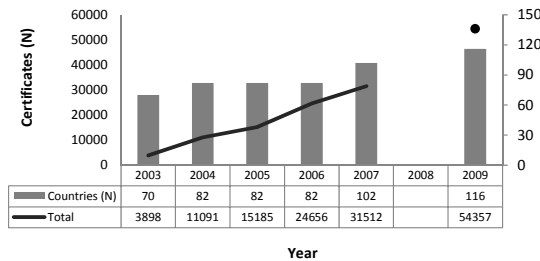


Figure 5 - OHSAS 18001 certification.

The certification according to ISO 22000 (Figure 6) on the food safety management system, the growth rate remains almost constant since 2007. It was stagnated between 2010 and 2011, but there was a 3569 world growth in 2013, compared with 2012. Existing about 26,847 entities certified according to ISO 22000, spread over 142 countries, in December 31, 2013.

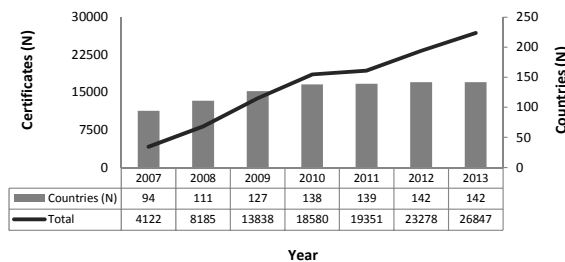


Figure 6 - ISO 22000 certification.

Figure 7 reflects the evolution of the ISO 22000 certification framework, and it can be seen an increase in all regions. The most distinctive regions were "Europe" and "East Asia and Pacific". In Europe there was an increase of 1,426 certifications, from 2012 to 2013. And in "East Asia and Pacific" region there was an increase of 1,477 certifications in the end of 2013, over the year 2012. These regions together represented 83% of all certifications worldwide, in December 31, 2013.

Regarding the percentage of growth, we find that "Europe" has been declining against the entire certifications worldwide. In 2007 this region boasted 66.7% and by the end of 2013 only 36.3%. The region with the highest percentage growth is "East Asia and Pacific", growing from 17.1% in 2007 to 46.8% by the end of 2013.

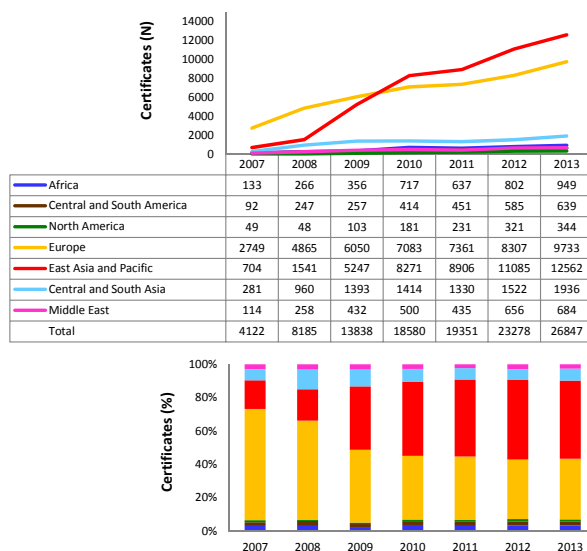


Figure 7 - ISO 22000 worldwide certification, in absolute terms and percentage

The diverse needs of the organizations bring an expected different in order of management systems. These differences vary from organization to organization and from business sector to business sector. In most cases, the order of implementation followed the natural order of publication of the standards. The organizations got their certificates gradually, being the first certificate in accordance with ISO 9001, then ISO 14001 and finally according to the OHSAS 18001 (Sampaio & Saraiva, 2010).

CONCLUSIONS

The last decades of the twentieth century witnessed the emergence of a new culture in the enterprises, in general, in regard to the organization's management paradigm. The adoption of management systems is, nowadays, a strategic decision of great importance for the competitiveness and sustainability of organizations.

This reason, among others, led organizations to certificate according to the management systems. In fact there was a very significant increase in all reference standards, over the years, and in all regions, including the "Europe", "East Pacific and Asia". Although there was an increase in the number of certificates according to ISO 9001, ISO 14001 and ISO 22000, in Europe the growth could not keep up with the other trend continents, it was seen a sharp decline in European numbers. OHSAS 18001, besides not being able to provide a lot of data (even because the fact that the OHSAS standard will soon be revoked by an ISO standard), there was a significant increase in the certifications numbers between 2003 and 2009.

Despite the phenomenon of opportunities that the progress and dissemination of the global management system brought, it also can be seen as a threat. Part of the threat may come from market saturation, reality that has been observed in some countries. An opportunity of study is to relate the European economic situation and the decrease in the number of certificates, framework that is different from the reality observed the other countries worldwide.

REFERENCES

- Billig, O.; Camilato, S. (2008). Sistema de gestão integrada de qualidade, segurança, meio ambiente e saúde. Unisinos. São Leopoldo.
- Ferreira, M. (2009). Capacidade de inovação empresarial e políticas públicas de incentivos. Universidade de Aveiro.
- Franceschini, F.; Galetto, M.; Cecconi, P. (2006). A worldwide analysis of ISO 9000 standard diffusion. *Benchmarking: An International Journal*, 13(4), 523-41.
- ISO (2004), The ISO Survey of Certifications 2003. International Organization for Standardization, Geneva.
- ISO (2014), The ISO Survey of Certifications 2013. International Organization for Standardization, Geneva.
- Karapetrovic, S.; Casadesús, M.; Heras I. (2006). Dynamics and integration of standardized management systems – an empirical study. Universitat de Girona.
- Kondo, Y. (2000). Innovation versus standardization. *The TQM Magazine*, 12(1), 6-10.
- OHSAS (2010), The OHSAS Survey of Standards and Certifications 2009. British Standards Institution, London.
- Saizarbitoria, I.; Landín, G.; Casadesús, M. (2006). The impact of quality management in European companies' performance - The case of the Spanish companies. *European Business Review*, 18(2), 114-131.
- Sampaio, P.; Saraiva, P. (2010), Integração ou adição de sistemas de gestão? Associação Portuguesa para a Qualidade - Revista Qualidade, Vol. Primavera-Verão, pp. 36-40.
- Sampaio, P.; Saraiva, P.; Rodrigues, A. (2011). ISO 9001 certification forecasting models. *International Journal of Quality & Reliability Management*, 28(1), 5-26.
- Seddon, J. (2000). The Case Against ISO 9000. Oak Tree Press: Dublin, Ireland.

Radon activities of thermal water in Turkish thermal baths in Central Anatolia

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ABSTRACT: Since ancient times, Turkish thermal baths are used for therapeutic purposes by local people (From pre-Roman to Present). Workers and visitors in Turkish thermal baths are exposed to radiation from radon and short-lived daughters. For this reason, radon (^{222}Rn) activity concentrations in the thermal waters of 11 Turkish thermal baths located at Central Anatolia were measured by using AlphaGUARD PQ 2000PRO radon gas analyzer. It was also shown the relation between the thermal water resources and the geological structure of the area. The radon concentrations were found to be between 0.33 and 17.76 Bq l⁻¹ for autumn and winter seasons of 2012. We also calculated effective doses related to inhalation per treatment in the Turkish thermal baths for the two seasons. The calculated minimum and maximum effective doses per treatment was found to be range of 0.07-1.9 fSv for mean radon activity of two seasons.

Keywords: Central Anatolia, radon, effective dose, thermal water

INTRODUCTION

Radioactive elements and their products are found throughout nature. Detectable amounts occur naturally in soil, rocks, water, air and vegetation, from which it is inhaled and ingested into the body. In addition to this internal exposure, humans also receive external exposure from radioactive materials that remain outside the body and from cosmic radiation from space. Both natural and artificial radiation varies by location. Radon and its short-lived decay products is the most important natural source of radiation which people are exposed (UNSCEAR, 2000). It is also a colorless, odorless, tasteless and radioactive noble gas, and therefore not detectable by human senses alone. At standard temperature and pressure, radon forms a monatomic gas with a density of 9.73 g l⁻¹ (UNSCEAR, 1993). Its most stable isotope, ^{222}Rn , has a half-life of 3.82 days and is generated from radioactive transformation of ^{226}Ra (Radium) in the decay chain of ^{238}U . Its radioactive daughter isotopes ^{214}Po (Polonium) and ^{218}Po decay by emitting 7.69 and 6.00 MeV α particles, respectively. They also contribute over 90% of the radiation dose received by people due to radon exposure (Gillmore et al., 2001). The inhalation of air containing high level of the radon gas and ingestion of water may cause a direct risk to the population health because sensitive cells in the respiratory and gastrointestinal tracts are exposed to ionize radiations, lead to disease due to the occurrence of some cancer types in these organs (ICRP, 2007; Zamboni, 2002).

Radon is soluble in water and its solubility depends on various factors such as temperature and pH of the water itself. Therefore, dissolved radon in water can be transported via ground waters very far from its original place in a short time (Erees et al., 2007). The ground water circulating in active volcanic areas displays high radon content, especially if issued from geothermal systems (D'Alessandro & Vita, 2003). Because, during transport of the liquid, radon gas escapes from the rocks and minerals to the surrounding liquid phase such as ground and thermal waters (Erdogan et al., 2013). The evaluation of radon concentrations is important for both the public health and many other applications. The high concentrations of radon in the ground and thermal waters may cause a great risk not only for people who ingest it, but also in the air for people who inhale it (Villalba et al., 2005). However, the monitoring radon concentration is highly related to the geologic formation (Sac et al., 2011).

This paper reports the results of radon activity of thermal water in the Turkish baths measured during autumn and winter of 2012 in the study area. Radon measurements and effective dose calculations for autumn season were previously presented as talk presentation at 8th Conference on Sustainable Development of Energy, Water and Environment Systems in Croatia (Erdogan, 2013). However, the

obtained results for the winter season were compared with those for the autumn season. Also, the relation between the thermal water resources and the geological structure of the area is shown. This study also draws a general picture of the natural radioactivity of thermal waters in Turkish baths of Nevşehir, Aksaray and Niğde provinces (as shown Fig. 1) and evaluates the doses to the populations resulting from their consumption. Therefore, the results are very important for public health as a lot of people use thermal waters for therapeutic purposes.

GEOLOGICAL BACKGROUND

Because Turkey is squeezed between the northerly moving Afro-Arabian Plate in the south and southerly moving giant Avrasiatic plate in the north, the country has an extremely complex geology. As a result of this compression, several types of rocks including intrusive, extrusive, sedimentary and metamorphic rocks can be seen even in relatively small areas. Closure of Tethyan Ocean resulted the occurrence of ophiolitic rocks which subsequently overlain metamorphic basement such as Menderes Massive in the West and Central Anatolian Massive in the center. In the Central Anatolia, the recent geology has been pictured by Mt. Hasandağı and Mt. Erciyes volcanic activity. The erupted materials of Mt. Erciyes are mainly andesite-dasite and rhyolite lavas of subductuion-related mantle instead of original mantle sourced magma (Dogan et al., 2013).

Intrusive and extrusive magmatic rocks were mostly formed during Cenozoic. While the Aksaray-Niğde granitoids represent intrusive activity, Hasandağı and Erciyes dasite-andesite-rhyolite-basalt and tuffs (including well-known Cappadocian tuffs and basalts) represent volcanic activity in the region. The Tertiary times witnessed the formation of several types of sedimentary rocks including detrital, lacustrine and marine sediments. Diversity is not limited to rock type. Several types of tectonic features (thrust, reverse and normal faults, folds, horsts and grabens) also displayed in the region. A wide variety of metal and industrial raw material deposits have also been formed.

Since the beginning of the closure of Tethyan Ocean during Mesozoic, the simultaneous tensile and compressive tectonic movements caused the complication of the Anatolian geology. In particular, during and after the Oligocene times extensional tectonic regime is in effect in Western and Central Anatolia. This regime gave rise many hot springs along the faults in the Aksaray, Nevşehir and Niğde region which is the subject of this study. The heat source is geothermic gradients while the water source is largely meteoric in many thermal springs (Pasvanoğlu & Chandrasekharam, 2011). Figure 2 summarizes the general geological, structural and hydrogeological situation regardless true scale and geography in the region. Turkish thermal bath locations can be also shown in Figure 1.



Figure 1- Water sampling locations

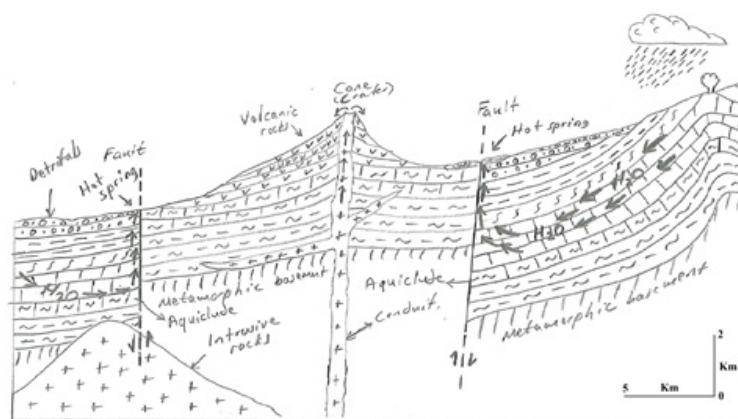


Figure 2- Sketch geological cross-section of Central Anatolian region related to structural and hydrogeological-hydrothermal system

The thermal springs of Çelikhhan, Nargölü (or Narlıgöl) and Çiftelhan are found within Niğde province. In general, there has been a metamorphic basement at the bottom, some marine-micritic, reddish limestones, ophiolites with volcanic rocks cover this basement at Çiftelhan (Toroğlu & Ceylan, 2013). Toroğlu and Ceylan stated that the Narlıgöl thermal springs formed in a caldera system which is developed over the rhyolitic (0.5 my ago) and basaltic volcanism (50 000 y ago). Especially, the

Çiftehyan thermal springs is situated on micritic limestones of Çiftehyan Formation named as Kirkgeçit formation by Çevikbaş and Öztunalı (Çevikbaş & Öztunalı, 1992).

The thermal springs of Kozaklı (Nevşehir) have a mixing history with formation waters and cold, near-surface groundwater (Pasvanoğlu & Chandrasekharam, 2011). Pasvanoğlu and Chandrasekharam (Pasvanoğlu & Chandrasekharam, 2011) also point out that the trace element contents of the thermal water indicate a major role of Miocene marls to the hydrothermal system in the Kozaklı region. The reservoir temperature is about 125°C in all over Central Anatolia (Mutlu & Güleç, 1998). The main younger (Eocene to Holocene) rock units in the area are gypsum, silt, marl, tuff, ignimbrite, limestone, travertine and alluvium (Çetin, 2011).

The thermal springs of Ziga (Aksaray) is a part of Ihlara Valley. The travertines (old and new) around the spring were formed by emerging of hydrothermal waters along faults (Karabacak, 2007). Karabacak (Karabacak, 2007) has divided travertines into three: fissure-ridge (I), eroded-sheet (II) and terraced-mound. Tuffs and ignimbrites are the main surface rocks in the region.

EXPERIMENTAL METHOD

The AlphaGuard radon monitor, is an example of an active electronic device that uses an ionisation chamber that allows for detection through alpha spectroscopy. It has the added option to pump air into a 0.56-liter cell or by means of diffusion. The two common isotopes of radon ^{222}Rn and ^{220}Rn can be identified through their respective energies from the alpha decays. The signal arising from the alpha detection is then filtered and then converted to a digital output that can be readily processed with the AlphaGuard or relayed to a PC via a RS-232 cable (Fathabadi et al., 2013). The ionization chamber designed for measuring radon in air, water and soil gas. AquaKIT is used for water measurements. In a closed gas cycle, radon was expelled from the water samples (placed in a degassing vessel) using a pump. The security vessel was connected with the degassing vessel. All water droplets would deposit in it if they had got into the gas cycle during the degassing process. For the radon monitor, this way the stress of the water vapor was minimized. Before every water-sample measurement, the background of empty set-up was measured for a few minutes (Akar Tarim et al., 2011). The pressure of the water vapour was thus minimized for the radon monitoring. Before every water-sample measurement, the background of the empty set-up was measured for 10 minutes. After that, the water was injected into the degassing vessel, and the AlphaGUARD and AlphaPUMP were switched on. After 10 minutes, the pump was switched off and the AlphaGUARD remained switched on for another 20 minutes, so the radon measurement was continued. In order to obtain a better precision this cycle was repeated three times (Kochowska et al., 2004; Schubert et al., 2006; Erdogan et al., 2013). The radon concentration was recorded every minute while the AlphaGUARD monitor worked in a 'flow' mode. The flow rate was 0.5 l min^{-1} of the pump. The AlphaGUARD ionization chamber is a part of this gas cycle as well. The radon concentration was determined with the AlphaGUARD in the water samples. Because of the radon driven out had been diluted in air within the measurement set-up, and a small part determined by the partition coefficient of the radon remained diluted in the aqueous phase, the value measured by the AlphaGUARD is not the radon concentration in the water sample. For quantifying the dilution effect, the exact interior volume in the measurement set-up (V_{system}) is required. The amount of radon remaining can be determined by the introduction of the partition coefficient k in the sample which describes the temperature and salinity dependence of the radon remaining chemically dissolved in the sample. The more detailed description and discussion of this experimental technique can be found in Kochowska et al. (Kochowska et al., 2004) and Schubert et al. (Schubert et al., 2006). The radon activity of the thermal water samples in the Turkish baths can be determined by the following equation (Saphymo, 2008).

$$C_{\text{water}} = \frac{C_{\text{air}} \left(\frac{V_{\text{system}} - V_{\text{sample}}}{V_{\text{sample}}} - k \right) - C_0}{1000} \quad (1)$$

In this equation, C_{water} is the radon concentration in water sample (Bq l^{-1}), C_{air} the radon concentration (Bq m^{-3}) in the measuring set-up after expelling the radon indicated by the AlphaGUARD), C_0 the radon concentration in the measuring set-up before sampling (zero level) (Bq m^{-3}), V_{system} the interior volume of the measurement set-up (ml), V_{sample} the volume of the water sample (ml), k the radon partition coefficient.

