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Northern Minorities Farmers Who Used Pesticides Experience Different Health Symptoms and Quality of Life than Thai Farmers

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Abstract Pesticides impact Thai and minority farmers' health and quality of life. This cross-sectional study examined pesticide-related health symptoms, Thai and minority farmers' quality of life (QoL), and factors determining QoL. Pesticide-exposed 406 farmers in Phayao province's highlands district were sampled. Multi-stage cluster sampling randomized it. Descriptive analysis, Mann-Witney U, Kruskal-Wallist, and Enter binary logistic regression were studied. The average age of the samples is 53.25 years, with 68.5% Thai farmers and 31.5% minority farmers (Mein 18.2%, Hmong 13.1%). Cholinergic, CNS, neuromuscular, and general health issues existed. Thai farmers and minorities had considerably varied health symptoms, including red skin and muscle clamps ($p< 0.05$). Overall, 53.2% QoL was good. When domain and overall QoL scores were classified, minority farmers had a higher mean QoL than Thai farmers. One social relation component showed significant differences between Thai and minority farmers ($p<0.01$). The five independent variables that significantly predict farmers' QoL were listed in order of strength: socioeconomic status, ethnic group, underlying condition, farm hour labor duration, and health symptoms (OR=2.028, 95% CI=1.302-3.159, OR=1.651, 95% CI=1.016-2.681). This research should be used by health agencies and the agricultural district to improve farmers' lives, especially Thai farmers.

Keywords Pesticides, Health Symptoms, Quality of Life, Thai and Minorities Farmers

1. Introduction

Pesticides are chemical compounds used to eliminate insects, vermin, fungi, and undesirable vegetation [1, 2, 3, 4, 5]. Over a thousand distinct pesticides are used globally [1]. Pesticides can pollute soil, water, and non-target plants and animals, reducing biodiversity and crop productivity [6]. Moreover, it can affect population health [7]. Pesticides are widely used and inadequately controlled, posing a risk to the health of farmers [7, 8, 9, 10, 11, 12], farm families [7, 8], the general population, particularly children [7], and the environment [2]. Pesticide-caused problems include health symptoms which were numerous systems, including the central nervous system [8, 9, 10, 12], respiratory system

[8], gastrointestinal system [9, 10, 12, 13], skin irritation [12, 13, 14], ocular irritation [8, 9, 10, 12, 13], and muscular system [8]. All of these health symptoms have an impact on farmers' quality of life [15].

Quality of life as an individual's perspective of their situation in life is related to their goals, desires, standards, and concerns in the context of the culture and value systems in which they live [16, 17, 18]. Quality of life is also related to long-term development objectives [19]. It is possible to argue that quality of life is a critical fundamental aspect in development [20]. Factors determining farmer quality of life are numerous, including demographic factors such as age, education, and status [21, 22], economic [22, 23], disease [15], symptoms and signs of disease [24], and ergonomics [20].

FAO statistics show that over half of the world's pesticides have been used in agriculture in the previous 30 years, with Asia using 1.7 kg per hectare and the rest worldwide using 1.2 to 1.86 kg per hectare. The Asian agricultural nation of Thailand imports chemicals [25, 26], during 2012-2017, agricultural hazardous chemical imports increased from 134,480,269 to 136,101,302 kg, without control, indicating farmers can access more chemicals. As an agricultural nation, Thailand has 32.37% farmers [27]. Thus, pesticides may affect agriculture, which employs most of the nation. It lowers life quality [25].

Phayao Province's Pong District has a flat terrain like a pan, natural mountain ranges, and thick forests. Thai, Hmong, and Mien people live in Pong District, which has a diverse population with different beliefs than the lowland population, such as respecting ancestral spirits, sacred nature, and the environment. Most people in the highlands are informal workers who work in agriculture, animal husbandry, and general labor [28]. The Pong District Farmers Office reports 9,861 farmers, putting ethnically diverse highlanders at risk of pesticide exposure from work [29]. The 2021 pesticide residue survey identified abnormalities and increased cholinesterase in 96% of Hill tribe people [30]. Hill tribes had 2.6 times more blood cholinesterase than average people, supporting previous studies. Studies show that hill tribes with high blood cholinesterase impacted neurological symptoms [31], lowering quality of life [32].

