ORIGINAL ARTICLE

Comparative Assessment of Knowledge on Household Poisons and First-Aid Management of Poisoning among Medical and Non-Medical University Students in Pakistan

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Abstract

Background: Poisoning incidents present a significant health risk worldwide, necessitating effective first-aid responses. Accurate and timely first-aid responses are essential for saving lives and improving treatment outcomes, particularly in emergencies. Assessing public knowledge of poisoning management is, therefore, crucial.

Objectives: To determine the knowledge of household poisons and first-aid treatment of poisoning among undergraduate university students of Pakistan and to compare this knowledge among undergraduate non-medical and medical students.

Method: This was a cross-sectional study conducted in different universities in Karachi from August 2023 to March 2024. Data was collected using a self-designed 17-item questionnaire. SPSS version 26 was used to analyze data.

Results: Among 406 university students, 62% students demonstrated adequate knowledge, while 38% students demonstrated inadequate knowledge, with medical students exhibiting significantly higher knowledge levels (73.4%) compared to non-medical students (51.2%) ($p<0.001$). While females had slightly higher adequate knowledge levels (65.8%) than males (58.9%), the difference was not statistically significant ($p=0.142$). Knowledge levels increased significantly with age ($p=0.012$) and academic progression ($p<0.001$), ranging from 52.1% in first-year to 72.3% in fifth-year students. The highest competency areas included emergency number awareness (83.2%) and personal protective equipment use (82.3%), whereas the lowest scores were observed in snakebite management (58.7%) and neutralizing agent use (55.3%).

Conclusion: It was concluded that many medical as well as non-medical students lack the required amount of information about poisoning and its first aid measures. This is an eye-opening study, and immediate measures should be taken to establish poisoning information and control centers.

Keywords: *Poison, poisoning information, poisoning control centers, first-aid of poisoning, poisoning knowledge.*

INTRODUCTION

The history of poisons is as old as mankind [1]. Several definitions are available in the literature for the term poison. According to Parikh's textbook of medical jurisprudence, forensic medicine, and toxicology, poison is defined as "a substance that when inhaled, administered, or ingested, is capable of acting deleteriously on the human body" [2]. Uges attempts to define poisoning as "an individual's medical or socially unacceptable condition as a consequence of being under the influence of an exogenous substance in a dose too high for the person concerned" [3]. These broad definitions result in an extensive list of poisons, including pharmaceuticals, chemicals, plants, and gases.

Globally, the burden of poisoning is substantial. Data from the World Health Organization (WHO) indicated that, in 2016, more than 100,000 people lost their lives due to accidental poisoning. This shows that poisoning is a worldwide health problem that needs to be addressed [4]. According to a survey, poisoning is the second most commoncause of accidental injuries among under-5 children in Pakistan [5].

Various factors, including age, weather, geographical regions, sociocultural status, *etc.*, can contribute to different types of poisoning [6]. For example, in agricultural countries, pesticide poisoning is a major concern, while in developed countries, suicide by poisoning is more common [7]. Likewise, poisonous snakebites are a significant issue in tropical regions with higher rainfall [8].

Given that Pakistan is an agricultural country, organophosphate poisoning represents a notable burden. Contributing factors include insufficient knowledge and inadequate training in minimizing risks or exposure to pesticides in agricultural fields [9].

Moreover, various plant species, including *Nerium oleander, Ricinus communis, Leptopus cordifolius, Justicia adhatoda, Datura stramonium*, *etc.*, are found in Pakistan, but the public is unaware of them [10]. Among domestic poisons, lead poisoning is a global concern that results in the mortality of 800,000 people every year worldwide, with paints and polyvinyl chloride (PVC) toys as its main sources [11]. In domestic settings, commonly

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encountered poisons also include cleaning agents such as bleach and toilet cleaners; insecticides and mosquito repellents; hydrocarbons like kerosene oil; naphthalene balls; rat poison (zinc phosphide); and even cosmetics and medications when taken in excess [11, 12].

