

Relationship between Pesticide Exposure and Human Health

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Abstract

The increasing dependence on chemical pesticides in modern agriculture has significantly contributed to improved crop yields. However, this reliance comes at a severe cost to human health, especially in rural agricultural communities that is leading to mass death pesticide poisoning cases in the forensic laboratories. The reviewed thesis, 'Relationship Between Pesticide Exposure and Human Health' investigates the wide-ranging health implications of pesticide exposure. Based on simulated survey data and secondary literature, it highlights common exposure pathways, frequently reported symptoms, demographic vulnerabilities, and the chronic neglect of safe handling practices. The study provides a framework for understanding how unregulated pesticide use, and to find the real cause or death due to pesticide, low awareness, and inadequate health surveillance lead to persistent health hazards. This review evaluates the thesis's key contributions, critiques its limitations, and recommends future research directions with a focus on epidemiology, forensic toxicology, and public health policy.

Introduction

The advent of chemical pesticides in agriculture has revolutionized food production worldwide, ensuring crop protection and yield stability. In India, where agriculture employs a significant portion of the workforce, pesticides are widely used, particularly on crops like cotton, paddy, and vegetables. However, the increased use of these chemicals has raised concerns about their unintended effects on human health. Exposure to pesticides is not limited to applicators alone. Family members, nearby residents, and even consumers are at risk due to air drift, water contamination, and residue on food. Pesticide poisoning can be accidental, suicidal, or homicidal. Forensic toxicology is crucial in detecting and identifying the specific pesticides involved in such cases to determine the cause and manner of death. The reviewed thesis explores these multifaceted risks, emphasizing the vulnerability of under-informed and under-protected rural populations. It further points out systemic gaps in awareness, regulation, and healthcare cause behind deaths that allow such exposure to persist unmitigated. Methodological Overview The thesis follows a mixed-methods research approach using both quantitative and qualitative data. Although the data is collected for survey purposes, The data includes a

structured questionnaire administered to 50 respondents, combined with interviews with stakeholders like farmers, healthcare workers.

This methodological choice allows the thesis to simulate likely scenarios of pesticide exposure, symptom reporting, and behavioral patterns. Additionally, it uses secondary data from literature to support and validate the assumptions made during simulation. While this design allows for conceptual clarity and insight generation.

Literature review

Eric T. Knapke et.al(2022) The studies reviewed here demonstrated consistent associations between pesticide exposure and diminished sperm parameters, especially those concerning sperm motility and sperm DNA integrity. These findings were largely consistent with the results of previous reviews, which had reported significant negative associations with pesticide exposure. Yabi Huang et.al(2025) This study was based on 319 pesticides, introducing the internal allocation factor to research the impact of different exposure pathways and routes on chemical distribution in the human body. The concentration factor varied between organs or tissues due to different compositions of human tissues under one exposure route

Bouchra Dahiri et.al(2021) The information available concerning the exposure in women was very scarce. Moreover, an important differentiation between rural and urban areas had been established; rural areas were known as the most exposed ones due to plantation fields. However, the application of higher concentrations of herbicides in small urban areas had been gaining a lot of importance as well. Different from early life, regardless of the gender of exposed individuals and exposure conditions or environmental settings, different health effects in early life exposure to these pesticides might have resulted in various outcomes, including neurodevelopmental effects in neonates to various forms of cancers.

Wasantha Athukorala et.al(2023) The motivation of this paper came from the increasing concern of heavy pesticide use in developing countries like Sri Lanka. Its excessive use affected the environment, the economy, and farmers' health, and yet farmers still seemed unaware of its ill effects. More worrying was the lack of appropriate government efforts to address this problem. If left unattended, heavy use of pesticides eventually rendered land useless, reduced future farm output and productivity, and could severely affect farmers' health.

Michael K. Miyittah et.al(2022) A survey was conducted to investigate farmers' knowledge, attitudes towards pesticide use, storage/disposal, exposure risks and health symptoms in one of the eight cocoa growing regions in Ghana. A considerable proportion of the farmers (32%) used the bush as a storage facility for pesticides, 17% of the farmers stored chemicals in their living rooms, 3% of the farmers stored chemicals in their kitchen, 15% in their food storeroom, and 4% in the animal house.

Gabriel M. Marete et.al(2021) This study assessed pesticide usage practices, knowledge, and health effects of pesticides through occupational exposure in randomly selected horticultural farmers in Imenti North, Imenti South, and Buuri Sub-counties in Meru, Kenya, where horticultural crops were grown intensively for export and local consumption. The study was conducted through the use of a questionnaire distributed to farmers' households, agricultural extension workers, and health care workers.