RESULTS AND DISCUSSION

Water temperature and radon activity of the thermal water samples collected from 11 different Turkish thermal baths in the regions of Aksaray, Niğde and Nevşehir cities was determined for autumn (Erdogan, 2013) and winter and averaged for the seasons as shown in Table 1. According to the results, it is seen that radon activity measurements for winter season is higher than autumn except for samples #7,10. Reason of seasonal variation might be due to the fact that thermal water in some baths is mixed water from other water resources with very low or high radon concentration. This situation is also supported by the fact of that the measured pH value of the water samples to be different for the two seasons as shown in Table 1. Arithmetic mean of radon activity results varied from 0.47 Bq l⁻¹ to 12.87 Bq l⁻¹ for two seasons. While the highest averaged radon activity of 12.87 Bq l⁻¹ was measured for the sample #8 in the Nevşehir region, the lowest averaged radon activity level of 0.47 Bq l⁻¹ was measured for sample #1 in the region of Aksaray. As a result, while the region with the highest averaged radon activity of 6.30 Bq l⁻¹ is Nevşehir region, the region with lowest averaged radon activity of 0.47 Bq l⁻¹ is Aksaray region. In the area that we studied, there has been no positive and negative correlation between water temperature and radon concentrations of the water. Radon concentrations and temperature have great variations even between adjacent springs. This may have been resulted from different pathway of the water interact variety of rocks and mixing of deep-seated thermal water with superficial local cold water.

Table 1 – ²²²Rn activity for some Turkish thermal baths and the contribution of radon activity in the thermal water to indoor radon activity, mean effective dose of the thermal water for the inhalation and pH values of the waters for two seasons

Samples	Place	Radon activity (Bq l ⁻¹) / Temperature(°C)		Aritmetic Mean	Mean Contribution (Bqm ⁻³)	Mean Effective dose (fSv)	pH (Autumn-Winter)
		Autumn*	Winter				
1	Aksaray	0.38 / 40	0.55 / 47	0.47 / 44	0.05	0.07	7.3-6.5
2	Niğde	1.19 / 45	1.67 / 44	1.43 / 45	0.14	0.20	8-11.6
3	Niğde	0.58 / 42	1.48 / 43	1.03 / 43	0.10	0.14	7-7.8
4	Niğde	2.15 / 48	2.90 / 48	2.53 / 48	0.25	0.36	9-8.6
5	Nevşehir	2.39 / 63	3.34 / 68	2.87 / 66	0.29	0.42	8.4-9.2
6	Nevşehir	4.47 / 59	8.80 / 65	6.64 / 62	0.66	1	7-8.1
7	Nevşehir	9.98 / 51	1.56 / 45	5.77 / 48	0.58	0.83	6.7-7.3
8	Nevşehir	7.97 / 49	17.76 / 45	12.87 / 47	1.29	1.9	7-8.3
9	Nevşehir	7.53 / 53	11.95 / 57	9.74 / 55	0.97	1.4	6.3-7.2
10	Nevşehir	0.84 / 52	0.33 / 43	0.59 / 48	0.06	0.08	7.9-7.3
11	Nevşehir	4.90 / 52	6.32 / 45	5.61 / 49	0.56	0.81	8.1-7.3

(Erdogan, 2013)

In Turkey, there are some studies on radon activity of thermal waters close to the study area. The Konya (Erdogan et al., 2013), Bursa (Gurler et al., 2010) and Afyonkarahisar (Akkurt, 2006) regions have 0.60-70.34, 2.51-82.55, 0.09-44.57 Bq l⁻¹ ²²²Rn respectively. There are also reports with regard to the radon activity of thermal waters in some other countries such as, the radon activity of thermal waters of Greece (Vogiannis et al., 2004), Venezuela (Horvath et al., 2000) and Spain (Soto et al., 1995) were reported to be 10-304, 1-576, 824 Bq l⁻¹, respectively. It can be seen that the reported values are generally higher than those obtained in this study around of Aksaray, Niğde and Nevşehir cities of Turkey.

In general, the radon concentrations are higher in winter than in autumn (Table 1). Because, the soil in winter months have a higher temperatures than air, and this give rise more transportation of radon movement through surface (Klusmand & Jaacks, 1987).

Radon is assumed that 10 kBq m⁻³ of ²²²Rn in water contributes about 1 kBq m⁻³ of the radon to the indoor air (UNSCEAR, 2000). Therefore, it may lead to exposure from the inhalation of radon when water is used especially for thermal bath. For this study, the average contributions of mean radon concentration levels for two seasons to indoor radon can easily be obtained from the radon activity values from Table 1 as shown in Table 2. For the estimate the effective indoor dose, the conversion

coefficient has to take into account from an absorbed dose of air to the effective dose and the occupancy factor. According to the UNSCEAR report, a value of 9 nSv h^{-1} per Bq m^{-3} was used for the conversion factor that shows effective dose received by adults per unit ^{222}Rn activity per unit of air volume, 0.4 for the equilibrium factor of ^{222}Rn indoors and 0.8 for the indoor occupancy factor (UNSCEAR, 2000). A treatment session generally lasts about 30 minutes for Turkish thermal baths. Mean effective doses for inhalation were calculated for a 30 minute treatment period in the baths, and range from 0.07 to 1.9 nSv for autumn and winter seasons as shown in Table 1.

CONCLUSIONS

We have performed radon activity of thermal water in some Turkish thermal baths located at Central Anatolia. Analyses of the results remark that the highest radon activity in Nevşehir region has been found in the sample #8. USEPA (The United States Environmental Protection Agency) has recommended 11.1 Bq l^{-1} in water as the safe limit (USEPA, 1991), whereas the World Health Organization (WHO) has recommended 100 Bq l^{-1} in water as the safe limit for drinking purposes (WHO, 2008). According to the results, only sample #8 is slightly higher than recommendation of USEPA (USEPA, 1991), other water samples are within the USEPA safe limit especially for drinking purposes. The thermal waters of the Turkish thermal baths are not generally used for drinking. The source of water in any geothermal systems in intercontinental areas, as in the Central Anatolian region, could have been meteoric, while the source of heat is geothermic gradient. The faults and related fracture systems play an important role as hydrothermal conduits for thermal water in the region.

REFERENCES

- Akkurt, A. (2006). Determination of Radon Concentrations in Geothermal Waters in Afyon (Afyonkarahisar). Ms. C. Thesis Afyon Kocatepe University.
- Akar Tarim U., Gurler O., Akkaya G., Kilic N., Yalcin S., Kaynak G. & Gundogdu O. (2011). Evaluation of radon concentration in well and tap waters in Bursa, Turkey. *Radiation Protection Dosimetry*, 150(2), 207-212.
- Çetin, T. (2011). Kozaklı (Nevşehir) spas as regards to thermal tourism potential. *Turkish studies, International periodical for the languages, literature and history of Turkish or Turkic*, 6(1), 899-924.
- Çevikbaş, A. & Öztunalı, Ö. (1992). Ulukışla-Çamardı (Niğde) Mestrihtiyen sonrası çökel havzasının jeolojisi (in Turkish), geology of sedimentary basin after Mestrihtiyen in Ulukışla-Çamardı (Niğde) (in English). *Journal of General Directorate of Mineral Research and Exploration*, 114, 155-172.
- Dogan, A. U., Peate, D. W., Dogan, M., Yeşilyurt-Yenice, F. I. & Unsal, O. (2013). Petrogenesis of mafic-silicic lavas at Mt. Erciyes, central Anatolia, Turkey. *Journal of Volcanology and Geothermal Research*, 256, 15-28.
- Erdogan, M. (2013). Measurements of radon concentrations in thermal water in some Turkish baths. *8th Conference on Sustainable Development of Energy, Water and Environment Systems*. Dubrovnik, Croatia.
- Erdogan, M., Ozdemir, F. & Eren, N. (2013). Measurements of radon concentration levels in thermal waters in the region of Konya, Turkey. *Isotopes in Environmental and Health Studies*, 49(4), 567-574.
- Erees, F.S., Aytas S., Saç, M.M., Yener G. & Şalk M. (2007). Radon concentrations in thermal waters related to seismic events along faults in the Denizli Basin, Western Turkey. *Radiation Measurements*, 42, 80-86.
- Fathabadi, N., Mohammadi, M., Dehghani, R., Kardan, M., Atoof, F., Farahani, M.V. & Moradi, M. (2013). The Effects of Environmental Parameters on the Radon Exhalation Rate from the ground Surface in HBRA in Ramsar with a Regression Model. *Life Science Journal*, 10, 563-569.
- Gillmore, G.K., Phillips, P., Denman, A., & Sperrin, M. & Pearce, G. (2001). Radon levels in abandoned metalliferous mines, Devon, Southwest England. *Ecotoxicology and Environmental Safety*, 49, 281-292.
- Gurler, O., Akar, U., Kahraman, A., Yalcin, S., Kaynak, G. & Gundogdu, O. (2010). Measurements of Radon Levels in Thermal Waters of Bursa, Turkey. *Fresenius Environmental Bulletin*, 19(12), 3013-3017.
- Horvath, A., Bohus, L.O., Urbani, F., Marx, G., Piroth, A. & Greaves, E.D. (2000). Radon Concentrations in Hot Spring Waters in Northern Venezuela. *Journal of Environmental Radioactivity*, 47(2), 127-133.
- ICRP, (International Commission on Radiological Protection), (2007). The 2007 Recommendations of the International Commission on Radiological Protection. *ICRP Publication 103. Annals of the ICRP*.
- Karabacak, V. (2007). General properties of Ihlara Valley (central Anatolia) travertines and their implications on crustal deformation. *Journal of Engineering and Architectural Faculty, Eskişehir Osmangazi Univ. (in Turkish, with English abstract)*, 20 (2), 65-82.

- Kochowska, E., Mazur, J., Kozak, K. & Janik, M. (2004). Radon in Well Waters in the Krakow Area. *Isotopes in Environmental and Health Studies*, 40, 207-212.
- Klusman, R.W. & Jaacks, J. A. (1987). Environmental influences upon mercury, radon and helium concentrations in soil gases at a site near Denver, Colorado. *Journal of Geochemical Exploration*, 27(3), 259-280.
- Mutlu, H. & Güleç, N. (1998). Hydrogeochemical outline of thermal waters and geothermometry applications in Anatolia (Turkey). *Journal of Volcanology and Geothermal Research*, 85, 495-515.
- Pasvanoğlu, S. & Chandrasekharam, D. (2011). Hydrogeochemical and isotopic study of thermal and mineralized waters from the Nevşehir (Kozaklı) area, Central Turkey. *Journal of Volcanology and Geothermal Research*, 202, 241-250.
- Sac, M.M., Harmanşah, C., Camgöz, B. & Sözbilir, H. (2011). Radon monitoring as the earthquake precursor in fault line in western Turkey. *Ekoloji*, 20, 93-98.
- Saphymo, (2008). Determination of the radon concentration. *AquaKIT manuel*, Page:13.
- Schubert, M., Buerkin, W., Pena, P., Lopez, A.E. & Balcazar, M. (2006). On-site determination of the radon concentration in water samples: methodical background and results from laboratory studies and a field-scale test. *Radiation Measurements*. 41, 492-497.
- Soto, J., Fernandez, F.L., Quindos, L.S. & Gomez-Arozamena, J. (1995). Radioactivity in Spanish Spas. *The Science of the Total Environment*, 162(2-3), 187-192.
- Toroğlu, E. & Ceylan, S. (2013). The problems and solutions about hot spring, drinking water and natural mineral in the territory of Niğde. *Doğu Coğrafya dergisi-Eastern Geographical review*, 18(30), 47-70.
- UNSCEAR, (United Nations Scientific Committee on the Effects of Atomic Radiation), (1993). Exposures from natural sources of radiation. *Annex A*, United Nations, 45-46.
- UNSCEAR, (United Nations Scientific Committee on the Effects of Atomic Radiation), (2000). Sources, effects, and risks of ionizing radiation. *Annex B*, United Nations, 96-109.
- USEPA, (United States Environmental Protection Agency), (1999). National primary drinking water regulations; radon-222; proposed rule. 64(211), 59246-59252.
- Villalba, L., Sujo, L.C., Cabrera, M.E.M., Jimenez, A.C., Villalobos, M.R., Mendoza, C.J.D., Tenorio, L.A.J., Rangel, I.D. & Peraza, E.F.H. (2005). Radon Concentrations in Ground and Drinking Water in the State of Chihuahua, Mexico. *Journal of Environmental Radioactivity*, 80(2), 139-151.
- Vogiannis, E., Nikolopoulos, D., Louizi, A. & Halvadakis, C.P. (2004). Radon Exposure in the Thermal Spas of Lesvos Island-Greece. *Radiation Protection Dosimetry*, 111(1), 121-127.
- D'Alessandro, W., & Vita, F. (2003). Groundwater Radon Measurements in the Mt. Etna Area. *Journal of Environmental Radioactivity*, 65, 187-201.
- WHO, (The World Health Organization), (2008). Guidelines for drinking-water quality. 1, Geneva, 206-207.
- Zamboni, M. (2002). Epidemiologia do cancer do pulmao. *J. Pneumol*, 28, 41-47.

Relationship between mental illness or intellectual disability and homeless life

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ABSTRACT: [Background] Several studies reported the prevalence of mental illness or intellectual disability of homeless was high. However, few studies have investigated how the mental illness or intellectual disabilities have an influence on the homeless people life. Cross-sectional studies focusing on mental problem among homeless people should be required. In this study, we comprehensively assessed the impact of mental problems on the homeless people life in Nagoya, Japan. [Methods] The subjects were 18 homeless men. We diagnosed their mental illness and intellectual disability and divided them into three groups: I, without mental problems; II, with mainly mental illness; III, with mainly intellectual disability. We also interviewed them using two questions: "Why did you fall into the street life?" and "Why is it difficult with you to get out of the street life?" We analyzed the relationship between the reasons of falling into or difficulty getting out of homelessness and the mental or intellectual disabilities. [Results] Five, five, eight of the 18 participants were categorized into three groups. Individuals in Group I tended to have financial problems including debt and did not to want to resolve their current homeless state. Group II individuals had difficulties involving human relationships. Group III individuals appeared to be unaware of their current situation and unable to resolve their homelessness.[Conclusion] This study showed that the needs of homeless people varied with their mental conditions. Appropriate support should be considered based on their mental or intellectual disabilities.

Keywords: *homeless, mental illness, intellectual disability, WAIS-III*

INTRODUCTION

Several studies have reported that the prevalence of mental illness or intellectual disability is higher among the homeless people compared to community control in Western countries (Dunne, 2012; Edidin, 2012; Fazel, 2008; Fichter, 2001; Foster, 2012; Längle, 2005; Salize, 2002; Strehlau, 2012; Paul, 1999; Peter, 2008; Straaten, 2014). However, there are very few prevalence studies of mental illness among homeless in Japan or Asia. Therefore, we investigated and reported the prevalence of mental illness and intellectual disability among homeless people in Nagoya, Japan (Nishio, 2015). We have also investigated how the mental illness or intellectual disabilities had an influence on the homeless people life. This is the first study that assessed the impact of mental problems on the homeless people life using cross-sectional studies focusing on mental problem among homeless people in Japan.

METHODS

Definition of subjects and recruitment of the participants

Eighteen homeless people had agreed informed consent to participate in this study that was carried out in Nagoya city, Japan on October 27, 2013. The definition of “homeless people” followed the specifications by the Special Measures Concerning Assistance in Self-Support of Homeless Act in Japan. A homeless is a person who takes up residence in a city park, riverbank, roadside, station building, or other place to live without a reason. “Absolute homeless” are those who sleep outdoors like in a park or subway station; as opposed to “relative homeless” who are in precarious circumstances like in a shelter for the homeless. For the current study, homeless people were recruited to participate in this survey via a handbill distributed at a meal service place and at the Sasashima Support Center, a social welfare center. This research was approved by the Ethical Review Committee, Graduate School of Medicine, Gifu University on October 2, 2013 (approval No. 25-212). Based on the results obtained from this survey, the participants who required medical care or welfare services were referred to the appropriate medical institutions via the Sasashima Support Center.

Diagnosis of mental illness and intellectual disability

The specialized psychiatrist interviewed the participants through semi-structured interviews using the Mini-International Neuropsychiatric Interview (MINI) according to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR). Current mental capacity and peak mental capacity of each participant were measured with the WAIS-III simplified version by clinical psychologists and with the Japanese Adult Reading Test (JART) by psychiatrists. To simplify the WAIS-III, in this study, we used Dairoku’s method by doubling the total evaluation points of Picture Completion, Digit Symbol-Coding, Digit Span, and Information and adding 20 points (Dairoku, 2008). These scores of WAIS-III and JART were compared in each individual after having taken the tests. The JART is a test measuring intellectual capacity, which was developed based on the National Adult Reading Test (NART). The JART measures mental capacity under the assumption that the reading of Kanji (Japanese version of Chinese character) is highly correlated with mental capacity (Fukue, 2013). Since it is rare for people to lose their ability to read Kanji despite a decrease in cognitive functioning due to aging and effects of psychosis, administering the JART is suitable as it is less susceptible to these changes. The JART uses this specificity to estimate each participant's peak mental capacity. Therefore, by measuring the WAIS-III and JART at the same time and comparing them, we can determine whether a participant’s lower mental capacity is congenital or acquired. In our study, an Intelligence Quotient (IQ) lower than 40 was defined as intellectual disability.