Such a great burden requires proper setups and skillful people in every part of the world to deal with such cases. WHO also recommends that all countries should build fully equipped health centers for poisoning cases [13]. Unfortunately, less than 50 % of WHO member states have established poison centers. Moreover, research suggests that neither the general public nor the health professionals have adequate knowledge of dealing with poisoning cases [8, 14, 15]. It is evident from research that parents and the general public in various regions are unaware of domestic poisons and poisonous plants [10, 16].

The health centers specially established to deal with poisoning cases are known as Poison control centers, which serve 2 major functions: poison information dissemination and education about poison prevention. The Poison Information and Control Centers aim to reduce morbidity and mortality associated with poisoning [17]. Thus, they are the potential solution to this problem.

According to research, in addition to the role of Poison Information Centers, mass media platforms such as newspapers, television, and educational materials displayed at bus stops and local shops can significantly contribute to public awareness about poisoning prevention and management [18]. This is particularly important because prompt and appropriate first-aid measures, including the immediate removal of the patient from the exposure site, securing the airway, and providing supportive care, play a critical role in reducing morbidity and mortality associated with poisoning incidents before professional medical help becomes available [1].

There has been little research associated with poison information centers and knowledge about poisoning among university students in Pakistan. One research from 2014 indicated that Pakistan currently has only two poison control centers, one located at Jinnah Postgraduate Medical Centre (JPMC), Karachi, and another at Allied Hospital, Faisalabad. Both face significant limitations, including the absence of a 24/7 emergency helpline for the general public [19]. One study from Turkey shows that nonmedical undergraduate students lack adequate first aid knowledge on poisoning management [12].

The study aimed to evaluate the knowledge of household poisons and first-aid treatment of poisoning among undergraduate students from two specific institutions in Pakistan through a questionnaire-based assessment. The study also compares the knowledge levels between clinical-year medical students (who have received formal toxicology education) and non-medical students, to identify key educational gaps and inform future interventions.

Poisoning incidents present a significant health risk worldwide, necessitating effective first-aid responses. Assessing public knowledge of poisoning management is, therefore, crucial. The absence of existing literature on poisoning knowledge in Pakistan underscores the urgency of this study. Additionally, the research has determined whether medical students demonstrate a better ability to identify household poisons compared to non-medical counterparts. The findings will inform the development of training programs related to poisoning awareness and first-aid response, which will enhance public health outcomes.

METHODOLOGY

This cross-sectional study was conducted at Sindh Medical College, Jinnah Sindh Medical University (JSMU), and Nadirshaw Eduljee Dinshaw (NED) University in Karachi from August 2023 to March 2024. The study protocol was approved by the Institutional Review Board of JSMU (Reference Number: JSMU/IRB/2023/802). We included undergraduate medical students from the fourth and final year MBBS at Sindh Medical College, JSMU, and undergraduate students from first through final year at NED University Karachi. The non-medical participants were undergraduate students at NED University from disciplines such as engineering and applied sciences, selected to represent the general educated population who may still encounter poisoning risks at home or in industrial environments. Students from other universities and those who did not provide consent were excluded from the study.

The sample size was calculated using the single proportion formula: $n = (Z^2pq)/d^2$, where $Z = 1.96$ (95% confidence interval), $p = 0.773$ (77.3% expected frequency of adequate knowledge based on a previous study) [20, 21], $q = 1-p = 0.227$, and $d = 0.05$ (5% margin of error). The calculation yielded a minimum required sample size of 270 participants. After accounting for a 10% non-response rate, the final required sample size was 297 participants. Using non-probability convenience sampling, we recruited 406 participants with equal distribution between medical (n=203) and non-medical students (n=203), which exceeded the minimum required sample size.

Data collection was conducted through an online self-administered structured questionnaire. The questionnaire link was shared through their institutional email addresses and class representatives. All participants were required to fill out an online consent form first. A reminder was sent after one week to maximize the response rate.

The study questionnaire was self-designed by researchers with the help of related literature [19, 22-27]. The questionnaire consisted of two sections: demographic information and knowledge assessment.

