Original Article

Validity of Environmental Health Literacy Scale for Homebound and Bedbound Elder of Village Health Volunteer

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Background: The goal of global environmental health is to increase health literacy. The elder is the group that has lower health literacy. The health volunteers can support them to improve this aspect.

Objective: To develop an environmental health literacy (EHL) scale and examine a causal relationship model of environmental management behavior (EMB).

Materials and Methods: The cross-sectional study of 454 village health volunteers that were selected by a quota cluster random sampling. Data were collected through the five points Likert rating scale questionnaire. A confirmatory factor analysis (CFA) and a structural equation model (SEM) were conducted by LISREL software.

Results: The quality assessment of the EHL consisted of 25 items and four key components. Those components are accessible, understanding, assessment, and decision-making. The EHL has a high acceptable reliability (alpha=0.91 to 0.93), validity (IOC 0.80 to 1.00), and factor loading (0.50 to 0.84). The EHL measurement model on the development and validation sample fit the empirical data. All factors can explain EHL and EMB of total sample with variance of 80% and 69%, respectively. The environmental literacy (EL) directly influenced EHL (beta=0.90), EL, and EHL directly, which influenced awareness of environmental management for the elder (beta=0.35 and 0.28, respectively). Additionally, EHL and awareness of environmental management directly influenced EMB towards the homebound and bedbound elder (beta=0.34 and 0.59, respectively) at significance level of 0.05.

Conclusion: The EHL scale should be used to encourage EMB towards the homebound and bedbound elder among village health volunteers.

Keywords: Environmental health, Health literacy, management, Health volunteer, Homebound, Bedbound, Elder

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Global environmental health means "education, training, and research translation directed at health problems related to environmental exposures and transcend national boundaries, with a goal of health for all people by reducing the environmental exposures which lead to avoidable diseases, disabilities, and deaths"[1]. This is done by promoting hygiene and safer management of toxic substance in home and increasing literacy[2]. The Department of Health Service Support conducted a survey in 77 provinces from 30,793 Thai adults at risk of diabetes and hypertension in 2014. In 2016, a health literacy (HL) survey of 15,278 Thai adults found that better HL, had inadequate HL (59.4% and 49.0%, respectively), and excellent HL (1.6% and 5.5%, respectively), with lower HL in patients and the elderly people[3].

Thailand has already entered an ageing society with over 10% of its population aged 60 or older[4]. One of the challenges of environmental health practice

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is preparation for environmental management in living environments to protect the elder from accidents and dangers. In the survey of the Thai elder in 2017, 6.6% of the elder slipped in the past with the percentage of elderly women being higher than that of elderly men (7.8% and 5.3%, respectively) and the causes of the slip were slippery surfaces (39%), obstacles (36.6%), fainting (9.3%), and inadequate lighting (2.6%)[5]. The percentage of dependent elder was 8.2%, or 928,400 elderly people including homebound and bedbound elder[5]. The World Health Organization (WHO) attaches importance to the development of village health volunteers (VHVs) by encouraging them to improve the environments for well-being[6], especially the environmental management, which helps support the dependent elder[7]. Key disciplines of environmental health literacy (EHL) required VHVs' understanding to manage environments for the elder. Finn and O'Fallon[8] defined EHL as an understanding of the connection between environments and human health. EHL are integrated among HL, environmental health science, risk communication, and safety culture. According to Gray[9], EHL is the skills that people use to make decisions regarding health using available environmental information. EHL develops individuals and communities' understanding of health-related information concerning environmental hazards[10].

In this conceptual framework for EHL, four skills were accessed to environmental health, which are information, understanding, verification, and health-protective decision-making[9,11]. The Department of Health[7] stated in the 2019 to 2022 Research Strategic Action Plan that the priority areas to reduce health environmental risks is focusing on its key indicator, which is to have approximately 1,000,000 VHVs who have EHL and can be leaders in reducing waste, and creating good health environments. Therefore, the authors aimed to develop an EHL scale for VHVs and examine a causal model of environmental management behavior (EMB) for elder.