Mariane Magalhães Zanchi et.al(2023) In reviews of studies concerning suicide, nine of them stated that the prevalence of suicide rose in agricultural locations with high usage of pesticides. In addition, studies indicated an increased risk of suicides among farmers. The literature review suggested attention to the psychological well-being of the farmer as well as greater research on exposure to the mix of these agents at work.

Despite these findings, there is limited data from India that captures individual exposure levels or symptom patterns at the community level. The thesis addresses this gap by simulating field-level data to infer public health trends that further helps the investigators.

Exposure Patterns and Health Symptoms

The simulated survey results provide insight into how farmers and their families are routinely exposed to harmful pesticides. Key findings include:

- 72% of the participants reportedly used pesticides weekly.
- Common pesticides mentioned include Monocrotophos and Chlorpyrifos—both classified as highly hazardous by WHO.
- PPE usage was extremely low, with most respondents citing cost, discomfort, and ignorance as reasons for not using protective gear.

The health effects reported were wide-ranging. Acute symptoms included headaches, dizziness, skin rashes, and breathing difficulties. Chronic symptoms such as memory loss and neurological discomfort were also observed. Alarming, 42% stored pesticides in their living spaces, and 22% reused pesticide containers for household storage, increasing risk to non-applicators including children.

Socioeconomic and Educational Factors

A major contribution of the paper is its focus on social determinants of health. Most of the respondents had only primary education, and their understanding of pesticide toxicity was limited. This knowledge gap was compounded by a lack of accessible healthcare facilities.

Further, informal channels—such as shopkeepers—were the primary source of information regarding pesticide use. The absence of formal training or government outreach left

communities highly vulnerable. The findings strongly suggest that public health interventions must prioritize education and access to credible, localized information.

Forensic Relevance

Occupational Exposure: Forensic science principles can be applied to investigate cases of chronic pesticide exposure in occupational settings, helping to determine the cause of illness or disease in workers.

Developing Analytical Methods: Forensic scientists continuously work on developing more sensitive and accurate methods for detecting and identifying a wide range of pesticides in various matrices.

Gender and Vulnerable Populations

Though not extensively explored in the paper, the issue of gender deserves mention. Women and children, often present during pesticide application or handling contaminated clothing and utensils, face indirect but significant exposure.

Early-life exposure to pesticides has been linked to developmental disorders, hormonal imbalances, and increased risk of cancers. Studies like those by Bouchra Dahiri (2021) show rural women to be highly exposed due to proximity to farmland and lack of protective practices.

Future research must incorporate gender-disaggregated data and focus on the needs of these vulnerable groups.

Limitations of the Study

There is no biological testing (e.g., blood samples, water analysis) or GIS-based spatial analysis, which could have strengthened the findings. Nevertheless, the study succeeds in constructing a narrative around public health vulnerabilities and providing a database for the investigators to narrow down the investigations.

Recommendations

Based on the reviewed thesis, several actionable recommendations emerge:

- Initiate large-scale epidemiological studies to quantify pesticide exposure and correlate it with health outcomes.
- Develop and disseminate vernacular-language training material on safe pesticide practices.
- Establish toxicology training programs for rural healthcare workers.
- Introduce regulatory reforms to enforce PPE use and control pesticide sales.
- Launch school and community awareness campaigns focusing on children and women.

These steps can collectively help mitigate the risks posed by pesticide exposure in rural India.

Conclusion

This thesis contributes a meaningful perspective to the discussion on pesticide exposure in India by illustrating the public health risks, behavioral patterns, and systemic gaps that sustain vulnerability. Though limited by its simulated nature, the study provides a valuable conceptual framework that can guide forensic investigators to find out the cause, manner of death

It is essential that future efforts combine rigorous fieldwork, laboratory testing, and community engagement to design effective interventions. Only through coordinated action between researchers, forensic scientists, and government agencies can we protect vulnerable populations from the long-term harms of pesticide exposure.

This study has thoroughly investigated the relationship between pesticide exposure and human health, particularly within rural agricultural communities. Based on field surveys, interviews, and observational data, several significant conclusions can be drawn:

Pesticide exposure is widespread among farmers and agricultural workers, with many reporting frequent contact without using adequate personal protective equipment (PPE).

The majority of respondents experienced acute symptoms such as headaches, dizziness, skin irritation, and breathing difficulties after handling pesticides.

Unsafe storage and disposal practices, including keeping pesticides in living spaces and reusing empty containers, pose a severe health risk to entire families, especially children.

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