The demographic section collected information about age, gender, institution, and year of study. The knowledge section comprised 17 multiple-choice questions assessing participants' knowledge about household poisons and first aid management of poisoning (questionnaire provided as a supplementary file in **Appendix A**). The knowledge assessment was scored out of 17 points, with one point awarded for each correct answer. Participants' knowledge was categorized as adequate (≥75% correct responses, score ≥13) or inadequate (<75% correct responses, score <13). The 75% threshold was selected based on established educational assessment practices, where it is widely recognized as the minimum standard for adequate performance, especially in health sciences education. This benchmark has also been used in previous studies to categorize knowledge levels as adequate or inadequate [20, 21]. The cut-off was further supported by expert consensus during the questionnaire validation process.

The content validity of the questionnaire was established through expert review by two specialists in emergency medicine and toxicology who evaluated the relevance, adequacy, and clarity of each item. The questions were adapted from previously published articles to ensure that the content was evidence-based and comprehensive [12, 22-27]. The internal consistency was found to be 0.725 using dichotomous scoring, reflecting acceptable reliability.

Statistical analysis was performed using SPSS version 26. All categorical variables were summarized as frequencies and percentages. A descriptive analysis was conducted to assess participants' awareness of poisoning first-aid treatments. Chi-square test was used to compare knowledge scores across different groups (study years, gender, age groups, and type of university). A p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 406 undergraduate students participated in the study, with an equal distribution between medical (n = 203) and non-medical students (n = 203). The demographic breakdown is detailed in Table **1**. The majority of participants were in the age group of 18-20 years (52.7%), followed by 21-23 years (35.0%), with a smaller proportion in the 23-25 years (9.4%) and >25 years (2.9%) categories. Female participants constituted a larger proportion of the sample (56.7%) compared to males (43.3%). Regarding the year of study, fourth-year students represented the largest group (30.5%), followed by first-year (20.2%), fifth-year (19.3%), second-year (16.7%), and third-year students (13.3%).

Out of all students, 62% demonstrated adequate knowledge, while 38% showed inadequate knowledge regarding poisoning and its first-aid management. A visual summary comparing overall knowledge levels between the two groups is illustrated in Fig. **(1)**.

Table 1: Demographic characteristics of study participants.

Characteristic	Frequency (%)
Age Groups	
18-20 years	214 (52.7)
21-23 years	142 (35.0)
23-25 years	38 (9.4)
>25 years	12 (2.9)
Gender	
Male	176 (43.3)
Female	230 (56.7)
Institution	
Medical University	203 (50.0)
Non-medical university	203 (50.0)
Year of Study	
1st year	82 (20.2)
2nd year	68 (16.7)
3rd year	54 (13.3)
4th year	124 (30.5)
5th year	78 (19.3)

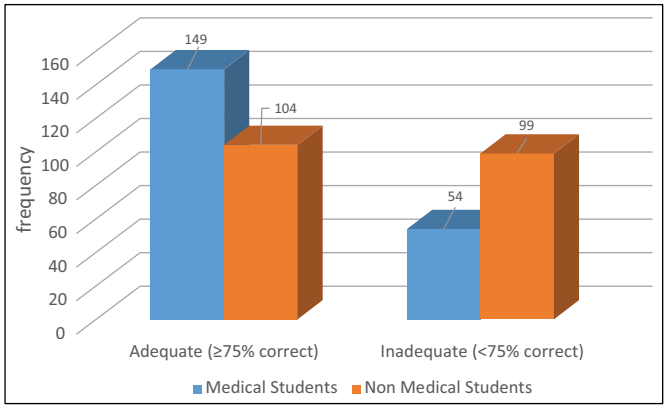

Fig. (1): Comparison of knowledge levels between medical and non-medical students (n=406).

Table 2: Knowledge assessment results by groups.

