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Household pesticide use: attitudes, behaviors, and health risks

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Abstract

The main objective of the scientific study was to determine the level of use and attitudes toward the use of pesticides designed for domestic use. Pesticides, intentionally released toxic substances, have the potential to cause adverse health effects even at very low exposure levels, including hormonal disorders, asthma, allergies, and cancer. The rate of pesticide usage and attitudes toward pesticides in the home were measured through an online questionnaire that was completed by a total of 250 respondents. Based on the data collected, we found that the majority of respondents use pesticides in their homes to control insects. The questions in the questionnaire were focused on the respondents' practices in handling, application, storage, disposal, and purchasing of pesticides. Exposure to pesticides can result in mild symptoms, such as vomiting, through to more severe consequences like cancer. Despite the risks associated with pesticide use, regulatory measures are in place; however, misuse often stems from improper storage and disposal practices. We found that gender did not influence safe pesticide handling behavior, although women exhibited more responsible behaviour in purchasing, storing, and disposing of pesticides. Compared to men, women had a higher overall mean score for attitude towards pesticides and thus approached pesticides more responsibly than men. We examined differences in pesticide handling behaviour between urban and rural residents. Based on the data collected, we found that attitudes towards pesticides of urban and rural dwellers are not different. Through the statistical analysis, we concluded that respondents' attitudes towards pesticides influence safe behaviour in purchasing, handling, storage, and disposal of pesticides. The more positive the respondents' attitude toward pesticides, the more responsible their attitude towards pesticides.

Keywords: Pesticides, Attitude, Behaviour, Household, Safety, Enviroment

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INTRODUCTION

Definition of Key Terms

Pesticides are substances or agents used to affect the basic life processes in an organism (Frankovska et al., 2010). These substances are one of the few toxic substances that are intentionally released into the environment by human activities (Kim, Kamir, Jahan, 2017). Worldwide, nearly 3 billion kilograms of pesticides are used annually for various purposes (Sharma et al., 2020). Of the 1,361 pesticide-active substances registered in the European Union, 489 (35.9%) active substances are authorized for plant protection. Attitudes toward pesticides are shaped by a variety of factors, including access to information, education level, and participation in training courses on pesticides. These factors significantly influence how people follow the pictograms and instructions on pesticide products (Bagheri et al., 2021). Education and awareness play a critical role in promoting responsible pesticide use, as individuals with better access to information are more likely to adhere to safety guidelines. The concept of "attitude" appeared in psychology as early as the 18th century and was defined in 1860 as a state of the internal environment ready to act. The term "attitude" was first mentioned in the sense of individual action and consciousness at work (Cacioppo et al., 1994; Mónus, 2022). Based on its structure, attitudes are divided into a cognitive component (knowledge about the object), an affective component (emotions and feelings towards the object), and a conative component (behavior towards the object) (Ostrom, 1989). The development and formation

of attitudes are largely influenced by the amount and quality of information that individuals possess. There are many ways to influence attitudes, with education being the foundation (Horan et al., 2022). The most reliable method for measuring attitudes is considered to be the method of attitudinal scales, which are bipolar and composed of statements and their intensity that the respondent selects (Tajfel, 1982). According to Stern (2000), environmental values and attitudes are fundamental for developing pro-environmental behavior. People strive to align what they believe is right with what they actually do. When environmental values and attitudes are confronted with personal responsibility, they often lead to a sense of moral obligation and responsible action (Kanzler et al., 2022). This connection between values and behavior is crucial in fostering a responsible approach toward pesticide use. Each pesticide product label contains a safety warning that lists the requirements for protective measures. The user is responsible for reading and following the instructions on the product labels (Hansen, Walker, & LEGAULT, 2015). Proper use of gloves and other protective equipment is as important as their selection (KWON, Campbell, & Zirwas, 2006). Teachers play a pivotal role in shaping the attitudes of students. Research by Ulug et al. (2011) demonstrated that positive attitudes held by teachers can influence the personalities and future behaviors of their students. This shows that education not only imparts knowledge but also molds attitudes, which is particularly relevant when it comes to topics like pesticide use and environmental conservation. Palmer et al. (1993) found that the most significant predictor of pro-environmental behavior was individuals' childhood experiences with nature, such as time spent in gardens or other natural settings. Hinds & Sparks (2008) discovered that students raised in rural areas tend to have more positive attitudes towards the environment compared to those raised in urban areas, suggesting that direct exposure to nature plays an important role in shaping environmental attitudes. Gender differences in attitudes toward the environment have also been extensively studied. Many authors have found that girls tend to have better environmental attitudes than boys (Bulut, 2019; Collado et al., 2017). This indicates that gender may also influence how individuals perceive and engage with environmental issues, including the responsible use of pesticides.

