ORIGINAL ARTICLE

The influencing factors of protective behaviors among elderly people in Phayao Province, Thailand

Russamee Junkraweekoon[1], Taweewun Srisookkum[2], Patipat Vongruang[1], Somkid Juwa[2]

[1]Environmental Health Program, School of Public Health, University of Phayao, Thailand
[2]Doctor of Public Health Program, School of Public Health, University of Phayao, Thailand

Corresponding Author: Somkid Juwa **Email:** sjuwa@hotmail.com

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ABSTRACT

Particulate matter with a diameter of less than 2.5 micrometers (PM2.5) is an environmental contaminant that significantly impacts the health of the elderly. Therefore, socio-demographic variables, environmental health literacy (EHL), and protective behaviors (PB) are essential factors to examine among the elderly people. This cross-sectional study aimed to assess the levels of EHL and PB, as well as the factors influencing PB related to PM2.5, among elderly individuals. The sample included 626 elderly participants from Phayao Province, a region in northern Thailand affected by PM2.5. Participants were selected using multistage sampling, and data were collected via a questionnaire between February 2024 and April 2024. Descriptive statistics and multiple regression analysis (MRA) were used for data analysis.

The results indicated that the majority of participants were female (54.8%), married (67.7%), had an elementary education (67.7%), had worked in agriculture (32.7%), and had underlying diseases (49.4%). The mean age was 67.2 years, while the mean duration of residence was 51.7 years. The EHL level was low (mean=1.53 out of 5.0 points), whereas PB was moderate (mean=2.27 out of 3.0 points). MRA identified four independent variables that predicted PB: EHL (B = 0.102), occupation (B = -0.886), duration of residence (B = -0.018), and underlying disease (B = -0.539). This study highlights the need for health organizations to prioritize enhancing EHL to promote preventive behaviors, establish EHL programs, and assess EHL and PB among elderly people. Moreover, relevant organizations should develop policies to improve EHL and PB among the elderly in the study area.

Keywords:
environmental health literacy; protective behavior; elderly people

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INTRODUCTION

Exposure to fine particulate matter with a diameter of less than 2.5 micrometers (PM2.5) is recognized for its adverse health effects,[1] including increased mortality[2,3] and economic costs.[3] Phayao Province, located in Northern Thailand, has a complex terrain within the Phi Pan Nam mountain range and the Phayao-Chiang Rai basin. The high-altitude plateau surrounded by towering mountains significantly influences the accumulation of air pollution.[4,5] The PM2.5 levels in Phayao frequently exceed the National Ambient Air Quality Standards (NAAQS), highlighting the severity of air pollution in the region.[6] Moreover, the highest recorded 24-hour mean PM2.5 concentration reached 366 μg/m³, a level 24 times higher than the WHO standard, reflecting extreme air pollution episodes affecting Phayao and other areas in Northern Thailand.[7] The increase in PM2.5 levels has a significant impact on health. It results in respiratory diseases,[8,9,10] cardiovascular diseases,[8,9] and lung cancer.[9] It particularly impacts vulnerable populations, including children[11], pregnant women,[12] and the elderly.[9,13,14]

The elderly experience a decline in physical health and function over time.[15] At the biological level, aging results from the accumulation of diverse molecular and cellular damage, leading to a progressive decline in physical and cognitive abilities, increased susceptibility to illness, and, ultimately, mortality.[16] Consequently, exposure to PM2.5 particulate matter increases the risk of developing heart disease and asthma, particularly in elderly people with chronic conditions.[13,17-19] Phayao Province has a significant elderly population, accounting for 24% of the total population.[20] Therefore, the elderly population in Phayao Province is a target group for efforts to prevent and mitigate the adverse health impacts of PM2.5 exposure.

