Research in Health & Medical Sciences *Research Article*

2024 July; 3(3)

Major urban pests and pesticide utilization in Sabzevar and Neyshabur counties: Insights from pesticide vendors

Mehdi Miri[1], Soheil Oftadeh [1], Mohebat Vali[2], Fariba Mokhtari[3], Amir Hossein Roozitalab[1], Alireza Dehghani[4], Amin Hosseinpour[1], Ali Bakhish[5], Mozaffar Vahedi[6]*, Zahra Derakhshan[7*]

[1] Student Research Committee, Department of Biology and Control of Disease Vectors, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran.
[2] Department of Epidemiology, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran
[3] Department of Vector Biology and Control, School of Health, Ilam University of Medical Sciences, Ilam, Iran.
[4] Student Research Committee, Department of Epidemiology, Shiraz University of Medical Sciences, Shiraz, Iran.
[5] Medical Entomology and Parasitology Department, Tarbiat Modares University, Tehran, Iran.
[6] Department of Biology and Control of Disease Vectors, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran.
[7] Research Center for Health Sciences, Department of Environmental Health Engineering, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran.

*** Corresponding Author Email: z.derakhshaneng@gmail.com , mozaffarvahedi@gmail.com**
Received: 2025/1; Revised: 2026/4; Accepted: 2026/4

Abstract

The application of pesticides for pest control and eradication in agriculture and public health has a long history both globally and in Iran. As urbanization and agriculture expand, the use of pesticides is steadily increasing. Since urban pest control is a primary reason for using these chemicals, this study investigated and identified the best-selling pesticides and the most significant urban pests from the perspective of pesticide sellers.

This cross-sectional study was carried out in the cities of Sabzevar and Neyshabur, located in the northeast of Iran. The primary data collection tool was a questionnaire that was designed to evaluate demographic variables, available and best-selling pesticides, pesticide producing countries, and awareness of the most important urban pests. This questionnaire was distributed among 100 pesticide sellers in the study areas. Data collection was carried out by two trained entomologists, and data analysis was performed utilizing SPSS version 19 software. ANOVA and Chi-Square tests were employed to analyze the types of variables and assess the percentage of best-selling pesticides and significant urban pests. A significance level of 0.05 was applied in all tests.

The results indicate that the majority of pesticide sellers in northeastern Iran are men (76%) with upper-middle education (56%). Also, based on the collected information, organophosphorus and Pyrethroids pesticides are the best-selling pesticides, and German cockroach, American cockroach and head lice are the most important urban pests in the studied areas, respectively.

The expertise of pesticide sellers, along with the production and import of pesticides tailored to the key urban pests in each district, will significantly influence pest control.

Keywords: Pesticides, Insecticides, Pest Control, Cockroaches, Northeastern Iran

Introduction

The application of pesticides for pest control and eradication in agriculture and public health has a long-standing history both globally and in Iran. Currently, approximately 550 different types of pesticides are used worldwide, classified into various categories based on their chemical structures and intended functions. The major categories include insecticides (used for insect control), acaricides (for mites and ticks), herbicides (for weed management), rodenticides (for rodent control), fungicides (for fungal pathogens), among others (1-6). Despite the well-documented risks these substances pose to human health and their adverse environmental impacts, global pesticide consumption particularly in developing countries such as Iran continues to increase. The rising use of hazardous chemicals, including pesticides, in countries such as Iran represents a serious concern for both public health and environmental sustainability (7-10). Statistical reports indicate that, in numerous cases, pesticide usage in Iran exceeds the recommended limits. Such practices not only affect target pest species but also exert harmful effects on non-target organisms, including humans. (11-14). Urban pests comprise a diverse group of organisms that frequently inhabit human residential and commercial environments. These include insects such as houseflies, cockroaches, mosquitoes, bedbugs, lice, ants, and termites; arachnids such as spiders and scorpions; reptiles such as lizards; and rodents such as house mice. The presence of urban pests in residential settings and human-utilized environments including restaurants, hotels, food storage facilities, and water sources represents a significant public health concern. Beyond causing nuisance and physical discomfort through biting and infestation, these organisms can contribute to the transmission of various infectious diseases through multiple direct and indirect pathways (10, 15-17).