As stated, the researchers questioned pesticide use in a multiethnic study region. Does pesticide use affect Thai and Minority farmers' symptoms, and quality of life? What factors predicted Phayao Province's highland farmers' quality of life? Because literature reviews on farmer quality of life found that in most Thai farmer quality of life studies [20, 21, 22, 23, 24], few of them studied on differences between Thai farmers and minorities, including pesticide effects. This research aimed to explore health symptoms, and quality of life, as well as characteristics which could predict their quality of life in Phayao Province's highlands.

2. Materials and Methods

Sample size and sampling technique: The population consists of farmers aged 20 and above in the area of study, as well as 9,861 farmers from a government agency's registered farmer database in Pong District, Phayao Province [29]. The sample's inclusion criteria were being able to read and write in the study area and being willing to engage in the research, but the target population's exclusion criteria were not answering all of the questions in the instrument. The total sample size of 406 farmers was determined from the sample size using the formula Daniel [33] by estimating the Proportion (p) from prior study = 0.95 [34], error (d) = 0.022, and Alpha (α) = 0.05. Multistage sampling is carried out through sampling. The first phase was to partition Pong District into seven sub-districts: Pong Subdistrict, Khuan Subdistrict, Oil Subdistrict, Pha Chang Noi Subdistrict, Khun Khuan Subdistrict, Ngim Subdistrict, and Na Prang Subdistrict. Yes, Step 3: Perform a basic selection of 5 villages from the randomized sub-districts and then collect data in the proper time frame, 27-28 persons per group.

Measures: Questionnaires were employed as research tools and were separated into four sections: part 1, demographics, exposure history, and age, gender, educational level, marital status, ethnicity group, financial status, length of year of work, and hours worked; part 2, past illness history, which included underlying disease, COVID-19 infection, and work-related accident; part 3, signs and symptoms after pesticide exposure, which included cholinergic symptoms, CNS symptoms, neuromuscular symptoms, and general signs; and part 4, quality of life (QoL) was measured using the WHOQOL-BREF-THAI-26 [35], which consists of 26 questions divided into four categories: physical domain (items 2, 3, 4, 10, 11, 12, 24); psychological domain (items 5, 6, 7, 8, 9, 23); social relationships (items 13, 14, 25); and environmental domain (items 15, 16, 17, 18, 19, 20, 21, 22) and 1 and 26 use total QoL and health. There were 26 items to choose from for the QoL questions, including both perceived objective and self-reported subjective ones. Negative questions were 2, 9, and 11, while positive questions were another 23 items. Negative questions were graded on a 5-point scale: 5 = not at all, 4 = slightly, 3 = moderate, 2 = much, and 1 = the most. Positive responses were 1 = not at all, 2 = little, 3 = moderate, 4 = much, and 5 = the most. For reliability, the WHOQOL-BRIEF-THAI-26 questionnaire was employed, with a Cronbach's alpha coefficient of 0.84 [36] the researcher had taken reliability by Cronbach’s = 0.89. Total quality of life ratings were assigned between 26-130 points, separated into two categories of QoL and domain by dividing the mean of the QoL into two groups, low QoL scores below the average, 25-97 = poor, and high QoL above average = 97-125.

Data collection: Before obtaining study data, the University of Phayao study Ethics Committee No. 1.2/016/63 accepted this research on December 29, 2020. The data was then collected from randomized samples in the study region by the researchers and research assistants. The study team and research assistants received informed permission from the individuals prior to data collection. And the team questioned each individual for 20 minutes, according to the prepared questionnaire, before checking the data for correctness for further data analysis.

Data analysis: For sociodemographic, farm work, past illness history, and symptoms and signs after pesticide exposure, the research team used descriptive data. A univariate analysis was used to investigate the relationship between two variables, the Mann-Whitney U test and the Kruskal-Wallis test [37]. Multivariate analysis was used to predict the quality of life relationship between the independent variable and the sample's QoL. The researcher used the Enter method in binary logistic regression [38].

