

Risk perception among health science students about the use of chemicals

Percepção de risco entre estudantes de ciências da saúde sobre o uso de substâncias químicas

Percepción de riesgo en estudiantes de ciencias de la salud sobre el uso de sustancias químicas

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Abstract

The activities of health professionals foresee the constant contact and handling of chemical agents. Therefore, knowledge about chemical risk is essential for personal safety both in the work environment and in the teaching environment. This research aimed to understand the perception of students in the health area about the risks related to the presence of chemicals in their study and/or work environment. This is a descriptive study with a quantitative approach, carried out in a private institution of Higher Education (HEI) in the city of Brasília (Brazil), with students from biomedicine, biological sciences and nursing, with the application of a questionnaire. Results showed that students are more concerned with social issues such as pedophilia or racial intolerance than those related to the presence of chemicals. Most students mentioned cancer as an issue of concern, but the absence of risk perception is observed in issues considered to be of little concern, such as cigarette use. Regarding the hazardous nature of chemicals and professional activities, vaccination, antibiotics, blood tests, ethyl alcohol and iodine were considered as non-hazardous. Although these may also present risks to professional health, the results showed that the students did not perceive them as risks. The obtained data indicate that most students have a low level of risk perception in the presence of chemicals, and it is suggested that questions about toxicology and biosafety should be intensified during the academic training process.

Keywords: Teaching; Toxicology; Safety; Poisoning; Occupational health.

Resumo

As atividades dos profissionais de saúde prevêem o contato e manuseio constante de agentes químicos. Portanto, o conhecimento sobre o risco químico é essencial para a segurança pessoal tanto no ambiente de trabalho quanto no ambiente de ensino. Esta pesquisa teve como objetivo conhecer a percepção de estudantes da área da saúde sobre os riscos relacionados à presença de produtos químicos em seu ambiente de estudo e/ou trabalho. Trata-se de um estudo descritivo com abordagem quantitativa, realizado em uma instituição privada de Ensino Superior (IES) da cidade de Brasília (Brasil), com estudantes de biomedicina, ciências biológicas e enfermagem, por meio da aplicação de um questionário. Os resultados mostraram que os alunos estão mais preocupados com questões sociais como pedofilia ou intolerância racial do que com a presença de substâncias químicas. A maioria dos estudantes mencionou o câncer como uma questão preocupante, mas a ausência de percepção de risco é observada em questões consideradas pouco preocupantes, como o uso do cigarro. Quanto à periculosidade dos produtos químicos e das atividades profissionais, vacinação, antibióticos, exames de sangue, álcool etílico e iodo foram considerados não perigosos. Embora estes também possam apresentar riscos para a saúde profissional, os resultados mostraram que os alunos não os perceberam como riscos. Os dados obtidos indicam que a maioria dos alunos tem baixo nível de percepção de risco na presença de produtos químicos, e sugere-se que questões sobre toxicologia e biossegurança sejam intensificadas durante o processo de formação acadêmica.

Palavras-chave: Ensino; Toxicologia; Segurança; Intoxicação; Saúde ocupacional.

Resumen

Las actividades de los profesionales de la salud prevén el constante contacto y manejo de agentes químicos. Por tanto, el conocimiento sobre el riesgo químico es fundamental para la seguridad personal tanto en el ámbito laboral como en el ámbito docente. Esta investigación tuvo como objetivo conocer la percepción de los estudiantes de salud sobre los riesgos relacionados con la presencia de productos químicos en su ambiente de estudio y/o trabajo. Se trata de un estudio

descriptivo con enfoque cuantitativo, realizado en una institución privada de Educación Superior (IES) de la ciudad de Brasilia (Brasil), con estudiantes de biomedicina, ciencias biológicas y enfermería, mediante la aplicación de un cuestionario. Los resultados mostraron que los estudiantes están más preocupados por temas sociales como la pedofilia o la intolerancia racial que por la presencia de sustancias químicas. La mayoría de los estudiantes mencionaron el cáncer como un tema de preocupación, pero se observa ausencia de percepción de riesgo en temas considerados de poca preocupación, como el consumo de cigarrillo. En cuanto a la peligrosidad de los productos químicos y de las actividades profesionales, se consideraron no peligrosos las vacunas, los antibióticos, los análisis de sangre, el alcohol etílico y el yodo. Aunque estos también pueden presentar riesgos para la salud profesional, los resultados mostraron que los estudiantes no los percibieron como riesgos. Los datos obtenidos indican que la mayoría de los estudiantes tienen un bajo nivel de percepción de riesgo en presencia de productos químicos, por lo que se sugiere que durante el proceso de formación académica se intensifiquen las cuestiones sobre toxicología y bioseguridad.