Current State of Literature

Even very low levels of exposure to pesticides can have adverse effects on human health, including hormonal disorders, asthma, allergies, and cancer (Kım, Kamır, & Jahan, 2017). Pesticide poisoning is most dangerous when the pesticide enters the human body through the oral route. Oral exposure to pesticides most commonly occurs accidentally due to inattention (spilling pesticide into an unlabeled bottle, improper storage, children's access to pesticides) or due to intentional suicidal reasons (Gılden et al., 2010). Despite sufficient regulation and stringent pesticide legislation, it is estimated that three million cases of pesticide poisoning occur worldwide each year, resulting in more than 250,000 deaths (World Health Organization, 2006). Exposure to pesticides has been linked to various diseases, from mild symptoms such as vomiting to serious conditions like cancer or death (Thundıyıl et al., 2008; Alavanja, Hoppın, Kamel, 2004). Many authors have addressed the proper use of pesticides in households. Since the home environment is generally considered the most pesticide-treated indoor environment, improper use of pesticides poses significant risks to both humans and domestic animals (NALWANGA and SSEMPEBWA, 2011). Studies indicate that men and women behave differently in pesticide use. More men disposed of pesticide containers in an environmentally friendly way, but fewer men applied self-protective measures when using pesticides (Wang et al., 2017, Jin et al., 2015; FAO, 2011). Attitudes toward pesticides are crucial in determining responsible pesticide use. Currently, the term attitude is most often used to refer to a relatively general and sustained evaluation of an object or concept, ranging from the positive to the negative range (Fabrıgar and Wegener, 2010). Attitudes can include a cognitive (rational), emotional (affective), or conative component (Bızer, Barden, & Petty, 2006). Research shows that friends and relatives often influence individuals' choices regarding pesticides. Gray et al. (2005) reported that 53% of respondents relied on friends and family members for insecticide selection, while over 33% used radio and television advertisements. Other sources of information, such as point-of-sale and retail outlets, accounted for 48%. Azratul-Hızayuz et al. (2021) conducted research in Selangor, Malaysia, and found that up to 90% of the respondents read the manufacturer's instructions before using pesticides. In Nigeria, Adje and Aremu (2020) reported that 79% of respondents read product labels before using pesticides. However, Nalwalnga and Ssempebwa (2011) found that only 48% of respondents read the manufacturer's instructions before applying pesticides in their homes. Proper storage and disposal are also crucial: 88% of respondents stored excess pesticides, and 10% disposed of them improperly. Only 2% recycled pesticide packaging (Grey, Nıeuwenhuıjsen, Goldıng, 2005). Similar findings were reported by Adje and Aremu (2020), who found that most empty pesticide containers were discarded or incinerated, with only 5% being recycled. Finally, pesticide handling practices such as washing hands after pesticide use (64%) or washing used clothing (4%) remain insufficient (Azratul-Hızayuz et al., 2021; Dje and Aremu, 2020). These practices highlight the need for greater awareness and education on safe pesticide use among end-users.

MATERIALS AND METHODS

Respondents

The work was carried out in the Slovak Republic, while the selection of respondents was random. The research sample consisted of 250 respondents. We had to exclude two persons from the age category 65 years and older

from the analysis because of the low representation of this age category (Table 1). Respondents were selected randomly; the only condition for participation in the research was that respondents were at least 18 years old. The research was conducted using an online questionnaire, which was posted on the social network Facebook from 01 November 2021 to 10 December 2021. These months were deliberately chosen after the summer months, when people most often use pesticides, especially against unwanted vegetation and insects.