Environmental health literacy (EHL) is a subset of health literacy that focuses on an individual's capacity to actively seek, comprehend, evaluate, and apply environmental health information. This enables individuals to make informed decisions, safeguard their well-being, and improve the environment, ultimately enhancing their overall quality of life.[21, 22] Prior research has established a correlation between EHL[23-28], socio-economic variables,[23-24,25-26,28-29] and protective behaviors (PB) related to PM2.5. Additionally, research has revealed that gender,[26] age,[29] education,[23,29] underlying disease,[24,26] income,[29] job experience,[24] knowledge,[30] and attitude[30] are significant factors. Previous studies have examined various groups, including children[31], village health volunteers (VHVs), [24-25] the general population,[29] and pregnant women.[12] However, there is a paucity of studies focusing on the elderly population, particularly regarding the impact of PM2.5 on their health[3] and their intentions to engage in protective behaviors.[30]

Based on the facts presented, there are few studies that have examined EHL, PB, and factors influencing PB related to PM2.5 among elderly people in Thailand. Consequently, we developed the following research question: What is the level of EHL and protective behavior among elderly people exposed to PM2.5 in Phayao Province, Thailand, and which factors can predict protective behavior? The results of this study will inform initiatives aimed at improving the well-being and health of elderly individuals. The aim of this study was to determine the level of EHL and PB and to investigate the factors that predict protective behavior among elderly people exposed to PM2.5 in Phayao Province, Thailand.

METHODS

The research design employs an analytical strategy known as a cross-sectional study; the data collected between February 2024 and April 2024 were utilized using the following research methods:

Population and Samples

The study population consisted of 43,678 elderly people derived from the Office of Social Development and Human Security, Phayao Province[32]. A sample of 603 elderly people was calculated using a formula [33] as below with the following parameters: a standard deviation (σ) of 0.63 from a previous study, an error (d) of 0.05, a significance level (α) of 0.05, and a Z-score of 1.96. Additionally, a 4% increment was applied to the calculated sample size to account for potential losses, resulting in a total sample size of 627.

$$n = \frac{N\sigma^2 z^2_{1-\frac{\alpha}{2}}}{d^2(N-1) + \sigma^2 z^2_{1-\frac{\alpha}{2}}}$$

We employed a multistage cluster sampling technique, following these guidelines: 1) The nine districts in the study area are Mueang Phayao District, Dok Khamtai, Chiang Kham, Phu Sang, and Phu Kam Yao District, Pong, Chiang Muan, Chun, and Mae Chai. 2) We conducted simple random sampling utilizing the lottery method without replacement in Mueang Phayao District, Chiang Kham District, Pong District, and Chiang Muan District. 3) Select one subdistrict randomly from each district. Mae Ka Subdistrict was selected from Mueang Phayao District, Yuan Subdistrict was selected from Chiang Kham District, Na Prang Subdistrict was selected from Pong District, and Ban Mang Subdistrict was selected from Chiang Muan District using the random sampling utilizing a lottery method without replacement. 4) Employed random sampling utilizing a lottery method without replacement from four subdistricts. In the third step, we obtained 12 villages, with three villages from each subdistrict. 5) We perform random sampling utilizing a lottery method without replacement across three sub-districts: Mae Ka, Yuan, and Na Prang, gathering data from 52 samples from each village within these sub-districts. Conversely, in the Ban Mang sub-district, we gathered data from a group of 53 participants per village due to its higher population than the other three sub-districts, resulting in a total of 627 samples, as shown in Figure 1.

