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ORIGINAL ARTICLE

The association between farmer characteristics, behavior, and pesticide spraying patterns and skin disorders in citrus farmers in Aji Mbelang Village, Karo Regency

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ABSTRACT

Agriculture forms a vital component of Indonesia's economy, yet pesticide use poses significant occupational health hazards, particularly skin disorders from exposure. This study aimed to analyze the association between farmer characteristics, behavior, and pesticide spraying patterns with the incidence of skin disorders among citrus farmers in Aji Mbelang Village, Karo Regency. A quantitative analytical cross-sectional study was conducted involving 30 citrus farmers selected through accidental sampling. Data were collected using a structured questionnaire assessing demographic variables, behavioral factors, and pesticide spraying patterns. Univariate and bivariate analyses, including chi-square tests, were performed to explore associations between independent variables and skin disorder incidence, with significance set at $p<0.05$. The majority of respondents were male (86.7%), aged over 36 years (43.3%), and had completed senior high school (46.7%). The prevalence of skin disorders was high (90.0%). Most farmers demonstrated poor knowledge about pesticide risks (60.0%) but exhibited positive attitudes (86.7%) and safety practices (76.7%). Contradictorily, 96.7% engaged in high-risk spraying behaviors. Age was the only statistically significant variable associated with skin disorders ($p=0.044$), with all farmers over 32 years reporting skin disorders. Skin disorders are highly prevalent among citrus farmers and significantly associated with older age. The findings reveal a gap between positive safety attitudes and hazardous field practices, highlighting the need for targeted educational interventions to enhance knowledge and promote safer pesticide application to mitigate dermal health risks.

Keywords: skin disorders, citrus farmers, pesticide spraying, risk factors

Introduction

The agricultural sector is a vital pillar of Indonesia's economy, employing approximately 38.22 million workers in 2020.[1] To enhance productivity, pesticide use has become a common practice. However, pesticides also represent a significant occupational health hazard for farmers.[2,3] Pesticide poisoning is a significant health issue in developing countries, with an estimated 3 million acute cases and 220,000 deaths annually worldwide.[4] Annually, exposure to these agrochemicals is associated with substantial morbidity and mortality worldwide. It is estimated that millions of individuals, primarily agricultural workers, suffer from pesticide poisoning each year. Consequently, this exposure results in hundreds of thousands of fatalities

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annually, highlighting the severe occupational hazards prevalent within the agricultural sectors of developing countries.[5,6]

One of the most common health effects of pesticide exposure is skin disorders. Review on pesticide exposure risks includes the prevalence of occupational skin diseases, highlighting that skin disorders from exposure are very common among occupational illnesses.[7] Literature on pesticides' skin effects shows that contact dermatitis is the predominant occupational skin disease caused by pesticides, either as irritant or allergic dermatitis.[8] In Indonesia, the national prevalence of dermatitis is 6.78%. Within the subcategory of occupational health, contact dermatitis is the predominant condition, representing the vast majority of all work-related skin diseases. Specifically, 92.5% of skin ailments linked to employment are diagnosed as contact dermatitis, while skin infections and other miscellaneous factors account for the remaining 5.4% and 2.1%, respectively.[9]

Pesticide exposure poses significant health risks to agricultural workers, with unsafe handling practices being a major concern.[10,11] Key risk factors include age, education level, farming experience, and inadequate safety training.[10,12] Common unsafe behaviors include improper storage, preparation, and disposal of pesticides, as well as insufficient use of personal protective equipment (PPE).[11,13] Farmers who received training on pesticide use demonstrated higher levels of knowledge, safety beliefs, and protective behaviors compared to untrained farmers.[12] Inadequate PPE usage was identified as the dominant factor contributing to pesticide poisoning among horticultural farmers.[13]

A case of particular concern is found in Aji Mbelang Village, Tiga Panah District, Karo Regency, a major orange-producing area. The high incidence of fruit fly infestations has prompted excessive pesticide use among farmers. Preliminary surveys identified numerous risky practices, such as mixing up to three types of pesticides simultaneously with bare hands or wooden sticks, prolonged spraying durations (approximately four hours daily), and incomplete use of PPE. Post-application hygiene is often limited to rinsing with water only. Consequently, farmers frequently report skin complaints, including itching, erythema, dryness, and occasionally swelling accompanied by pain.

Given this background, there exists a notable gap between safe pesticide use practices and actual farmer behaviors in the field, resulting in a high prevalence of skin disorders. Therefore, this study aims to analyze the relationship between farmer characteristics, pesticide spraying behaviors, and the occurrence of skin disorders among orange farmers in Aji Mbelang Village, Tiga Panah District, Karo Regency.