Research Tool

A Likert scale questionnaire is most commonly used to measure the attitudes of participating respondents (Gáborová, Porubčanová, 2016). The questionnaire was anonymous and intended for adults. The questionnaire contained 15 questions and 9 statements. The research instrument was divided into two parts, with the first part of the questionnaire containing 15 questions with one correct answer choice and one multiple choice question. The second part of the questionnaire included nine statements with a Likert scale. Respondents used the statements: strongly agree, agree, don't know, disagree, and strongly disagree to express their level of agreement or disagreement with a given statement about pesticides.

Data Analysis

We then scaled the collected data and calculated the average attitude in the three question areas: pesticide purchasing, handling, and application, pesticide storage, and pesticide disposal. We scored the results by assigning a value of 5 to statements of strongly agree and a value of 1 to statements of strongly disagree. For negative statements, we rescored in reverse. After, we calculated the average score. The data collected were recorded into a table (Microsoft Excel), which serves as a basis for this work. The statistically processed data were subjected to an analysis in the Statistica Programme, version 12.

Table 1. Division of respondents.

Gender		Age					Residence	
Men	Women	18-25	26-35	36-45	46-55	56-65	Village	Town
72	176	170	27	34	12	5	167	81

RESULTS

The results section was divided into three categories, according to the focus of the questions on purchasing, handling and application, and storage and disposal of pesticides. This division corresponds to the three question areas from the questionnaire.

Purchase of pesticides

In the section on pesticide purchase respondents answered questions 6, 7, and 8 which were focused on motivation to use the pesticide and reading the product label. Most respondents, 33%, reported that they purchase pesticides based on recommendations from friends and family. Further, more than 28% of respondents reported that they purchase pesticides based on the information on product labels, and more than 27% reported purchasing pesticides based on retailer recommendations. Only 6% of respondents buy pesticides according to the pictures on the product packaging without further information about the product. Only 4% of respondents buy pesticides based on advertisements for home use. 56% of respondents follow the information and instructions given on the product labels. The instructions and information on the product labels are followed by 39% of respondents only if they are using the product for the first time. Around 5% of respondents reported that they do not follow the labels or do not read the instructions on the product labels.

Manipulation with pesticides

Another area of questions in the questionnaire was related to pesticide handling. This area was covered by questions 9 and 10, which dealt with the use of personal protective equipment. Questions 11 and 12 focused on safety precautions after pesticide application, such as hand washing. Protective gloves are not used when handling pesticides by 25% of respondents, protective clothing is not used by up to 71% of respondents, 20% of respondents stated that they only use protective clothing if it is stated on the product label, and 3% of respondents only use protective clothing if they are using the pesticide for the first time. After pesticide application, 92% of respondents always wash their hands, while up to 8% of respondents do not wash their hands after pesticide application. Some respondents reported that they do not wash their hands if they use protective gloves or if it is not stated on the product packaging. Ventilating the room where the pesticide is applied is always done by up to 84% of respondents, with 12% doing so only if it is stated on the product label and 4% ventilating the room only if there is a pet, a small child nearby or if it is the first time they have used the pesticide.

Storage and disposal of pesticides

The last area of questions was aimed at the storage and disposal of pesticides. Questions 13, 14, and 15 deal with the topic of this section. A storage location in the home that is out of reach of children and pets is used by 81% of respondents, 14% of respondents use a cellar to store pesticides and 5% of respondents use a shed in the garden. None of the respondents store pesticides near medicines and food. More than 79% of respondents store pesticides in their original labeled containers, according to the instructions on the product labels. The second most

common way to store pesticides is in open original containers with labels. This option was chosen by 18% of respondents. Two percent of respondents indicated that they store pesticides in new containers with the original label or store pesticides in original containers without a label with a self-label or without label. Approximately 50% of respondents indicated that they dispose of packaging according to the instructions on the product and 24% of respondents dispose of the packaging in unsorted waste, and 24% of respondents indicated that they dispose of the packaging in sorted waste.