Group	Adequate Knowledge n(%)	Inadequate Knowledge n(%)	p-value
Institution			
Medical university	149 (73.4)	54 (26.6)	*<0.001
Non-medical university	104 (51.2)	99 (48.8)	
Gender			
Male	104 (58.9)	72 (41.1)	0.142
Female	151 (65.8)	79 (34.2)	
Age Groups			
18-20 years	116 (54.3)	98 (45.7)	*0.012
21-23 years	95 (67.2)	47 (32.8)	
23-25 years	27 (70.1)	11 (29.9)	
>25 years	8 (69.8)	4 (30.2)	
Year of Study			
1st year	43 (52.1)	39 (47.9)	*<0.001
2nd year	39 (56.8)	29 (43.2)	
3rd year	34 (63.4)	20 (36.6)	
4th year	86 (69.7)	38 (30.3)	
5th year	56 (72.3)	22 (27.7)	

*Statistically significant (p<0.05)

Table 3: Response pattern for knowledge assessment questions.

Question Topic	Correct Response n(%)
Emergency number awareness	338 (83.2)
Chemical/Corrosive substances management	314 (77.4)
Personal protective equipment	334 (82.3)
Recovery position knowledge	280 (68.9)
Carbon monoxide poisoning	285 (70.2)
Pesticide poisoning management	281 (69.1)
Lead poisoning awareness	267 (65.8)
Snake bite management	238 (58.7)
Eye decontamination procedures	248 (61.2)
Use of neutralizing agents	224 (55.3)

A detailed comparison of knowledge adequacy across groups is presented in Table **2**. Medical students exhibited significantly higher knowledge (73.4%) compared to non-medical students (51.2%), with a statistically significant difference (p<0.001). While females had a slightly higher rate of adequate knowledge (65.8%) than males (58.9%), this difference was not statistically significant (p=0.142). Age was positively associated with knowledge adequacy (p = 0.012), ranging from 54.3% in the youngest group (18-20 years) to 69.8% in the oldest group (>25 years). A significant increase in knowledge was also observed with academic progression (p<0.001), from 52.1% in first-year students to 72.3% in fifth-year students.

Regarding specific knowledge areas, the response pattern is summarized in Table **3**. The highest scores were noted in emergency number awareness (83.2%), use of personal protective equipment (82.3%), and chemical/corrosive substance management (77.4%). Moderate knowledge was seen in topics like carbon monoxide poisoning (70.2%), recovery position (68.9%), and pesticide poisoning (69.1%). Lower scores were reported for snake bite management (58.7%), eye decontamination (61.2%), and the use of neutralizing agents (55.3%).

Table 4: Comparison of specific knowledge areas between medical and non-medical students.

Knowledge Area	Medical Students n(%)	Non-Medical Students n(%)	p-value
Emergency Response			
Emergency number awareness	186 (91.6)	152 (74.8)	*<0.001
Recovery position placement	167 (82.3)	113 (55.5)	*<0.001
Initial response steps	174 (85.7)	116 (57.3)	*<0.001
Chemical/Corrosive Substances			
First aid management	171 (84.2)	143 (70.6)	*0.002*
Eye decontamination	156 (76.8)	92 (45.6)	*<0.001
Use of neutralizing agents	145 (71.4)	79 (39.2)	*<0.001
Specific Poisoning Types			
Carbon monoxide awareness	170 (83.7)	115 (56.7)	*<0.001
Lead poisoning knowledge	157 (77.3)	110 (54.3)	*<0.001
Pesticide poisoning	162 (79.8)	119 (58.4)	*<0.001
Preventive Knowledge			
Personal protective equipment	181 (89.2)	153 (75.4)	*0.001
Household safety measures	165 (81.3)	134 (65.9)	*0.003
Risk identification	156 (76.8)	114 (56.0)	*<0.001

*Statistically significant (p<0.05)

The comparison of knowledge in specific domains between medical and non-medical students is presented in Table **4**. Medical students consistently outperformed non-medical students across all domains, with statistically significant differences in emergency response (*e.g.*, recovery position knowledge: 82.3% *vs.* 55.5%, p<0.001), management of chemical/corrosive substances, and understanding of specific poison types. Notably, medical students demonstrated better preventive knowledge, such as proper use of personal protective equipment (89.2% *vs.* 75.4%, p=0.001) and household safety measures (81.3% *vs.* 65.9%, p=0.003).

