

# Health communication strategies to prevent pesticide exposure risks among tomato harvesters in karo regency, Indonesia: A preliminary study

*Rizka Annisa<sup>1</sup>, Kintoko Rochadi<sup>2</sup>, Taufik Asbar<sup>2</sup>, Eka Lestari Mahyuni<sup>2</sup>*

<sup>1</sup>Student of Doctoral Program Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia; <sup>2</sup>Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia

**Abstract.** In the lush fields of Karo Regency, Indonesia, tomato harvesters work tirelessly to ensure a bountiful harvest. However, with the use of pesticides to protect the crops from harmful pests, there is a looming risk of exposure to toxic chemicals. This presents a serious health concern for the farmers and their families who consume the produce. To address this issue, a comprehensive health communication strategy must be implemented to educate and empower the tomato harvesters on the risks of pesticide exposure and the preventive measures they can take to protect themselves. Community engagement is also a crucial component of a successful health communication strategy. By involving local organizations, community leaders, and government agencies, outreach programs can be organized to promote safe farming practices and raise awareness about the risks of pesticide exposure. Community members can play a key role in disseminating information and supporting the implementation of health communication activities among tomato harvesters.

**Key words:** health communication, pesticide exposure, public health, tomato harvesters

## Introduction

Humans are social beings who constantly interact with others and their environment. These interactions can be observed in how information or messages, including health messages, are communicated. In the health sector, communication is crucial in helping the public prevent diseases and enhance health quality. The health paradigm and goals will always focus on preventing and improving public health. One of the health risks is pesticide exposure, which involves chemicals or chemical mixtures that can potentially impact human wellness. Pesticide exposure is a common problem that can affect individuals through ingestion, skin contact, inhalation, or even eye contact. Pesticides can be toxic and pose health risks, necessitating effective communication with users to mitigate these risks. Therefore, health communication is vital, and health messages must be delivered accurately, effectively, and efficiently (1). Health communication

is essentially communication in the health domain aimed at achieving a complete state of physical, mental, and social well-being. It also relates to efforts by individuals to maintain their health at the individual, group, organizational, or governmental levels. Thus, communication is a key element in health promotion, serving as a strategy for initiating changes to improve public health quality (2). Health communication systematically aims to positively influence public health behaviors by applying common communication principles and methods, such as interpersonal and mass communication. Generally, communicated topics include disease prevention, health promotion, health maintenance, and choices of health facilities, among others (3). Disease prevention, health promotion, and health maintenance are preventive measures requiring health elements such as doctors and laboratory technicians (4). Indonesia, as an agrarian country, has a primary workforce in agriculture. The management of agricultural resources aligns with development goals to

enhance agricultural productivity, emphasizing food crops. One of the agricultural commodities in demand is horticultural crops, with tomatoes being a significant product managed by farmers. Tomatoes are beneficial for health and meet household consumption needs, as do fruits or vegetables. As a horticultural vegetable, tomato plants are vulnerable to pests and diseases. Farmers frequently use pesticides to protect the final yield during harvesting, including spraying 2-3 days before harvesting. High pesticide exposure frequency in tomatoes can be hazardous to both the environment and humans. Pesticides can enter the human body directly or indirectly, typically from the work environment where farmers apply pesticides to crops. Pesticides can enter the body through different pathways (ports of entry): orally, dermally, or via inhalation (5). Continuous respiratory exposure to pesticides can damage the respiratory system, causing chronic cough or chest tightness, which might be symptoms of bronchitis, asthma, or other lung diseases. Long-term exposure can lead to lung cancer. The numerous chemicals in pesticides are known carcinogens. Individuals exposed to pesticides have a higher likelihood of developing cancer, although not every pesticide user will necessarily get cancer (6-8). Poisoning can occur due to excessive pesticide exposure or chemical ingestion. Therefore, toxic exposure is a relevant clinical toxicology issue. Typically, pesticides enter the digestive system through contaminated hands, in fact, although voluntary ingestion or drinking of pesticides is rare, it usually occurs when contaminated hands are used without cleaning before eating or touching the face, mouth, nose, or eyes. The quality of pesticide exposure results in toxicity. Prolonged, low-level pesticide exposure can cause chronic effects on farmers (5, 9).