The frequency of usage of pesticides and its influence

When asked how often respondents use pesticides, more than 55% answered that they use pesticides once a year. More than 34% of the respondents use pesticides once a month and only about 6% of the respondents use pesticides once a week. The remaining respondents used pesticides at a lower frequency. The next question was used to find out the main reason for pesticide use by the respondents. Respondents could choose several options. More than 81% of respondents use pesticides to control insects. Pesticides against rodents are used by 23% of the respondents and more than 20% of the respondents stated that the main reason for using pesticides is fungi. We have shown that the frequency of pesticide use does not have a significant effect (p=0.407) on the rate of pesticide use method (Figure 1).

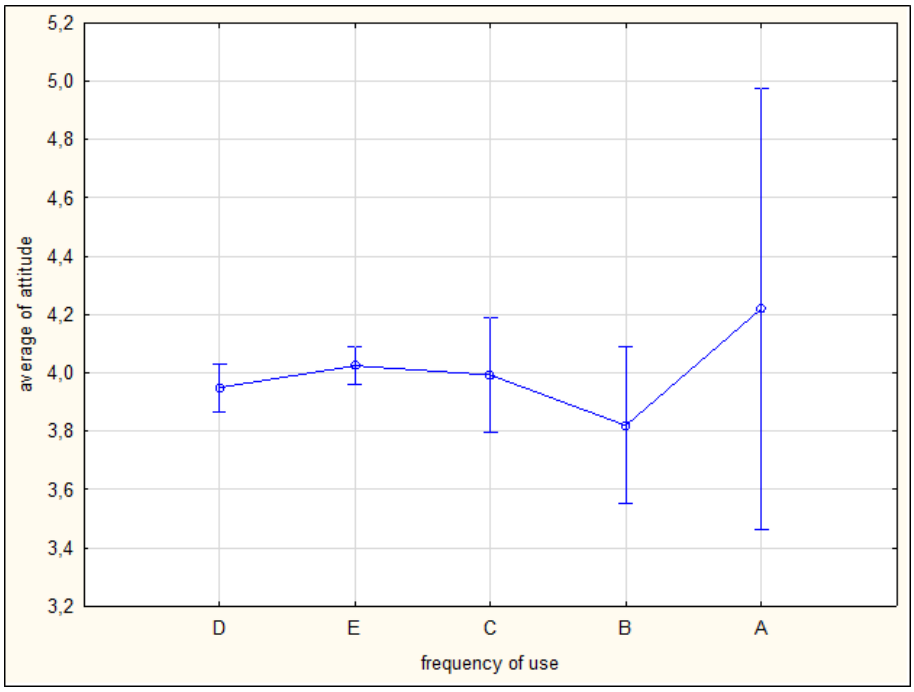

Figure 1. Impact of frequency of use on the rate and pattern of pesticide use
A - every day, B - three times a week, C - once a week, D - once a month, E - once a year

We investigated how the frequency of pesticide use influences responsible pesticide purchasing behaviour. We found that respondents who use pesticides the most frequently - three times a week are the least responsible when buying pesticide products. Respondents who use pesticides once a year behave the most responsibly and safely when purchasing pesticides. Frequency of pesticide use has a significant effect (p=0.005) on pesticide purchasing, the more frequently respondents used pesticides, the less responsible they were in purchasing pesticides (Figure 2).

