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Cholinesterase Enzyme Association with Quality of Life Among Farmers in Khong Chai District, Kalasin Province, Thailand

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Abstract

The agricultural sector in Thailand faces challenges that impact farmers' health and quality of life. This study examines the quality of life, cholinesterase enzyme levels, and factors associated with quality of life among farmers in Khong Chai District, Kalasin Province, Thailand. This cross-sectional analytical study was conducted using systematic random sampling. The respondents had a mean age of 54.97 ± 10.50 years (range 25–75 years) and comprised 75.56% females (n = 204), 24.44% males (n = 66). Data collection included demographic information, blood samples to assess cholinesterase enzyme safety levels, and responses to the World Health Organization Quality of Life Brief-Thai (WHOQOL-BREF-THAI) questionnaire. Data were analyzed using descriptive and inferential statistics. Multiple linear regression was utilized to identify factors associated with WHOQOL-BREF-THAI scores, presenting adjusted mean differences, 95% confidence intervals (95% CI), and p-values. The mean of WHOQOL-BREF-THAI score was 89.97 ± 10.34. Factors associated with higher quality of life scores included gender (male: 3.06; p = 0.032), agricultural land size of 10 Rai (1600 m^2) or more (2.55; p = 0.039), frequency of cholinesterase blood testing (1 time: 3.01; never: 3.40; p = 0.039; reference: 2 times or more), and blood cholinesterase enzyme safety levels (unsafe: 1.69; p = 0.037). These findings highlight the need for interventions to reduce risk factors, particularly among farmers with unsafe cholinesterase enzyme levels, to improve the quality of life in this population.

Keywords: cholinesterase enzyme safety levels, farmers, quality of life (QoL)

Abstrak

Enzim Kolinesterase Berhubungan dengan Kualitas Hidup Petani di Distrik Khong Chai, Provinsi Kalasin, Thailand. *Sektor pertanian di Thailand menghadapi tantangan yang mempengaruhi kesehatan dan kualitas hidup petani*. *Penelitian ini mengeksplorasi kualitas hidup, kadar enzim kolinesterase, dan faktor-faktor yang berhubungan dengan kualitas hidup petani di Distrik Khong Chai, Provinsi Kalasin, Thailand*. *Kami melakukan studi analisis* cross-sectional *terhadap petani yang dipilih menggunakan teknik* systematic random sampling. *Responden memiliki usia rata-rata 54,97 ± 10,50 tahun dengan rentang usia antara 25 hingga 75 tahun*. *Sebanyak 75,56% responden adalah perempuan* (*n = 204*)*, 24,44% adalah laki-laki* (*n = 66*). *Keuesioner terstruktur mengumpulkan data demografi, sampel darah untuk tingkat keamanan enzim kolinesterase, dan respon terhadap kuesioner* World Health Organization Quality of Life Brief-Thai (WHOQOL-BREF-THAI). *Data dianalisis menggunakan statistik deskriptif dan inferensial*. *Regresi linear berganda digunakan untuk mengidentifikasi faktor-faktor yang terkait dengan skor* WHOQOL-BREF-THAI*, menyajikan* adjusted mean differences*, 95%* confidence intervals (*95%* CI)*, dan nilai p*. *Penelitian mengungkapkan bahwa rerata skor* WHOQOL-BREF-THAI *adalah 89,97 ± 10,34*. *Faktor-faktor yang berhubungan dengan skor ini antara lain jenis kelamin* (*laki-laki*: *3,06; p = 0,032*)*, luas lahan pertanian 10 Rai* (*1600 m^2*) *ke atas* (*2,55; p = 0,039*)*, frekuensi tes darah kolinesterase* (*1 kali*: *3,01; tidak pernah*: *3,40; p = 0,039; referensi*: *2 kali atau lebih*)*, dan tingkat keamanan enzim kolinesterase darah* (*tidak aman*: *1,69; p = 0,037*). *Temuan ini menyoroti perlunya intervensi untuk mengurangi faktor-faktor risiko, khususnya di kalangan petani dengan tingkat enzim kolinesterase yang tidak aman, guna meningkatkan kualitas hidup pada populasi ini.*