By implementing targeted control strategies and promoting proper knowledge of pesticide application, urban pest management can be improved in terms of both efficiency and effectiveness, thereby contributing to the creation of healthier and safer human environments. Insects such as mosquitoes, sand flies, houseflies, and cockroaches are recognized as vectors of various infectious diseases that pose significant threats to public health. To control these urban pests, pesticides are commonly applied within human environments. Therefore, it is essential to maintain adequate knowledge of the pesticides in use and to understand the major urban pest species prevalent in a given region (18-21).

Although many studies have examined urban pest species and chemical control methods, the perspectives of pesticide vendors regarding major urban pests and commonly used pesticides are not fully documented. Vendors interact directly with a variety of end-users and can help to better understand real-world pesticide utilization, commonly used products, and prevailing practices, which may not be fully captured through surveys of consumers or public health records. Gaining such information can contribute to more informed urban pest management strategies, while also highlighting potential risks and areas for improvement in pesticide use. Therefore, this study was designed to identify the major urban pests and examine pesticide utilization in Sabzevar and Neyshabur Counties from the perspective of pesticide vendors, providing practical insights to support pest control practices in these urban settings.

Materials and Methods

This cross-sectional study focuses on evaluating the awareness and knowledge of pesticide vendors in North East of Iran, located in Khorasan Province. Neyshabur and Sabzevar Counties were selected to study. The population studied for this research was pesticide resellers operating within the province. Through sample size calculation for cross-sectional studies using the formula of one proportion and considering a precision level (d) of 0.025 and a probability (p) of 0.05 based on similar studies (22), a sample

size of 100 pesticide resellers was determined totally for inclusion in this study. Structured questionnaire was distributed to pesticide vendors across 200 registered stores, as listed by the Agricultural Organization, in the selected cities according to the statistics of the Agricultural Organization; all interviews and data collection procedures were conducted by two trained entomologists to ensure accuracy and consistency.

The questionnaire comprised three main sections: the initial section encompassed inquiries regarding personal and contextual details (such as age, gender, marital status, educational level, and work experience), the second section focused on pesticides (including types, application methods, and classification), and the final section addressed urban pests (covering pest types, significance, and distribution). Data collection was carried out by two trained entomologists, and data analysis was performed utilizing SPSS version 19 software. To report qualitative variables, frequency and percentage were reported, and for quantitative variables, mean and standard deviation were reported, and to check the percentage of familiarity with urban pests and pesticides based on demographic information, ANOVA and Chi-Square tests were used. A significance level of 0.05 was considered in all tests.

This study was approved by the Ethics Committee of Ilam University of Medical Sciences with the number IR.MEDILAM.REC.1403.273. No personally identifiable information was included in the dataset used for analysis.

Results

Demographic Information

The demographic characteristics of pesticide resellers showed variability in educational background and work experience. The mean age of the surveyed resellers was 36.08 years (SD = 6.18), and the mean work experience was 9.20 years (SD = 4.70). Regarding gender distribution, 72% (n = 72) of the participants were male and 28% (n = 28) were female. Educational attainment varied among respondents, with 56% (n = 56) holding a Master of Science degree and 36% (n = 36) possessing a Bachelor's degree. Associate and Ph.D. degrees were each reported by 4% (n = 4) of the participants (Table 1).

Table 1. Demographic information of pesticide resellers

Variables	Level	N (%)
Age (Mean±SD)	-	36.08±6.18
Years Of Work Experience (Mean±SD)	-	9.20±4.70
Gender	Male	72 (72.0%)
	Female	28 (28.0%)
Education	Associate degree	4 (4.0%)
	Bachelor`s degree	36 (36.0%)
	Master of Science	56 (56.0%)
	PhD degree	4 (4.0%)

Pesticide Manufacturing and Import Origins

The distribution of pesticide manufacturing and import origins is presented in

Figure 1. Iran accounted for 40% of the manufactured products, followed by China at 31%. Regarding pesticide imports, China was identified as the primary supplier, contributing 63% of the imported products, followed by Turkey at 21%.