Pesticides can weaken the human immune system, making the body more susceptible to serious infections and harder to recover. Over 90% of poisoning cases globally are due to skin contamination, though not all cases result in acute poisoning (10). Preventive measures against pesticide exposure include following usage and storage instructions, storing pesticides away from water sources, using protective gear like masks and gloves, washing fruits and vegetables with running water or special solutions, and peeling fruits and vegetables before consumption or cooking.

## Methods

This research uses a mixed-method approach with an exploratory sequential design. The goal is to develop or examine communication issues concerning pesticide exposure among tomato farmers in Karo Regency, affecting their health. This design collected, identified, and analyzed qualitative data as important variables and generalized them into measurable groups. The qualitative data interpretation was then quantitatively tested to explain meaningful correlations of the explored variables. Quantitative analysis results can reinforce the mixed-method approach to finding solutions for health communication strategies to prevent pesticide exposure risks (11).

## Pesticides and their health risks

Agricultural sector development focuses on increasing agricultural production, significantly contributing to the national economy. Production increases aim to meet domestic food and industrial needs and boost export products, enhancing farmers' incomes. Thus, agriculture also contributes to expanding job opportunities and promoting equal business opportunities (12-13). Agricultural production growth can improve farmers' lifestyles and activities, causing various environmental and public health issues. Health issues in the Sustainable Development Goals (SDGs) are integrated into goal number 3: ensuring healthy lives and promoting well-being for all ages. This goal addresses global health concerns, emphasizing comprehensive public health achievement outlined in targets based on evolving health problems due to technological changes. One of the 2030 SDG targets is reducing diseases and deaths from hazardous chemicals and pollution (target 3-9). Diseases from chemical or pollution exposure in air, water, and soil indicate poor environmental quality, directly impacting health. Chemical exposure is a global issue, increasing various infectious and non-infectious diseases and mortality rates. Pesticide use, widespread in agricultural work environments, significantly contributes to environmental emissions (14-15). In Indonesia, agricultural intensification typically involves extensive use of chemical or synthetic

pesticides to enhance crop yields. These pesticides control harmful pests and prevent crop loss or damage but, on the other hand, their high biological activity and environmental persistence cause undesirable public health and environmental effects (16). Overusing pesticides, and ignoring health and environmental impacts, increases pesticide poisoning rates in many countries. Pesticide poisoning incidents, intentional or accidental, are prevalent in poor and developing countries like India, Indonesia, China, Thailand, Nicaragua, Africa, Vietnam, Cambodia, Bangladesh, and Brazil (5). In Indonesia, 168 pesticide poisoning cases were reported, with 96 resulting in death. However, actual incidents are likely higher due to underreporting: many farmers exposed to pesticides do not report poisoning cases because the symptoms are not severe or fatal and can be treated with general medication (5). Pesticides can be systemic or non-systemic, causing acute or chronic exposure effects (17). The chemical effects of pesticide exposure pose different health risks depending on the chemical type and properties. Symptoms like fatigue, dizziness, nausea, vomiting, diarrhea, and muscle weakness are common reactions among farmers, often considered usual. Chemical exposure depends on the dosage and the processes of absorption, distribution, metabolism, and excretion of the chemical (toxicant) (18-19). Many farmers are unaware of the severe chronic effects of pesticide exposure. Long-term cumulative exposure can damage and disrupt farmers' health, causing long-term effects and being a major cause of death. Chronic poisoning can manifest as neurological and behavioral disorders or mutagenicity, damaging organ systems and tissues, evident through symptoms and complaints. Hundreds of pesticides and their ingredients are known carcinogens (9). Low farmer awareness of pesticide dangers significantly contributes to increased exposure risks. Studies indicate that poor knowledge and awareness among farmers correlate with behaviors that increase pesticide exposure risk (20-21). Additionally, misuse of pesticides and hazardous behaviors elevate health or poisoning risks. Studies in Karo Regency, Indonesia, show farmers ignore pesticide labels, are unaware of side effects and health impacts, and are unaware of recommended usage guidelines. Farmers typically use doses based on pest attack severity, often excessively

and dangerously (5, 22-24). Farmers' ignorance and disregard for long-term health impacts from pesticide exposure is a critical issue. Studies suggest that such attitudes result from poor and ineffective information dissemination. Comprehensive information must be conveyed through clear and engaging messages. Inaccurate information can lead to different perceptions, resulting in behaviors that contradict desired outcomes due to personal assumptions (25).