Kata Kunci: *kualitas hidup, petani, tingkat keamanan enzim kolinesterase*

Introduction

In the fiscal year 2018, the Royal Thai government, specifically the Office of the Prime Minister, issued a directive aimed at enhancing the quality of life (QoL) in local communities. This directive serves as a comprehensive guide for improving QoL among residents in designated areas by fostering collaboration among government agencies, private entities, and local communities. The primary focus of these QoL development initiatives is on central population centers, addressing various challenges and improving access to essential services, such as healthcare and social support, to ensure sustainability (Department of Provincial Administration, Ministry of Interior et al., 2018). Aligned with this directive, the Twelfth National Economic and Social Development Plan (2017–2021) prioritizes the enhancement of the QoL of Thai farmers (Ministry of Agriculture and Cooperatives, 2017). However, the agricultural sector faces numerous challenges that directly impact farmers' health and QoL. One of the most pressing issues is exposure to pesticides, which have been linked to various acute and chronic health conditions. In line with "Sustainable Development Goal 3, "Good Health and Well-being", which aims to ensure healthy lives and promote well-being for all ages, monitoring and evaluation processes are essential for measuring outcomes such as satisfaction and QoL (Fukuda-Parr, 2016).

QoL has gained significant global attention, with organizations such as the World Health Organization (WHO) defining it as an individual's perception of their position in life within the context of culture, value systems, life goals, standards, and priorities (Bahramnezhad et al., 2017). Kalasin Province has proactively aligned its policies with WHO and Thai government directives to enhance QoL among its residents. In Khong Chai District, Kalasin Province, farming is the predominant occupation. Farmers in this area rely heavily on pesticides to protect crops from pests and diseases, maintain high yields, and meet market demands. This widespread use of pesticides makes it crucial to understand how these exposures affect the local farming community. Previous studies have identified specific factors associated with farmers' QoL, including demographic variables such as gender, occupational characteristics such as agricultural land size, and health-related indicators such as the frequency of cholinesterase blood testing and blood cholinesterase enzyme safety levels (Suwunnakhot, 2024). As farming is predominant in this district, initiatives are underway to improve QoL, with a particular focus on food safety and factors affecting farmers' well-being (Suwunnakhot, 2024).

Several studies have highlighted the detrimental effects of pesticide exposure on farmers' health. For instance, Perwitasari et al. (2017) found that chronic exposure to organophosphate pesticides significantly reduces cholinesterase activity, leading to various health issues, including neurological and psychological disorders. Similarly, Taghavian et al. (2016) emphasized the adverse effects of pesticide exposure on both physical and mental health, highlighting the need for protective measures. Farming occupations inherently pose risks due to pesticide exposure, resulting in acute and chronic health conditions that affect multiple bodily systems (Division of Occupational and Environmental Disease, 2020). In addition to environmental hazards and chronic illnesses, farmers face economic, personal, and behavioral challenges that further affect their QoL (Chomphoosri et al., 2020).

Understanding the concept of QoL and government policies is crucial for addressing issues in Khong Chai District, with a focus on promoting safe farming practices, improving farmer well-being, and reducing health risks. To assess QoL, the World Health Organization Quality of Life Brief-Thai (WHOQOL-BREF-THAI) instrument was utilized, covering four dimensions: physical health, psychological, social relationships, and environment (Mahatnirunkul et al., 1998). Existing literature highlights the detrimental effects of pesticide exposure on farmers'

health and underscores the critical need for effective interventions to improve their QoL. To address these complex challenges and inform local public health initiatives, a comprehensive understanding of the current QoL and health status among farmers in this specific district is essential. Therefore, this study aims to explore QoL, cholinesterase enzyme levels, and associated factors among farmers in Khong Chai District, Kalasin Province, Thailand.