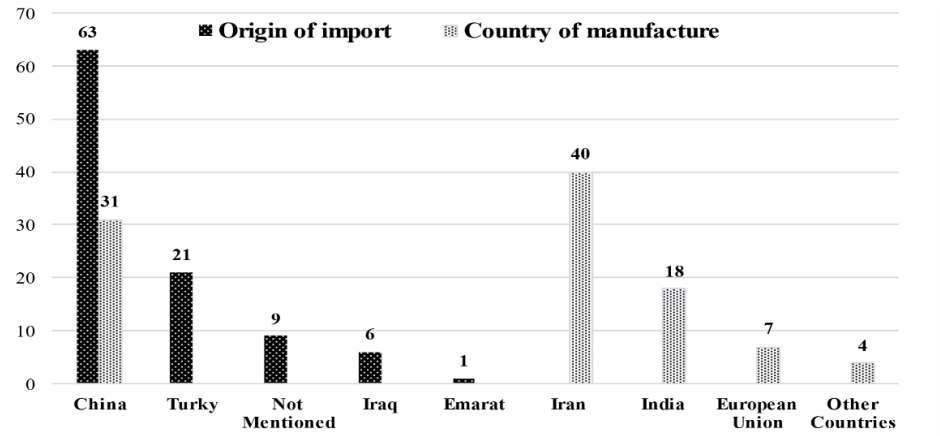

Figure 1. Pesticide Manufacturing Countries, and Geographical origins of imported pesticides

Participants' Familiarity with Urban Pests and Pesticides

Participants' familiarity with urban pests and pesticides is presented in Figure 2. A majority of respondents reported high (40%) and very high (31%) levels of familiarity. German cockroaches were identified as the primary concern by 31% of participants, followed by American cockroaches at 23%, while scorpions were reported at a low frequency (1%). Additionally, the sales rate of newer pesticides, including herbal and low-risk products, was low, and only 35% of participants indicated willingness to purchase such products.

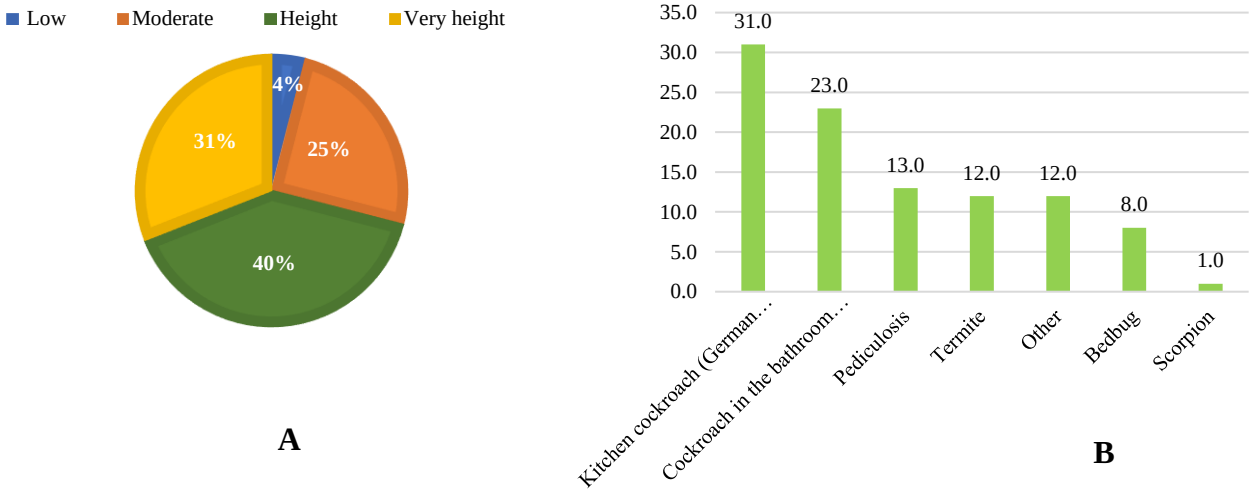

Figure 2. A: Participants' familiarity with urban pests and pesticides; B: The main health problem