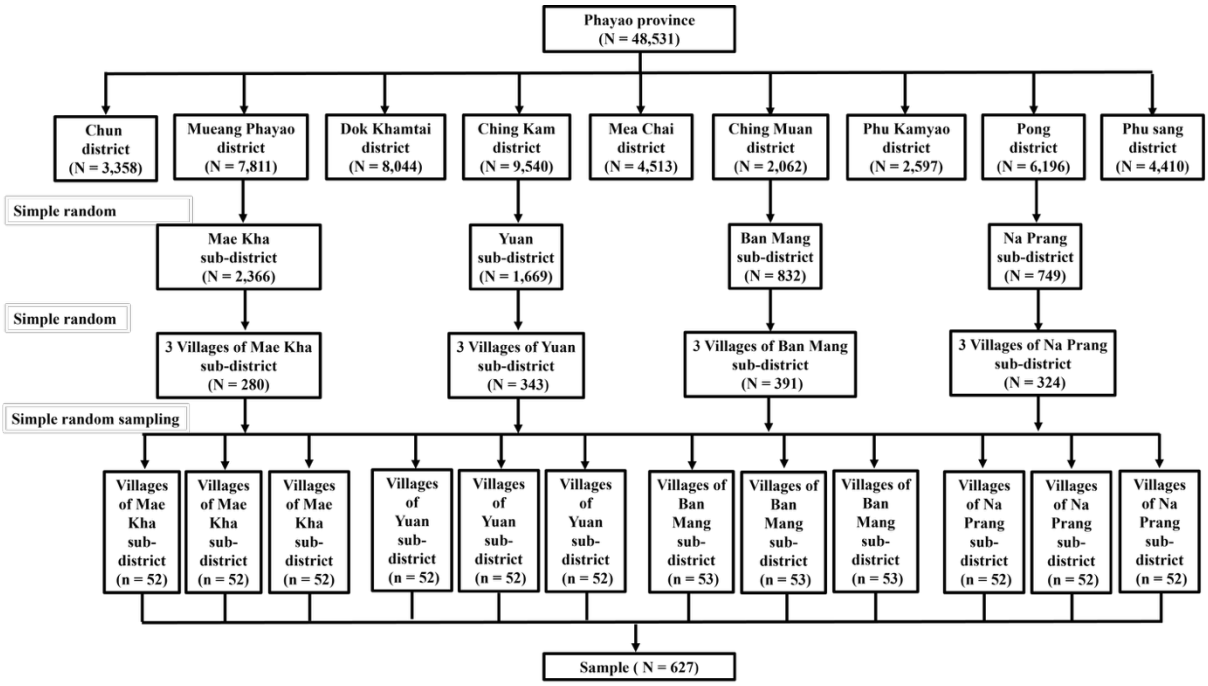

Figure 1. Flowchart of sample selection

The inclusion criteria were as follows: 1) People aged 60 years and above with an ADL score greater than 12; 2) People without perceptual impairments residing in the designated area between February 2024 and April 2024; and 3) People who willingly provided information for the study. The exclusion criterion was that the sample did not respond to all questions.

Research Instrument

The research instrument was a questionnaire developed based on prior research [21,22,34] and comprised three parts:

Part 1 examined socio-demographic characteristics, including gender, age, marital status, education level, duration of residence, occupation, and underlying diseases.

Part 2 assessed EHL based on previous research, with a Cronbach's alpha coefficient of 0.93. This part consisted of 28 items rated on a five-point rating scale, and divided into four components, each with seven items: environmental health information (AEHL), understanding of environmental health science (UEHL), evaluating environmental health information (EEHL), and making health protection decisions (DEHL). EHL and the four domain scores were categorized into three levels as low EHL below 60% (mean 1–3), moderate EHL 60–80% (mean 3.0–4), and high EHL above 80% (mean 4.01–5.0).

Part 3 assessed PB related to exposure to PM2.5, comprising 7 items rated on a five-point rating scale. This assessment was developed by the Ministry of Public Health[34] and Intarakamhang.[21] The reliability of the assessment, as measured by Cronbach's alpha, was determined to be 0.89. The overall PB score was divided into three levels: low PB below 60% (mean 1-1.79), moderate PB 60-80% (mean 1.80-2.39), and high PB above 80% (mean 2.4-3.0).

The questionnaire was verified by three experts and subsequently piloted with 30 elderly people whose characteristics were similar to those of the study sample. The Cronbach’s alpha coefficients for EHL

and PB levels were 0.97 and 0.87, respectively.

Data Collection

Upon obtaining consent, we commenced the investigation as follows: 1) The research team clarified the research objectives and methods and requested collaboration in conducting activities and gathering data from the sample group by face-to-face technique. 2) The research team scheduled a designated date and time for data collection and worked with research assistants to collect information from the sample groups in the study region. 3) Upon completion of data collection, we assessed the comprehensiveness of the responses before analyzing the data.