3. Results

The majority of the samples were 50-59 years old, 39.4%, with a mean age of 53.25 years; female 53.0%; 42.6% had completed elementary education; 83.5% were married; Thai 68.5%; and minorities 31.5% (Mein 18.2% and Hong. 13.1%). In terms of the economy, 64.8% of people have sufficient money. The longest annual work period represented 25.4%, the average working life was 27.34 years, and 56.9% of duration of hours worked 7 hours and over. The sample group's diseases revealed that 35.8% had underlying diseases, with 12 diseases being the most frequent. High blood pressure was identified in 20% of all samples, 29.3% had COVID-19, and 51.0% experienced a workplace injury.

Health symptoms of samples after pesticide exposure in the previous year were as follows: cholinergic symptoms included excessive sweating (49.3%), CNS symptoms featured dizziness (31.0%), neuromuscular symptoms were muscle cramps (16.5%), and the general sign was red skin (16.0%). When the Thai and minority groups were compared, it showed that red skin and muscular cramp symptoms were significantly different (p-value 0.05), as indicated (Table 1).

Most farmer groups indicated a high overall QoL (53.2%). The dimensions in order of percentage of QoL from highest to lowest: quality of life in social connections, psychological, environmental, and physical domains, as shown in Table 2. A comparison of total QoL scores between Thais and minorities revealed that the minority group had a higher overall QQL score than the Thai group. The mean scores of social relationships among minority farmers were significantly higher than those in the Thai farmers (p-value < 0.01), as demonstrated in Table 3. Financial situation, ethnic group, frequency of underlying disease, duration of hour employment, and frequency of signs and symptoms were five of the 12 independent factors identified by binary logistic analysis that highly predicted QQL, according to a prediction strength ranking (Table 4). After combining these five independent components at a rate of 15.8%, all factors were constructed, and the following equation was developed to predict the sample QoL: Y(QQL)= Constant (2.141) + FS (0.707)+EG(.0501)-FUD(0.302)-DFHW(0.119)-FSS (0.117).

Table 1. Comparative sign and symptom after working with pesticide between Thai and Minority farmers. (n = 406)

Group	Total		Thai		Minority		*p*-value
	Number	%	Number	%	Number	%	
Symptoms and Sign							
1. Cholinergic symptoms							
1.1 Excessive Sweating	184	49.3	131	47.1	53	41.3	0.282[a]
1.2 Blurred vision	78	19.2	54	19.4	24	18.8	0.873[a]
1.3 Nausea	51	12.6	31	11.6	20	15.6	0.206[a]
1.4 Excessive salivation	30	7.4	19	6.8	11	8.7	0.586[a]
2. CNS symptoms							
2.1 Dizziness	126	31.0	79	28.4	47	36.7	0.093[a]
2.2 Headage	106	29.1	71	25.5	35	27.3	0.701[a]
2.3 Fatigue	86	21.2	57	20.5	29	22.7	0.622[a]
2.4 Numbness	63	15.5	39	14.0	24	18.8	0.222[a]
2.5 Convulsion	16	3.9	13	4.7	3	2.3	0.262[b]
2.6 Coma	8	2.0	5	1.8	3	2.3	0.713[b]
3. Neuromuscular symptoms							
3.1 Muscle cramp	97	16.5	39	14.0	28	21.9	0.048[a]*
3.2 Abdomen cramp	34	8.4	26	9.4	8	6.3	0.294[a]

[a]Chi-square test, [b]Fisher exact test, **p*-value < 0.05

Table 2. Percentage and mean score of QoL in samples classify by domain

Domain	Total		Poor		Good	
	Number (%)	Mean ± S.D	Number (%)	Mean ± S.D	Number (%)	Mean ± S.D
1. Physical	406 (100.0)	97.56±13.21	199 (49.0)	88.85±10.52	207 (51.0)	105.93±9.63
2. Psychological	406 (100.0)	97.56±13.21	149 (36.7)	86.09±9.05	257 (63.3)	104.21±97.56
3. Social relationships	406 (100.0)	97.56±13.21	121 (29.8)	85.93±10.15	285 (70.2)	102.49±11.10
4. Environment	406 (100.0)	97.56±13.21	191 (47.0)	87.86±9.44	215 (53.0)	106.18±9.61
5. Overall QoL	406 (100.0)	107.3 ±97.93	190 (46.8)	86.38±8.09	216 (53.2)	97.56+13.21