The survey data assessing familiarity with urban pests and pesticides among pesticide vendors showed no statistically significant differences across demographic variables, including age (p = 0.279), work experience (p = 0.976), and educational level (p = 0.148). Among male participants (n = 72), 4 (5.5%) reported very low familiarity, 19 (26.3%) low, 28 (38.8%) moderate, and 21 (29.1%) very high, while among female participants (n = 28), 0 (0.0%) reported very low, 6 (21.4%) low, 12 (42.8%) moderate, and 10 (35.7%) very high familiarity, with no statistically significant association between gender and familiarity (p = 0.612). Regarding educational attainment, Associate degree holders (n = 4) reported 1 (25.0%) very low and 3 (75.0%) very high familiarity, Bachelor's degree holders (n = 36) reported 1 (2.8%) very low, 8 (22.2%) low, 16 (44.4%) moderate, and 11 (30.6%) very high familiarity, Master of Science holders (n = 56) reported 2 (3.6%) very low, 14 (25.0%) low, 24 (42.9%) moderate, and 16 (28.6%) very high familiarity, and Ph.D. holders (n = 4) reported 2 (50.0%) low and 2 (50.0%) very high familiarity, with no statistically significant association between educational level and familiarity (p = 0.148) (Table 2).

Table 2. Percentage of familiarity with urban pests and pesticides based on demographic information

Variable		Familiarity				P.value
		Low	Moderate	Height	Very height	
Age, Mean±SD		36.50±6.80	34.25±6.18	37.35±5.83	35.81±6.46	0.279[a]
Work Experience, Mean±SD		10.25±5.18	9.21±4.75	9.15±4.43	9.13±5.14	0.976[a]
Gender (%)	Male	4 (5.5)	19 (26.3)	28 (38.8)	21 (29.1)	0.612[b]
	Female	0 (0.0)	6 (21.4)	12 (42.8)	10 (35.7)	
Education (%)	Associate degree	1 (25.0)	0 (0.0)	0 (0.0)	3 (75.0)	0.148[b]
	Bachelor`s degree	1 (2.8)	8 (22.2)	16 (44.4)	11 (30.6)	
	Master of Science	2 (3.6)	14 (25.0)	24 (42.9)	16 (28.6)	
	Ph.D. degree	0 (0.0)	2 (50.0)	0 (0.0)	2 (50.0)	

a: ANOVA, b: Chi-Square

Diazinon, Chlorpyrifos, and Ethion were among the most commonly recommended and utilized pesticides for controlling agricultural pests. For health-related pest management, Cypermethrin and Permethrin were widely applied. In the category of fungicides, Mancozeb, Bordeaux Fix, and Carbendazim were frequently used. Abamectin and Omite (Propargite) were common acaricides. Paraquat and Glyphosate were popular herbicides, while Brodifacoum and Zinc phosphide were commonly employed rodenticides. Molluscicides, including Metaldehyde and Diazinon, were also frequently used in pest control practices (Table 3).

Table 3. Recommended and available pesticides in Northeast Iran

Insecticides recommended in agriculture	Insecticides recommended in health	Fungicides	Acaricide	Herbicide	Rodenticide	Molluscicides
Permethrin [a]	Permethrin [a, b]	Bordeaux Fix [a, b]	Fenpyroximate [a]	Treflan [a]	Brodifacoum [b]	Diazinon [a, b]
Deltamethrin [a]	Cypermethrin [a, b]	Fenpyroximate [a]	Cypermethrin [a]	Glyphosate [b]	Bromadiolone	Malathion [a]
Diazinon [a, b]	Deltamethrin [a]	Copper Oxychloride [a]	MAC-TOMIL [a]	Gallant Super	Zinc phosphide [b]	Metaldehyde [b]
Malathion [a]	Chlorpyrifos [a]	Thiophanate-methyl (Topsin-M)	Chlorpyrifos [a]	Paraquat [b]	Chlorate	
Bordeaux Fix [a]	Lambdacyhalothrin [a]	Mancozeb [b]	FujiMite	Linuron	Difenacoum	
Chlorpyrifos [a, b]	MAC-TOMIL [a]	Carboxy tiram	Fenpropathrin	2,4-D		
Treflan [a]	Pyrethrin	Metalaxyl	OMITE [b]	Triflumuron		
Lambdacyhalothrin [a]		ELITE	Abamectin [b]	Tribenuron methyl		
MAC-TOMIL[a]		Carbendazim [b]	Bromopropylate			
Cypermethrin		Tilt (Propiconazole)	Omite (Propargite)			
Abamectin		Iprodione	Ethion			
Ethion [b]		Penconazole	Phoxim			
Acetamiprid		Sulfur				
Volk Oil		Tabuconazole				
Dichlorvos						