Palabras clave: Enseñanza; Toxicología; Seguridad; Envenenamiento; Salud laboral.

1. Introduction

Among the activities of health professionals are constant contact with and handling of chemical agents, whether in application or medical treatment, in cleaning and organizing the work area, in preparing solutions, in disinfecting and sterilizing materials, or even in fixing biological material for collections, especially because they all involve activities related to the use of laboratories.

According to Karapantsios et al. (2008) in this environment, it is necessary to identify the hazards, and assess and control potential risks, in order to provide a safe working environment for users who handle these agents.

However, more recent studies highlight that laboratory safety does not only depend on compliance with regulations, but is also the result of the commitment and attitude of those involved (Walters et al. 2017). Also according to these authors, effective safety education and knowledge of risks is a crucial step in the development of attitude.

Regarding accidents among professionals, Tachikake et al. (2016) analyzed, for a period of 4 years, the accidents observed in laboratories at the University in Japan and concluded that 58.2% of the cases involved the use of chemical substances in laboratory research.

For all of this, it is understood that health professionals tend to be exposed to this chemical risk, and thus understanding and knowledge about this risk is essential for personal safety as well as for communication and risk management. This is the case both in the work environment and in the teaching environment, since proper management can only be done when there is knowledge about the best strategies to be used. Do university students know this or are they aware of these risks? How do they perceive these issues?

Thus, the aim of this research was to know how students in the health area perceive the risks related to the presence of chemicals in their study and/or professional environment.

2. Material and Methods

This was a descriptive study characterized by a quantitative approach, which aimed to know the perception of health sciences college students about the risks of chemical substances.

2.1 Construction and development of the data collection instrument

The method for the present study was based on 3 main studies. In the first, Bilgin et al. (2016) sought to determine the views and perceptions of university students on environmental issues and environmental awareness. In the second, Karapantsios et al. (2008) aimed to investigate whether students were able to correctly identify the risks related to the chemical agents they handle in their laboratory work, and how this knowledge is influenced by students' progression through the various semesters.

And in the third model, Adane and Abeje (2012) evaluated the familiarity and understanding of students from two university departments about the chemical risk of substances.

Based on these studies, a questionnaire was prepared composed of seven questions, encompassing three aspects: 1. Perception about different types of accidents and diseases, including those related to the professional area; 2. Knowledge about chemical substances and their properties; and 3. Knowledge about contact with substances during future professional activities.

2.2 Place and participants

The research was carried out in a private Higher Education Institution (IES) based in the city of Brasília (FD), Brazil, with students from Biomedicine, Biological Sciences and Nursing, after prior authorization from the teachers who were present in the classroom at the time of the questionnaire application.

The sample consisted of 400 college students, including 141 biomedicine students, 39 biological sciences students, and 220 nursing students, enrolled between the 1st and 10th semester.

Participants were both male and female; aged 18 years or over; duly enrolled in the year of 2019 at the participating institution and in the determined courses; were present at the time of data collection and agreed to participate in the research by signing the Free and Informed Consent Term (FICT).

2.3 Data analysis

After acquiring supporting information through data collection, the analysis followed the following steps: a) Data organization in spreadsheets using Microsoft Excel 2016® software, belonging to the Microsoft Office 2016® for Windows® package; b) Categorization and classification of data based on the variables of interest; c) Descriptive statistical analysis, thus allowing the acquisition of percentage values (%) for the collected data, and d) Presentation of results in the form of tables.