Method

This study employed a quantitative approach with an analytical cross-sectional design. The primary objective was to analyze the relationship between independent variables—namely farmer characteristics (X1), behavior (X2), and pesticide spraying patterns (X3)—and the dependent variable, incidence of skin disorders (Y) among farmers. The research was conducted in Aji Mbelang Village, Tiga Panah District, Karo Regency. Data collection took place over two months, from April to May 2025. The target population comprised all orange farmers active in the village. The sample size was determined using Slovin's formula, and respondents were selected via accidental sampling. This technique involved recruiting subjects who were conveniently encountered at the research site and met the established inclusion criteria.

Data were collected from two primary sources: primary and secondary data. Secondary data, including village profiles and general information, were obtained from the village head office and through literature review of journals and books. Primary data were collected directly from respondents using a structured questionnaire. The questionnaire consisted of closed-ended, ordinal-scaled questions producing categorical responses, such as “Yes” or “No,” to ensure data clarity. Data collection was conducted personally by the researcher, who explained the research purpose and questionnaire instructions, allowed respondents to ask questions, and immediately retrieved completed questionnaires for further processing.

Each variable was systematically measured using specific parameters outlined in the questionnaire. The dependent variable, Skin Disorders, was assessed by recording symptoms reported by respondents. Participants were categorized dichotomously: “Experiencing” included individuals reporting at least one symptom (e.g., rash, itching, dry skin, or swelling), while “Not Experiencing” included those reporting no symptoms. This dichotomous approach facilitated a clear understanding of skin disorder prevalence within the study population. Farmer characteristics were analyzed across four dimensions: age (categorized as ≤30 years [younger] and ≥31 years [older]), gender (male or female), education level (low: elementary/middle school; high: high school/university), and work frequency (once a week vs. daily). This classification

provided a detailed demographic profile of the participants. Behavior was measured across three domains. First, knowledge was evaluated based on the number of correct questionnaire answers and categorized as good, moderate, or poor. Second, attitude was assessed via percentage scores to classify respondents' attitudes as positive or negative toward specific practices. Third, action was measured using a combination of observation sheets and questionnaire scores, categorizing behavior as good or poor. Pesticide spraying patterns were assessed via respondents' reported habits and techniques. Responses were categorized as "Yes" if practices conformed to recommended standards or "No" if they did not. This measurement provided insight into adherence to guidelines potentially impacting farmers' health.

After data collection, a systematic data processing sequence was conducted beginning with editing to verify completeness and consistency of responses. This was followed by coding, assigning numerical values to answers, and data entry using SPSS software. Data were then tabulated, and cleaning procedures ensured the accuracy of data entry. Data analysis proceeded in two stages: first, univariate analysis to present frequency distributions and proportions of each variable in tabular form; second, bivariate analysis using Chi-Square tests to evaluate hypothesized relationships between variables. Associations were considered statistically significant when the p-value was less than 0.05.

Results

The study included a total of 30 citrus farmers from Aji Mbelang Village. The demographic distribution revealed that the majority of respondents were male (86.7%), with the largest age cohort being over 36 years (43.3%). The highest level of education completed by most participants was senior high school (46.7%), and a majority (60.0%) engaged in pesticide spraying activity daily.

A primary finding from the univariate analysis was the high prevalence of skin disorders, which were reported by 90.0% of respondents. Regarding behavioral variables, the majority of farmers had poor knowledge (60.0%) of pesticide-related risks. Despite this, most exhibited a positive attitude (86.7%) and positive practices (76.7%) concerning general occupational health and safety. However, a significant contradiction was observed in field practices, where nearly all respondents (96.7%) engaged in high-risk spraying patterns.

To examine the association between the independent variables (demographic and behavioral) and the dependent variable (incidence of skin disorders), a bivariate analysis was conducted using the *chi-square* test. The complete results of this analysis are presented in Table 1.

Table 1. Bivariate analysis of associations between variables and the incidence of skin disorders

Variable	Skin Disorders		p-value
	Experienced	Not Experienced	
	n (%)	n (%)	
Age			
< 32 years	13 (81,3%)	3 (18,8%)	0,044
> 32 years	14 (100%)	0 (0,0%)	
Gender			
Male	23 (88,5%)	3 (11,5%)	0,341
Female	4 (100%)	0 (0,0%)	
Education			
Primary	7 (100%)	0 (0,0%)	0,065
Junior High	10 (100%)	0 (0,0%)	
Senior High	10 (76,9%)	3 (23,1%)	
Work Frequency			
Daily	17 (89,5%)	2 (10,5%)	0,899
Weekly	10 (90,9%)	1 (9,1%)	
Knowledge			
Poor	17 (94,4%)	1 (5,6%)	0,080
Fair/Good	10 (83,3%)	2 (16,7%)	
Attitude			0.677
Negative	4 (100%)	0 (0,0%)	

Positive	23 (88,5%)	3 (11,5%)	
Practices			
Negative	6 (85,7%)	1 (14,3%)	0.341
Positive	21 (91,3%)	2 (8,7%)	
Spraying Pattern			
High-Risk (Yes)	26 (89,7%)	3 (10,3%)	0.643
Low-Risk (No)	1 (100%)	0 (0,0%)	

The analysis revealed that age was the only variable with a statistically significant association with the incidence of skin disorders (p=0.044). Specifically, all respondents (100%) over the age of 32 experienced skin disorders, compared to a prevalence of 81.3% in the younger age group.