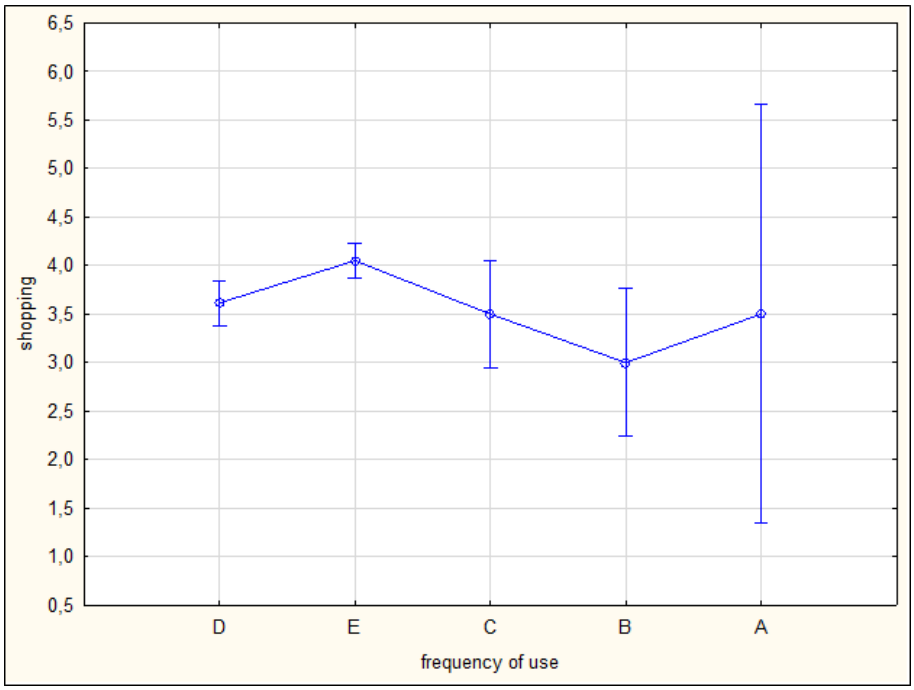

Figure 2. Impact of frequency of use on pesticide purchasing
A - every day, B - three times a week, C - once a week, D - once a month, E - once a year

Further, we found a statistically significant difference (p=0.051) for respondents who used pesticides most frequently and were the most responsible in handling and applying pesticides. Respondents that use pesticides once a year (E) had the second highest score. Respondents that use pesticides once a week (C) had the lowest rate of appropriate pesticide handling (Figure 3). We did not observe an effect of frequency of pesticide use on pesticide storage and disposal (p=0.306).

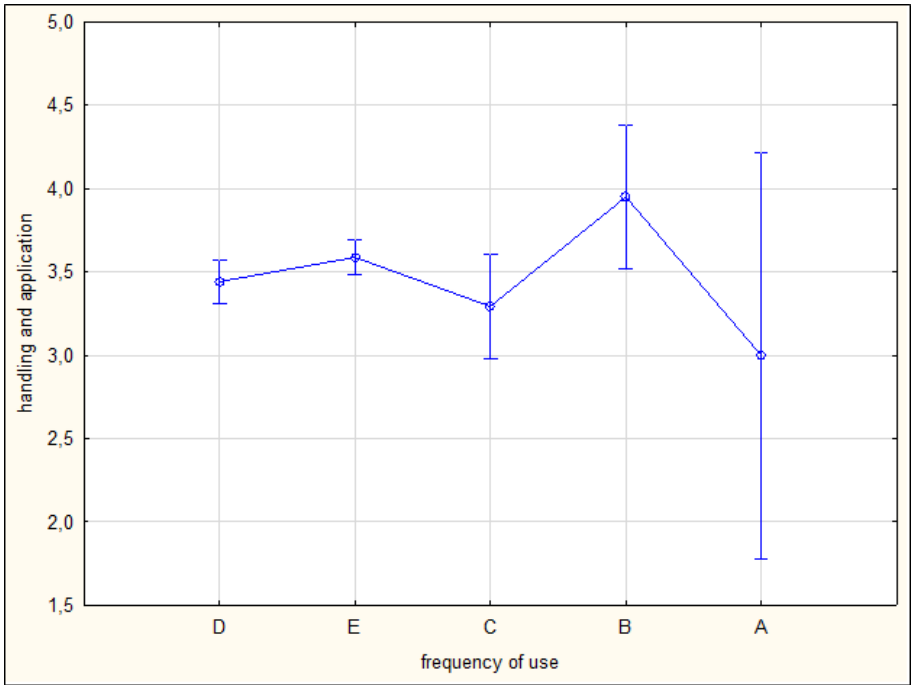

Figure 3**.** Impact of frequency of use on handling and application of pesticides

Influence of gender

In another research investigation, we looked at the impact of gender on pesticide handling, pesticide purchasing, and pesticide application. We did not find a statistically significant difference, but the p-value was at the borderline of provability (p=0.075). Women have higher mean scores for attitude towards pesticides compared

to men, thus showing an indication that women are more responsible in their approach towards pesticides (Figure 4).