Methods

This cross-sectional analysis study was conducted following approval from the Kalasin Provincial Public Health Office Research Ethics Committee (reference no. KLS.REC 43/ 2566), Kalasin Province, Thailand. Written informed consent was obtained from all participants before their inclusion in the study. The sample size was determined using Wayne's formula (1998), resulting in an approximate sample size of 270 farmers selected using systematic random sampling. This involved identifying a random starting point in each village and subsequently selecting every fifth farmer on the list for participation. The inclusion criteria were literate farmers over the age of 18, while exclusion criteria were individuals with communication impairments, including hearing loss, psychological disorders, or any form of physical disability.

A structured questionnaire was designed to collect data on independent variables, including gender, age, education level, marital status, body mass index (BMI), farm size, monthly income, experience with cholinesterase blood testing, health insurance coverage, smoking, alcohol consumption, energy drink consumption, coffee and tea consumption, underlying diseases, and blood samples for assessing cholinesterase enzyme safety levels. Blood cholinesterase enzyme safety levels were categorized into four groups: normal (> 100 Units/mL), safety (87.5–100 Units/mL), risk (75.0–87.5 Units/mL), and unsafe (< 75.0 Units/mL) (Kachaiyaphum et al., 2010).

The primary outcome measure of this study was assessed using the WHOQOL-BREF-THAI questionnaire, comprising 26 items across four domains: physical health (7 items), psychological health (6 items), social relationships (3 items), and environmental health (8 items), along with additional items on overall QoL and general health. The reliability of the WHOQ OL-BREF-THAI instrument was assessed with a Cronbach's alpha coefficient of 0.84 (Mahatnirunkul et al., 1998).

Following data collection, descriptive statistics, including frequency, percentage, mean, standard deviation (SD), minimum (min), and maximum (max) values, were used to analyze all variables. Factors associated with WHOQOL-BREF-THAI scores were identified using simple linear regression. Those with significance at p-value < 0.20 were entered into multiple linear regression analyses. Results were presented as adjusted mean differences with 95% confidence intervals (95% CI), with statistical significance at $p < 0.05$ (Greenland et al., 2016).

Results

Table 1 presents the characteristics of the study participants. The mean age was 54.97 ± 10.50 years, mean BMI was 23.43 ± 3.33, mean monthly income was 4,132.47 ± 4,332.38 Baht, and the average farm size was 9.63 ± 7.73 Rai (equivalent to 1600 m^2). The majority of respondents were female (75.56%), married (77.78%), and had attained primary school education (64.81%). Regarding health-related factors, 41.11% of the participants reported undergoing cholinesterase blood tests once, and 72.22% were covered under the Universal Health-care Coverage Scheme (UCS).

Most participants reported no smoking (85.93%), no alcohol consumption (72.22%), no energy drink consumption (73.33%), and no coffee or tea consumption (50.74%). Additionally, 69.63% reported having no underlying diseases. Blood cholinesterase enzyme levels showed that 22.22% had normal levels, 38.52% had safety

Table 1. Characteristics of Respondents

Characteristic	n (%)
Gender	
Male	66 (24.44)
Female	204 (75.56)
Age	
< 50 years	64 (23.70)
50–59 years	127 (47.04)
> 60 years	79 (29.26)
Marital status	
Single	21 (7.78)
Married	210 (77.78)
Widowed	35 (12.96)
Divorced/Separated	4 (1.48)
Education level	
Primary school	175 (64.81)
High school and above	95 (35.19)
Body mass index (BMI)	
< 22.9 (normal)	132 (48.89)
> 23.0 (overweight/obese)	138 (51.11)
Agricultural land size (1 Rai: 1600 m^2)	
< 10 Rai (1600 m^2)	144 (53.33)
> 10 Rai (1600 m^2)	126 (46.67)
Monthly income (Baht)	
< 2,500 Baht	90 (33.33)
2,500–4,999 Baht	100 (37.04)
> 5,000 Baht	80 (29.63)
Experience with cholinesterase blood testing	
Never	59 (21.85)
Once	111 (41.11)
Two or more times	100 (37.04)
Health insurance	
Universal Coverage Scheme (UCS)	222 (72.22)
Civil Servants Medical Benefit Scheme (CSMBS)	27 (10.00)
Social Security Scheme (SSs)	5 (1.85)
Private health insurance	16 (5.93)
Smoking	
No	232 (85.92)
Yes	38 (14.08)
Alcohol consumption	
No	195 (72.22)
Yes	75 (27.78)
Energy drink consumption	
No	198 (73.33)
Yes	72 (26.67)
Coffee/tea consumption	
No	137 (50.74)
Yes	133 (49.26)
Underlying disease	
None	188 (69.63)
Diabetes Mellitus	21 (7.78)
Hypertension	28 (10.38)
Musculoskeletal diseases	7 (2.59)
Gastroenteritis	8 (2.96)
Allergic rhinitis	7 (2.59)
Dermatitis	2 (0.74)