Dimethoate						
Fenvalerate						
Imidacloprid						
Profenofos						
Hexaflumuron						

a: Pesticides which are also recommended in other class, b: Most recommended pesticide in its Class

Discussion

The research findings reveal a significant predominance of educated males in the pesticide retail sector, with 76% of respondents being male and 56% holding a Master of Science degree. This demographic profile suggests a relatively high level of academic qualifications among pesticide sellers. In contrast, global studies present varying perspectives on the educational backgrounds of pesticide retailers. For example, in Kerala, India, a significant number of pesticide vendors demonstrated a lack of formal education regarding pesticide safety and alternative methods. Specifically, only 63% of the vendors were knowledgeable about non-chemical pest control techniques, and merely 52% were acquainted with Integrated Pest Management (IPM) practices (23).

Similarly, in Uganda, despite 97% of argonaut dealers acknowledging the responsibility to advise customers on pesticide use, only 26.6% provided such advice during shopping exercises (24). This gap in knowledge and practice underscores a deficiency of formal training and education among pesticide sellers in these areas. The contrast in the demographic and educational backgrounds of pesticide sellers between our study and others globally indicates diverse approaches to pesticide retailing. In regions like India and Uganda, where formal education among pesticide sellers is limited, there appears to be a reliance on experience or informal learning. In contrast, the high educational attainment in our study suggests a more structured approach to pesticide knowledge and its dissemination.

This disparity in educational levels could be attributed to various factors, including the availability and accessibility of educational and training programs, the regulatory environment, and the socio-economic status of the region. For instance, regions with more stringent regulations and greater access to educational resources might naturally have a more educated pesticide-selling workforce. The high level of education among pesticide sellers in our study could positively impact the quality of advice and service provided to customers. Educated sellers are likely to have a better understanding of pesticide properties, safety protocols, and environmental impacts. This might contribute to more responsible and informed pesticide use in Khorasan Razavi Province, potentially leading to better pest control outcomes and reduced health risks.

Our study highlights local production of 40% from Iran, import origins from China 63%, and Turkey 21% of pesticides. This is different from the study in South Africa, where a significant amount of pesticide trade occurs in the informal sector (25).

In our study, 40% of participants had a high familiarity with urban pests and pesticides. This level of familiarity is noteworthy compared to

studies in other countries. For example, in Cameroon, about 93% of producers do not respect the pre-harvest interval, indicating a lack of proper application knowledge and safety awareness (26). In Pakistan, 65.9% of participants had limited knowledge of using the recommended amounts of pesticides (27).

Our findings show that the main health problem is Kitchen cockroaches aligns with the global trend where household pests like cockroaches are common concerns. However, unlike our study, where new pesticides like herbal and low-risk pesticides have low sales (35%), studies in other regions did not specifically address the sales trends of such alternative pesticides.

In our study, age, work experience, gender, and education did not significantly affect the level of familiarity with urban pests and pesticides. This is in contrast to the study in Uganda, where demographic factors like age and education level significantly impacted knowledge and practices related to pesticides 24) .

The comparison of our study's results with global findings emphasizes the diversity in pesticide usage, knowledge, and practices across different regions (28-30). While our study participants appear to be more educated and familiar with pests and pesticides, this is not a common trend globally. The diversity in the origin of pesticides, as indicated in our study, also highlights the global nature of the pesticide market and the varying regulatory environments in different countries. Moreover, the specific health problems identified in our study reflect the localized nature of pest-related challenges.

Given the low acceptance of new pesticides, educational programs can be implemented to inform participants about the benefits and safety of these products. Older participants with higher work experience may benefit from targeted awareness campaigns to enhance their familiarity with urban pests and safe pesticide use. Understanding the primary sources of pesticide production and import can guide policymakers in ensuring the safety and quality of pesticides entering the region. The identified health problems, especially the prevalence of kitchen cockroaches, highlight the need for public health interventions targeting pest control in the region.

Limitations of the Study

This study has several limitations that should be considered when interpreting the findings. First, financial constraints limited the scope of data collection and resources available for the study. Second, some pesticide vendors were occasionally reluctant to provide complete or precise information, which may have affected the accuracy of the reported practices. Third, the study relied on self-reported data, which can be inherently variable and subject to recall or reporting bias. Despite these limitations, the study provides valuable insights into the perspectives of pesticide vendors regarding major urban pests and commonly used pesticides in the surveyed counties.

