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Availability of Safety Measures and Knowledge towards Hazardous Waste Management among Workers in Scientific Laboratories of Two Universities in Lebanon

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Abstract

Hazardous Waste Management (HWM) is critical to human health outcomes and environmental protection. A survey-based observational study was conducted in scientific laboratories of a public and a private university in Lebanon, where a total of 309 participants were recruited to evaluate the knowledge regarding safety measures to be applied when collecting and storing waste. Chi-square and Fisher's exact tests, Independent Sample T-test, Pearson correlation coefficient, and ANOVA were used for comparing differences and associations among socio-demographic variables. Linear regression models were used to map predictors of knowledge score and its relationships with demographic variables as well as training on proper HWM.

A significant association ($p<0.05$) was found between knowledge score and job function, years 'experience, educational level, professional status, work schedule, and training on HWM. Participants had adequate perceptions regarding the impact of HWM on health and the environment. Linear regression modeling revealed that knowledge score was significantly higher among bachelor level lab workers compared to those with doctoral degrees ($p=0.043$), full-time workers versus part-timers ($p=0.03$), and among public university participants compared to those of private university ($p<0.001$). It highlights the importance to improve the culture, attitude, and practice of proper HWM in scientific laboratories.

Keywords: Hazardous waste; knowledge score; safety measures; scientific laboratory workers; waste management.

1. Introduction

University laboratories are specialized sites for learning and conducting research, in which a large amount of waste are generated. Based on their properties, these wastes can be classified as inert (non-hazardous) or hazardous.

Hazardous waste (HW) is a priority issue for the State Members of the World Health Organization (WHO) Regional Office for Europe and was on the agenda of the Sixth Ministerial Conference on Environment and Health (WHO, 2016). WHO has also published a biosafety manual outlining the basics of laboratory biological safety, which is considered a guide for safe laboratory practice (WHO, 2020).

Among others, HW may include chemical, biological and radioactive waste. Improper handling and disposal of these kinds of waste may lead to critical harm on personal safety and on the environment pollution (Hanifa & Elzagheid, 2019). Previous studies revealed gaps in the knowledge and attitude of some laboratory workers at the academic university laboratories regarding the biological waste practices (Mohammed, Sanyi, & Al-Rayahi, 2018).

In addition, one of the main key aspects of chemical, biological safety is the waste management (WM) principles, which should be communicated to the laboratory workers and applied effectively in order to avoid their harmful impact (Fazzo et al., 2017).

For this purpose, designated staff must follow a structured guideline concerning the handling and disposal of these HWs. Several methods of treatment may be used before disposing HW such as incineration, neutralization, and chemical fixation. A good planning is also necessary to meet the recommended requirements of storing, disposing, and treating HW in order to avoid their potential impact on the environment and public health (Pourzamani et al., 2019)

Unfortunately, there are no reported data and existing regulations related to HWM knowledge and practices of academic laboratories in public university in Lebanon. Consequently, the objective of this study was to assess for the first time the HWM knowledge of workers in scientific university laboratories in the public university in Lebanon of and to explore the factors associated with such knowledge on HWM.

2. Materials and methods

2.1. Study design and population

This was a survey-based observational study conducted during 2019-2020 at the research and practical laboratories of faculties and branches of the public Lebanese University, located in 6 different governorates, and in the research core facilities of a private university in Lebanon. In total, 309 lab workers participated in the survey.They are senior researchers, research assistants, post-doctoral fellows, volunteers, masters and Ph.D. candidates. all

working in chemical or biological fields. Undergraduate students were excluded from the study.

2.2. Data collection and study instrument

The survey was prepared by our team based on existing literature of the prudent practices in the laboratory (Pedrozo & Philipi Jr, 2005) and guidelines of OSHA regulations (HAMM, 2021). It consisted of 26 main questions organized into five parts. All of the questions were close-ended.

2.3. Statistical analysis

Chi-square and Fisher's exact tests, Independent Sample T-test, Pearson correlation coefficient, and ANOVA were used for comparing differences and associations among socio-demographic variables. Linear regression models were used to map predictors of knowledge score and its relationships with demographic variables as well as training on proper HWM.

3. Results

A significant association ($p<0.05$) was found between knowledge score and job function, years 'experience, educational level, professional status, work schedule, and training on HWM. Participants had adequate perceptions regarding the impact of HWM on health and the environment. Linear regression modeling revealed that knowledge score was significantly higher among bachelor level lab workers compared to those with doctoral degrees ($p=0.043$), full-time workers versus part-timers ($p=0.03$), and among public university participants compared to those of private university ($p<0.001$). It highlights the importance to improve the culture, attitude, and practice of proper HWM in scientific laboratories.

4. Conclusion

This study gives good insight about the knowledge of academic lab workers in scientific laboratory of universities in Lebanon toward HWM and on the impact of HW on occupational health and on the environment. However, few suggestions emerge from the study that can be beneficial to encourage responsible of academic lab to work further towards the improvement of the culture, attitude and practice on proper waste management in academic scientific laboratory and that academic universities should provide regular inspection on storing and eliminating HW, and perform annual refresher training on safety measures for an effective HWM according to the Environmental Health & Safety office to increase the awareness of their laboratory personnel, students, and researchers which could have protective impacts on health and on the environment.

Acknowledgment

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