Materials and Methods

The present study design was a cross-sectional survey. The present study was carried out between 2018 and 2019 and consisted of a synthesis of related documents and research studies for developing a scale and a causal model. The present research began by conducting a synthesis of EHL assessment tools, reviewing the HL assessment tools[12-14], and integrating the assessment tools with the concepts of EHL[9,11], leading to the development of EHL scale items for VHVs. The accuracy and validity of the newly developed EHL scale items were examined by three experts with IOC between 0.80 to 1.00. Consistent version of EHL scale was confirmed from the health professionals by public hearing and tried out by 80 VHVs with corrected item-total correlation between 0.30 to 0.85. For the examination of causal relationship model of EMB towards the homebound and bedbound elder, a sample size for structural equation modeling (SEM) was determined. An adequate sample size-to-parameters ratio was 20:1[15]. Since there were 22 parameters, a sample size should be at least 440 plus 5% for data missing protection. Therefore, a sample size of 454 was adequate. The sample was obtained from the Ministry of Public Health's database and approximately divided into an urban group and a rural group. A sample of 40 villages was selected using quota-cluster random sampling methods from two districts in a Suphanburi province with high proportion of elderly. Inclusion criteria for the eligible participants were 1) voluntary in providing information, 2) have experience working in health volunteering for at least a year, 3) have experience taking care of the elder, and 4) be literate and fill the self-administered questionnaire between January and April 2019. The selected participants signed the informed consent forms after they received the explanations about the method to administer questionnaire from the research assistants at the community healthcare center in each district.

Measurement and data collection. Four variables were measured with Likert scale questionnaires on a 5-point scale ranging from 1 (not at all true of me) to 5 (completely true of me). The first variable was environmental literacy (EL). The content of the EL measurement was developed from several studies[16-18]. It included three factors that consisted of 1) basic understanding of environmental concepts, 2) analysis and examination of environmental issues, and 3) environmental responsibility. The second variable was EHL. It included four factors that consisted of 1) access to environmental health information, 2) understanding of environmental health information, 3) verification of environmental health information, and 4) health-protective decision-making. The third variable was awareness of environmental management for the elder. It included two factors that consisting of 1) awareness of fall prevention, and 2) awareness of waste management. The last variable was EMB towards the homebound and bedbound elder. It included two factors that consisted of 1) fall prevention behavior for the elder,

and 2) waste management behavior for waste from elderly health care activities measured on a 5-point scale ranging frequency from 1 (Never) to 5 (Always).

The researchers performed descriptive statistics, confirmatory factor analysis (CFA), and SEM to analyze data, using maximum likelihood estimation. The statistical values confirmed the goodness of fit of hypothetical model with empirical data by considering the following criteria, the relative chi-square (χ^2/df) less than or equal 5, comparative fit index (CFI) greater than or equal 0.90, Tucker-Lewis index (TLI) greater than or equal 0.90, and root mean square error of approximation (RMSEA) less than or equal 0.05[15].

Ethical approval and consent to participate

Ethical approval No.64-3/2562 for research was granted by the Ethical Review Committee for Research in Human Subjects, Department of Health, Ministry of Public Health, Thailand. In addition, the participants were required to read and understand the information on the present study before signing the consent forms to allow data collection.

Results

Demographic data

There were 454 participants who were active VHVs and consisted of 221 and 233 participants in urban area and rural area, respectively. Most VHVs were female (87.4%), married (58.4%), with less than 10 years' experience working as health volunteer (62.7%), having the highest level of education in primary school (43.6%), and working as worker and farmer (53.7%). Their mean age was 50.67 years old and mean time of living in the community was 40.75 years. Hence, all of them lived with the elder who were either their parents or close relatives.

Development and validation of EHL scale

The quality assessment of the EHL scale found that the discrimination power of the 25 scale items with the item-total correlation coefficient ranged between 0.65 to 0.84 as shown in Table 1, and the reliability of the scale with Cronbach's alpha coefficient ranged between 0.91 to 0.93 as shown in Table 2. The second order CFA conducted to examine the construct validity of the 4-factor EHL measurement model on the development sample found that the EHL measurement model fit the empirical data with acceptable model fit indices (χ^2/df=1.493, RMSEA=0.046, CFI=0.99, TLI=0.99). A similar analysis was then repeated in validation sample. Acceptable model fit was seen to the data for 4-factor EHL model (χ^2/df=1.489, RMSEA=0.047, CFI=0.99, TLI=0.99). In other words, the factor structured modified and developed in the development sample was replicated in the validation sample, suggesting cross-sample stability of the EHL scale. Factor loadings of development and validation sample are shown in Table 3.

Analysis of the SEM

The analysis of the SEM of variables affecting EMB towards the homebound and bedbound elder among VHVs found that the hypothetical model fit the empirical data with acceptable model fit indices (χ^2/df=2.548, RMSEA=0.058, CFI=1.00, TLI=0.99) as shown in Figure 1. The analysis showed that EL directly influenced EHL (beta=0.90, $p<0.05$), and that EL and EHL directly influenced awareness of environmental management for the elder (beta=0.35 and 0.28, respectively, $p<0.05$). Furthermore, EHL and awareness of environmental management for the elder directly influenced EMB towards the homebound and bedbound elder (beta=0.34 and 0.59, respectively, $p<0.05$). The analysis also found that EHL indirectly influenced EMB towards the homebound and bedbound elder via awareness of environmental management for the elder (beta=0.16, $p<0.05$) and EL indirectly influenced EMB towards the homebound and bedbound elder via EHL and awareness of environmental management for the elder (beta=0.66, $p<0.05$). Considering R^2, this model could explain the variances of EHL, awareness of environmental management for the elder, and EMB towards the homebound and bedbound elder as it equal to 80%, 37%, and 69%, respectively.