Conclusions

This study provides insights into the major urban pests and patterns of pesticide utilization in Sabzevar and Neyshabur Counties from the perspective of pesticide vendors. The findings indicate a generally high level of familiarity with urban pests and pesticides among vendors, along with clear trends in pesticide sources and usage practices. These results emphasize the importance of considering local contexts and vendor knowledge when developing strategies for urban pest management. Targeted educational programs and interventions may further enhance awareness, particularly among specific demographic groups. Additionally, policymakers could use these insights to improve regulation and monitoring of pesticide distribution, ultimately supporting safer and more effective pest control practices in urban settings.

Author Contributions

Conceptualization, M.M. and M.V[6]; methodology, A.R. and A.B; software, M.V[2].and A.D; validation, Z.D., M.V[6]. and A.D.; formal analysis, M.V[2].; investigation, M.M. and S.O; resources, A.H.; data curation, M.V[6].; writing original draft preparation, M.M. and S.O. and M.V[6]; writing review and editing, F.M.; visualization, A.B.; supervision, Z.D. and A.H; project administration, M.V[2].and M.V[6]; funding acquisition, F.M. All authors have read and agreed to the published version of the manuscript.

Funding: This study was an approved research project funded by the Ilam University of Medical Sciences.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Ilam University of Medical Sciences with the number IR.MEDILAM.REC.1403.273.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All data supporting the findings of this study can be obtained from the corresponding authors upon reasonable request.

Acknowledgments: The authors are thankful for the assistance of the vice-chancellorship for research and technology at Ilam University of Medical Sciences (IUMS) and Shiraz University of Medical Sciences (SUMS).

Conflicts of Interest: The authors declare no conflicts of interest.

The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Donley N, Bullard RD, Economos J, Figueroa I, Lee J, Liebman AK, et al. Pesticides and environmental injustice in the USA: root causes, current regulatory reinforcement and a path forward. BMC Public Health. 2022;22(1):708.
2. Dehghani R. Environmental toxicology Publications of Tak Derakhat and Kashan University of Medical Sciences. Sci J Kurdistan Univ Med Sci. 2010;17(1):172-206.
3. Hassaan MA, El Nemr A. Pesticides pollution: Classifications, human health impact, extraction and treatment techniques. Egyptian journal of aquatic research. 2020;46(3):207-20.
4. Sharma A, Kumar V, Shahzad B, Tanveer M, Sidhu GPS, Handa N, et al. Worldwide pesticide usage and its impacts on ecosystem. SN Applied Sciences. 2019;1(11):1446.
5. Kumar M, Yadav AN, Saxena R, Paul D, Tomar RS. Biodiversity of pesticides degrading microbial communities and their environmental impact. Biocatalysis and Agricultural Biotechnology. 2021;31:101883.
6. Syafrudin M, Kristanti RA, Yuniarto A, Hadibarata T, Rhee J, Al-Onazi WA, et al. Pesticides in drinking water a review. International journal of environmental research and public health. 2021;18(2):468.
7. Atreya K. Pesticide use knowledge and practices: A gender differences in Nepal. Environmental Research. 2007;104(2):305-11.
8. Yadav IC, Devi NL, Syed JH, Cheng Z, Li J, Zhang G, et al. Current status of persistent organic pesticides residues in air, water, and soil, and their possible effect on neighboring countries: A comprehensive review of India. Science of the Total Environment. 2015;511:123-37.
9. Aryal S, Adhikari JR. Recent use and distribution pattern of pesticides in Nepal. A Journal of the Environment. 2006;10.
10. Miri M, Fakhraie M, Garmsirinejad M, Feizabadi P, Motazedi N, Khodabakhshi F, et al. Chemical Pesticides Used Against Urban Pests in Kohgiluyeh and Boyer-Ahmad Province: A Descriptive Cross-Sectional Study. Journal of Research in Health and Medical Sciences. 2023;2(3):15-21.
11. Jolodar NR, Karimi S, Bouteh E, Balist J, Prosser R. Human health and ecological risk assessment of pesticides from rice production in the Babol Roud River in Northern Iran. Science of the Total Environment. 2021;772:144729.
12. Kalyabina VP, Esimbekova EN, Kopylova KV, Kratasyuk VA. Pesticides: formulants,

distribution pathways and effects on human health–a review. Toxicology reports. 2021;8:1179-92.