Dividing into three groups

From the comparison between WAIS-III and JART score, we considered the subjects who had a discrepancy between the two scores (11 points) as acquired intellectual disability. Since the JART cannot measure IQ scores lower than 69, the participants who had IQ score lower than a certain level due to developmental reasons might show an apparent dissociation between IQ scores on the WAIS-III and the JART. To exclude such participants, we excluded those participants whose JART IQ score was than 79. We distinguished the subjects whose intellectual disability was inborn from the subjects whose intellectual disability was acquired by 11 points of difference between WAIS-III and JART IQ. Since all of the latter subjects had mental illness, we considered them as their decline of IQ was due to mental illness and divided all participants into 3 groups and named; I, without mental problems; II, with mainly mental illness; III, with mainly intellectual disability.

The background, diagnosis and grouping of all participants were shown in Table 1.

Table 1 –Background, diagnosis and grouping of participants (incited from Psychiatry and Clinical Neurosciences 12265 and modified by context of this article)

Case number	Age	Psychiatric diagnosis	Full-Scale IQ	JART-IQ	Intellectual disability	Group
1	42	None	34	69	Severe intellectual disability	III
2	48	Major depression; PTSD	91	104	None	II
3	50	None	49	77	Moderate intellectual disability	III
4	51	Alcohol dependence	96	94	None	II
5	53	None	138	120	None	I
6	54	Major depression; Alcohol dependence	108	112	None	II
7	54	Alcohol abuse	65	75	Mild intellectual disability	III
8	55	Major depression; PTSD	63	85	Mild intellectual disability	II
9	55	None	100	106	None	I
10	59	None	116	120	None	I
11	61	None	83	75	None	I
12	61	Mood disorder with psychiatric feature; alcohol dependence	53	71	Moderate intellectual disability	III
13	62	Psychotic disorder, alcohol dependence	89	114	None	II
14	63	Major depression	54	71	Moderate intellectual disability	III
15	63	Psychotic disorder	76	98	None	II
16	63	Alcohol abuse	102	118	None	II
17	64	Mood disorder with psychiatric feature	65	108	Mild intellectual disability	II
18	65	None	106	96	None	I

Interview about homeless life

We interviewed the participants with two questions: “Why did you fall into the street life?” and “Why is it difficult with you to get out of the street life?” and get answers by free talk style. We pick the keywords out from the interview record and arranged them by Affinity Diagram Method and compared each group.

RESULTS

The keywords picked up from interview record “Why did you fall into the street life?” in three groups were demonstrated in Table 2. Subjects of group I had a tendency to have a problem of debt and human relationship except for family. Subjects of group II had a tendency to mention lots of facts. It seems accident and disease brought big impacts. Subjects of group III had a difficulty of human relationship.

Table 2 - Reasons that the participants dropped into street life

	Group I	Group II	Group III
Essence picked out and arranged by Affinity Diagram Method	Without mental problems (5 persons)	With mainly mental illness (8 persons)	With mainly intellectual disability (5 persons)
Problem of one's ability or qualification	1 (person)	1 (person)	0 (person)
Social problem	2	3	3
Relationship of family	2	3	3
Human relationship except for family	3	2	1
Disease	1	5	0
Accident	0	2	0
Debt	3	0	0
Problem of one's will	2	2	0

The keywords picked up from interview record “Why is it difficult with you to get out of the street life?” in three groups were demonstrated in Table 3. Subjects of group I seemed they stay in the street life by their will. Subjects of group II mentioned that they didn’t have a guarantor, job or money. However their words are not containing enough reason but only complaining their actual status. Subjects of group III don’t want to create human relationship which made them to be isolated from society.

Table 3 - Reasons they cannot leave their street life

	Group I	Group II	Group III
Essence picked out and arranged by Affinity Diagram Method	Without mental problems (5 persons)	With mainly mental illness (8 persons)	with mainly intellectual disability (5 persons)
No guarantor for housing	0 (person)	3 (person)	0 (person)
No job	1	3	1
No money	0	3	0
Difficulty of human relationship	1	0	2
Not want to receive social welfare	2	4	2
Can't receive social welfare by past trouble	1	1	1
Not want to live in temporary group house	0	0	1
Homeless life is acceptable	2	1	1
I'me better than before	0	0	2

To summarize these results, individuals in Group I tended to have financial problems including debt and did not to want to resolve their current homeless state. Group II individuals had difficulties involving human relationships. Group III individuals appeared to be unaware of their current situation and therefore were not capable of resolving their homelessness.

DISCUSSION

This is the first report which shows the relationship between mental illness or intellectual disability and homeless life in Japan. This study showed that the needs of homeless people varied according to their mental conditions. Subjects with mainly intellectual disability have a difficulty of human relationship. House where they can live alone might be helpful for them. On the other hand, subjects with mainly mental illness appear to have a difficulty of grasping the present situation and finding appropriate way to solve it. Providing the information and indicative help might be useful for this type. Finally, subjects without mental problem have a tendency to have debt. It is useful to have a point of view that help by legal advice might be helpful. Based on this study, appropriate support should be considered based on their mental or intellectual disabilities

CONCLUSION

This study showed that the needs of homeless people varied with their mental conditions. Appropriate support should be considered based on their mental or intellectual disabilities.

REFERENCE

- Dunne E, Duggan M, O'Mahony J. Mental health service for homeless: patient profile and factors associated with suicide and homicide. *Ir. Med. J.* 2012; 105: 71-72.
- Dairoku K, Yamanaka K., Fujita K.: Simplified Japanese version of WAIS-III, Anthology of 73th Japanese Psychological Association Forum, 2008; 433 (in Japanese)
- Edidin JP, Ganim Z, Hunter SJ, Karnik NS. The mental and physical health of homeless youth: a literature review. *Child Psychiatr. Hum. Dev.* 2012; 43: 354-375.
- Fazel S, Khosla V, Doll H, Geddes J. The prevalence of mental disorders among the homeless in western countries: systematic review and meta-regression analysis. *PLoS Med.* 2008; 5: 1670-1681.
- Fichter MM, Quadflieg N. Prevalence of mental illness in homeless men in Munich, Germany: results from a representative sample. *Acta Psychiatr. Scand.* 2001; 103: 94-104.
- Foster A, Gable J, Buckley J. Homelessness in schizophrenia. *BMC Health Serv Re.* 2012; 12:717-734
- Fukue T., Fukue M., Ishizuka Y. Relationship between Japanese Adult Reading Test (JART) and cognitive dysfunction, *Jpn J Gen Hosp Psychiatry.* 2013; 25(1): 55-61 (in Japanese)
- Längle G, Egerter B, Albrecht F, Petrasch M, Buchkremer G. Prevalence of mental illness among homeless men in the community - approach to a full census in a southern German university town. *Soc. Psychiatry Psychiatr. Epidemiol.* 2005; 40: 382-390.
- Nishio A, Yamamoto M, Ueki H, et al. Prevalence of Mental Illness, Intellectual Disability, and Developmental Disability among Homeless People in Nagoya, Japan - A Case Series Study. *Psychiatry Clin Neurosci.* 2015;
- Salize HJ, Dillmann-Lange C, Stern G et al. Alcoholism and somatic comorbidity among homeless people in Mannheim, Germany. *Addiction* 2002; 97: 1593-1600.
- Strehlau V, Torchalla I, Kathy L, Scheutz C et al. Mental health , concurrent disorders, and care utilization in homeless women. *J Psychiatr Pract.* 2012; 18(5): 349-360
- Paul R., John N., Linda O.: IQ Scores among Homeless older Adolescents: Characteristics of intellectual performance and associations with psychosocial functioning, *Journal of Adolescence*, Vol.22(3), p319-328, 1999
- Peter M.O., Ros C.D.: Intellectual disability in homeless adults: A prevalence study, *Journal of Intellectual Disabilities*, 12(4),p325-334, 2008
- Van Straaten, B, Schrijvers CT, Van der Laan J, et al. Intellectual disability among Dutch homeless people: prevalence and related psychosocial problems. *PLoS One* 2014; 9: DOI: 10.1371/journal.pone.0086112

CO₂ emission in the collection and transport of differentiated waste

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ABSTRACT: This process of collection and transport of waste is mostly done by diesel-powered lorries that emit polluting gases. This research was an observational study, retrospective in nature, level II (descriptive-correlational). This work aims to relate the amount of waste produced by the inhabitants of a town, in the central area of Portugal, with emissions of carbon dioxide (CO₂) produced by lorries during the course of collection and transport. Considering the three years, the population average is 17541 inhabitants. This estimate of CO₂ emissions was performed with the program COPERT 4 (Computer Programme to Calculate Emissions from Road Transport), computer software that estimates CO₂ emissions from road transport. To obtain the estimated values of CO₂, this program uses as main variables the miles driven, characteristics of lorries (registration, fuel type), type of route (rural/urban /highway), speed, weather conditions including temperature and relative humidity, Reid Vapor Pressure (RVP) and the population. In relation to the CO₂ emissions produced during the collection and transport of waste, the differences were statistically significant for the Cardboard-Waste-Bank between 2010 and 2012 and between 2011 and 2012. It was noted further that the months of August were those in which greater quantities of waste were produced in the Glass-Waste-Bank (GWB - green container where we placed waste glass), as well as in the CWB and also in the Metal/Plastic-Waste-Bank (M/PWB - yellow container where we placed waste metal/plastic). However, this does not motivate an increase in the CO₂ emissions of these months. We concluded that the optimization of collection routes must be a priority commitment for the Portuguese towns, so that lorries move with full load, maximizing the processes and consequently minimizing CO₂ emissions. In this way the cost related with the transport of differentiated waste will be monetized and the environment will be less beaten.

Keywords: Amounts collected, CO₂ emissions, differentiated waste

INTRODUCTION

Municipal waste (MW) is a major environmental problem for cities in the XXI century. Waste production has continued to assert itself increasingly, with great importance on the economical and technological sectors. Thus, proper waste management contributes to the preservation of natural resources, through prevention or through recycling and recovery, to ensure the optimization of environmental objectives. Faced with this, the fulfilment of these goals requires an orientation of the behavior of economic operators and final consumers towards the reduction of waste production and its more efficient treatment. Therefore, it is critical that the identification and characterization of wastes and the use of appropriate logistical means for their collection and transport, according to their specific characteristics (Duarte, 2008).

Municipal residues may be classified according to their deposition in differentiated and undifferentiated waste. In this study we look at differentiated waste, more specifically at the packaging wastes which are properly separated by categories (paper and card; plastic and metal; glass) and deposited in the recycling bins. The different residues can be separated into three categories Cardboard -Waste-Bank (CWB - blue container where we placed paper and cardboard); Glass Waste Bank (GWB - green container where we placed glasses) and Metal/Plastic Waste Bank (M/PWB - yellow container where we placed plastic and metal).

Another activity that assumes high importance in terms of urban waste management, regarding gaseous emissions, is the collection and transportation of waste. The assessment of these emissions is essential to set priorities on the optimization of collection/transport circuits in order to reduce fuel consumption and hence GHG emissions (Fontaras et al, 2012; Larsen et al, 2009).

After their deposition in containers, the MW is collected by the responsible entities, which forwards them to the various final destinations. The collection is performed using a vehicle-based service that, as a general rule, has diesel engines and emits polluting gases. Urban transport accounts for a very significant percentage of the transport sector as a whole, influencing both air quality parameters (CO, HC, NO_x, PM) in local pollution, and climate change through emissions of CO₂ (Armstrong & Khan, 2004).

An investigation carried out by Oliveira (2009) found that when compared to diesel and biodiesel fuels, diesel was the one which caused higher CO₂ emissions in the collection and transport of MW. Also noted is that its replacement by biodiesel contributed significantly to the reduction of GHG emissions. It was also found that the use of natural gas vehicles decreased CO₂ emissions by about 16% per year.

The collection, transfer and transport of waste are basic activities of waste management systems worldwide. These activities' use of fossil fuels, according to the study developed by the authors, has a strong contribution to the production of greenhouse gases, contributing in this way thus for the global warming potential (GWP). In this study, Larsen and Christensen concluded that the optimization of long-distance transport of wastes, for example by using the railways, may be a more suitable option in terms of environment (Eisted et al, 2009).

Armstrong and Khan (2004) described an integrated system for the calculation of these emissions, assisted by GIS-T (geographic information Systems for transport), taking into account the activity and the fleet of automobiles, as well as the climate and characteristics of fuels in the region under study. These authors concluded that the emission of harmful gases to the environment is closely linked to the quality of road infrastructures. It is essential to note that, regardless of recognized environmental impact resulting from the use of motor vehicles for waste transport, energy and environmental benefits of recycling programs, compared with the use of materials that are not recycled are not, generally, compromised even when they involve long distance transport (Salhofer et al, 2007).

MATERIAL AND METHODS

This research was an observational study, retrospective in nature, level II (descriptive-correlational) (Fortin, 1999). This study follows a distinctive design, not an experimental or post-fact study, which aims to measure the volume of waste produced in the town centre area, and the impact that the collecting and transporting of such waste produced in the environment, from the point of view of CO₂ emissions generated by lorries.

The data were analyzed for the waste produced in the municipality of the central region of the country, in a given time window, from January 2010 to December 2012. In this sense, we had access to the total quantity of waste of the municipality and not a sample.

Data were obtained from the electronic platform of the company ERSUC (Resíduos Sólidos do Centro, SA), located in the district of Coimbra. This company is responsible for the management of differentiated and undifferentiated waste in the central region of Portugal.

Regarding the use of technical resources, we resorted to the program COPERT4 (Computer Programme to Calculate Emissions from Road Transport), computer software that estimates CO₂ emissions from road transport (Agência Portuguesa do Ambiente, 2013; Gkatzoflias et al, 2007). To obtain the estimated values of CO₂, this program uses as main variables the miles driven, characteristics of lorries (registration, fuel type), type of route (rural/urban /highway), speed, weather conditions including temperature and relative humidity, Reid Vapor Pressure (RVP) and the population. Relation to temperature and relative humidity were used in their average monthly values for Continental Portugal. As for the vapor pressure of diesel vehicles, we used the values stipulated in Decree-Law no. 142/2010 (Ministério da Economia, da Inovação e do Desenvolvimento e do Trabalho e da Solidariedade Social, 2010) for the months in study. The route carried by the lorry was the same for all three types of waste. Since the vehicles were used for the GWB a lorry with registration year 2002 and the CWB and M/PWB a lorry with registration year 2010, thus the collection of waste from waste CWB and M/PWB was performed by the same lorry in different moments. The route was determined through Google Earth software with 40% in urban and 60% in rural regime. The speeds were an average of 56km/h for rural regime and 25Km/h in urban regime.

For treatment of the data, we use the IBM SPSS Statistics Statistical program 22 version for Windows. Descriptive statistics were used as measures of location (the mean) and standard deviation of dispersion. There was also the resort to a statistical parametric ANOVA one factor test, using the

Bonferroni post hoc test for comparisons between groups. The interpretation of statistical tests was performed based on a significance level of p-value ≤ 0.05 with 95% confidence interval.

RESULTS

For this study, the data considered for the selective collection of waste in the years 2010, 2011 and 2012, in a town on the central region of Portugal. It is a town of the central part of Portugal belonging to the district of Coimbra. This town had in 2010 a total of 17544 inhabitants, in 2011 there were 17584 inhabitants and in 2012 the population consisted of 17494 inhabitants. Considering the three years, the population average is 17541 inhabitants (Pordata).

The concern with environmental issues is a priority for the town in this region, because they have a significant network of differentiated waste collection points. Specifically, this town has a network of 57 points of differentiated waste collection, of which 30 are in the centre and the other in adjacent locations.

The data obtained from the ERSUC platform for the months January 2010 to December 2012, allowed us a detailed analysis for differentiated waste, GWB, CWB and M/PWB, which are presented in the form of tables and figures of CO₂ emissions in the collection and transportation.

Regarding CO₂ emissions, we noted the absence of average change in the type of waste GWB and M/PWB during the three years under study. However, with regards to CO₂ emissions of waste CWB, there were mean differences statistically significant on the amount of emissions between the three years under review. These differences, according to the Bonferroni test, demonstrated a reduction of CO₂ emissions from 2010 until 2012 significantly.

Table 1: Mean difference in CO₂ emissions produced by lorries of collection and transport of waste in the years 2010 to 2012

CO ₂ emissions (kg)	N	$\bar{x} \pm s$	F ;df ; sig	
Glass Waste Bank	2010	12	3709.42 ± 1059.92	
	2011	12	3117.83 ± 1054.02	1.052 ; 2.33 ; 0.361
	2012	12	3201.58 ± 1127.63	
Carboard Waste Bank	2010	12	13706.33 ± 1080.40	
	2011	12	10773.33 ± 1415.73	32.167 ; 2.33 ; 0.000*
	2012	12	10014.17 ± 1040.83	
Metal/Plastic Waste Bank	2010	12	7590.42 ± 1326.13	
	2011	12	7473.00 ± 689.56	1.465 ; 2.33 ; 0.246
	2012	12	8236.75 ± 1386.79	

Test: ANOVA one factor

*Mean difference statistically significant (post hoc Bonferroni test, between 2010 and 2012, and 2011 and 2012)

Figures 1 to 3 refer to the CO₂ emissions produced by lorries for the collection and transport of differentiated waste from different recycling bins.