### **Health communication**

Effective health communication is crucial for building a society capable of achieving program or target goals through interactions promoting healthy behavior. Health communication is closely linked to public relations functions, establishing and maintaining beneficial relationships that determine the success of efforts (26). Effective communication requires informative messages to build appropriate perceptions. Message delivery should consider key factors to ensure successful communication. The role of the communicator and the message's content are fundamental for conveying the communication's purpose. Effective message delivery can enhance knowledge, skills, or education to address health issues, including reducing pesticide exposure risks. Direct communication can raise farmers' awareness, fostering trust in health messages and preventing work-related risks (5, 27). Mahyuni's study (24) in Sumber Mufakat Village, Kabanjahe, Karo Regency, revealed that farmers are aware of pesticide dangers, but agricultural extension workers never convey information on health effects or side effects. Farmers are only advised to use personal protective equipment (PPE) during pesticide spraying. The study empowered farmers to read pesticide labels before use to reduce poisoning risks. Reading labels is expected to enhance farmers' knowledge of pesticide hazards, promoting safe behavior. Mahyuni (28) also suggested using the safety talk method to prevent pesticide poisoning. Safe communication in agricultural settings in Karo Regency often occurs in coffee shops, aligning with the local farmers' habit of discussing information while resting after farming.

## Pesticide exposure in tomato plants in Karo regency

Karo Regency is a major agricultural center in North Sumatra Province, Indonesia. Agricultural patterns in Karo Regency often follow intercropping systems, using multiple pesticide types, resulting in complex exposure. Tomatoes are a widely cultivated crop that requires pesticides for pest control. As an important health-related crop, tomatoes are the fifth largest in the area and second in yield in Karo Regency (29).

Tomato plants are highly susceptible to pest attacks, which can disrupt their growth and reduce yields, necessitating immediate pest control measures. One common method for controlling pest attacks on tomato plants is using pesticides, particularly chemical pesticides. Chemical pesticides are considered effective by farmers and significantly help in achieving high yields due to their rapid action in controlling pest attacks (30).

A preliminary study conducted by the researchers on pesticide exposure among tomato farmers in Merdeka Subdistrict, Karo Regency, began in 2019. Tomato cultivation generally allows for two planting seasons per year. The harvesting frequency for tomatoes can reach up to 16 times per planting season. This indicates the presence of different growth and maturation phases of tomatoes simultaneously, ranging from buds and green mature fruits to ripe fruits ready for harvest. Based on the researchers' observations, pesticide application on tomato plants should be carried out 7 to 14 days before harvest as per the instructions on pesticide labels. However, in Merdeka Subdistrict, pesticides are applied only 1 to 2 days apart, and tomatoes are harvested every 3 days. The harvesting period can last up to 45 days in one planting season, or up to 10 or more pesticide applications while the tomatoes are still on the plants. This results in pesticide accumulation on the surface of ripe tomatoes, as they are sprayed with pesticides 3 to 5 times during the maturation phase. Pesticide application can occur 3-5 times per week, often using more than two types of pesticides simultaneously. Observations of significant pesticide residues on ripe tomatoes further support high and excessive pesticide use. Pesticides adhering to the surface of ripe tomatoes contribute to the pesticide exposure of tomato farmers, especially during harvesting.