13. Nasrabadi M, Gholian Aval M, Tajfard M, Peyman N, Tavakoly Sany SB, Khodadadi N. The effect of educational intervention based on the health action model on safe use of pesticides in Iranian farmers. Scientific Reports. 2025;15(1):19955.

14. Sookhtanlou M, Allahyari MS, Surujlal J. Health risk of potato farmers exposed to overuse of chemical pesticides in Iran. Safety and Health at Work. 2022;13(1):23-31.

15. Eliopoulos P, Tatlas N-A, Rigakis I, Potamitis I. A "smart" trap device for detection of crawling insects and other arthropods in urban environments. Electronics. 2018;7(9):161.

16. von Essen E, Redmalm D. License to cull: A research agenda for investigating the necropolitics of countryside culling and urban pest control. society & animals. 2023;33(2):131-46.

17. Pai H-H, Chang C-Y, Lin K-C, Hsu E-L. Rapid pesticide resistance bioassays for three major urban insects in Taiwan. 2023.

18. Naqqash MN, Gökçe A, Bakhsh A, Salim M. Insecticide resistance and its molecular basis in urban insect pests. Parasitology research. 2016;115(4):1363-73.

19. Khan HAA, Akram W, Fatima A. Resistance to pyrethroid insecticides in house flies, Musca domestica L.,(Diptera: Muscidae) collected from urban areas in Punjab, Pakistan. Parasitology Research. 2017;116(12):3381-5.

20. Kalantari M, Azizi K, Junaghani NK, Vahedi M, Mohammadpour I, Asgari Q, et al. Molecular evidence of Enterocytozoon bieneusi in arid urban landscapes of shiraz cockroaches (Blattodea), Southwest Iran: Implications for urban public health surveillance. Parasite Epidemiology and Control. 2025;30:e00446.

21. Ghahvechi Khaligh F, Vahedi M, Chavshin AR. Identification of symbiotic bacteria in the midgut of the medically important mosquito, Culiseta longiareolata (Diptera: Culicidae). BMC Research Notes. 2020;13(1):378.

22. Sagheghi M, Malayedari R, Rostaghi S, Rastgar A, Rezaei H. Survey of the knowledge, attitude and practice of farmer s for aspects of pesticide use In Jouvin. 2020.

23. Devi PI, Jayasree M, Sarada A, Raju RK. Sales practices in pesticides retail: a case study of Kerala. Indian Journal of Agricultural Economics. 2017;72(1):102-16.

24. Staudacher P, Brugger C, Winkler MS, Stamm C, Farnham A, Mubeezi R, et al. What agro-input dealers know, sell and say to smallholder farmers about pesticides: a mystery shopping and KAP analysis in Uganda. Environmental Health. 2021;20(1):100.

25. Rother H-A. Pesticide vendors in the informal sector: trading health for income. NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy. 2016;26(2):241-52.

26. Nkuh A, Tarla D, Ngameni N, Payne V. Pesticide Usage in Pest Management by Vegetable Producers in the Foumbot Production Basin of the Western Highlands (Cameroon). American Journal of Agriculture. 2023;5(2):36-52.

27. Saeed MF, Shaheen M, Ahmad I, Zakir A, Nadeem M, Chishti AA, et al. Pesticide exposure in the local community of Vehari District in Pakistan: an assessment of knowledge and residues in human blood. Science of the Total Environment. 2017;587:137-44.

28. Jallow MF, Awadh DG, Albaho MS, Devi VY, Thomas BM. Pesticide risk behaviors and factors influencing pesticide use among farmers in Kuwait. Science of the total environment. 2017;574:490-8.

29. Sun S, Hu R, Zhang C. Pest control practices, information sources, and correct pesticide use: Evidence from rice production in China. Ecological Indicators. 2021;129:107895.

30. Nalwanga E, Ssempebwa JC. Knowledge and practices of in-home pesticide use: a community survey in Uganda. Journal of environmental and public health. 2011;2011(1):230894.