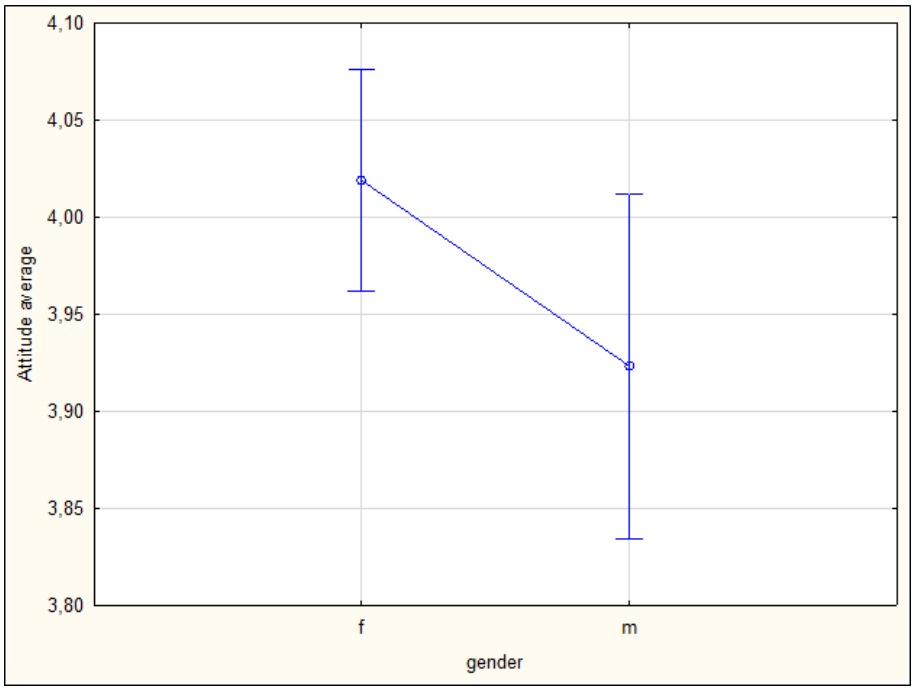

Figure 4. Influence of gender on the rate and pattern of pesticide use

We further demonstrated that gender is statistically significant (p=0.035) in pesticide purchasing. Women take a more responsible approach to pesticide shopping compared to men (Figure 5). Gender had no statistically significant effect on the handling and application of pesticides (p=0.909). Similarly, we showed no statistically significant difference in pesticide storage, although women scored better than men (p=0.136).