In addition, farmers do not use appropriate protective equipment and often have direct contact with pesticide-contaminated tomatoes. Interviews revealed that farmers frequently experience health complaints such as eye irritation, red eyes, facial skin itching, and burning sensations on their hands due to direct contact with pesticides on tomato surfaces. Farmers in Merdeka Subdistrict generally use pesticides excessively and rarely follow government recommendations for proper pesticide use. Farmers believe that government advice through extension activities or socialization does not significantly contribute to improving their income or well-being. The government is perceived as merely fulfilling its duties through messages that do not bring tangible changes for farmers. Farmers are more likely to follow advice from their peers to solve agricultural problems, including pesticide use. The use of personal protective equipment (PPE) to reduce pesticide exposure risks, as communicated in meetings with agricultural extension workers or the government, is often ignored as it is seen as hindering their work. This phenomenon indicates that while the messages delivered to farmers are accurate, they are ineffective. Consequently, farmers continue to disregard the dangers of pesticide use. Therefore, a communication strategy is needed to change farmers' perceptions of the dangers of pesticide exposure to prevent the associated risks.

## Conclusion

Well-designed health communication strategies are essential in preventing pesticide exposure risks among tomato harvesters in Karo Regency, Indonesia. The health and well-being of agricultural workers can be protected by raising awareness about the dangers of pesticide exposure, educating harvesters on safety measures, and involving the local community and authorities. Effective communication is key to ensuring that tomato harvesters can work safely and sustainably in the agricultural sector in Karo Regency, Indonesia. The benefits of this research include providing information to tomato farmers on the importance of preventive measures against pesticide exposure in performing high-risk tasks, enabling them to work safely and healthily. In addition, this research can serve as

input for relevant institutions and agencies to enhance health promotion and occupational safety, particularly regarding the dangers of pesticide use, and as a reference for future researchers addressing pesticide use mitigation among farmers.

**Acknowledgment:** This article discusses the importance of creating an effective health communication strategy to address pesticide exposure risks among tomato harvesters. Although tomato harvesters are aware of the pesticide exposure risks, they face daily, inadequate communication often leads to a lack of serious response to these risks in the workplace.

This article is a small part of my dissertation. Therefore, I extend my deepest gratitude to all those who contributed and provided feedback during the writing process. Special thanks to the informants who provided the data and to my advisors for their critiques and guidance, enabling me to complete this article successfully.