DISCUSSION

Enhancing awareness is essential for the prevention and effective management of poisoning cases. Timely and accurate first-aid responses are crucial in reducing morbidity and mortality in poisoning-related emergencies [28]. This study assessed knowledge of household poisoning and its first-aid management among university students in Pakistan, comparing clinical-year medical students with non-medical students.

The findings revealed that 62% of the participants demonstrated adequate knowledge, while 38% showed inadequate awareness. Medical students significantly outperformed non-medical students, with 73.4% achieving adequate scores compared to 51.2% of non-medical students. This outcome is likely influenced by medical students' exposure to toxicology as part of their formal curriculum in Forensic Medicine.

These findings are consistent with results from Goktas *et al.,* who reported that Turkish medical students had significantly better poisoning-related first-aid knowledge than their non-medical counterparts [12]. Similarly, Popiołek *et al.* found that medical students in Poland scored higher than non-medical students regarding carbon monoxide poisoning awareness [15].

Nevertheless, the fact that 26.6% of medical students lacked adequate knowledge is concerning, particularly since they had already studied this subject. This aligns with the findings of Elsakkar *et al.,* who observed substantial gaps in poisoning-related first-aid knowledge even among senior medical students in Saudi Arabia [29].

Among non-medical students, 48.8% demonstrated inadequate knowledge. Notably poor knowledge areas in our study included snakebite management (58.7%), eye decontamination procedures (61.2%), and the use of neutralizing agents (55.3%). Bhargava *et al.* similarly reported inadequate and sometimes misleading knowledge regarding snakebite management among teachers, students, and healthcare workers in India [14].

These international comparisons affirm the relevance of our findings and emphasize the need for structured educational interventions to improve poisoning management knowledge across both medical and non-medical student groups.

LIMITATIONS

This study has several limitations. Firstly, a non-probability convenience sampling technique was used, which, although practical and common in educational research, limited the institutional representation in Pakistan. This limited institutional representation may affect the generalizability of the findings to broader student populations across the country.

Secondly, the study assessed only theoretical knowledge through a self-administered online questionnaire. While understanding first-aid concepts is essential, practical skills are equally important for effective real-world responses. The absence of a practical assessment component limits the ability to evaluate students' actual preparedness in poisoning emergencies. Incorporating simulation-based or hands-on assessments in future studies is recommended for a more comprehensive evaluation.

CONCLUSION

The findings of this study indicate that a significant proportion of both medical and non-medical university students lack adequate knowledge regarding household poisons and their first-aid management. This highlights existing gaps in awareness that may compromise timely and appropriate responses in poisoning emergencies.

RECOMMENDATIONS

Based on the study findings, the following recommendations are proposed:

Immediate measures should be taken to conduct workshops and awareness sessions on first-aid management of poisoning for both medical and non-medical university students to enhance their preparedness and potentially save lives. Greater emphasis should be placed on strengthening toxicology education in the medical curriculum to ensure that future healthcare professionals are equipped to respond effectively in poisoning emergencies. There is an urgent need to establish fully functional Poison Information and Control Centers (PICCs) in every major city of Pakistan. These centers should operate with a 24/7 helpline to assist both the general public and healthcare providers in managing poisoning cases promptly. We recommend that future studies focus exclusively on all years of MBBS students to more accurately assess the effectiveness of toxicology teaching and to guide curriculum enhancements based on identified knowledge gaps.

ETHICS APPROVAL

This study was conducted in accordance with the ethical principles outlined by the Declaration of Helsinki and received approval from the IRB of JSMU (Reference Number: JSMU/IRB/2023/802).

CONSENT FOR PUBLICATION

Informed consent was obtained from all the participants of this study.

AVAILABILITY OF DATA

Data supporting the article's results is available within the manuscript. The detailed data with its analysis is available and will be provided on demand.

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None.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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SUPPLEMENTARY MATERIAL

Supplementary material is available on the journal's website.

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