Discussion

The present research is the first study that developed an EHL scale for VHVs in Thailand and conducted a SEM analysis to explore the relationships between EHL and EMB towards the homebound and bedbound elder among VHVs. The development of the EHL scale consisted of a synthesis of related documents and research studies, a content review by experts, and a public hearing. After examining the reliability and construct validity, the scale consisted of 25 items and four key components which are accessibility, understanding, assessment, and decision-making and had acceptable levels of reliability and validity. The scale was easy to use and took 10 minutes to complete. In recent years, EHL scale have been developed for community members and water-well owners[19,20]. However, EHL scale for

Table 1. Quality assessment of the environmental health literacy scale

Items	Correlation coefficients
Factor 1: Access to environmental health information	
1.1 I can look for reliable environmental health information from different sources.	0.76
1.2 I'm always open to new environmental health information and share it with my community.	0.68
1.3 I can look for environmental health information by myself.	0.65
1.4 I can look for environmental health information related to my problem situations.	0.78
1.5 I strongly believe that the environmental health information I look for can answer my questions or can be used.	0.73
1.6 When I need environmental health information, I can ask experts or check printed materials and online media immediately.	0.75
1.7 I know how to look for environmental health information to get answers to my questions or my friends' questions.	0.78
Factor 2: Understanding of environmental health information	
2.1 I can read and understand information, contents and knowledge related to environmental health.	0.75
2.2 I know and understand environmental health information available on different media channels.	0.80
2.3 I understand the explanations of different methods of reducing environmental health risks.	0.83
2.4 I can protect myself or other people from health hazards with my sufficient knowledge and understanding of environmental health.	0.78
2.5 I understand the causes and effects of environmental health issues.	0.74
2.6 I can explain environmental health information to other people.	0.80
2.7 I can describe and follow the instructions in manuals, printed materials and brochures related to environmental health care.	0.75
Factor 3: Verification of environmental health information	
3.1 I usually verify environmental health information before believing or using it.	0.77
3.2 I usually compare environmental health information from different sources before believing or using it.	0.78
3.3 I usually ask environmental health experts to confirm my beliefs.	0.81
3.4 I know where I can get reliable information on prevention of environmental risks towards health before taking action.	0.78
3.5 When I receive information on environmental health risk prevention, I will verify the information sources first.	0.80
3.6 Before choosing an environmental health risk management method, I will compare different methods to determine which one is the best.	0.78
Factor 4: Health-protective decision-making	
4.1 I applied my sufficient environmental health information necessary for household and community environmental management.	0.81
4.2 I have reliable environmental health information that can be used to help other people who are affected by environmental health issues.	0.83
4.3 I use my sufficient environmental health information to create safe environments for people's good health.	0.84
4.4 I can improve environments for the elder's safety and good health.	0.82
4.5 I participate in environmental health activities to gain experience and use it to develop and improve environments for people's good health.	0.80

VHVs had not been developed before.

The SEM analysis found that EHL was influenced by EL, which was consistent with EHL framework[9] suggesting that basic knowledge and understanding of environmental concepts were one of the dimensions of EHL. EHL was also found to directly influence awareness of environmental management for the elder and EMB towards the homebound and bedbound elder, which was consistent with many studies[21-23]. A lack of environmental health understanding leads to inability to prevent or handle environmental hazards when facing environmental risks and hazards. Environmental health knowledge and understanding and accessibility to environmental health information can reduce environmental risks and increase safety culture.

Dangerous living environments can lead to health risks and illness[24-26]. For the homebound

Table 2. Descriptive statistics of observed variables and Cronbach's alpha coefficient

Latent variables	Observed variables	Items	Mean±SD	Alpha
Environmental literacy	• Basic understanding of environmental concepts	7	3.54±0.61	0.89
	• Analysis and examination of environmental issues	7	3.45±0.66	0.91
	• Environmental responsibility	7	3.84±0.66	0.90
Environmental health literacy	• Access to environmental health information	7	3.51±0.66	0.91
	• Understanding of environmental health information	7	3.56±0.65	0.93
	• Verification of environmental health information	6	3.59±0.64	0.93
	• Health-protective decision-making	5	3.61±0.67	0.93
Awareness of environmental management for the elder	• Awareness of fall prevention	10	4.22±0.72	0.96
	• Awareness of waste management	7	4.14±0.67	0.89
Environmental management behavior towards the homebound and bedbound elder	• Fall prevention behavior for the elder	5	4.03±0.76	0.94
	• Waste management behavior for waste from elderly care activities	9	3.86±0.72	0.95