Characteristic	n (%)
Glaucoma	9 (3.33)
Blood cholinesterase enzyme safety level	
Normal (> 100 U/mL)	60 (22.22)
Safety (87.5–100 U/mL)	104 (38.52)
Risk (75.0–87.5 U/mL)	80 (29.63)
Unsafe (< 75.0 Unit/mL)	26 (9.63)

Table 2. WHOQOL-BREF-THAI Scores by Domain and Overall

Domain	Mean	SD.	Min	Max	Interpreted level
Physical health	24.92	3.23	15	35	Moderate
Psychological	20.91	2.69	15	30	Moderate
Social relationships	10.50	1.73	4	15	Moderate
Environment	27.16	3.37	20	40	Moderate
Overall score	89.97	10.34	66	128	Moderate

levels, 29.63% had risk levels, and 9.63% had unsafe levels.

Table 2 presents the mean WHOQOL-BREF-THAI scores, with an overall mean score of 89.97 ± 10.34, indicating a moderate level of QoL. The mean scores for each domain were as follows: physical health 24.92 ± 3.23 (moderate level), psychological health 20.91 ± 2.69 (moderate level), social relationships 10.50 ± 1.73 (moderate level), and environmental health 27.16 ± 3.37 (moderate level).

Table 3, using multiple linear regression analysis, illustrates the relationship between QoL and various factors. The mean QoL score was 89.97 ± 10.34, indicating a moderate level. The analysis revealed statistically significant associations ($p < 0.05$) between QoL and several factors: Gender: Being male was associated with an increase in QoL of 3.06 units (95% CI: 0.18–5.91; $p = 0.032$). Participants farming on plots of land sized approximately 10 Rai (1600 m^2) or larger had an increase in QoL of 2.55 units (95% CI: 0.11–5.00; $p = 0.039$).

Participants who underwent cholinesterase blood testing once reported a QoL increase of 3.01 units (95% CI: 0.25–5.77), while those who never underwent the test showed an increase of 3.40 units (95% CI: 0.12–6.67) compared to those tested two or more times ($p = 0.045$). Participants with normal and safe blood cholinesterase enzyme levels demonstrated a QoL increase of 1.69 units (95% CI: 0.45–2.07; $p = 0.037$). These findings emphasize the importance of considering demographic and health-related factors in understanding and improving the quality of life in the study population.

Discussion

This study found that the mean WHOQOL-BREF-THAI score and the scores across the four domains were at a moderate level. These findings align with other studies, including Chomphoosri et al. (2020), who also reported moderate WHOQOL-BREF-THAI scores across domains among Thai farmers. Prommawai et al. (2019) also found that the overall QoL among farmers in the Northeast region of Thailand was moderate, with one-third experiencing poor QoL. In contrast, a study among Vietnamese farmers by Nguyen et al. (2020) reported poor overall QoL, with the psychological dimension scoring the highest and the environmental dimension scoring the lowest.

Additionally, a study among China's farm workers found poor QoL, reflecting challenges associated with the transition from rural to urban labor markets (Lu et al., 2015). The authors

Table 3. Mean Differences in Quality of Life by Factors Based on Multiple Linear Regression