Data Analysis

We analyzed the socio-demographic variables, EHL, and PB related to exposure to PM2.5 using descriptive statistics, such as frequency, percentage, mean, and standard deviation. We employed stepwise multiple regression analysis (MRA) to identify variables predicting PB, establishing statistical significance at 0.05. The criteria for MRA included a variance inflation factor value below 10,[35] signifying no multicollinearity, and a Durbin-Watson statistic between 1 and 3.[36]

RESULTS

We gathered data from 626 samples out of 627, achieving a response rate of 99.84%. The majority of the sample were female (54.8%). The mean age was 67.2 years, with 70.9% of the sample belonging to the age group of 60-69 years. The marriage rate was 67.7%, 62.8% of the participants had attained primary education, 45.5% had lived in the study area for 41–60 years, 32.7% were involved in agriculture, and 49.4% reported having an underlying disease.

Table 1. Socio-demographic Variables (n = 626)

Socio-demographic Variables (N = 626)	Frequencies	%
Gender		
Male	283	45.2
Female	343	54.8
Age (Years)		
60–69	444	70.9
70–79	155	24.8
≥80	27	4.3
Mean ± SDSD = 67.2±5.5	Min-Max = 60–87	
Martial status		
Single	58	9.3
Married	424	67.7
Divorced	144	23.0
Education level		
Illiterate	44	7.0
Primary Education	393	62.8
Lower Secondary Education	62	9.9
Upper Secondary Education	88	14.1
Bachelor and Master Degrees	39	6.2
Duration of Residence (Years)		
1–29	35	5.6

Socio-demographic Variables (N = 626)	Frequencies	%
21–40	123	19.6
41–60	285	45.5
≥ 61	183	29.3
Mean ± SD = 51.7±15.5	Min-Max = 3–85	
Occupation		
Labor	130	20.7
Agriculture	204	32.7
Business/Merchant	92	14.7
Government/State Enterprise Officer	22	3.5
Private Sector	5	0.8
Unemployed	161	25.7
Others	12	1.9
Underlying Disease		
No	317	50.6
Yes	309	49.4

Table 2 indicates lower levels of EHL, AEHL, UEHL, EEHL, and DEHL, whereas PB is classified at a moderate level.

Table 2. The Level of EHL and PB (n = 626)

Variables	Level	$\bar{x} \pm$SD.	Low	Moderate	High
1. EHL	Low	1.53±.65	348 (55.6)	223 (35.6)	55 (8.8)
1.1 AEHL	Low	1.41±.64	422 (67.4)	149 (23.8)	55 (8.8)
1.2 UEHL	Low	1.51±.66	367 (58.6)	199 (31.8)	60 (9.6)
1.3 EEHL	Low	1.51±.65	364 (58.2)	206 (32.9)	56 (8.9)
1.4 DEHL	Low	1.59±.69	332 (53.0)	268 (34.8)	76 (34.8)
2. PB	Moderate	2.27±.81	145 (23.2)	164 (26.2)	317 (50.6)

We employed the Stepwise MRA approach to predict PB using seven independent factors, including gender, age, education, duration of residency, occupation, underlying disease, and EHL. The models were identified, with the optimal model presented in Table 3. The independent variables that significantly predicted PB were duration of residency, occupation, underlying disease, and EHL. These four variables collectively accounted for 55.2% of the variance in predicting PB.

Table 3. The Multiple Regression of Factors Predicting PB (n = 626)

Variables	B	SE	Beta	p-value	95% CI	
					LL	UL
1. Duration of residence	-.018	.007	.075	.007**	.005	.032
2. Occupation	-.866	.219	-.107	.000***	-1.297	-.436

Variables	B	SE	Beta	p-value	95% CI	
					LL	UL
Agriculture (ref) /Non-Agriculture						
3. Underlying Disease Yes (ref)/No	-.539	.206	-.071	.000***	-1.297	-.436
4. EHL	.102	.004	.746	.000***	.095	.109
Constant	7.41	1.509		.000***		
R^2 = .552		F-test = 191.61			p-value = 0.000***	

DISCUSSION

The analysis indicated that EHL and its four constituents—AEHL, UEHL, EEHL, and DEHL were at low levels. This aligns with the research conducted by Koteprom et al.[37,] which revealed that health literacy regarding PM2.5 among older people living in high-risk regions was low. It was determined that UEHL, EEHL, and DEHL were at low levels, however the comprehension of PM2.5 was at a moderate level. The elderly participants in this study may have been located in high-risk areas. This result is lower than the study conducted by the Department of Health, Ministry of Public Health in Thailand[25], which found that elderly individuals exhibited moderate levels of EHL due to their roles as village health volunteers, granting them better access to health information compared to the broader elderly population in Thailand.