2.4 Ethical aspects

This study fully followed the stipulations of Resolution N° 466/2012 of the Brazilian National Health Council (CNS) related to "guidelines and regulatory standards in research using human beings" and was only started after express authorization from the Research Ethics Committee (CEP) of the Brasilia University Center - UniCEUB under CAAE N°. 03161318.5.0000.0023 and subsequent approval under Opinion N° 3,096,536, from 2018.

3. Results and Discussion

After collecting, organizing and analyzing the data, it was possible to verify through the socio-demographic survey (Table 1) that there was a greater predominance of females among the participants, with 78.0% (n=110) in the biomedicine course, 64.1% (n=25) in the biological sciences course and 86.4% (n=190) in the nursing course.

The data reveal that there is a predominance of female college students in all courses surveyed, totalizing 81.2% (n=325) among the 400 research participants. These results are in accordance with data from the Brazilian synopsis of higher education (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, 2020), where among the 10 main courses, Biomedicine, Biological Sciences and Nursing are found as some of the courses occupied, for the most part, by women.

Table 1: Distribution of students by course.

Courses	Female	Male	Total
	%	%	%
Biomedicine	78.0	22.0	100
Biological Sciences	64.1	35.9	100
Nursing	86.4	13.6	100
Total	81.2	18.8	100

Source: Authors.

Similar data are found in a study carried out at Unicamp (State University of Campinas), for which in the Nursing and Biology courses, women are present in greater proportion, with 94% and 63.5%, respectively (Vasconcellos & Brisola, 2009).

Regarding the college students' level of concern regarding some issues of modern life, Table 2 presents three questions considered of greatest concern and three of least concern, among the sixteen varied questions that were presented to students in the survey.

About the issues that cause major concern, pedophilia was the most considered by 86.5% of biomedicine students, 92.3% of biological sciences and 82.7% of nursing, followed by racial intolerance with 70.0, 82.1 and 67.7%, as well as cancer with 58.1, 69.2 and 63.2%, respectively.

With regard to issues of little concern, cigarette use was the most considered by 19.8 in biomedicine, 17.9 in biological sciences and 16.3% in nursing, followed by chemical warfare with 11.3, 15.4 and 10.9% and finally a nuclear accident with 7.8, 10.2 and 7.7%, respectively. Table 2 presents the sample distribution.

Table 2: Level of concern of college students about certain social issues or involving chemical substances.

Courses	Major Concern		
	1. Pedophilia	2. Racial Intolerance	3. Cancer
	%	%	%
Biomedicine	86.5	70.0	58.1
Biological Sciences	92.3	82.1	69.2
Nursing	82.7	67.7	63.2
Courses	Little Concern		
	1. Cigarette use	2. Chemical Warfare	3. Nuclear Accident
	%	%	%
Biomedicine	19.8	11.3	7.8
Biological Sciences	17.9	15.4	10.2
Nursing	16.3	10.9	7.7

Source: Authors.

These data reveal that students of biomedicine, biological sciences and nursing consider social issues, such as pedophilia and racial intolerance, to be more worrying than issues related to chemical risks. These results corroborate a study carried out in Poland, where similar data were obtained when verifying that students considered social issues more important (Bilgin et al. 2016). In this context, Cooper and Nisbet (2016) observed how the use of media narratives may be effective to communicate about hazards and influence preferences and behaviors.

The present findings indicate that the use of narratives may be an effective means by which to communicate about environmental hazards in order to influence policy preferences.

Such results lead us to consider the influence of the media on the individual's concerns. People are curious about what can represent a threat and the media exploits this fragility, disseminating facts in a way that they become closer to people's daily lives and leading them to believe that this or that risk situation could happen within their social group (Groth et al. 2017).

Another issue observed as very worrying by most students was cancer (58.1%), (69.2%), (63.2%), which may be closely related to chemical substances. It is known that occupational exposure to chemical agents in general contributes to the emergence of different types of cancers (Chagas et al. 2013). The data obtained did not make it possible to identify whether this option was considered due to the association between the risks of chemicals and exposure, or just out of fear of facing the disease in everyday life.