Conversely, no significant associations were found between the incidence of skin disorders and other demographic characteristics, including gender (p=0.341), educational level (p=0.065), and work frequency (p=0.899). Similarly, all behavioral variables—knowledge (p=0.080), attitude (p=0.677), practices (p=0.341), and spraying pattern (p=0.643)—showed no statistically significant association with skin disorders in this study population.

Discussion

This study aimed to investigate the prevalence of skin disorders and their associations with demographic and behavioral variables among citrus farmers in Aji Mbelang Village. The high overall prevalence of skin disorders (90.0%) among the farmers underscores a significant occupational health concern in this population. This finding aligns with previous studies highlighting the vulnerability of agricultural workers to dermatological conditions due to pesticide exposure and other field-related hazards.[14,15] Notably, the demographic profile showed a majority of male farmers (86.7%) predominantly over 36 years old (43.3%), with most having a senior high school education (46.7%). The frequent engagement in pesticide spraying, with 60.0% spraying daily, likely intensifies exposure risks contributing to skin health problems.

The bivariate analysis revealed that age was the only factor significantly associated with the incidence of skin disorders (p=0.044). Specifically, all farmers older than 32 years experienced skin disorders compared to 81.3% of younger farmers. This suggests cumulative exposure effects or age-related susceptibility to dermatological damage, which may exacerbate the health burden among older agricultural workers. A study in North Carolina reported high prevalence of inflammatory (57.2%) and infectious (73.8%) skin diseases among farmworkers, with age, pesticide exposure, and poor housing quality identified as risk factors.[16] Contrarily, other demographic factors including gender, education level, and work frequency showed no statistically significant associations, indicating that these characteristics might be less predictive of skin disorder risk in this context. A research in rural Honduras found higher rates of dermatologic symptoms among male agricultural workers, suggesting increased exposure to environmental risk factors.[17]

Surprisingly, despite a majority of farmers having poor knowledge about pesticide-related risks (60.0%), a positive attitude (86.7%) and general health and safety practices (76.7%) were observed. A study on pesticide-related health symptoms and practices in farmers highlights discrepancies between knowledge and practices regarding pesticide risks and safety.[18] Nevertheless, an important discrepancy was identified in the actual spraying behavior, with nearly all farmers (96.7%) engaged in high-risk spraying patterns, which are likely to increase dermal exposure. Reports emphasizing high-risk pesticide spraying behavior despite protective attitudes are found in agricultural health studies, underscoring increased dermal exposure risk.[18] Yet, behavioral variables including knowledge, attitude, practices, and spraying patterns were not significantly linked to skin disorders in this study. Studies have found mixed or non-significant associations between behavioral variables and pesticide-related skin disorders due to measurement limitations or confounders.[19,20] This lack of association may reflect limitations in how these variables were measured or the influence of unmeasured confounders, such as the type or concentration of pesticides used, or personal protective equipment adherence specifics. Recognition of limitations in exposure and behavior measurement and the role of unmeasured factors including pesticide type, concentration, and PPE adherence are commonly discussed in pesticide exposure literature.[18]

Overall, these findings emphasize the critical role of age and cumulative exposure in the development of pesticide-related skin conditions among citrus farmers. They further highlight a paradox where positive

occupational health attitudes and reported practices coexist with hazardous behaviors, suggesting gaps in effective risk communication or enforcement. Future studies should explore longitudinal exposure assessment and intervention strategies to improve both knowledge translation and practical safety behavior to mitigate dermatological risk in this vulnerable workforce.

Conclusion

The study demonstrated a high prevalence of skin disorders among citrus farmers in Aji Mbelang Village, with age identified as the only significant demographic factor associated with increased skin disorder incidence. Despite generally positive attitudes and practices toward occupational health and safety, the majority of farmers exhibited poor knowledge about pesticide risks and engaged in high-risk spraying behaviors. These findings underscore the urgent need for targeted interventions focusing on improving knowledge, promoting safer spraying practices, and addressing age-related vulnerabilities to reduce pesticide-related skin health problems in this population.

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