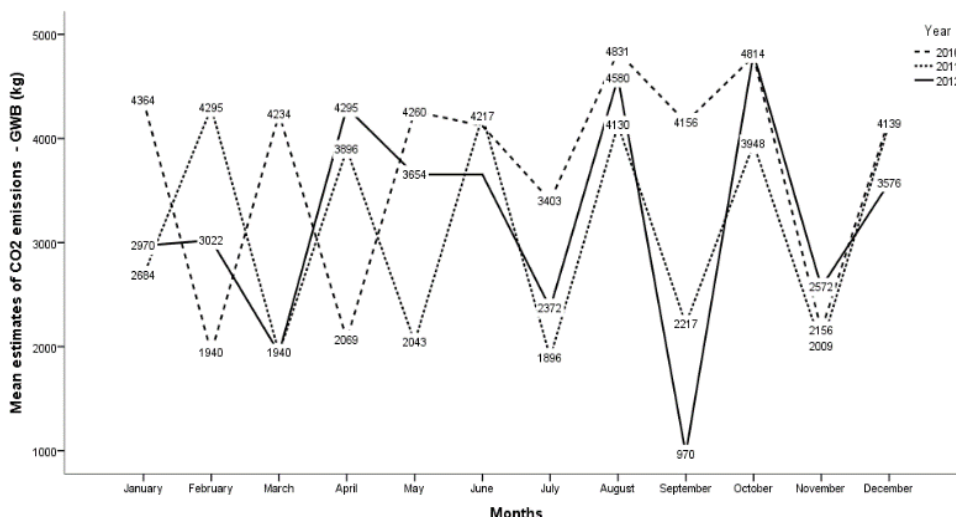


Figure 1: Graph of the mean estimates of CO₂ emissions produced during transport of waste of GWB according to the months in a calendar year

Regarding CO₂ emissions in the transport of waste from GWB (Fig. 1), we found that the largest emissions were in August and October. As we can see, in the month of September, since 2010 until 2012, there has been a significant average reduction of CO₂ emissions. The lowest emissions were recorded during November for three years, and in March, July and September for the years 2011 and 2012, with particular relevance for the month of September 2012, in which was found the lowest value of CO₂ emissions.

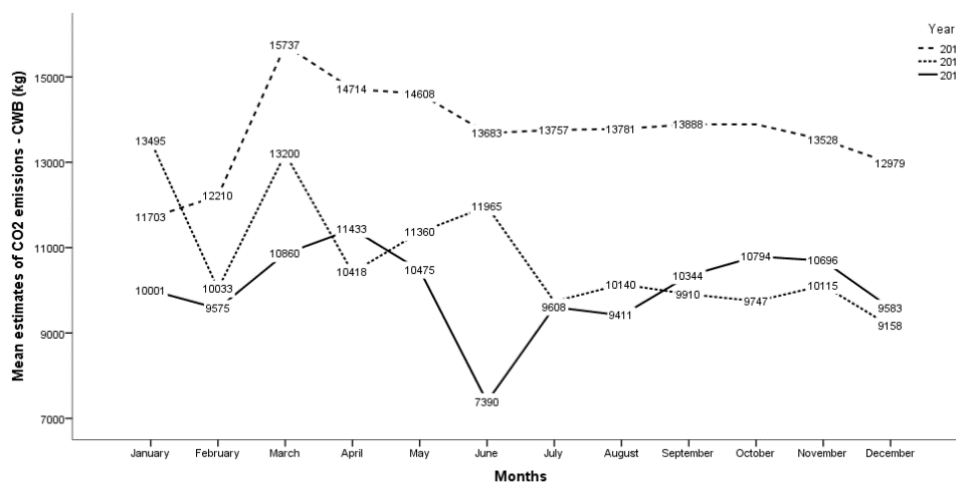


Figure 2: Graph of the mean of CO₂ emissions produced during transport of waste of CWB according to the months in a calendar year

In relation to CO₂ emissions in the transport and collection of waste CWB (Fig. 2) found that in 2010 emissions were higher compared to the other years. In the second half of 2012, a tendency to increase emissions was confirmed, noting a slight increase in 2012 from September until December, but fairly similar to the previous year.

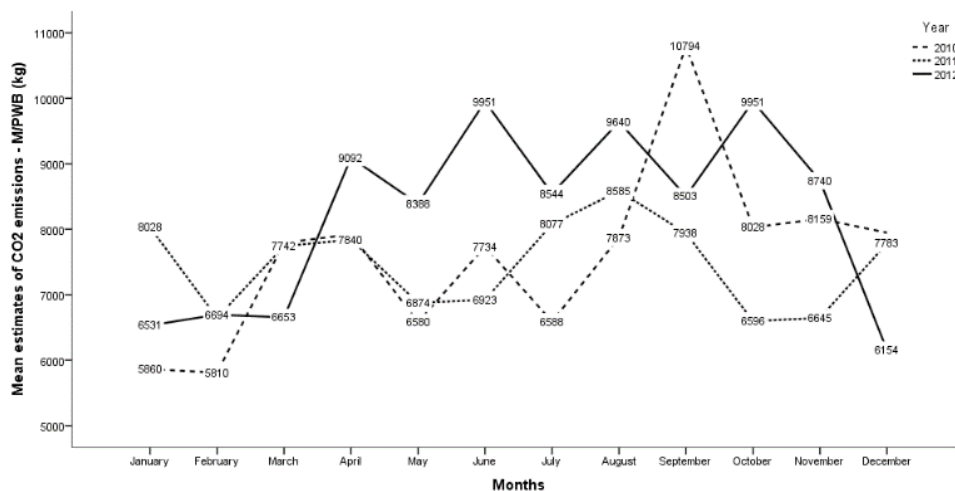


Figure 3: Graph of the mean estimates of CO₂ emissions produced during transport of waste of M/PWB according to the months in a calendar year

The average estimates of CO₂ emissions related to transport of wastes from M/PWB (Fig. 3) show some monthly variability during the course of the three years, but with a tendency to higher production in the months April to November, especially in 2012. Overall, the year 2012 was characterised by an increase in emissions in comparison with the previous years.

DISCUSSION

It was observed a statistically significant mean difference for the production of CWB waste, and these differences between the years 2010 and 2012, and 2011 and 2012, with the lowest value in the year 2012. These results differ from what was the previous behavior of the general Portuguese population during the years 2004-2009 relatively to selective waste collection. In fact, according to data from the National Statistics Institute (INE) (Instituto Nacional de Estatística, 2010), in this three-year period there was an increase in waste generation, which did not happen in the town studied between 2010-2012. We believe that this decrease can be attributed to several factors, including the financial rescue of Portugal in 2011 and the implementation of policies of economic austerity program, which led to a decline in purchasing power (Dennison et al, 1996), policies that had already been initiated in the year 2010. We found that in the case of waste from CWB, all months of 2012 were less productive than the other years under review. We can infer this decrease due to decreased purchasing power of the Portuguese, since in the CWB is discarded waste resulting from gift wrapping, magazines, newspapers and others. These kinds of goods are the first to be eliminated from the list of household consumption when the first financial difficulties appear.

The mean differences of CO₂ emissions in the collection and transportation of waste were statistically significant only for the waste of CWB, these differences were between 2010 and 2012, and between 2011 and 2012, and the lowest value was in year 2012. However, it is noted that months with higher CO₂ emissions without corresponding to an effective increase of the quantities of waste collected, which led us to see that in these concrete situations there was no optimization of routes (Oliveira, 2009). This is the case of the collection route CWB, which had higher values of CO₂ emissions in 2012 when the amount of this type of waste that year was lower.

Although in this study, the age of the vehicles used has not been one of the variables analyzed, we found that the older vehicle (2002), produced smaller amounts of CO₂ emissions on its pathways during collection, than the latest vehicle (2010). Which led us to consider that the age of the vehicle is not always the most important factor when it comes to emissions of pollutants (Larsen et al, 2009, Tavares et al, 2008, Tavares et al, 2009 & Tavares et al, 2010).

Factors as more optimized routes, speeds used and adverse weather conditions, interfere with the quantification of the value of this variable (Oliveira, 2009).

CONCLUSION

This study we have found that the three years analyzed there was a decrease in the production of differentiated waste, although this difference was statistically significant in the CWB. We also have found that the same reduction in CO₂ emissions in the transport of waste was statistically significant for the collection and transportation of CWB.

In view of this we believe that recognized regardless of the environmental impact resulting from the use of transport vehicles of different waste, energy and environmental benefits of recycling programs, compared with the use of non-recycled raw materials should not be placed in question. The focus should continue to focus on raising awareness of the general public to separate waste and its proper placement in the respective recycling bins by investing in their education and taking it to a value of citizenship.

From the point of view of CO₂ emissions, which were the heart of this study, we have found that in some specific situations to optimize collection routes should have a special attention from responsible companies. Often, vehicle kilometers traveled collection, from the Treatment Center and Waste Recovery to the different locations where the recycling bins are not correctly monetized, because these trucks after effecting all the way return without charging is complete. Therefore, it is proper monitoring of the filling volume of recycling bins for these circuits are properly monetized and optimized. In this process the gains will be reflected in the number of kilometers traveled and consequently CO₂ emissions produced in these transports.

REFERENCES

- Agência Portuguesa do Ambiente. (2013). Portuguese Informative Inventory. Amadora.
- Armstrong J M. & Khan A M. (2004). Modelling urban transportation emissions: role of GIS. *Computers, Environment and Urban Systems* 28, 421-433.
- Dennison, G.J., Dodd, V.A. & Whelan B. (1996). A socio-economic based survey of household waste characteristics in the city of Dublin, Ireland. *Waste Composition*. Resources, Conservation and Recycling vol.17: 227-244.
- Duarte L. et al (2008). *Gestão e Tratamento de Resíduos*. 1ª ed. Coimbra: Almedina.
- Eisted, R. et al (2009). Collection, transfer and transport of waste: accounting of greenhouse gases and global warming contribution. *Waste Management & Research*, vol. 27, 738-745.
- Fontaras, G. et al. (2012). Assessment of on-road emissions of four Euro V diesel and CNG Waste collection trucks for supporting air-quality improvement initiatives in the city of Milan. *Science of the Total Environment* vol. 426, 65-72.
- Fortin M (1999). *O processo de investigação: da concepção à realização*. 1999 Loures: Lusociência.
- Instituto Nacional de Estatística, 2010. *Gestão de Resíduos em Portugal de 2004-2009*. Destaque – informação à comunidade social agosto 2010.
- Gkatzoflias, D. et al (2007). COPERT 4 Computer programme to calculate emissions from road transport. Thessaloniki.
- Komilis D.P. (2008). *Conceptual modeling to optimize the haul and transfer of municipal solid waste*. *Waste Management* vol 28, 2355-2365.
- Larsen, A. W. et al. (2009). Diesel consumption in waste collection and transport and its environmental significance. *Waste Management & Research*, vol. 27, 652-659.
- Oliveira N (2009). *Avaliação de sistemas de recolha e transporte de Resíduos Sólidos urbanos: Eficiência energética e emissões poluentes*. Coimbra. Faculdade de Ciências e Tecnologias da Universidade de Coimbra
- Pordata.base de dados Portugal Contemporâneo (webpage) Lisboa: FFMS 2009 available from: <http://www.pordata.pt>.
- Portugal. Ministério da Economia, da Inovação e do Desenvolvimento e do Trabalho e da Solidariedade Social (2010). Dec-Lei n.º 142 de 31 de Dezembro de 2010. Diário da República. Lisboa, nº 253 - Série I: 6098- 6119.
- Salhofer, S., Schneider, F. & Obersteiner, G. (2007). The ecological relevance of transport in waste disposal systems in Western Europe. *Waste Management* vol. 27, 47-57.
- Sonesson, U. (2000). Modelling of waste collection – a general approach to calculate fuel consumption and time. *Waste management and Research* vol 18, 115-123.
- Tavares, G. et al. (2010). Minimisation of operation costs by vehicle fleet routes optimisation in waste collection activities. Proceedings Venice 2010, Third International Symposium on Energy from Biomass and Waste, Venice: Environmental Sanitary Engineering Centre.

Tavares, G. et al. (2008). A case study of fuel savings through optimisation of MSW transportation routes. *Management of Environmental Quality: an International Journal* vol.19, 444-454.

Tavares, G. et al. (2009). Optimisation of MSW collection routes for minimum fuel consumption with 3D GIS modelling. *Waste Management* vol 29, 1176-1185.

The influence of Body Mass Index on the levels of DNA damage after treadmill exercise

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ABSTRACT: Obesity is considered the epidemic of the 21st century and represents one of the most serious challenges for Public Health. The practice of regular exercise is understood to be an important part of the solution, but it is also believed to increase the DNA damage in some situations. The aim of this study is to characterise the alterations in DNA damage after a treadmill exercise and to investigate the possible influence that body mass index (BMI) may have on these levels. Study population consisted of 26 subjects, between 18 and 35 years old, and were assigned to different groups according to their BMI: normal weight, overweight or obese. All participants underwent a treadmill exercise test using the classic Bruce protocol, and alkaline and oxidative versions of the comet assay were performed to detect DNA damage. The results suggest a decrease in genetic damage after exercise as well as an inverse association between BMI and genetic damage after exercise although they are not statistically significant. In order to achieve an accurate and more reliable understanding of this matter more studies are needed to explore other possible confounding variables. Thus, aside widening the study population to include a larger number of participants and a more representative sample of the population, future studies should consider the influence of nutrition and timing of samples' collection after the physical challenge.

Keywords: *Body Mass Index, Obesity, DNA damage, Oxidative Stress, Exercise*

INTRODUCTION

Obesity is frequently described as a chronic disease of multifactorial origin that develops from the interaction of social, behavioural, psychological, metabolic, cellular, and molecular factors (WHO, 2015). It can be defined as an increase in body weight that results in abnormal or excessive fat accumulation in adipose tissue (Donmez-Altuntas, 2014), and which represents a huge risk to health. The World Health Organization (WHO) defines obesity as a BMI equal or above 30 kg/m² and overweight as a BMI between 25 and 29.9 kg/m² (WHO, 2014).

Nowadays, obesity is considered the epidemic of the 21st century and represents one of the most serious challenges for Public Health. This particular health problem has been increasing in all countries: in 2014, 39% of adults aged 18 years and older (38% of men and 40% of women) were overweight, and the prevalence of obesity nearly doubled between 1980 and 2014 worldwide. In 2014, 11% of men and 15% of women worldwide were obese, which means that more than half a billion adults worldwide were classified as obese (WHO, 2014).

It has been reported that obesity contributes to a pro-inflammatory status and may induce systemic oxidative stress, which is a major mechanism in the initiation and progression of different forms of non-communicable diseases, including cardiovascular diseases, atherogenesis, neurodegeneration and cancer (Roberts, 2009 & Fernandez-Sanchez, 2011). The exacerbated production of reactive oxygen species (ROS) can modify the structure and function of lipids, proteins and nucleic acids due to their high reactivity. The oxidative modification of the DNA induces the formation of 8-oxo-7,8-dihydroguanine (8-oxoGua) and 2,6-diamino-4-hydroxy-5-formamidopyrimidine (FaPyGua) and increases genetic instability due to its mutagenic potential (Kryston, 2011).

Increasing physical activity is one of the usual recommendations for obesity treatment. Nevertheless, the role of exercise on DNA damage levels seems to depend on the intensity and duration of the exercise. Different studies show that intensive exercise is on the basis of increased metabolic rate and may therefore increase the rate of oxidative DNA, while regular exercise with moderate intensity and duration upregulates the activity of DNA repair enzymes, decreasing the oxidative challenge to the

body (Radak, 2008a). The aim of this study is to characterise alterations in DNA damage after a treadmill exercise and investigate the possible influence that BMI may have on these levels.

MATERIALS AND METHODS

Study design

This study is a quasi-experimental single group pretest-posttest design study and it is a subproject of the interventional study 'Meal-Exercise Challenge and Physical Activity Reduction Impact on Immunity and Inflammation (MERIIT)' carried out in the University of Oporto (Portugal) and approved by the Research Ethics Committee of São João's Hospital (Oporto).

All participants who agreed to participate in the study were fully informed about the procedures and objectives of the study, and each subject signed an informed consent form prior to the study. BMI was computed as the weight divided by squared height (kg/m^2) and their waist circumference was also measured. Relevant individual information such as gender, age, race, profession, smoking and dietary habits, caffeine consumption, health conditions and medication were assessed using questionnaires.

Study population

Study population consisted of 14 females and 12 males, totalising 26 subjects, between 18 and 35 years old, who were recruited to take part in the research between April and December 2014.

The exclusion criteria encompassed respiratory diseases, screening of upper/lower respiratory tract infection in the 4 weeks prior to the first interview, smoking in the past 6 months, requiring mechanical ventilation for respiratory event within 6 months of screening, medical conditions (hematologic, cardiovascular, renal, hepatic, neurologic or metabolic) or medication that may interfere with meal or physical activity intervention, significant chronic infectious diseases (e.g. HIV, hepatitis B or C), abnormal electrocardiogram screening, cardiac arrhythmia, angina, congestive heart failure, renal or hepatic failure and systemic disease, mal-absorption disease history or intestinal inflammatory disease, women breast-feeding, pregnant or intending pregnancy during the study.

Participants were recruited from adverts' applications and were assigned to different groups according to their BMI: normal weight (BMI: 18.5-24.9 kg/m^2), overweight (BMI: 25.0-29.9 kg/m^2) or obese (BMI: ≥ 30.0 kg/m^2). The general characteristics of the participants are described in Table 1.

Table 1 – Characteristics of the study group

	BMI		
	Normal Weigh n = 15 (57.7%)	Overweight n = 8 (30.8%)	Obese n = 3 (11.5%)
Gender			
Female	8 (53.3%)	5 (62.5%)	1 (33.3%)
Male	7 (46.7%)	3 (37.5%)	2 (66.7%)
Age (years) ^a	25.0 ± 4.5	28.1 ± 5.3	30.3 ± 5.7
Waist Circumference (cm) ^a	72.4 ± 7.6	79.1 ± 10.7	92.3 ± 11.9
Disease Risk based on BMI & WC ^b			
No additional Risk	15 (100.0%)	0 (0.0%)	0 (0.0%)
Increased Risk	0 (0.0%)	8 (100.0%)	0 (0.0%)
High Risk	0 (0.0%)	0 (0.0%)	3 (100.0%)

^a Mean ± Standard Deviation; ^b Modified from Expert Panel. 1998. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Archives of Internal Medicine*, 158, 1855–67; BMI – Body Mass Index; WC – Waist Circumference

Exercise test and sample collection

All participants underwent a treadmill exercise test using the classic Bruce protocol (Bruce, 1956), which is mainly used for evaluating cardiac fitness and function. Bruce's test is a continuous, incremental protocol where treadmill speed and grade are increased every 3 minutes. During the first stage, participants walk at a speed of 2.7 km/h at 10% grade, and then the speed increases to 4.0 km/h at 12% grade; further increases in grade and speed continue at 3-minute intervals until the participant reaches volitional exhaustion.