S.D, Standard deviation

Table 3. Comparative mean score of QoL between Thai and Minority farmers

Domain	Total	Thai	Minority	Z	*p*-value
	Mean ± S.D	Mean ± S.D	Mean ± S.D		
1. Physical	25.56± 4.00	25.3± 3.81	26.09± 4.53	-1.842	0.065
2. Psychological	23.37± 3.56	23.23± 3.54	23.69± 3.71	-1.229	0.219
3. Social relationships	11.44± 2.15	11.22 ±2.61	11.92 ±2.08	-3.067	0.002**
4. Environment	30.01± 5.04	29.99 ±4.83	30.67 ±5.51	-.093	0.926
5. Overall QoL	97.56 13.21	96.75 ± 12.83	99.23 13.88	-1.838	0.060

Statistically significant (* = p <0.05, **= p-value <0.01, ***= p-value <0.001)

Table 4. Logistic Model of quality of life among samples

Variables	B	SE	Wald	OR	95% CI
1. Age(AGE)	-0.013	0.041	0.826	0.987	0.961 - 1.015
2. Gender (GD) Reference = male	-0.055	0.222	0.062	0.946	0.612 - 1.463
3. Education(ED) Reference = below and primary school	-0.291	0.268	1.175	0.748	0.442 - 1.265
4. Martial status(MS) Reference = single	-0.046	0.294	0.025	0.955	0.536 - 1.700
5. Ethnic group(EG) Reference = Thai	0.501	0.247	4.103	1.651	1.016 - 2.681
6. Financial status(FS) Reference = single	0.707	0.226	9.779	2.028	1.302 - 3.159
7. Duration farm year work (DFYW)	-0.003	0.009	0.088	0.997	0.979 - 1.015
8. Duration farm hour work (DFHW)	-0.119	0.054	4.830	0.888	0.798 - 0.987
9. Injury(IJ) Reference = no	0.176	0.259	0.459	1.192	0.717 - 1.981
10. COVD-19 infection (CV19) Reference = no	0.148	0.279	0.597	1.159	0.671 - 2.003
11. Frequencies of underlying disease (FUD)	-0.302	0.119	6.442	0.740	0.586 - 0.934
12. Frequencies of sign and symptoms (FSS)	-0.117	0.039	9.088	0.890	0.825 - 0.960
Constant = 2.141				-2 log likelihood = 509.950	
Model Chi-Square = 51.219				R Square = 0.158	

Statistically significant (* = p <0.05, **= p-value <0.01, ***= p-value <0.001)

4. Discussion

According to the findings, almost half of the farmers experienced cholinergic symptoms, and approximately half experienced excessive perspiration. This finding differed from previous studies such as Srisookkum and Sapbumrer [12], which found that 1 in 4 (28%) corn field farmers have the highest back pain; Ong-Artborirak et al. [39] revealed Thai farmers using pesticides had the most insomnia at 8.1%; Perwitasari et al. [9], who founded organophosphate, affected tremor at 71.4%; and Onmoy and Aungudornpukee [40] studied onion farmers and reported eye irritation at 79.3%. Because of the various methods of cultivation, each study revealed a unique set of signs and symptoms.

Skin irritation and muscular cramps were significantly different between minority farmers and Thai farmers (p-value< 0.05). Minority farmers showed higher skin irritation and muscular cramps than Thai farmers in this study, which was comparable to a study by Hutter et al. [13], who examined pesticide-exposed banana growers and discovered a statistically significant difference in skin irritation. There was no difference in musculoskeletal complaints, which might be attributed to the fact that the exposed farmers in agriculture in this study had crops such as fruit orchards and rice farms, and the study's site was in the highlands.

Farmers' overall QoL was considered to be half as good. This result was higher than that of Nippanon et al. [34] who discovered that one-third (32.60%) of rubber plantation farmers in northern Thailand had a high quality of life, Srichaijaroonpong et al. [15] indicated that pineapple farmers' quality of life approximately 24.86%, and Arsa et al. [20] found that farmers had a quality of work life (QoWL) mostly at a high level of 7.0%. It has been identified that, similar to the study of Kruajina et al. [41], the quality of life of rice farmers during the COVID-19 epidemic was very good as a result of the research done during the COVID-19 outbreak.