On the other hand, regarding the issues that cause little concern, students of biomedicine (19.8%), biological sciences (17.9%) and nursing (16.3%) consider cigarette use one of the least worrying issues. It is known that cigarettes are one of the most sold products in the world and smoking is a chronic habit that can cause numerous complications, and it is considered by the World Health Organization (2021a) as a public health problem and the main cause of preventable death in the world.

Inhaled smoke is responsible for most tobacco-related diseases, especially lung cancer (Centers for Disease Control and Prevention, 2010). In view of the results, it was possible to observe the low association between cigarette use and concern about cancer, demonstrating a clear lack of risk perception in the face of these specific factors.

Other issues considered by students of biomedicine, biological sciences and nursing as causing little concern were chemical warfare with (11.3%), (15.4%) and (10.9%) respectively and a nuclear accident with (7.8%), (10.2%) and (7.7%) respectively. Some of these results disagree with a study carried out in Poland, where students considered a nuclear accident as the second most worrying risk factor, even though there are no nuclear plants established in the country. The study considers that the nuclear accidents in Chernobyl in 1986 and in Fukushima in 2011 affected people (Bilgin et al. 2016). Therefore, despite being far from the reality of students in both Poland and Brazil, the level of concern and risk perception are different, being influenced by the social, cultural and economic scenario (Colasso, 2011) and possibly geographical aspects.

Table 3 presents some substances and actions that college students consider associated with their future professional activity, evidencing their considerations regarding the hazard of each of the exposed items. Also shown in Table 3 are the items considered as non-hazardous.

The results reveal that the majority of students of biomedicine and biological sciences (70.9% and 69.2%) consider mercury as the most dangerous substance, among the others mentioned in the survey. Although this substance has no direct relationship with the future professional activities of these training courses, the exposure to metallic and inorganic mercury can occur in an occupational, chronic and successive way through the inhalation of vapors in the health sector, which can lead to mercurialism, due to its neurotoxic, immunotoxic and teratogenic properties (World Health Organization, 2021b).

Table 3: Considerations of students about the hazard of chemicals and activities performed by professionals.

	Hazard	
	Hazardous	Non-Hazardous
Biomedicine	%	%
Mercury	70.9	Vaccination 61.7
Botulinum toxin	64.5	Antibiotics 58.1
Ultraviolet light	59.6	Iodine 38.3
Biological Sciences	%	%
Mercury	69.2	Vaccination 51.3
Ultraviolet light	66.7	Blood test 38.5
Formaldehyde	61.5	Iodine 35.9
Nursing	%	%
Blood transfusion	71.3	Blood test 44.5
Nitrous oxide	61.8	Ethyl alcohol 41.4
Antineoplastic drugs	60.4	Iodine 33.2

Source: Authors.

Botulinum toxin was pinpointed by 64.5% of Biomedicine students as a hazardous substance with which they will have contact in the profession. The biomedic professional is qualified to work in the area of aesthetics through resolution n°197/2011 of the Brazilian Federal Council of Biomedicine, being a qualified professional to carry out the application of this substance. It may present risks to patients due to adverse effects that can occur after an application error, error in patient evaluation for the procedure, dose or dilution error (Conselho Federal de Biomedicina, 2014). As for the occupational hazard of the substance for the professionals of biomedicine, no paper on this subject was found and, thus, it is believed that the hazard pointed out by the students about these chemicals should be related only to the personal view as a patient.

Ultraviolet Light was considered by 59.6% of the Biomedicine university students and by 66.7% of the Biological Sciences as a dangerous activity inherent to the profession. We can compare the data obtained with those presented in Table 2, where 58.1% of university students in Biomedicine and 69.2% in Biological Sciences considered cancer as an issue that causes great concern. This association demonstrates some perception of risk in the face of these factors, since ultraviolet radiation plays an important role in triggering non-melanoma skin cancer.

It should be noted that care is needed when handling instruments/equipment that emit this type of radiation, and users should always have the necessary protective equipment, to avoid the resulting cellular changes (Surdu et al. 2013).