Venous blood samples were obtained by venipuncture into ethylenediamine tetraacetic acid (EDTA) anticoagulant tubes 3 hours before and immediately after the treadmill exercise. Blood was cooled to approximately 4°C with freeze packs, transported to the laboratory and processed immediately for further analysis. All samples were coded and analysed under blind conditions.

Comet assay

The alkaline comet assay was performed as described by Singh (1988) with minor modifications to detect basal levels of DNA damage (strand breaks, alkaline labile sites, and transient repair sites). In addition, the assay was carried out with an additional step of incubation with the restriction enzyme formamidopyrimidine DNA-glycosylase (FPG) that is able to detect oxidised purines, including 8-oxoGua, FaPyGua and 4,6-diamino-5-formamidopyrimidine (FaPyAde) and other ring-opened purines.

Statistical analysis

Statistical analyses were performed using SPSS for Windows statistical package (version 22.0). The comet assay parameter (%TDNA) was analysed for normality using Kolmogorov-Smirnov test. To evaluate the impact of BMI on DNA damage a mixed effect model was used and a p-value of 0.05 was considered significant.

RESULTS

Table 1 shows the characteristics of the study group. The normal weight group was composed by 8 females and 7 males, the overweight group by 5 females and 3 males, and finally the obese group by 1 female and 2 males. BMI and waist circumference were used to categorise individuals by disease risk and as expected, increased risk and high risk individuals were in the overweight and obese group, respectively.

The mean duration of the Bruce Protocol (Table 2) was higher in the normal weight group (00:16:23 ± 00:01:37) than in the remaining groups. The anaerobic threshold (%) mean was higher in the obese group (71.0 ± 14.0) than in normal (63.8 ± 13.5) or overweight (65.6 ± 11.1) individuals.

Table 3 shows the results obtained from the alkaline and the oxidative versions of the comet assay. These results suggest a decrease in genetic damage after exercise even though they were not statistically significant. The results also seem to show an inverse association between BMI and genetic damage after exercise although this is also not statistically significant.

Table 2 – Results from Bruce Protocol

	BMI		
	Normal Weigh	Overweight	Obese
Bruce Protocol			
Duration (hh:mm:ss) ^a	00:16:23 ± 00:01:37	00:15:32 ± 00:02:45	00:12:36 ± 00:05:42
VO ₂ (ml/min/kg at max VO ₂) ^a	52.2 ± 8.7	45.6 ± 11.2	40.0 ± 5.9
RER ^a (VCO ₂ /VO ₂ at max VO ₂) ^a	1.1 ± 0.1	1.1 ± 0.1	1.2 ± 0.1
Heart Rate (bpm at max VO ₂) ^a	179.8 ± 26.0	183.3 ± 6.9	180.7 ± 12.7
Anaerobic threshold (%) ^a	63.8 ± 13.5	65.6 ± 11.1	71.0 ± 14.0

^a Mean ± Standard Deviation; RER – Respiratory Exchange Ratio; bpm – beats per minute

Table 3 – The impact of BMI in DNA damage

	Primary Damage		Oxidative Damage	
	Adjusted β [95% CI]	p-value	Adjusted β [95% CI]	p-value
Exercise				
Before	Ref	N/A	Ref	N/A
After	- 2.33 [- 3.80; - 0.87]	0.002	- 1.19 [- 2.48; 0.10]	0.071
BMI	- 0.19 [- 0.42; 0.04]	0.100	- 0.11 [- 0.32; 0.11]	0.307

DISCUSSION

In this study we analysed the DNA damage after a treadmill exercise on normal weight, overweight and obese people. The comet assay or Single Cell Gel Electrophoresis (SCGE) was used as a biomarker of effect that combines the simplicity of biochemical techniques for detecting DNA single strand breaks (strand breaks and incomplete excision repair sites), alkali labile sites and cross-linking, with the single cell approach typical of cytogenetic assays (Kumaravel, 2009 & Azqueta, 2013 & Singh, 1988).

According to the WHO (2014), there are more than half a billion adults worldwide classified as obese, i.e. with a BMI ≥ 30 kg/m², which make obesity a dramatic challenge for Public Health (WHO, 2014).

There are several mechanisms associated to the generation of free radicals in obesity, namely the adipose tissue, the fatty acid oxidation, the overconsumption of oxygen, the accumulation of cellular damage, the type of diet, as well as the role of mitochondria in the development of oxidative stress in obesity. The increase in obesity associated to oxidative stress is likely to be due to the presence of excessive adipose tissue itself, since adipocytes and preadipocytes have been identified as a source of pro-inflammatory cytokines (Fernandez-Sanchez, 2011).

The practice of regular exercise is believed to be an important and feasible part of the solution. Regular exercise prompts biological adaptations that strength antioxidant defences and reduce basal production of oxidants, allowing for an additional protection against the oxidative stress (Knez, 2006 & Radak, 2008a & Volvaard, 2005). Nevertheless, there are several studies showing that exercise increases free radical production during muscle contractile activity and therefore increases DNA damage (Hills, 2015 & Haskell, 2007).

Results obtained herein show a non-significant decrease in genetic damage after exercise (Table 3). This could be due to a delay in the body response to exercise; previous authors have reported that reactive oxygen species may reach their maximal levels hours or even days after the end of the exercise (Hartmann, 1994 & Poulsen, 1999 & Demirbag, 2006). In future studies, timing of samples' collection must be reconsidered.

Another feasible explanation is the hypothesis that there is a U-shaped curve relationship between oxidative DNA modification and the duration as well as the intensity of exercise. Considering that the mean duration of the Bruce Protocol was 00:16:23 for normal weight individuals, 00:15:32 for overweight and 00:12:36 for obese individuals, it can be argued that very short one-off sessions of training may not produce signs of oxidative DNA damage and may even be associated with a decrease in the levels of oxidation of DNA (Poulsen, 1999 & Radak, 2008a & Radak, 2008b).

The analysis using a mixed effect model detected an inverse association between BMI, primary damage (95% CI - 0.42; 0.04) and oxidative damage (95% CI - 0.32; 0.11), even though these associations were not statistically significant. These results are consistent with numerous studies that show the inverse relationship between BMI and 8-hydroxydeoxyguanosine (8-OHdG), a reliable marker of oxidative DNA damage (Mizoue, 2006 & Mizoue, 2007 & Kasai, 2001). Oxidative DNA damage may be related to weight loss through the mechanism of ROS production: if weight loss is induced by an increase in either energy expenditure or metabolic rate, there may be an increase in the mitochondrial production of ROS in the cells, thereby leading to higher levels of oxidative stress (Mizoue, 2007).

CONCLUSION

Results suggest a decrease in genetic damage after exercise as well as an inverse association between BMI and genetic damage after exercise although they are not statistically significant. In order to achieve an accurate and reliable understanding of this matter, it is imperative that further studies are carried out, namely widening the study population. It is also recommended that other relevant variables are considered in the study, namely the impact of regular physical activity as opposite to a single bout of exercise, the influence of nutrition, and timing of samples' collection after the physical challenge.

Addressing these topics may enable the creation of a set of recommendations that will assist the successful prescription of exercise for those researching and prescribing physical activity as well as for the individuals receiving professional guidance, which may take into account people's individual characteristics as well as the different intensities and types of exercise and fitness levels that may have different effects on individuals' DNA.

REFERENCES

- Azqueta, A., et al. (2013). The Essential Comet Assay: A Comprehensive Guide to Measuring DNA Damage and Repair. *Archives of Toxicology*, 87(6), 949-968.
- Bruce, R. A. (1956). Evaluation of Functional Capacity and Exercise Tolerance of Cardiac Patients. *Modern Concepts of Cardiovascular Disease*, 25(4), 321-326.
- Demirbag, R.Y., (2006). Effects of Treadmill Exercise on Oxidative/Antioxidative Parameters and DNA Damage. *Anadolu Kardiyoloji Dergisi*, 6, 135-140.
- Donmez-Altuntas, H., et al. (2014). Evaluation of Chromosomal Damage, Cytostasis, Cytotoxicity, Oxidative DNA Damage and their Association with Body-mass Index in Obese Subjects. *Mutation Research/ Genetic Toxicology and Environmental Mutagenesis*, 771, 30-36.
- Fernandez-Sanchez, A., et al. (2011). Inflammation, Oxidative Stress, and Obesity. *International Journal of Molecular Sciences*, 12(5), 3117-3132.
- Hartmann, A., et al. (1994). Does physical activity induce DNA damage? *Mutagenese*, 9(3), 269-272.
- Haskell, W.L., et al. (2007) Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise*, 39(8), 1423-1434.
- Hills, A.P., et al. (2015). Supporting Public Health Priorities: Recommendations for Physical Education and Physical Activity Promotion in Schools. *Progress in Cardiovascular Diseases*, 57(4), 368-374.
- Kasai, H., et al., (2001). Life Style and Urinary 8-Hydroxydeoxyguanosine, a Marker of Oxidative DNA Damage: Effects of Exercise, Working Conditions, Meat Intake, Body Mass Index, and Smoking. *Japanese Journal of Cancer Research*, 92, 9-15.
- Knez, W.L., et al. (2006). Ultra-endurance Exercise and Oxidative Damage: Implications for Cardiovascular Health. *Sports Medicine*, 36(5), 429-441.
- Kryston, T. B., et al. (2011). Role of Oxidative Stress and DNA Damage in Human Carcinogenesis. *Mutation Research*, 711(1-2), 193-201.
- Kumaravel, T.S., et al. (2009). Comet Assay Measurements: A Perspective. *Cell Biology and Toxicology*, 25(1), 53-64.
- Mizoue, T., et al. (2006). Leanness, Smoking, and Enhanced Oxidative DNA Damage. *Cancer Epidemiology, Biomarkers & Prevention*, 15(3), 582-585.
- Mizoue, T., et al. (2007). Body mass index and oxidative DNA damage: A longitudinal study. *Japanese Cancer Association*, 98(8), 1254-1258.
- Poulsen, H., et al., (1999). Methods to Detect DNA Damage by Free Radicals: Relation to Exercise. *Proceedings of the Nutrition Society*, 58, 1007-1014.
- Radak, Z., et al. (2008a). Systemic Adaptation to Oxidative Challenge Induced by Regular Exercise. *Free Radical Biology & Medicine*, 44(2), 153-159.
- Radak, Z., et al. (2008b). Exercise, Oxidative Stress and Hormesis. *Ageing Research Reviews*, 7(1), 34-42.
- Roberts, C. K., et al. (2009). Oxidative Stress and Metabolic Syndrome. *Life Sciences*, 84(21-22), 705-712.
- Singh, N. P., et al. (1988). A Simple Technique for Quantitation of Low Levels of DNA Damage in Individual Cells. *Experimental Cell Research*, 175(1), 184-191.

Vollaard, N.B., et al. (2005). Exercise-induced Oxidative Stress: Myths, Realities and Physiological Relevance. *Sports Medicine*, 35(12), 1045-1062.

World Health Organization. (2014). *Global Status Report on Noncommunicable Diseases 2014*.

World Health Organization. (2015). *Obesity and Overweight*. Available from: <http://www.who.int/mediacentre/factsheets/fs311/en/>.

The MOBI-Kids study in young people, mobile phone use and brain tumor – the Austrian perspective

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ABSTRACT: The popularity of mobile phone (MP) use even among (very) young children is growing. Public concern has been raised regarding adverse health effects, particular in children. MOBI-Kids, a multinational case control-study, investigates effects of childhood/adolescent exposure to EMF from mobile telecommunications technologies on brain tumor risk in 14 countries. Aim of the study is to include approximately 1,000 brain tumor cases (10–24 years of age) and two matched controls for each case (appendicitis patients). A detailed questionnaire based on the INTERPHONE study protocol, simplified and extended for younger subjects, was administered by trained interviewers. Exposure assessment includes use of communication technologies and exposure to non-communication sources of EMF. Country specific results will be integrated into sensitivity analyses. The implementation of this study posed a number of methodological challenges (addressing ethics concerns, many involved hospitals, eligibility issues etc.) resulting in a loss of over a year of field work in Austria, where 25 cases and 50 controls were recruited. Interestingly the proportion of long term users are higher than expected: approximately 14% of all subjects have used a mobile phone for 10 years or longer. Childhood radiofrequency EMF exposure is a concern. The CEFALO study on brain tumors in children demonstrated a significant trend of increasing risk with increasing time since first use based on operator data. Epidemiological studies on children are increasingly difficult to conduct (ethical and methodological constraints). MOBI-Kids will likely be the last comprehensive study on this issue.

Keywords: Austria, brain tumors, case control-study, children's and adolescents health, mobile phone use, public health

INTRODUCTION

Children today get their first cellular phone at an early age. Today's teenagers are the first mobile phone (MP)-generation having grown up using MP and often have been exposed to radiofrequency fields already during childhood. Due to several reasons (e.g. deeper penetration into the head, developing nervous system, longer lifetime exposure) they may be at the greatest risk if exposure is harmful to health.

As public concern on possible harmful effects of mobile phone use in children - especially brain tumors - has been raised, evidence based epidemiological information will be essential for public health policy. However, research in this field is rare. CEFALO, a case-control study conducted in Denmark, Norway, Sweden and Switzerland, investigated children and adolescents (7-19 years) with primary intracranial brain tumors. It demonstrated a significant trend of increasing risk in association with increasing time since first use based on operator data (Aydin et al. 2011).

Because brain tumors in children, adolescents, and young people are rare, the effect of EMF exposures from mobile phones, if any, at the population level is expected to be small. Studies in single countries will generally lack sufficient statistical power to evaluate the possible relation between these exposures and the risk of brain tumors. Only careful large-scale collaborative studies, with detailed exposure assessment and major efforts to avoid and characterize possible biases will therefore be able to address this aim.

In 2010/11 the MOBI-Kids study started (Health impacts of exposure to radiofrequency fields in childhood and adolescence). The multinational epidemiological case-control takes place in 14 countries (Australia, Austria, Canada, France, Germany, Greece, India, Israel, Italy, Japan, Korea, New Zealand, Spain, and The Netherlands). The study investigated brain tumors diagnosed in young people aged 10 to 24 years in relation to electromagnetic field (EMF) exposure from mobile telephones and other sources of radiofrequency (RF) and low-frequency fields.

The MOBI-Kids project aims to assess the potential effects of childhood and adolescent exposure to RF and extremely low frequency (ELF) from mobile telephones on tumors of the central nervous system.

In this paper we briefly report about design and methods used as well as about experiences from the Austrian study group. A detailed insight into the MOBI-kids study design is given by Sadetzki et al. (2014).

METHOD AND MATERIAL

Study population

Aim of the MOBI-kids project was the recruitment of over 1,000 cases of malignant and benign brain tumors and their respective controls. The study population consists of all persons (males and females) aged 10-24 years, living in the study region. In Austria, the size of the target population (Statistik Austria 2009) is 1.47 million with an expected number of 35 cases of brain tumors per year.

Cases and controls: selection and recruitment

The cases are all patients aged 10-24 years from the target population with a confirmed diagnosis of primary brain tumors, who are diagnosed during the study period in the study regions and who have given informed consent (either by themselves and/or their parent/guardian as applicable). Cases were histologically confirmed (from surgery or biopsy material). Only when biopsy or surgery was not performed, cases could be included on the basis of unequivocal imaging results. Only incident cases with a primary tumor, diagnosed within the study period, were included. Tumors along with genetic disorders and recurrent tumors were excluded. Excluded diagnoses were germ cell tumors, pineal and pituitary tumors as well as tumors close to the base of the skull. Patients with insufficient knowledge of German or non-Austrian residents were not eligible.

The primary source for ascertainment of brain tumors were relevant departments (neurosurgery, radiology, oncology etc.) of our participating health institutions. All neurosurgeries and neuropathologies in Austria that contribute to the Austrian Brain Tumor Registry notified cases. There is no other source for case identification, because the Central Cancer Registry provides only malignant cases and is allied with the Brain Tumor Registry. In Austria, case identification was by active surveillance with regular contact to neuropathologies.

Two hospital controls were selected per case. Patients hospitalized with suspected appendicitis, from the same population base as cases, served as controls. Controls were individually matched to cases on age (± 1 y for cases < 17 years and ± 2 y for cases 17 years and older; minimum age for controls was 10 and the maximum 24 y), sex and medical institute located within the catchments area of the neurosurgery department of the institute where the case was diagnosed.

Due to the fast progression of MP use it is important that cases and their matched controls are interviewed within a narrow time window (preferably within ± 3 months from case interview). In total, there is a strict time line of diagnosis, recruitment and interview (figure 1).

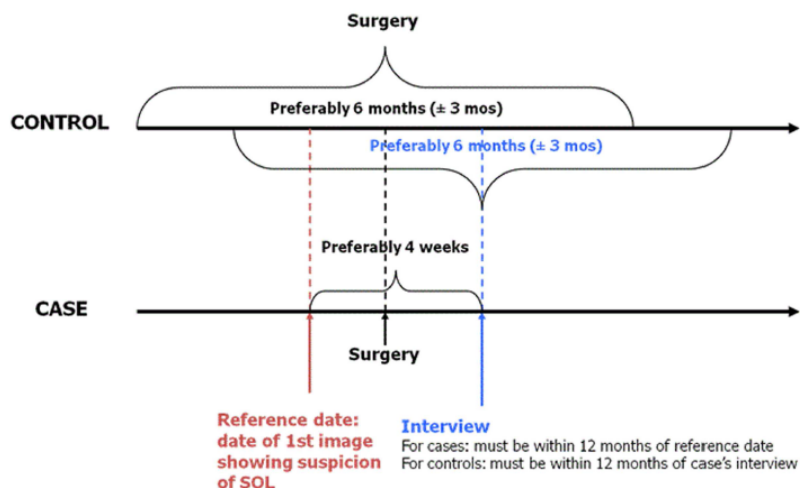


Figure 1 – MOBI-Kids key dates for case and control matching and eligibility (Sadetzky et al. 2014)

Participants were contacted, informed about the study, and asked to participate in the study. Depending on the time of notification the patient was contacted by the treating physician when still at the institution or by the Institute of Environmental Health, MUVI. An appointment for the interview was arranged in cooperation with the treating physician.