The sample exhibited a moderate level of PB, consistent with findings of Weng et al.'s study[30] among the elderly in Taiwan. In Thailand, the study results were found to be lower than those reported by Nomsiri et al.,[38] who found that 51.7% of elderly individuals exhibited a high level of preventive behavior. This was higher than those reported by Koteprom et al.,[37] who found low levels of PM2.5 preventive behavior among older people. This difference may be explained by the fact that Nomsiri et al. [38] had a sample group with a higher level of primary education, whereas in this study, about 1 in 10 were still illiterate, which may have affected their health literacy. On the other hand, the research by Koteprom et al., [37] conducted in one municipality, revealed that PB levels were lower than those in this study, which examined the entire province during a period of high PM2.5 levels.

EHL was identified as an important predictor of PB in this study. This finding aligns with the results of Koteprom et al.,[37] which found that AEHL, UEHL, DEHL and health literacy regarding PM2.5 among the elderly living in areas with high PM2.5 levels correlated with PB. However, Intarakamhang[21] reported that AEHL, UEHL, EEHL, and DEHL could predict PB among VHVs. These results align with the concepts proposed by Marsili et al.[22] and the Department of Health, Ministry of Public Health in Thailand,[25] both of which found that environmental health literacy is a critical factor that influences health behaviors.

Occupation was a significant predictor of PB, contrasting with the findings of Intarakamhang,[21] who reported no significant differences in PB among VHVs across various occupations in Thailand. Furthermore, Xiong et al.[26] indicated that occupation was not significantly related to PB in the general population. This finding clarifies that the study group in this research focused on elderly people, whereas Intarakamhang[21] conducted their studies among VHVs.

The duration of residence demonstrated a higher ability to predict PB among long-term residents. These findings are consistent with those of Wu et al.[39] and Malaicharoen et al.,[29] who identified an

association between the duration of residency and PM2.5 concentration in the overall population. It is plausible that long-term residents become more accustomed to addressing issues related to fine dust particles over time, leading to a decrease in the frequency of self-protective actions. Nonetheless, Intarakamhang[21] disclosed that the variation in residence time among VHVs was statistically insignificant for predicting PB.

The sample group with underlying diseases demonstrated a higher predictive ability for PB than those with low PB scores. This may be attributed to the fact that a significant proportion of elderly individuals with comorbidities are more likely to engage in proactive measures to manage and protect their health. Additionally, a correlation was observed between underlying diseases and PB in studies conducted by Koteprom et al.,[37] among older people living in high-risk regions, and Hou et al.[39] in the general population. In contrast, Weng et al.[30] determined that underlying diseases did not significantly influence PM2.5 preventive behavioral intentions among the elderly in Taiwan.

CONCLUSION

The findings indicated that EHL and its four components—AEHL, UEHL, EEHL, and DEHL were at a low level, whereas the PB of the elderly was at a moderate level. Factors related to PB encompassed the duration of residency, occupation, underlying disease, and EHL.

RECOMMENDATION

The study revealed that participants had a low EHL level, prompting health organizations to promote EHL through the organization of empowerment activities for all EHL components, including AEHL, UEHL, EEHL, and DEHL. In addition, techniques must be formulated for improving the PB of the elderly in the area study, considering factors such as their occupation, underlying disease, and duration of residence. Furthermore, health authorities and affiliated organizations must establish EHL as a principal policy to encourage PB and enhance health outcomes.

AUTHOR CONTRIBUTIONS

Russamee Junkraweekoon and Taweewun Srisookkum: Conceptualization, Formal analysis, Writing-original draft. Patipat Vongruang: Review and editing. Somkid Juwa: Review and editing. All authors have read and agreed to the published version of the manuscript.

ETHICAL CONSIDERATION

The University's Ethics Committee for Research. The University of Phayao Human Ethics Committee, under the reference number HREC-UP-HSST 1.2/044/67, dated March 7, 2024.

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CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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