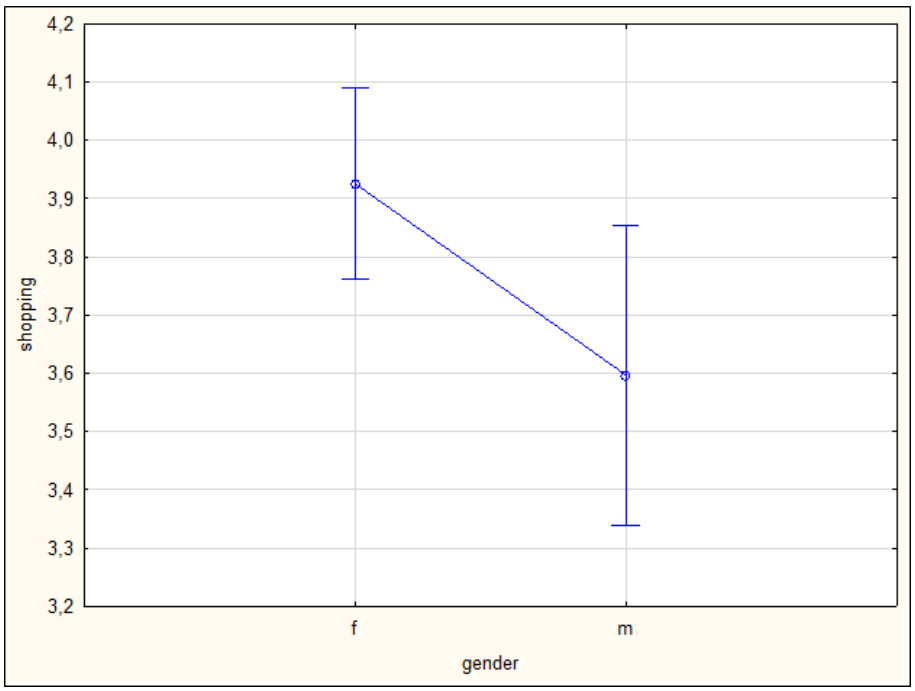

Figure 5**.** The influence of gender on purchasing of pesticides

Influence of residence

In the statistical evaluation of the data, we found that respondents from the city had a higher mean score on attitudes towards pesticides, but on the other hand, we did not find a statistically significant difference between people living in the city and those living in the countryside (p=0.648). Similarly, we did not show a significant

difference in pesticide-buying behavior between urban and rural dwellers (p=0.979). Further, we did not show any difference in pesticide handling and application behavior between urban and rural dwellers (p=0.979). The storage and disposal of pesticides for home use are also not influenced by the respondent's place of residence (p=0.267).

Correlations between respondents' behaviour and attitude

We demonstrated that the more positive the respondent's attitude towards the safe handling of pesticides, the more responsible the respondents were in handling and applying pesticides (p=0.0001). We also demonstrated that the more positive the respondent's attitude towards pesticides, the more responsible the respondent was in storing and disposing of pesticides (p=0.0001). The higher the mean score of the respondents' attitude towards pesticides, the more responsible they were in purchasing pesticides (p=0.002). It can be argued that attitudes towards pesticides are positively correlated in all the areas we looked at.

DISCUSSION

The aim of the present work was to find out the extent and pattern of pesticide use in households and the effect of attitude on pesticide use. We focused on the practices that people use in purchasing, storing, and disposing of pesticides and in handling and applying pesticides in the home. Most respondents use pesticides in their homes to control insects. When shopping for pesticides, 33% of respondents buy the products based on recommendations from friends and family. Further, more than 28% of respondents reported buying pesticides based on information on product labels and more than 27% reported buying pesticides based on retailer recommendations. GREY et al. (2005), in their study on household pesticide use and disposal, reported that 53% of respondents relied on friends and family for insecticide selection, followed by 48% of respondents who cited point-of-sale as an important source of information. We also found that the majority of respondents, over 56%, always read and follow the information and instructions on product labels when using pesticides. Azratul- Hızayuz et al. (2021), based on research conducted abroad, reported in their study that up to 90% of the respondents surveyed read the instructions given on product labels before using a pesticide. Adje and Aremu (2020) also obtained similar results. Based on the data obtained from our research, we conclude that the majority of the respondents, 81% store pesticides in a safe place designated for that purpose, and more than 79% of the respondents store pesticides in the original labeled containers according to the instructions given on the product labels. Similar conclusions were reached in the work of (Azratul-Hızayuz et al., 2021 and Adje and Aremu, 2020). We confirmed hypothesis 1, with our research results indicating that the higher the respondents' scores in their attitudes towards safe pesticide handling, the more responsible their practices in handling and applying pesticides were. Our findings are supported by the works of (Azratul-Hızayuz et al., 2021; Gholamı et al., 2018). We did not confirm hypothesis 2, which focused on women behaving more responsibly in pesticide use than men. Wang et al. (2017) found that there is a gender gap with respect to knowledge of pesticide impacts and pesticide use practices. Dunlap et al. (1992) report that women are significantly more concerned about pesticide safety. We have not demonstrated the influence of residence in purchasing, disposing of, or using pesticides. Similar results were also reached in the work of Coppın, Eısenhauer, and Krannich, 2003.

CONCLUSION

The results of this study showed that respondents' attitudes toward pesticides are correlated with their purchasing, disposal, or user behavior. Among the factors studied, we did not show the influence of gender and place of residence, in more responsible pesticide behavior. We did demonstrate an effect of frequency of pesticide use, with respondents who use pesticides more frequently behaving less responsibly. It can be concluded that the problem of pesticides plays an important role in environmental pollution and human health protection. By improving peoples' attitudes, we can help to solve this problem in society.

Compliance with Ethical Standards

Peer-review

Externally peer-reviewed.

Declaration of Interests

The authors have no conflict of interest to declare.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the text, figures, and tables are original and that they have not been published before.

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