Ethics

The study was approved by 10 ethic committees: Medical University Vienna (MUVI, 1204/2012), Vienna Hospital Association (EK-L2-T33-VK), Medical University Graz (25-303 ex 12/13), Medical University Innsbruck (UN4885) and Ethic Committees of Lower Austria (GS4-EK-4/182-2012), Upper Austria (C-52-13), Salzburg (415-EP/73/271-2013), Styria (25-303 ex 12/13), Carinthia (MZ 17/13), and Vorarlberg (2013-412).

Eight different informed consent forms were developed (for parents, and one for each of three age groups, each for cases and controls). For persons after the 10th birthday until before the 18th birthday both the patient and a parent/guardian signed the consent form. Above age 18 the patient and a parent/guardian signed separately (each for his/her own interview). As each ethics committee had different views about the legal aspects, we ended up with 80 different consent forms.

Data collection and questionnaires

Data collection was performed by using a personal questionnaire for the patients as well as the parent including information on demographic variables and data on potential risk factors. Clinical data were collected at the neuropathologies and CT and MRI images were used to define the tumor location.

The questionnaire was developed, based on the INTERPHONE questionnaire as well as other brain tumor and/or mobile phone studies (Cardis et al. 2007), modified in the light of the experience obtained in that studies and simplified for administration to younger subjects.

Two questionnaires (main questionnaire for subjects and parental questionnaire) were administered by trained interviewers of the MUVI. In Austria the paper version was used.

The main questionnaire included demographic variables, use of communication technologies (e.g. MP, cordless telephones); exposure to non-communication sources of ELF (e.g. electrical appliances) and RF-EMF, occupational history and other possible risk factors for brain tumors (e.g., ionizing radiation exposures).

In addition, parents/guardians (preferably the mother) were interviewed about exposures (smoking history, use of MP etc.) before conception, during the pregnancy and the first trimester of life of the child, as well as about the pregnancy itself, the child's delivery, and her/his school history. Parental occupational histories were collected for both parents/guardians. The questionnaire included exposures mainly of the mother and to a lesser extent of the father.

Exposure assessment and validation study

Exposure assessment is based on questionnaire data. A calculation of exposure to ELF and RF-fields (MP, cordless phones and all other devices operated near to the head) will be performed.

Geocodes will be extracted from residential, school and working addresses. This information could be linked to environmental data bases.

As self-reports of past MP use may be prone to error, it was planned to collect (with the subject's consent) historical information from network operators about the subject's past use of mobile phones (number and duration of calls). The self-reported information will be compared to the historical use information (assessment of comparability). Operator data will not be available in Austria.

RESULTS AND DISCUSSION

Ethics and field work

Ethics approvals for conducting the study were obtained in each country. However, significant differences were observed. While in some countries only one needed to be obtained (e.g. France) others needed ethics approval for each hospital (e.g. Spain).

In Austria requirements changed during study period. We had to apply countywide, in Vienna even twice due to different medical authorities. In total, ten different ethics votes were obtained. Some were approved eight months after submission (mostly legal aspects claimed). Some ethic committees required hearings. As mentioned before, due to different legal aspects we had to develop 10 sets of consent forms, each include 8 different documents.

Therefore the field work had to be started stepwise beginning with first approval of the MUVI on 6.6.2012. Last ethic approval was obtained on 13.08.2013. Due to these unforeseeable difficulties with approvals 31 eligible cases could not be interviewed within the eligibility period.

Cases and controls

The MOBI-Kids study started end of 2009, beginning of 2010. In Austria field work took place between August 2013 and December 2014 (with extensions until June 2015).

Based on the size of the target population we expected 35 cases of brain tumors per year. Detailed information about brain tumor incidence in children in Austria was available for 2005 at the onset of the study. Data from Cancer Registry covered only malignant tumors and were used to estimate the number of all brain tumors based on the fraction of malignant tumors in children in 2005. Due to changes in eligible diagnoses during development of the protocol the number of cases per years was reduced to an estimated 25 cases.

To date, 28 cases met the inclusion criteria. Of these 28 eligible cases 28 agreed to participate. By the end of March 2014, 25 subjects had completed interviews (3 pending decision). Of 61 identified controls, 41 agreed to participate. Of these, 39 have completed interviews.

Table 1 shows excluded diagnosis.

Table 1 – Excluded diagnoses in the Austrian study collective (n=22)

Diagnosis	Location	Frequency
Craniopharyngioma		3
Ependymoma	Spinal	2
Glioma	Spinal	4
Pineal germinoma		1
Pituitary adenoma		6
Neurofibroma	Spinal	1
Germ cell tumor		2
Neurinoma (Neurifibromatosis type 2)		2

Different aspects

As the health care providers in most countries become increasingly overworked due to understaffed institutions, it cannot be expected that study cooperation is a priority for them even if they consider the topic important. So it is mandatory to maintain a close relationship with participating departments to ensure that cases are not missed and that the required authorizations are obtained from treating physicians when necessary.

Furthermore, two neuropathologies were closed down during the study period and activities moved to other neuropathologies resulting in additional workload for these colleagues.

An important focus of the project will be the dissemination of knowledge about mobile phone exposure and health to the general public, stakeholders in public health and the scientific community. The huge efforts of all study centers concerning the proper design and conduct of the study, the avoidance of bias and assessment of possible confounders and to overcome the organizational challenges must be highlighted.

CONCLUSIONS

As public concern on possible harmful effects of MP use in children has been raised, information from epidemiology of mobile phone use and brain tumors will be essential for public health policy.

The MOBI-Kids study design is based on the experience from the INTERPHONE study (The Interphone Study Group 2010). Major efforts were undertaken to improve the design. That includes e.g. different epidemiological problems related to selection bias and recall errors and improving and optimizing the exposure assessment. Along with these efforts a lot of organizational problems resp. challenges had to be solved.

Conduction of observational epidemiological studies is increasingly difficult due to ethic constraints, problems with participation and problems with disclosure of study aims.

Discrepancy between often very simplistic views on the results that are provided and the limitations that are inherent in such studies and the difficulties the researchers must overcome to provide these results is striking.

Due to the difficulties of such an endeavor we deem it unlikely that a further study on that issue will be performed in the foreseeable future.

REFERENCES

- Aydin, D., Feychting, M., Schüz, J. et al. (2011): Mobile phone use and risk of brain tumours in children and adolescents: a multicenter case-control study (CEFALO). *J Natl Cancer Inst* 103, 1-13.
- Cardis, E., Richardson, L., Deltour, I. et al. (2007). The INTERPHONE study: design, epidemiological methods, and description of the study population. *Eur J Epidemiol* 22, 647-64.
- Sadetzki, S., Eastman Langer, C., Bruchim, R. et al. (2014): The MOBI-Kids study protocol: challenges in assessing childhood and adolescent exposure to electromagnetic fields from wireless telecommunication technologies and possible association with brain tumor risk. *Frontiers in Public Health* Sept 2014 Vol 2, Article 124.
- The Interphone Study Group (2010). Brain tumor risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* 39, 675-94.

Understanding toxicity outcomes of kaolinite for future nanocomposites applications

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ABSTRACT: Clay minerals are layered silicates used in nanocomposite applications due to their unique physico-chemical properties. In the present work it is intended to evaluate the *in vitro* cytotoxicity of a type of clay mineral, kaolinite, in a hepatocellular carcinoma human cell line to understand if this is a suitable and non-toxic substrate for the immobilization of nanoparticles. For this purpose, the clay mineral characterization was performed using dynamic light scattering and scanning electron microscopy techniques, while the MTT and Alamar Blue assays evaluated effects on cellular viability and comet assay estimated the genotoxic potential. Results obtained suggest that micro-sized kaolinite particles are not a suitable substrate for the immobilization of nanoparticles, since this mineral induced a reduction on cell viability and DNA integrity of the HepG2 hepatic cell line. However, more *in vitro* studies are required to better understand the mechanisms of cellular interaction and uptake of the kaolinite minerals. To improve the toxicity of these clay particles, organic compounds can be used to modify the surface of these particles and, therefore, create a more suitable material for immobilization on future nanocomposite materials.

Keywords: *clay mineral, nanotoxicity, cytotoxicity, genotoxicity, nanocomposites*

INTRODUCTION

In the last decades, nanotechnology has become increasingly attractive to different scientific and industrial fields as it becomes evident that the interconnection of different fields of knowledge (integrating physics, chemistry, engineering, biology and medicine) allows the study and manipulation of materials at nano scale, producing innovative structures, materials and/or devices with distinctive properties and functionalities (Laroui, Rakhya et al., 2013, OCDE, 2014).

On the other hand, different studies have been showing that nanomaterials can be toxic and therefore may harm both the environment and the human health (Piccinno, Gottschalk et al., 2012, Martirosyan & Schneider, 2014). The dramatic growth and possible applications that nanoparticles offer accompanies the risks and concerns associated with their exposure; therefore, there is a considerable need to address biocompatibility and biosafety concerns associated with their usage.

Recent advances in the production of nanomaterials lead to the development of new structures, namely of nanoparticles immobilized in layered silicates. Layered silicates are natural or synthetic minerals characterized by a regular laminar structure made of alumina and silica with high surface area (Pavlidou & Papaspyrides, 2008, Olad, 2011). These features make them unique for nanocomposite applications since they significantly improve the physico-chemical properties of the material, comparing to those derived from the individual component of the composite (Dawson & Oreffo, 2013). Among the existing layered silicates, clays are beyond the most commonly used in nanocomposites. Clay minerals are one of the most abundant natural minerals at the surface of the earth and are presented as a nanosized layer, with a particle size less than 2 nm (Davidovic, Kutin et al., 2011). Currently, clay minerals are being incorporated into biocompatible polymers, enhancing their mechanical and degradation properties (Tang, Kumar et al., 2012, Dawson & Oreffo, 2013). In spite of the new physico-chemical features and multiple functionalities of clay minerals, this nanomaterial must be tested in regards to its toxic potential and impact in human health.

In this context, the main objective of this work was to evaluate *in vitro* cytotoxicity of kaolinite clay mineral in a hepatocellular carcinoma human cell line (HepG2), to understand if it is a suitable substrate for the immobilization of nanoparticles.

MATERIALS AND METHODS

Material characterization

Micro-sized kaolinite clay mineral was supplied by the Ceramic for Smart System Group of the Electroceramic Department, Instituto de Ceramica y Vidrio, Madrid, Spain and characterized by dynamic light scattering (DLS) for particle size, particle distribution and suspension stability and scanning electron microscopy (SEM) for particle size distribution.

In vitro cytotoxicity and genotoxicity on HepG2 cell line

The cytotoxic effects of the different materials were evaluated on HepG2 cell line. After cell exposure to different concentrations and time periods (3, 6 and 24 h) of the microkaolinite mineral, cellular viability was assessed by employing 3-(4, 5- dimethylthiazol-2- yl)-2, 5-diphenyltetrazolium bromide (MTT) and Alamar Blue (AB) assays. To assess genotoxic effects, alkaline comet assay was performed in HepG2 cells exposed to non-cytotoxic concentrations of microkaolinite for a 24 h period. Triton X-100 (1%) was used as positive control for MTT and AB assays and MMS 100 μM for the comet assay. A minimum of three independent experiments (three replicates per experiment) was performed for each experimental condition tested.

Data analysis

Statistical analyses were performed using SPSS for Windows statistical package (version 23.0). Non-parametric tests – Mann–Whitney U-test (differences among groups) and Spearman's correlation (associations between two variables) – were used for the statistical analysis of these data. Experimental data was expressed as mean \pm standard error and a P-value of 0.05 was considered significant.

RESULTS AND DISCUSSION

Kaolinite is a 1:1 clay mineral structure with a general formula of $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_5$ with layer thickness of 0.7 nm and its layers are held together through weak (hydrogen bonding) and strong interactions (dipole-dipole and van der Waals interactions) (Olad, 2011). The micro-sized kaolinite under evaluation was characterized by several techniques, such as SEM and DLS. SEM images of the micro-sized kaolinite particles is shown in Figure 1, while Table 1 summarizes important physico-chemical properties of these particles such as primary particle size, average hydrodynamic size and size distribution, which are known to influence nanoparticle toxicity in cell lines (Kunzmann, Andersson et al., 2011).

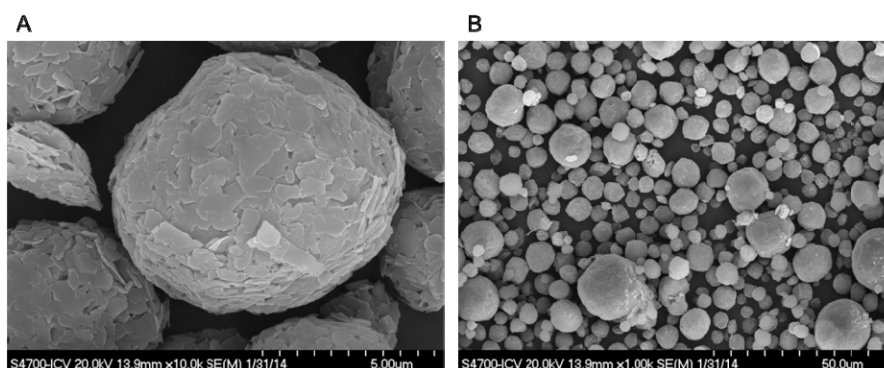


Figure 1 - SEM images from kaolinite microparticles material in two resolutions scales: (A) 5.0 μm ; (B) 50.0 μm . Particles were supplied by the Ceramic for Smart System Group of the Electroceramic Department, Instituto de Ceramica y Vidrio, Madrid, Spain.

The particle size is the most basic characterization of a micro and nano-sized materials and is crucial to understand the possible mechanisms of distribution and retention of the particles in living tissues (Cho, Holback et al., 2013, Lopez-Serrano, Olivas et al., 2014). The most common methods for size

determination are microscopy (for instance, transmission electron microscopy (TEM) and scanning electron microscopy (SEM)) and light scattering techniques, such as dynamic light scattering (DLS). While microscopy techniques allows accurate assessment of the size and morphology of the particle by image analysis, the DLS measures the size and size distribution but in relevant aqueous or biological solutions (Dhawan, Sharma et al., 2009, Lopez-Serrano, Olivas et al., 2014).

According the SEM technique assessed for this work, the kaolinite presents agglomerates of particles with a spherical morphology (Fig. 1) from ca. 3 to 10 μm , and primary particles with irregular laminar shape of ca. 300 nm (Table 1). In accordance with some authors, the size obtained by DLS is usually bigger than the size measured by SEM because DLS measures Brownian motion which determines hydrodynamic diameter instead of the few solvent layers in SEM (Dhawan, Sharma et al., 2009). Additionally, during DLS measurements, particles tend to aggregate in aqueous state, resulting in higher size than individual particles. In all aqueous or biological solutions (HepG2 cell culture media, with and without serum) DLS exhibited a larger size when compared with SEM.

Table 3 – Kaolinite mineral characterization. Primary particle size was characterized by scanning electron microscopy (SEM) and average hydrodynamic size of particles in suspension were determined by dynamic light scattering (DLS).

Primary particle size (nm)	SEM	300 ± 100
Size (nm) in HepG2 complete medium**	DLS	486 ± 112
Size (nm) in HepG2 incomplete medium**	DLS	1090 ± 115

* measured at 0.01 $\mu\text{g/mL}$

In the present work, the possible cytotoxic and genotoxic effects after exposure to the clay mineral under study (kaolinite) were evaluated on hepatocellular carcinoma human cell line (HepG2). This cell line is widely used *in vitro* as a surrogate model of human hepatocytes. It is an extremely well characterized cell line and it is commonly used in nanotoxicological studies (Jones & Grainger, 2009).

MTT is a sensitive, quantitative and reliable colorimetric assay (Vega-Avila & Pugsley, 2011) that allows the detection of mitochondrial activity through the catalysis of a mitochondrial enzyme (dehydrogenase) (Kroll, Pillukat et al., 2009). On the other hand, Alamar Blue is a cell viability indicator of the redox potential of the cells (Takhar & Mahant, 2011).

Micro-sized kaolinite induced a significant dose-dependent decrease in the viability of HepG2 cells after 3 and 24 hours of exposure, according to the MTT assay (Fig. 2.A.). However, the correlation coefficient was stronger for the 24 hour period ($r=-0.589$; $p<0.001$) than at early period of exposure ($r=-0.226$; $p=0.026$). These results suggest that alterations in mitochondrial activity due to exposure to kaolinite particles increases with the period of exposure.

Concerning the redox potential of the HepG2 cells (Fig. 2.B.), alterations were observed at all tested periods of exposure. In fact, results obtained from the AB assay support that exposure to kaolinite induced a dose dependent decrease in the cell viability which, corroborating results obtain with the MTT assay.