For 61.5% of Biological Sciences students, formaldehyde was considered a hazardous substance. According to a previous study, formaldehyde is toxic and can cause eye and mucous membrane irritation, presenting a high carcinogenic potential, being an agent that is used in anatomy and biological laboratories and for disinfection purposes in hospitals. According to the International Agency for Research on Cancer (IARC), formaldehyde is associated with the incidence of nasopharyngeal cancer and also with the development of leukemia (Clausen et al. 2015; Ladeira et al. 2012). The exposure to formaldehyde is also associated with the use of e-liquid nicotine present in e-cigarettes, causing potential health risks (Kosmider et al. 2020), but the exposure to this chemical in this kind of equipment is still unknown by the majority of the population.

The data also showed that, for 61.8% of nursing students, nitrous oxide is the most hazardous substance to which they will be exposed in their activities as a nurse. According to Eftimova et al. (2017), nitrous oxide is an inhalational anesthetic used

to maintain general anesthesia and, like other anesthetics, when chronically inhaled, in low concentrations, it can increase the incidence of liver disease, miscarriages, congenital malformations and some types of leukemia, when compared to other individuals who were not exposed to anesthetic agents.

Nursing students also considered anticancer drugs (60.4%) as dangerous substances. These data are close to the results obtained in two other surveys, where 86.7% of respondents considered anticancer drugs to be the most harmful to workers' health (Xelegati et al. 2006) and where 88.8% of the students considered these drugs as dangerous (Adachi & Kikuchi, 2017). Anticancer drugs can have carcinogenic, mutagenic and teratogenic effects, providing risks to professionals who handle them, when protection and safety measures are not followed (Nussbaumer et al. 2011). In terms of comparison, in the present study, 63.2% of nursing students are concerned about cancer (Table 2), while 60.4% consider anticancer drugs hazardous (Table 3).

Regarding activities considered to be non-hazardous (Table 3), 61.7% of biomedicine students and 51.3% of biological sciences cited vaccination. Another activity that was also considered non-hazardous by 51.3% of the biological sciences students and by 44.5% of nursing students was the blood test. It is known that health professionals are exposed to several risks in their work environment, including accidents with biological materials, such as injuries with sharps, as well as percutaneous exposure to blood and body fluids (Gara et al. 2015). Therefore, there is no activity that is not dangerous in the health field, and these data reveal the low risk perception in such activities.

For 58.1% of biomedicine students, antibiotics were considered not hazardous. For biomedics who will work in the biotechnology industries, the production of biologically active products such as antibiotics is one of their functions, so they must know how to handle them correctly during production and use the appropriate equipment for professional safety. It is known that antibiotics, when in direct contact with the skin, if inhaled or ingested, can lead to sensitization, which can trigger allergies and allergic rhinitis in those who have been exposed, as well as sensitization and resistance (Landecker, 2016; Souissi et al. 2017). Therefore, there is lower risk perception on the part of these students in relation to these chemicals.

Ethyl alcohol was considered by 41.4% of nursing students and iodine by 38.3% of biomedical students, 35.9% of biological sciences students and of 33.2% of nursing students as non-hazardous substances. These chemicals are generally safe and effective disinfectants, which can be used alone or in combination (Art, 2005). In a study carried out with nurses from a hospital in Ribeirão Preto (Xelegati et al. 2006), it was found that iodine was one of the chemical agents mentioned as the most seen in hospitals and that it is falling into disuse because it is a strong compound that can lead to skin irritation. The study reveals that half of the subjects identified iodine as harmful to the health of workers, while alcohol was scarcely considered as a possible cause of occupational health problems, although it has a high potential for flammability and produces irritating vapor classified as toxic to human health.

The low risk perception of ethyl alcohol for nursing students is probably due to its routine use in various activities that make up the work of nurses, tending to be undervalued, in addition to being consumed as a drink by students in general (Dumas et al. 2017; Balthazar et al. 2018). The low risk perception of iodine as a dangerous substance is probably because they are not in constant contact with the compound, considering it harmless since it is not used frequently (Xelegati et al. 2006; Art, 2005).

In the present study, it was found that in all courses, most college students claim to know what risk is, showing an increase in percentages from the beginning to the end of the training period. Table 4 presents the variation in the knowledge about risks among students from different semesters of each course.