Factors	n	Mean	SD	Mean difference			p
				Un-adjusted	Adjusted	95% CI	
Sex							0.032*
Female	204	89.22	9.54	0	0	Ref.	
Male	66	92.27	12.30	3.04	3.06	0.18 – 5.91	
Size of farming area (1 Rai: 1600 m^2)							0.039*
< 10 Rai (1600 m^2)	144	88.80	10.73	0	0	Ref.	
> 10 Rai (1600 m^2)	126	91.30	9.75	2.50	2.55	0.11 – 5.00	
Experience with cholinesterase blood testing							0.045*
Never	59	87.83	9.96	0	0	Ref.	
Once	111	91.26	9.70	3.43	3.01	0.25 – 5.77	
Two or more times	100	91.17	11.66	3.33	3.40	0.12 – 6.67	
Blood cholinesterase enzyme safety levels							0.037*
Risk – Unsafe Levels	106	91.00	9.35	0	0	Ref.	
Normal – Safety Levels	164	89.30	10.92	1.70	1.69	0.45 – 2.07	

SD: Standard Deviation, 95% CI: 95% Confidence Interval, p: p-values < 0.05, m^2: Square meters
*Significant p-value

emphasized that reducing workload and promoting reasonable work conditions and lifestyles are essential for improving QoL among farmers. It is also important to mitigate occupational burdens and foster more sustainable labor practices and healthier lifestyles among agricultural workers. The People's Republic of China has increasingly emphasized improving farmers' quality of work-life and facilitating entrepreneurship within rural communities as pivotal strategies for sustaining rural livelihoods and promoting endogenous local economic development (Kong et al., 2019).

Drawing upon the recommendations of Swasthaisong et al. (2022) regarding guidelines for enhancing farmers' QoL, initial priorities should include facilitating economic development, fostering positive attitudes among farmers towards the principles of the sufficiency economy, and incentivizing practices such as self-reliance, organic agriculture, and the reduction of synthetic fertilizer use. Similarly, Panyurat (2022) underscored the necessity of integrating QoL enhancement with the advancement of the primary health care (PHC) system. This integration highlights the importance of identifying relevant health risk factors and associated indicators that are critical for improving QoL and creating healthy built environments. Consequently, the overarching strategic approach should emphasize the development of policies, planning, and management frameworks that are accountable for promoting QoL and improving health outcomes among targeted populations within specific community contexts.

The study indicated that a substantial proportion of participants (60.74%) exhibited blood cholinesterase enzyme levels within the normal-safety range. Conversely, a notable segment of the study population (39.26%) presented with levels indicative of potential risk or unsafe conditions. This pattern is likely related to the participants' predominant engagement in year-round agricultural activities, given that farming is their primary occupation. A study by Ngomsangud et al. (2022) among farmers in Sisaket reported similar findings. However, Juntarawijit et al. (2021) observed contrasting results, with higher rates of unsafe cholinesterase levels at 27.00%. Additionally, Boonkhao and Baukeaw (2020) reported negligible levels within the safety range, with a substantial proportion of participants falling into risk and unsafe categories. These discrepancies may

reflect differences in pesticide exposure levels and usage practices among study populations. Exposure to organophosphate toxicity is known to decrease cholinesterase activity among farmers, with potential adverse effects on physical health and QoL (Perwitasari et al., 2017).

The study revealed statistically significant associations between QoL and several factors, including blood cholinesterase enzyme levels and experience with cholinesterase blood testing. Additionally, a statistically significant relationship was observed between chronic exposure to organophosphate pesticides and the measured outcomes. Exposure to these pesticides, as highlighted by Taghavian et al. (2016) and Perwitasari et al. (2017), can adversely affect farmers' psychological and physical health, resulting in lower QoL scores compared to the general population. Implementing pesticide safety education, as suggested by Jambari et al. (2020), and promoting the proper use of personal protective equipment (PPE), as recommended by Wilaiwan and Siriwong (2017), may help mitigate these risks and contribute to improving farmers' QoL.

Moreover, the study by Swasthaisong et al. (2022) demonstrated that the structural equation model affecting predicting Thai farmers' QoL had a high level of accuracy, with statistical significance at the 0.01 level. Governmental support was identified as the variable that directly affects farmers' QoL. Similarly, Romyen (2018) proposed that improvements in farmers' QoL should focus on three areas: the economy, education, and health. In line with these findings, Suwunnakhot (2024) reported a correlation between blood cholinesterase enzyme levels and QoL among farmers across different regions and recommended promoting knowledge and awareness regarding the safe use of organophosphate pesticides. Regular monitoring of blood cholinesterase enzyme levels among farmers and their family members was also recommended to safeguard their health, food, environment, and QoL.