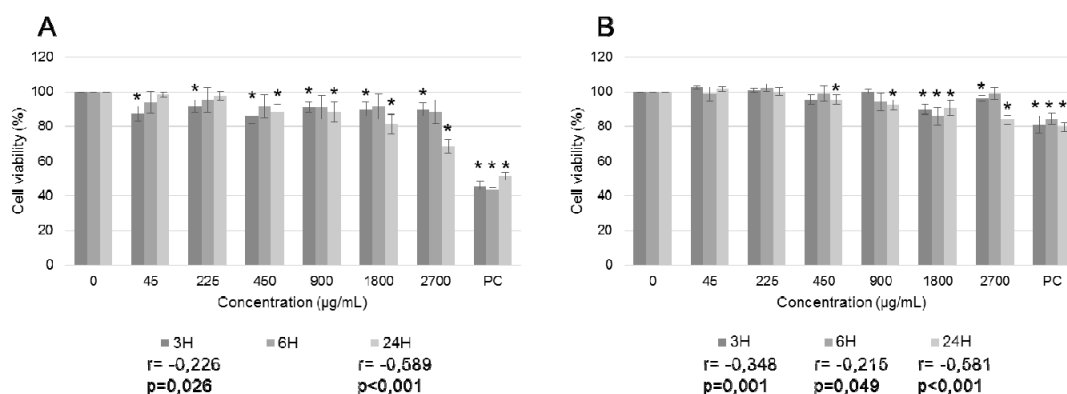


Figure 2 - Cell viability after 24 h exposure to kaolinite microparticles performed by two cytotoxicity assays: (A) MTT and (B) Alamar Blue. PC: Positive control. Bars present standard error of the mean. Values were normalized considering negative control as 100%. * P <0.05, significant difference with regard to the corresponding negative control.

Despite the multiple functionalities of the clay minerals, when the size of these layered silicates decreases, it raises some concerns. With the decrease in size, surface area increases and, consequently, they become more biologically active and, therefore, may induce more toxic effects than its bulk material (Jones & Grainger, 2009). Depending on its small size, these can penetrate the cell membranes and interfere with cellular processes (Frohlich, 2012).

Several studies already demonstrated that some types of clays are able to cause cytotoxicity in different cell lines, and even induce cell death. Most of the studies show that clay induce cytotoxicity induced only at high concentrations of this mineral. For example, Han et al (2011) verified moderate cytotoxicity of clay minerals modified with an amine functional group in different cell types only at 1000 µg/mL (Han, Lee et al., 2011). However, other authors have described significant loss of A549 lung epithelial viability after 24 hours of exposure to different nanoclays at lower concentrations (25 µg/mL) (Verma, Moore et al., 2012). Another study observed the same effect but in even inferior concentrations of nanoclay (1 µg/ mL), in HepG2 liver cell line, as well as the significant generation of ROS (Lordan, Kennedy et al., 2011). These authors also mentioned that the ultra-small sized clays particles tended to aggregate in the cell culture medium, which appeared to be correlated with the observed toxicity mechanisms.

Regarding genotoxicity evaluation, it was observed that the levels of DNA damage of the hepatic cells under evaluation increased in a dose-dependent manner after a 24 hours of exposure (Fig. 3). Concentrations chosen for this evaluation, 45, 225 and 450 µg/mL, proven to be non-cytotoxic when tested with MTT and AB assays.

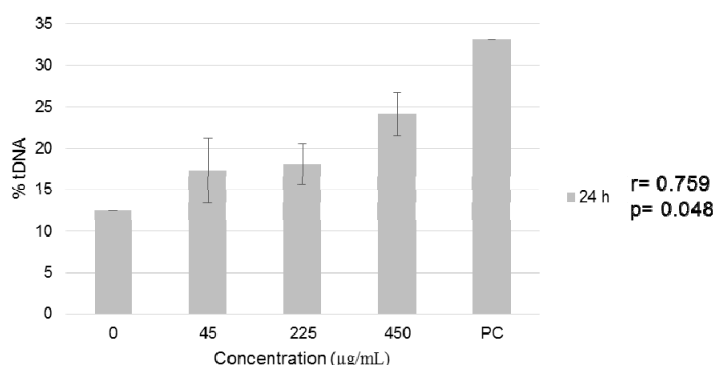


Figure 3 – Effect of 24 hours of exposure to kaolinite microparticles on DNA damage of HepG2 cells analysed by alkaline comet assay. PC: Positive control. Bars present standard error of the mean.

Previous studies have already demonstrated that clays commonly found in soils (e.g. smectites) can react with pesticides and modify their genotoxicity in mammalian cells; pesticides alone did not cause genotoxicity, while, when coupled to redox-modified clays, triggered environmental genotoxicity (Sorensen, Stucki et al., 2005). On the contrary, more recent studies performed by Li et al. (2010) showed no genotoxicity of exfoliated montmorillonite (a 2:1 clay mineral type), as well as, no accumulation in a specific organ, after this being absorbed into the body. Another study also demonstrated that a chemically modified clay mineral in the nanometer size (cloisite) could not induce *in vitro* damage on the DNA of mammalian cells (Sharma, Schmidt et al., 2010).

Results obtained herein indicate that kaolinite is not a suitable clay substrate for the immobilization of other nanomaterials, since, in opposition to what has been previously reported, high concentrations of clay induced a significant decrease in cell viability and a significant increase in DNA damage of HepG2 cell line.

Evaluation of the toxicity of nano and micro clay particles in different *in vitro* mammalian cell line (Lordan, Kennedy et al., 2011, Verma, Moore et al., 2012) is still scarce. Thereby, more studies are required to fully understand the potential mechanisms of cytotoxic and genotoxic potential of certain clay minerals (Reijnders, 2012), specifically kaolinite. Other aspects that still need to be assessed are the possible clay-cell or clay-media interactions (Dawson & Oreffo, 2013). Additionally, several mechanisms such as biodistribution, bioaccumulation and cellular uptake of the clay minerals in the human body and in the environment are mandatory, in order to better understand their safety in their application into novel nanotechnology-based materials, such as nanocomposites (Reijnders, 2012).

CONCLUSIONS

In spite of the multiple functionalities of clay minerals and polymer-clay nanocomposites, *in vitro* and *in vivo* toxicity studies are imperative to better evaluate the risk assessment of those materials. So far, few studies have been made regarding the *in vitro* characterization of cellular responses to this type of materials.

In vitro studies are the primordial steps during toxicological evaluation. For each type of nanomaterial, it is crucial to perform cytotoxicity studies because of their unique biological response. Cytotoxicity screening assays, for instance MTT and AB assays, allow the identification of adverse cellular effects on a particular human cell line in certain conditions and, in consequence, establishing priorities for further studies on the underlying molecular mechanisms of toxicity derived from micro-sized kaolinite exposure. On the other hand, the comet assay is especially relevant to assess genotoxic hazard of any materials/substances.

While there is a vista that the incorporation of single nanoparticles on nanocomposites may decrease their biological damage (Roy, Kumar et al. 2014, Allouni 2015, Memorandum of Understanding COST Action MODENA, 2012). Despite that, the present *in vitro* study suggests that kaolinite microparticles are not a suitable substrate for the immobilization of nanoparticles. Both cytotoxic and genotoxic effects were observed on the HepG2 hepatic cell line after exposure to kaolinite particles.

A possible strategy to overcome the cytotoxic and genotoxic effects of naked kaolinite observed in this study is to chemically modify the kaolinite particles with organic compounds. Even so, further toxicity studies must be performed in organoclay particles, in order to understand if the chemical modification allows the creation of a more compatible kaolinite mineral and, therefore, a more suitable material for the incorporation on future and safe nanocomposite applications.

ACKNOWLEDGMENTS

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REFERENCES

- Allouni, Z. E., Gjerdet, N. R., Cimpan, M. R. & Hol, P. J. (2015). The effect of blood protein adsorption on cellular uptake of anatase TiO₂ nanoparticles. *Int J Nanomedicine* 10, 687-695.
- Cho, E. J., Holback, H., Liu, K. C., Abouelmagd, S. A., Park, J. & Yeo, Y. (2013). Nanoparticle characterization: state of the art, challenges, and emerging technologies. *Mol Pharm* 10(6), 2093-2110.
- COST (2012). Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action TD1204: Modelling Nanomaterial Toxicity MODENA 2015, from http://w3.cost.eu/fileadmin/domain_files/MPNS/Action_TD1204/mou/TD1204-e.pdf.
- Davidovic, M., Kutin, M., Linic, S., Mioc, U., Nedic, Z., Sredic, S., Nikolic, A., Jovanovic, D. & Pissis, P. (2011). Nanocomposite Based on Natural Materials. *Advances in Diverse Industrial Applications of Nanocomposites*. D. B. Reddy, InTech.
- Dawson, J. I. & Oreffo, R. O. (2013). Clay: new opportunities for tissue regeneration and biomaterial design. *Adv Mater* 25(30), 4069-4086.
- Dhawan, A., Sharma, V. & Parmar, D. (2009). Nanomaterials: A challenge for toxicologists. *Nanotoxicology* 3(1), 1-9.
- Frohlich, E. (2012). The role of surface charge in cellular uptake and cytotoxicity of medical nanoparticles. *Int J Nanomedicine* 7, 5577-5591.
- Han, H. K., Lee, Y. C., Lee, M. Y., Patil, A. J. & Shin, H. J. (2011). Magnesium and calcium organophyllosilicates: synthesis and *in vitro* cytotoxicity study. *ACS Appl Mater Interfaces* 3(7), 2564-2572.
- Jones, C. F. & Grainger, D. W. (2009). *In vitro* assessments of nanomaterial toxicity. *Adv Drug Deliv Rev* 61(6), 438-456.
- Kroll, A., Pillukat, M. H., Hahn, D. & Schneckeburger, J. (2009). Current *in vitro* methods in nanoparticle risk assessment: limitations and challenges. *Eur J Pharm Biopharm* 72(2), 370-377.
- Kunzmann, A., Andersson, B., Thurnherr, T., Krug, H., Scheynius, A. & Fadeel, B. (2011). Toxicology of engineered nanomaterials: focus on biocompatibility, biodistribution and biodegradation. *Biochim Biophys Acta* 1810(3), 361-373.

- Laroui, H., Rakhya, P., Xiao, B., Viennois, E. & Merlin, D. (2013). Nanotechnology in diagnostics and therapeutics for gastrointestinal disorders. *Dig Liver Dis* 45(12), 995-1002.
- Lopez-Serrano, A., Olivas, R. M., Landaluze, J. S. & Camara, C. (2014). Nanoparticles: a global vision. Characterization, separation, and quantification methods. Potential environmental and health impact. *Analytical Methods* 6(1), 38-56.
- Lordan, S., Kennedy, J. E. & Higginbotham, C. L. (2011). Cytotoxic effects induced by unmodified and organically modified nanoclays in the human hepatic HepG2 cell line. *J Appl Toxicol* 31(1), 27-35.
- Martirosyan, A. & Schneider, Y. J. (2014). Engineered nanomaterials in food: implications for food safety and consumer health. *Int J Environ Res Public Health* 11(6), 5720-5750.
- OCDE (2014). OCDE Working Party on Nanotechnology (WPN): Vision Statement. Retrieved December, 30, 2014, from <http://www.oecd.org/sti/nano/oecdworkingpartyonnanotechnologywpnvisionstatement.htm>.
- Olad, A. (2011). Polymer/Clay Nanocomposites. *Advances in Diverse Industrial Applications of Nanocomposites*. D. B. Reddy, InTech.
- Pavlidou, S. & Papaspyrides, C. D. (2008). A review on polymer-layered silicate nanocomposites. *Progress in Polymer Science* 33, 1119–1198.
- Piccinno, F., Gottschalk, F., Seeger, S. & Nowack, B. (2012). Industrial production quantities and uses of ten engineered nanomaterials in Europe and the world. *Journal of Nanoparticle Research* 14(9), 1-11.
- Reijnders, L. (2012). Human health hazards of persistent inorganic and carbon nanoparticles. *J Mater Sci* 47, 5061-5073.
- Roy, R., Kumar, S., Tripathi, A., Das, M. & Dwivedi, P. D. (2014). Interactive threats of nanoparticles to the biological system. *Immunol Lett* 158(1-2), 79-87.
- Sharma, A. K., Mortensen, A., Schmidt, B., Frandsen, H., Hadrup, N., Larsen, E. H. & Binderup, M. L. (2014). In-vivo study of genotoxic and inflammatory effects of the organo-modified Montmorillonite Cloisite(R) 30B. *Mutat Res Genet Toxicol Environ Mutagen* 770, 66-71.
- Sharma, A. K., Schmidt, B., Frandsen, H., Jacobsen, N. R., Larsen, E. H. & Binderup, M. L. (2010). Genotoxicity of unmodified and organo-modified montmorillonite. *Mutat Res* 700(1-2), 18-25.
- Sorensen, K. C., Stucki, J. W., Warner, R. E., Wagner, E. D. & Plewa, M. J. (2005). Modulation of the genotoxicity of pesticides reacted with redox-modified smectite clay. *Environ Mol Mutagen* 46(3), 174-181.
- Takhar, P. & Mahant, S. (2011). In vitro methods for Nanotoxicity Assessment: Advantages and Applications. *Arch. Appl. Sci. Res.* 3(2), 389-403.
- Tang, X. Z., Kumar, P., Alavi, S. & Sandeep, K. P. (2012). Recent advances in biopolymers and biopolymer-based nanocomposites for food packaging materials. *Crit Rev Food Sci Nutr* 52(5), 426-442.
- Vega-Avila, E. & Pugsley, M. K. (2011). An overview of colorimetric assay methods used to assess survival or proliferation of mammalian cells. *Proc West Pharmacol Soc* 54, 10-14.
- Verma, N. K., Moore, E., Blau, W., Volkov, Y. & Babu, P. R. (2012). Cytotoxicity evaluation of nanoclays in human epithelial cell line A549 using high content screening and real-time impedance analysis. *Journal of Nanoparticle Research* 14(9), 1-11.

Vapers and vaping devices – A study into the use of electronic cigarettes in Ireland

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ABSTRACT: We have entered the electronic age of smoking, appropriately known as “vaping”, with the use of electronic cigarettes. Smokers know of the many adverse health associated with smoking through the use of graphic images on cigarette packages and numerous health warnings. Currently there is no adequate regulation regarding electronic cigarettes however the revised Tobacco Products Directive in 2016 will define the steps that member states must take to regulate the distribution, sale and supply of Electronic Cigarettes, in particular the sale of liquid nicotine. The aim of this paper was to get an insight into why electronic cigarettes have become such a popular device with the general public. In conjunction with this, an assessment of why smokers have opted to vape was completed along with their selection, understanding and knowledge of vaping devices. Sixty percent of vapers were unaware of any legal debate regarding electronic cigarettes. Their lack of interest in health warnings was attributed to their fear that if they took account of the health warning messages associated with electronic cigarettes that they would be tempted to return to smoking regular tobacco products. In total, 72% of vapers reported that “health” and “cost” were the two main factors they took into account when deciding to vape. Interestingly, 84% revealed self-perceived improvements in their health since they quit smoking and began vaping. The current craze among the vaping community is the PV – a personal vaping device also called a mod. In conclusion the need for adequate legislation regarding the manufacturing, sale and supply of electronic cigarette products is required. The overall concern from health experts internationally is that the electronic cigarettes market has been infiltrated by the tobacco industry. Nicotine is a poison that should be sold in a controlled manner.

Key words: *Electronic cigarettes, vaping, health and cost*

INTRODUCTION

“Nearly 9 out of 10 smokers start smoking by age 18, (The American Lung Association, 2014).” In Ireland in the early 20th Century, it wasn’t uncommon for a youth of 12 or 13 years of age, to be a smoker. With the development of visual advertising on televisions in the early to the middle of the 20th century, the cigarette companies used this medium to their advantage to boost sales and glamourise their product. There has been an international fight to stamp out smoking, however; it is the substitution of traditional cigarettes that is currently provoking controversy in relation to a potentially dangerous substitution; that is Electronic Cigarettes.

Denormalising smoking in the workplace

After years of research into the diseases that smoking causes, it has become an international fight to denormalise smoking in order to prevent younger people from developing an addiction to nicotine and absorbing the 4000 carcinogens that are in just one cigarette. “A number of EU countries have enacted strong smoke-free laws that ban smoking in virtually all indoor workplaces and public places, including bars and restaurants, (Smoke free Partnership, 2011).” Ireland was the first country in the world to completely ban smoking in public houses, restaurants, transport and places of work (ban on smoking in the workplace), which came into force on March 29th, 2004. “The list of countries with smoking bans in public places is growing. But facing pressure to enact weaker prohibitions, some have imposed only partial bans that allow smoking in limited circumstances in bars, cafes and restaurants, (WHO, 2014).” It was noted by international governments that this could be a benchmark for banning smoking in the workplace, worldwide. In 2011, in light of Ireland’s workplace smoking ban, Spain enacted a workplace smoking ban. In addition, Scotland, Wales, England and Northern Ireland have implemented workplace smoking bans.

Inception of Electronic Cigarettes

In 1963, the first Electronic Cigarette (currently also known as *Vapourisers*) was invented by a man of the name Herbert A. Gilbert who had a patent for the design of a device that would allow the user to inhale moist air instead of smoke and there was no nicotine, just steam. However; this never managed to take off in the markets of the times back then and Herbert was forced to abandon the idea. In 2003 Hon Lik, a Pharmacist in China, invented a more modern Electronic Cigarette, in the wake of his own father dying from cancer associated with smoking. The company Lik worked for, Golden Dragon Holdings, developed the device and changed their name to *Ruyan*, which means "like smoke." In the years to date, Electronic Cigarettes have become one of the fastest selling products in the last decade. However; the marketing in Europe since 2006, the U.S. since 2007 and currently worldwide, has sparked many political arguments, both for and against the distribution, sale and use of Electronic Cigarettes (CASSA, 2012).

Electronic Cigarettes – A growing industry

In August 2014, Time Magazine released a publication that Electronic Cigarettes are now a \$2 billion industry, and growing. With the sole tobacco manufacturers witnessing a decline in their sales over the last number of years due to people opting to quit smoking or using Nicotine Replacement Therapies, (NRT's), marketing tactics have led to some tobacco manufacturers choosing to focus on Electronic Cigarette manufacturing. "All of the major tobacco companies have invested in the development of e-cigarettes or similar nicotine delivery devices and all now have products on sale in the U.K., (ASH, 2014)." The 'Lorillard' Tobacco Company, paid \$135 million for the Electronic Cigarette brand 'Blu', and Phillip Morris International, the world's largest tobacco manufacturer launched its own brand of Electronic Cigarettes in 2014.

What is an Electronic Cigarette?