## References

- Laswell HD. Struktur dan fungsi komunikasi dalam masyarakat. In: L. Bryson (ed.). *Komunikasi ide*. New York: Harper dan Row; 1948. p.37–51.
- Junaedi F, Sukmono FG. *Komunikasi kesehatan*. Jakarta: Prenadamedia Group; 2018.
- Harahap RA, Putra FE. *Buku ajar komunikasi kesehatan*. Jakarta: Prenadamedia Group; 2019.
- Agustono B, Junaidi, Affandi KM. Pathology laboratory: An institution of tropical diseases in Medan, East Sumatra, 1906–1942. *Cogent Arts & Humanities* 2021; 8(1):1905261.
- Mahyuni EL, Harahap RH, Harahap U, Khalik N. Determinants of unsafe behavior in pesticide usage among horticulture farmer. *Open Access Macedonian Journal of Medical Sciences* 2020; 8(E):34–6.
- Prasetyaningsih Y. Persentase kejadian anemia pada petani terpapar pestisida di kelompok tani Karang Rejo, Dusun Krinjing Lor, Desa Jatisarone, Kecamatan Naggulan, Kabupaten Kulon Progo. *The 5th Urecool Proceeding*; 2017.
- Kumar R. *Review of plants*. John Press; 2008.
- Kurniasih SA, Setiani O, Nugraheni SA. Faktor-faktor yang terkait paparan pestisida dan hubungannya dengan kejadian anemia pada petani hortikultura di Desa Gombong Kecamatan Belik Kabupaten Pemalang Jawa Tengah. *Jurnal Kesehatan Lingkungan Indonesia* 2013; 12(2):132–7.
- Pamungkas OS. Bahaya paparan pestisida terhadap kesehatan manusia. *Bioedukasi* 2016; 14(1):27–31.
- Djojosumarto P, Armando R, Astutiningsih, Zulkarnain, Seto N, Setiawan I. *Panduan lengkap pestisida dan aplikasinya*. Jakarta: PT AgroMedia Pustaka; 2008.
- Creswell JW. *Research design: Pendekatan kualitatif, kuantitatif, dan mixed*. Yogyakarta: Pustaka Pelajar; 2015.
- Isbah U, Iyan RY. Analisis peran sektor pertanian dalam perekonomian dan kesempatan kerja di Provinsi Riau. *Jurnal Sosial Ekonomi Pembangunan* 2016; VII(19):45–54.
- Soekartawi. *Teori ekonomi produksi: Dengan pokok bahasan analisis cobb-douglas*. Jakarta: PT Rajagrafindo Persada; 2003.
- BAPPENAS. *Kesehatan dalam kerangka Sustainable Development Goals (SDGs)*. Jakarta: Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional; 2020.
- WHO. *World health statistics 2022: Monitoring health for the SDGs, Sustainable Development Goals*. World Health Organization; 2022.
- Damalas CA, Koutroubas SD. Farmers' exposure to pesticides: Toxicity types and ways of prevention. *Toxics* 2016; 4(1):1–10.
- Lu FC. A review of the acceptable daily intakes of pesticides assessed by WHO. *Regulatory Toxicology and Pharmacology* 1995; 21(3):325–64.
- Zeliger HI. *Human toxicology of chemical mixtures: Toxic consequences beyond the impact of one-component product and environmental exposures (2nd ed.)*. William Andrew; 2011.
- Mukono H. *Toksikologi lingkungan*. Surabaya: Pusat Penerbitan dan Percetakan Unair; 2010.
- Jannah MK, Sunarko B. Hubungan antara umur, tingkat pendidikan dan perilaku petani dalam penggunaan pestisida (studi kasus di Kelurahan Jogomerto Kec. Tanjunganom Kab. Nganjuk tahun 2017). *Gema Lingkungan Kesehatan* 2018; 16(1):73–82.
- Siegert K, Loon Wv, Gai PP, Rohmann JL, Piccininni M, Näher A-F, Boloor A, Shenoy D, Mahabala C, Kulkarni SS, Kumar A, Wedam J, Gai P, Devi R, Jain A, Kurth T, Mockenhaupt FP. The effect of socioeconomic factors and indoor residual spraying on malaria in Mangaluru, India: A case-control study. *International Journal of Environmental Research and Public Health* 2021; 18(22):11853.
- Houbraken M, Bauweraerts I, Fevery D, Labeke M-Cv, Spanoghe P. Pesticide knowledge and practice among horticultural workers in the Lâm Đông region, Vietnam: A case study of chrysanthemum and strawberries. *Science of the Total Environment* 2016; 550:1001–9.
- Riccò M, Vezzosi L, Gualerzi G. Health and safety of pesticide applicators in a high income agricultural setting: a knowledge, attitude, practice, and toxicity study from North-Eastern Italy. *Journal of Preventive Medicine and Hygiene* 2018; 59(3):E200–E211.
- Mahyuni EL. *GEMPAR Gerakan masyarakat petani atasi racun: Pemberdayaan masyarakat berdasarkan pendekatan participatory action research*. Sleman: Deepublish; 2022.
- Mulyana D. *Ilmu komunikasi: Suatu pengantar*. Bandung: Remaja Rosdakarya; 2001.
- Paramita S, Utami LSS, Sari WP. Peran komunikasi kesehatan dalam pelayanan Rumah Sakit melalui "Health Public Relations." *Jurnal Bakti Masyarakat Indonesia* 2020; 2(2):259–66.

27. Tambe AB, Mbanga BMR, Nzefa DL, Nama MG. Pesticide usage and occupational hazards among farmers working in small-scale tomato farms in Cameroon. *Journal of the Egyptian Public Health Association* 2019; 94(20).
28. Mahyuni EL, Yustina I, Sudaryati E. Safety talk and check to prevent pesticide toxicity among farmer. *International Journal of Public Health Science (IJPHS)* 2017; 6(4): 293–8.
29. BPS. Kabupaten Karo dalam angka. Brastagi: Badan Pusat Statistik Kabupaten Karo; 2022.
30. Januati, Parawansa AK, Saida. Analisis residu pestisida pada buah Tomat di Sulawesi Selatan. *Jurnal Agrotek* 2020; 4(1):77–87.

---

**Correspondence:**

Rizka Annisa  
Student of Doctoral Program Faculty of Public Health,  
Universitas Sumatera Utara, Medan, Indonesia  
E-mail: rizkaanisa.2017@gmail.com