The study identified statistically significant associations between QoL and certain demographic and agricultural factors, specifically gender and the size of the farming area. Similar findings were reported by Nguyen et al. (2020), Paunpankum and Jaitae (2023), and Prommawai et al. (2019), who identified various factors significantly associated with QoL among farmers. Gao et al. (2021) highlighted the importance of understanding the role of land size in pesticide use for policy formulation and in reducing pesticide-related risks. In addition, the study by Windon and Robotham (2021) found an association between farmers' QoL and self-leadership and leadership competencies, suggesting the need to support farmers in maintaining work-life balance during busy seasons and in managing difficult conversations with farm employees.

Contrary to findings in the existing literature, the present study did not identify significant associations between farmers' QoL and commonly cited demographic or socioeconomic factors, including age, marital status, income, type of housing, educational attainment, or healthcare entitlements. This contrasts with prior research, such as Sabillón et al. (2022), which highlighted the influence of social determinants—including access to agricultural information systems and indicators of on-farm sustainability—on the QoL of agricultural workers. Similarly, Hettich et al. (2022) reported that younger age, lack of a cohabiting partner, and immigrant status were associated with lower QoL, while higher income, home ownership, and advanced education were positively correlated with improved QoL. These discrepancies may be attributed to contextual differences in geographic settings, cultural norms, socioeconomic conditions, or variations in policy implementation across study populations.

The Department of Disease Control, Ministry of Public Health (2022) reported that QoL among Thai agricultural workers were significantly influenced by health insurance coverage,

the regularity of occupational health check-ups, the availability of complete blood cholinesterase assessments, and health literacy related to pesticide use. Collectively, these contrasting findings highlight the need for more localized, context-specific investigations to better understand the complex and multidimensional determinants of QoL among farming populations.

A notable strength of this study was the availability of comprehensive data obtained through a representative face-to-face survey, which included detailed information on participants' personal and sociodemographic characteristics. The sampling methods were strategically designed to ensure a representative sample of the Khong Chai farming population.

However, it is important to acknowledge the limitations of this cross-sectional study, which may not fully capture the complexity of diseases and illnesses resulting from farmers' occupational exposures. To effectively address the health challenges faced by farmers in Khong Chai district, it is crucial to implement targeted interventions based on the study's findings. Enhancing the QoL of these farmers requires a multifaceted approach that integrates health monitoring, education, policy reforms, and community support. The recommendations proposed in this study are designed to mitigate the negative impacts of pesticide exposure, improve health outcomes, and promote a sustainable and healthy farming environment. Future research should investigate farmers' knowledge, behaviors, and work characteristics to better understand their health and QoL within agricultural settings.

Conclusion

This study highlights the moderate QoL among farmers in Khong Chai district, revealing significant associations between QoL and blood cholinesterase enzyme levels, prior experience with blood testing, gender, and farm size. These findings underscore the critical importance of monitoring cholinesterase enzyme levels as a key health indicator for farmer well-being. Consequently, targeted interventions are essential, particularly for farmers with at-risk cholinesterase levels, to promote healthier behaviors and improve QoL. While specific to Thai farmers, these findings have significant implycations for nursing practice and policy in agricultural communities globally. Nurses can adopt a proactive, community-based approach to occupational health by implementing routine cholinesterase monitoring and culturally sensitive health education programs focused on pesticide safety and alternative farming methods. Nurses play a vital role in advocating for policies that enforce stricter regulations on pesticide use, promote access to PPE, and support the transition to sustainable agricultural practices.

Future research should build upon these findings by evaluating the effectiveness of targeted interventions, evaluating the long-term impact of cholinesterase normalization on QoL, and investigating broader socioeconomic factors that may influence these relationships within agricultural communities. Furthermore, employing participatory action research could provide valuable insights for developing sustainable policies and health promotion programs for farmers locally and internationally, fostering healthier and more fulfilling lives for agricultural workers worldwide.

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