The World Health Organisation (WHO) defines an Electronic Cigarette or otherwise known as an Electronic Nicotine Delivery System (ENDS), as a device that vapourises and delivers a chemical mixture to the lungs of the user. Typically the chemical mixture is composed of propylene glycol, nicotine, various flavours and other chemicals. Electronic cigarettes are the primary prototype of ENDS, (WHO, 2013). Many international health officials are concerned over the lack of testing of the liquids and level of nicotine within the liquids. The electronic cigarette company 'UKETA' based in Shanghai, China, outlines the composition of the e-cigarette, as shown in Figure 1, which includes a lithium ion battery, that is button activated, and an LED light, which, when the user 'vapes', depending on the brand, the LED lights up in a red, green or blue colour, to resemble a tobacco cigarette glow. An atomiser, which is the heating component, is a small metal tube with a heating coil on the upper part and the thread at the opposite end connects the atomiser to the battery. When the battery is activated, the electricity heats the liquid which changes it into vapour. There are disposable or rechargeable components called cartomisers, which consist of an atomiser and a cartridge. Some are sealed and disposable and others can be refilled.

Disposable Electronic Cigarettes

There are various types of Electronic Cigarettes including, disposable, rechargeable and modified (customised). At the Electronic Cigarette summit in November of 2013, Dr. Lynne Dawkins presented a detailed account of what Electronic Cigarettes are and how they work. Some manufacturers state on the packaging how long the usage of an Electronic Cigarette can be expected to last and compare it to the usage expected from a traditional packet of cigarettes. Figure 1 below graphically depicts the composition of a disposable Electronic Cigarette, (1st generation Electronic Cigarette).

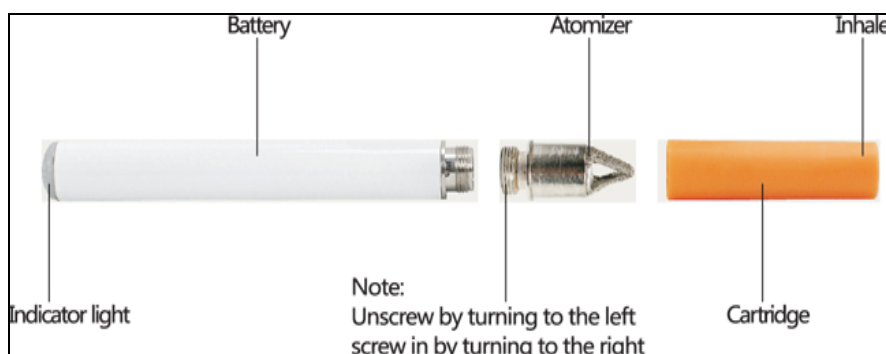


Figure 1 - UKETA International Ltd., 2011

Rechargeable Electronic Cigarettes

Dawkins (2013) reported on the ability to predict the number of uses per Electronic Cigarette, gave rise to users being more in control of planning how much they spend on vaping. The possibility to recharge the battery instead of replacing it, gave more control to the user in terms of money spent on replacing Electronic Cigarettes. This developed into 2nd generation Electronic Cigarettes or otherwise known as rechargeable Electronic Cigarettes. These rechargeable devices comprise of a battery, atomiser and a refillable clearomiser, (cartridge containing E-Liquid) and when the user activates the device, the atomiser heats the liquid to produce a vapour. The user inhales and exhales the vapour, hence the term 'Vaping'.

Modified (customised) Electronic Cigarettes

Third Generation E-Cigarettes are sometimes referred to as 'Mods' Modified E-Cigarette, because they have been modified to resemble an object such as a mobile phone or a writing pen and are used in the same way as 2nd Generation E-Cigarettes insofar as they operate by means of the battery, atomiser, and nicotine suspended in a flavoured/ unflavoured liquid. They are also manufactured to supply with the user with larger quantities of liquid nicotine as shown in Figure 2 below. In some modified Electronic Cigarettes, there is a mechanism that is used to vary the voltage and wattage of the device. The user can increase or decrease the voltage to strengthen the 'hit' to the throat. The variable wattage enhances the flavour so the user can adjust the device to suit his or her taste.

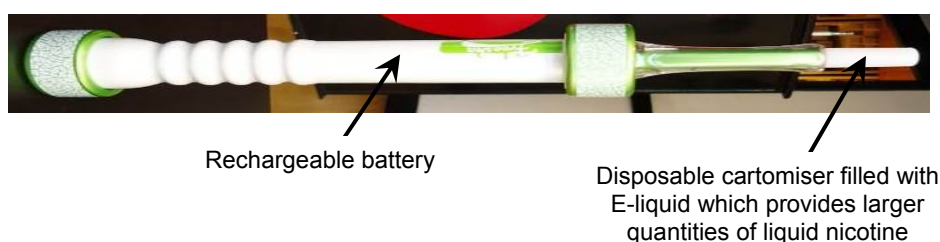


Figure 2 - Third Generation E-Cigarette

Composition of E-Liquids (liquid nicotine)

The main constituents of Electronic Cigarette liquid are Propylene Glycol and Vegetable Glycerine, nicotine and water. Propylene Glycol can be found in everyday household toiletries, including, deodorant, baby wipes, hair-gel and shaving foam. Vegetable glycerine is used as a food additive and together with the water, they create the vapour that is inhaled and exhaled. The E-Smoking Institute of Poland's research report of 2013, have carried out research on the constituents of what is in an Electronic Cigarette liquid. The results (in some instances only) included Formaldehyde, Acetaldehyde, Acrolein, Propylene Glycol, (the main ingredient in which all of the other chemicals are suspended in order for the user to inhale), and nicotine. In the report however; the levels of the above were found in trace amounts and it was stressed that they were considerably lower than the levels of these chemicals in a traditional tobacco cigarette. Further research suggests that Nitrosamines, known carcinogens, have been found in the testing of some Electronic Cigarette liquids. Until now, two studies have reported Tobacco Specific Nitrosamines (TSNs), being in the cartridge liquid of E-cigarettes. The U.S. Food and Drugs Administration (FDA, 2014), detected very low levels of TSNs

being in 5 of 10 cartridges tested as was reported in 2013 in the Journal of Chromatography A. Therefore; the general consensus is that more research is needed to determine the properties and the effects of Electronic Cigarette liquids. Some opinions from research experts in hospitals, universities and cancer research facilities have all expressed concern on how such a product has somehow; 'crept' into both national and international markets. There is no proper regulation, and a lack of qualitative or scientific knowledge as to what potential long-term dangers are associated with the Electronic Cigarettes or the products associated with them.

The Revised Tobacco Products Directive 2014/40/EU

This Directive will replace the Manufacture, Presentation and Sale of Tobacco Products Directive 2001/37/EC. The Tobacco Products Directive 2014/40/EU, Article 20, outlines the protocol that manufacturers and vendors must follow by May of 2016. Health warnings must comply with Article 12 of the Directive, for example, the manufacturer's details must be included, the amount of Electronic Cigarette liquid cannot be sold in excess of 10ml and the maximum threshold for nicotine within the liquid must not exceed 20mg/ml and currently none of these requirements apply. The directive also states that by May of 2016, all Electronic Cigarette devices and liquids must have "*instructions for use and storage of the product, including a reference that the product is not recommended for use by young people and non-smokers*, (Europa, 2014)."

Changing from traditional cigarettes to electronic cigarettes?

"Whilst there are anecdotal stories that e-cigarettes may have helped some smokers to quit, there are no properly conducted scientific studies which prove that they are an effective aid for sustained smoking cessation, (ICS, 2014)." In recent years, the trend in the use of Electronic Cigarettes has steadily increased. Australia, Canada, America, Ireland, and the U.K. have all experienced upward trends in their usage. There are also research studies that suggest the level of carcinogens and toxins that are in a traditional tobacco cigarette are not contained in the electronic cigarette liquids. *"There is no serious concern about the contaminants such as volatile organic compounds (formaldehyde, Acrolein, etc.) in the liquid or produced by heating. While these contaminants are present, they have been detected at problematic levels only in a few studies that apparently were based on unrealistic levels of heating, (Burstyn, Dr. Igor, 2013)."*

Renormalising smoking

Is smoking cool again? Not exactly, but "vaping" seems to be. If you haven't seen an e-cigarette yet, you will soon, (Canadian Living, 2014)." Public health experts and researchers are concerned that smoking is being renormalised by the action of vaping and that much of the effort to date to denormalise smoking will have been somewhat wasted. The Health Service Executive (H.S.E) of Ireland has vigorously campaigned to denormalise smoking and the image it promotes. They have already banned smoking on all H.S.E grounds in the country. However; with the use of Electronic Cigarettes among the general public, the H.S.E reacted to this by banning the use of Electronic Cigarettes on all H.S.E grounds from the 1st May 2014, due to how Electronic Cigarettes mimic the action of smoking.

METHODOLOGY

In order to achieve a qualitative analysis, a survey aimed at persons who vape and use vaping devices was designed. A combination of both structured and unstructured questions were used in the survey. The study survey was piloted in order to identify any ambiguity in the questions posed. Participants of varying educational levels were taken into account when designing the survey content. It was intended to find out what users knew about the product(s) they purchase and use and to measure their behaviour regarding product selection and influence. Twenty questions were designed, approved, piloted and distributed, based on research carried out for the literature review of this report. Seven of those questions were open ended to allow the person to convey their opinion, the remainder were 'yes' or 'no' options. A total of 50 surveys were completed by vapers,

The main source of completed surveys in this section came from patrons of the 'Enjoy E-Smoking' shop in the Leinster region. The manager of this premises granted permission to survey customers.

Analysis of the completed vapers surveys (VS)

Microsoft Excel was used to analyse collated data. Statistical Package for the Social Sciences (SPSS) software, was used for production of graphics having imported data from Excel.

RESULTS AND DISCUSSION - VAPERS SURVEY

The results are based on the data collected from a total of 50 Vapers. The gender breakdown of participants was 48% male and 52% female. Age distribution of participants is show in Table 1 below.

Table 1 - Age distribution of vapers.

18-30 years	30-40 years	40-50 years	>50 years
42%	22%	24%	12%

Vapers reported using their Electronic Cigarette device over a period of less than 3 years as outlined in Table 2 below.

Table 2 - Length of time that Vapers have used E-Cigarettes

6 months - 1 year	1 – 2 years	2 – 3 years	>3 years
70%	20%	10%	0%

The majority of participants (82%) first heard about e-cigarettes through word of mouth followed by social media. Not surprisingly 88% of vapers would welcome more research on vaping devices.

Vaping and perceived health benefits

A total of 84% of vapers reported a positive health changes since taking up vaping. Out of the 50 Vapers that were surveyed, 76%, (38/50) gave reasons as to why they have decided to vape. 74%, (28/38) said that cost and health reasons were the 2 main factors when answering this question. The remaining 26% added to their answers that vaping looks better than smoking, the curiosity of the hype of vaping enticed the smoker to try vaping and the remainder use their Electronic Cigarette as a means to cutting down on the traditional cigarettes. A total of 72% of respondents who stated health reasons as a factor in influencing their decision to start vaping, reported that “the cough” that was once there from smoking has now deteriorated or gone, Vapers who reportedly suffer from Asthma said that their breathing problems had improved and in general, feel better since quitting the traditional cigarettes.

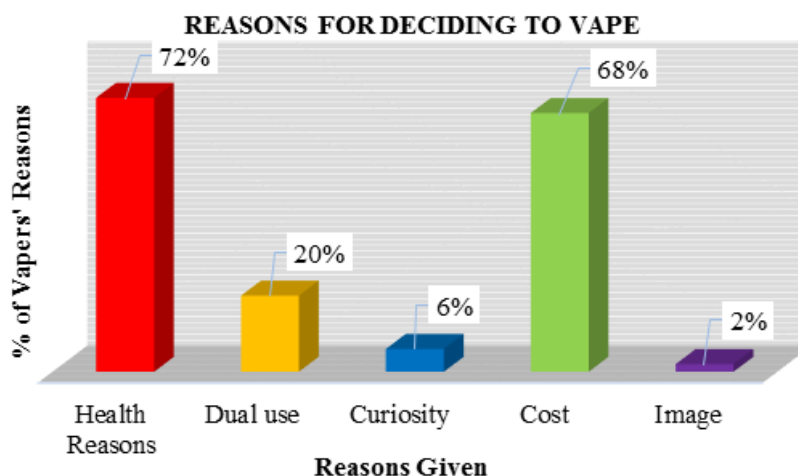


Figure 3 - Reasons for deciding to vape.

Costs and perceived cost benefits

Respondents reported that vaping was a cost saving exercise saving them from €20 per week to €200 per month. Respondents confirmed that the majority (94%) use re-chargeable devices while 4 % use disposable and 2% use modified or customised vaping devices. When asked about their current usage use of vaping devices, 82% reported sole use of electronic cigarettes with the remaining 18% reporting dual use with traditional cigarettes. Nearly all, 96% of respondents said the weekly cost of Electronic Cigarette products is €10 - €20 (or less) per week with only 4% reporting the weekly outlay is between €30 and €40.

E-Liquid Flavours

Out of the 50 Vapers that were surveyed, 48 gave examples of what E-Liquid flavours they use.

Table 3 - Various flavours of E-Liquid that Vapers use.

Tobacco	Fruity	Menthol	Mint	No Flavour-Natural	Drinks
35%	33%	19%	8%	2%	2%

Of the 35%, (17/48) there were no variation in the types of tobacco given, e.g. golden tobacco etc. Out of the 33%, (16/48) that said they use fruit flavour such as Apple, Strawberry, Blueberry, Tutti Fruity, Grape, Watermelon, and Cherry. One respondent that said they use 'Drinks' flavours, which included Cola, Red Bull, Amaretto and Coffee. 30% of respondents were concerned that the availability and range of flavours could entice younger people to start vaping.

Provision and use of vaping product information

Less than half (46%) of participants reported researching the product prior to purchasing it to conduct a price comparison (33%), investigate health benefits (33%), ensure they were purchasing a quality product (20%) and they researched the product as a matter of habit (14%). Just over half (56%) reported that they had read the accompanying information product leaflet to get direction on how to use the product (57%), to read the list of ingredients (21%), out of habit (10%), check for side effects (4%) and direction on disposal of packaging (4%).

CONCLUSIONS

Current Electronic Cigarette Market Conclusions. Since the inception of Electronic Cigarettes on to the Irish and international markets, the growth of sales of Electronic Cigarettes has grown exponentially. Electronic Cigarettes are the only development of nicotine delivery systems that deliver nicotine but also mimic of the action of smoking. Despite the efforts to promote Nicotine Replacement Therapiess, to promote smoking cessation, nothing has excelled in sales like the sales of Electronic Cigarettes. There is an increasing trend in franchised Electronic Cigarette retail outlets throughout Ireland. For what was once an intended smoking cessation product that could only be purchased on-line or in specific ENDS retail outlets here in Ireland, have now become a mainstream product and can be purchased in almost every retail outlet, nationwide.

The main factors for people deciding to vape are overwhelmingly health and cost reasons. 82% of Vapers in this study use an Electronic Cigarette only and are no longer smoking conventional cigarettes.

REFERENCES

Action on Smoking and Health Ireland, *ASH Ireland Current position on Electronic Cigarettes*, (2014), [Internet], available from: <http://www.ash.ie/ash-ireland-current-position-on-e-cigarettes-may-2104/> [Accessed, October 29th, 2014].

Burstyn, Igor, PHD, Department of Environmental and Occupational Health School of Public Health Drexel University, U.S.A., (2013), *Peering through the mist: What does the chemistry of contaminants in electronic cigarettes tell us about health risks?*, *Key Conclusions*, Page 13, [Internet], available from: <https://www.google.com/#q=http:%2F%2Fpublichealth.drexel.edu%2FSiteData%2Fdocs%2Fms08%2F90349264250e603%2Fms08.pdf> [Accessed, October 20th, 2014].

Canadian Living, *Are Electronic Cigarettes Safe?* (2014), [Internet, available from: http://www.canadianliving.com/health/prevention/are_electronic_cigarettes_safe.php [Accessed, August 9th, 2014].

Consumer Advocates for Smokefree Alternatives Association, *The History of E-Cigarettes*, (2014), [Internet], available from: http://casaa.org/E-cigarette_History.html [Accessed, June 6th, 2014].

Dawkins, L., E-Cigarette Summit, London, UK, November, 2013, [Internet], available from www.slideshare.net/lindsayfox/dr-lynn-dawkins-e-cigarette-summit

Smokefree Partnership, *A World Without Tobacco, Smoke Free Legislation in the E.U.*, [Internet], available from: <http://www.smokefreepartnership.eu/smoke-free-legislation-eu> [Accessed, June 1st 2014].

The American Lung Association, *Preventing Youth and Young Adults from Tobacco's Deathly Grip, The Facts*, (2014), [Internet], available from: <http://www.lung.org/associations/states/colorado/tobacco/the-facts.html#problem> [Accessed, October 26th, 2014].

The European Commission, Public Health, Revision of The Tobacco Products Directive, 2014/40/EU, *Electronic Cigarettes and Herbal Products for Smoking, Article 20, Electronic Cigarettes*, [Internet], available from: http://ec.europa.eu/health/tobacco/products/revision/index_en.htm [Accessed, October 6th, 2014].

The U.S. Food and Drug Administration, (2014), News & Events, Public Health Focus, *Summary or Results: Laboratory Analysis of Electronic Cigarettes Conducted by FDA*, [Internet], available from: <http://www.fda.gov/NewsEvents/PublicHealthFocus/ucm173146.htm> [Accessed December 17th, 2014].

The World Health Organisation, (2015), Tobacco Free Initiative, *Taxation*, [Internet], available from: <http://www.who.int/tobacco/economics/taxation/en/> [Accessed May 1st, 2015].

The World Health Organisation, *Business as usual for smoke free places*, (2014), [Internet], available from: <http://www.who.int/bulletin/volumes/84/12/06-021206/en/> [Accessed, October 24th, 2014].



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