The percentage of good QoL was highest in the social relationships domain when classified by domain, consistent with the findings of Chotchai et al. [42] and Matwangsaeng and Ronghanam [43] who found that the social relationships of agricultural groups participating in the Smart Farm project had the highest domain social relationships scores. In contrast to the samples, the percentage of good QoL was lowest in the physical domain, which contrasted with the Kaenjumpa and Hanchana research [21], which found a high mean score in the physical domain. Furthermore, the findings revealed that the mean total QoL scores and mean scores by domain were higher among minority farmers than among Thai farmers, and the difference was statistically significant at p-value < 0.01, possibly because most minority farmers had higher kinship than Thai farmers.

The analysis of factors predicting QoL among farmers revealed that financial status was the most statistically significant factor predicting overall quality of life. In the study, it was discovered that farmers with sufficient incomes had 2.02 higher level QoL than farmers with insufficient incomes. Because income affects well-being, income is a predictor of QoL [44]. In addition, during the study of this investigation, agricultural income from the distribution of products decreased during the outbreak of COVID-19. The findings were consistent with the Milanowska study [24], which discovered that subjects with higher incomes had a higher QoL. This was related to the research conducted by Tanta-aut [22], who discovered that the income of orchard cultivators was correlated with their QoL, as well as Sutcharitpan [23] and Klomthongcherin [45], who found the relationship between income and QoL.

The ethnic group was the second most statistically significant predictor of QoL. It was discovered that Mien and Hmong minority farmers had 1.65 times higher QoL than Thai farmers. Because a minority of the population reside in the Royal Project area, they receive government agricultural assistance, resulting in a higher level of life than Thai farmers [46]. In contrast, a Chinese study [47] found that Han Chinese had better physical and emotional total quality of life scores than minority groups.

The frequency of underlying disease, the third variable that can predict QoL, was found to be 26.0% higher in the sample without underlying disease compared to the group with underlying disease. This was related to Srichaijaroonpong's study [15], which found that tracer illness in agriculture can predict quality of life with statistical significance and that the QoL of those who do not have it is 2.6 times greater than that of those who do. This was similar to Wokleah's [48] claim that the diseased sample group can predict the QoL seen in a group of cerebrovascular patients.

The duration of hourly work was the fourth strongest predictor of farmers'QoL, and this study revealed that farmers exposed to the chemical for one day had 11.2% higher QoL than those exposed for the entire week. Nippanon et al. [34] found that the duration was able to predict the QoL quality of rubber farmers who work for 6-7 days, leading to a higher quality of life than those who work only one day, because working every day increases their income.

The final variable that substantially predicted the QoL was the frequency of signs and symptoms, which revealed that farmers exposed to pesticides with fewer signs and symptoms had a QoL, up to 11.0%, than those with significantly more signs and symptoms. This was due to the fact that an increasing number of these symptoms affect mental disorder [39] and, consequently, the QoL of farmer exposed pesticides. This study was comparable to Milanowska [24], who discovered that participants with symptomatic symptoms had a low QoL.

However, this study's findings indicate that there are limitations. All five variables predicted 15.8% with a minor degree of precision. Consideration should be given to the

selection of research variables for the applied the public.

5. Conclusions

This study discovered that approximately half of farmers experience a high quality of life. Minority farmers are exposed to more pesticides on a daily basis than Thai farmers, yet they have a higher quality of life rating. This was found to be consistent with the analysis of factors predicting QoL, which revealed that farmers with sufficient income, minority farmers, farmers exposed to pesticides for fewer days, farmers with few underlying diseases, and farmers with a low frequency of signs and symptoms have a high QoL. District Agriculture Office and the health services sector should be encouraged and measurement should be developed to improve the quality of life of farmers, particularly Thai farmers. Furthermore, the common element of economic sufficiency must be considered: farmers with underlying conditions exhibit more indications and symptoms, and farmers who are exposed to pesticides on a daily basis take priority.

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