Academics are exposed to different kinds of risk within the laboratory environment, not only to chemical risks, but also to physical, mechanical, biological and ergonomic risks, and it is extremely important to recognize, evaluate and control these risks by using the knowledge of biosecurity. In general, all the mentioned risks tend to be present in a high proportion in laboratories due to the handling of toxic, contaminating or infectious materials (Antunes et al. 2010).

Table 4: Knowledge about risk among college students in different semesters.

Courses	Do you know what the risk is?				
	Yes	No	More or Less	No Response	Total
Biomedicine	%	%	%	%	%
1st to 3rd semester	72.9	2.8	24.3	0	100
7th to 9th semester	95.5	4.5	0	0	100
Biological Sciences	%	%	%	%	%
3rd to 5th semester	89.5	10.5	0	0	100
7th to 9th semester	95.0	0	5.0	0	100
Nursing	%	%	%	%	%
1st to 3rd semester	77.8	0	21.0	1.2	100
8th to 10th semester	91.6	0	6.7	1.7	100

Source: Authors.

The laboratory environment and the activities developed therein can influence the occurrence of accidents, which are often caused by human error, and may be a consequence of a deficiency in the educational system and the absence of a safety culture. A variety of knowledge related to both risk factors and protection during laboratory activities should be disseminated (Stehling et al. 2012).

It is known that individuals respond differently to dangerous situations. The acceptance of an event by one may be unacceptable to others, and thus understanding these variations in responses is critical for the development of risk management options and strategies (Faustman & Omenn, 2018).

Langerman (2009) reviewed about 94 incidents in laboratories identified by the US Chemical Safety Committee and concluded that, among other things, all laboratory staff should receive specific safety training appropriate to the laboratory in which they work and the tasks performed there. This statement is reinforced by Taylor and Snyder (2017) who state that risk perception is an important aspect of safety behavior, but it is essential that risk perception measures are appropriate to the specific conditions of the exposed professional.

According to Garcia-Herrero et al. (2012), accidents happen because there is a risk, and this risk stems from a set of working conditions that influence the behavior of the worker. With adequate control of these working conditions and, therefore, of the associated risk, it may be possible to prevent accidents, regardless of the individual factors of each case. Of course, for this prevention, the existing risk must be exposed and its perception must be clear.

4. Conclusion

In the present study, it was possible to observe that the vast majority of university students claim to know what risk is and declare that they are concerned about the chemical substances present in laboratories. However, most of these students have a low level of risk perception in the face of the hazard of chemicals.

The influence of different realities can affect the perception and interfere with the association between risk and its health consequences. Having realized that some of the students are more concerned with social issues in evidence in the media, it is important to pay attention to the lack of knowledge related to chemical substances, and the consequent training of professionals who are unaware of the risks to which they are exposed. These results demonstrate the need for activities that encourage the familiarization of these students with chemical agents and associated risks. The consideration of some activities and substances

as “non-hazardous” calls into question the real risk perception of future professionals in the face of activities inherent to their profession.

In view of the data obtained, it is evident that a greater effort is needed from the coordinators of the researched courses, as well as from teachers, to change this context of misinformation, teaching students to understand and recognize the risks and not just follow safety rules. Therefore, in addition to providing guidance on the properties of chemical reagents and their hazards, an effort must be made to encourage the rigorous use of personal protective equipment inside laboratories, aiming to stimulate a safety culture in the daily life of future professional activities. In order to improve this knowledge, subjects such as biosafety and toxicology should be taught throughout the undergraduate course, whether in the biomedicine, biological sciences or nursing course, in addition to courses and workshops that promote continuing education.

It is hoped that this research will contribute to the implementation of teaching methods that improve students' perception of the risks of chemical substances.

This research is not intended to be the final word on the subject, recognizing that it has limitations because it is carried out in a single education institution. A new assessment after an educational intervention action could also be interesting, seeking to broaden the risk perception.

Therefore, more studies are needed to identify other important factors responsible for the low level of risk perception and knowledge of students about the risks involving hazards from chemical agents.

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