SD=standard deviation

Table 3. Factor loading for EHL scale for across development and validation samples

Items	Factor loadings	
	Development (n=221)	Validation (n=233)
Access to environmental health information		
Item 1	0.67	0.77
Item 2	0.73	0.82
Item 3	0.69	0.82
Item 4	0.70	0.70
Item 5	0.72	0.78
Item 6	0.73	0.78
Item 7	0.77	0.64
Understanding of environmental health information		
Item 8	0.75	0.74
Item 9	0.76	0.66
Item 10	0.72	0.84
Item 11	0.72	0.82
Item 12	0.71	0.80
Item 13	0.82	0.84
Item 14	0.74	0.82
Verification of environmental health information		
Item 15	0.71	0.79
Item 16	0.80	0.80
Item 17	0.79	0.78
Item 18	0.75	0.71
Item 19	0.67	0.76
Item 20	0.73	0.79
Health-protective decision-making		
Item 21	0.50	0.61
Item 22	0.78	0.76
Item 23	0.78	0.75
Item 24	0.69	0.57
Item 25	0.75	0.78

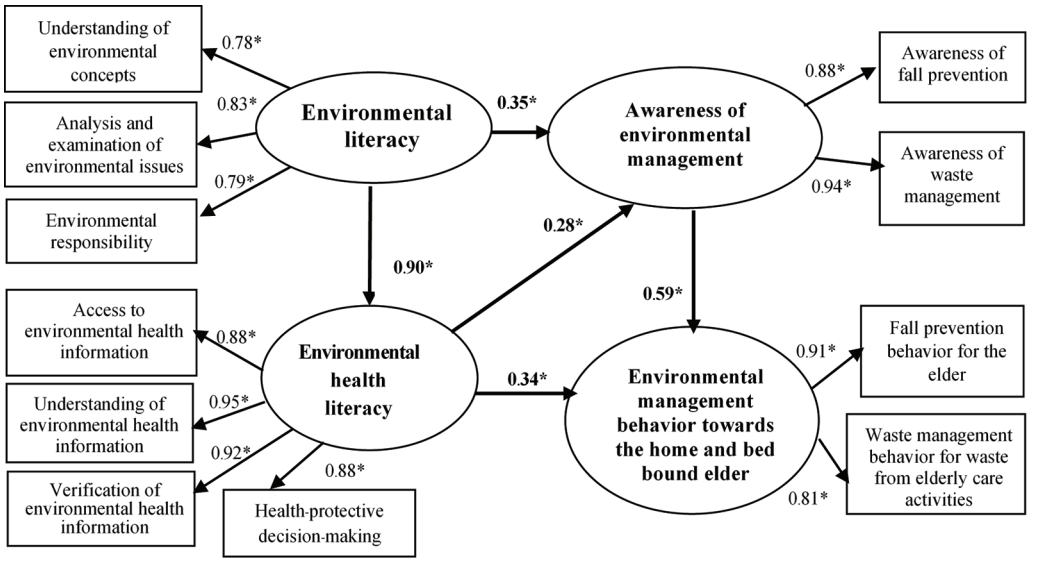

Figure 1. Causal model of environmental management behavior among village health volunteers.

* p<0.05

and bedbound elder, dangerous living environments include infectious waste[27] and falls at home[28], which can negatively impact on health if there is no proper management. It is found that the old people who are at high risk of falling, which increases with age, have movement problems, and lack assistive devices at home. Therefore, reducing dangerous living environments for the homebound and bedbound elder will increase well-being and safety at home such as repairing houses to reduce the risk of falls in elderly people[29,30], managing waste from health care activities[31], and home visiting by health care providers[32]. In Thailand, VHVs are community leaders in environmental health who provide environmental health information such as how to create clean and safe living environments, control improper waste disposal, report environmental issues, pass on environmental health knowledge to community members such as disease-carrying animals, environmental sanitation, and proper waste management, monitor and solve environmental health issues[33], arrange health activities for communities, inform community members of health news by word of mouth, reading materials, and broadcast towers, and act as role models regarding health for community members[34].

In addition, EL indirectly influenced EMB towards the homebound and bedbound elder through EHL and awareness of environmental management for the elder. In the authors opinion, apart from EHL that influences EMB for elder, health volunteers attach importance to EL, understand basic environmental information, types of waste, household tools and equipment, examine living environments, and be able to analyze environmental issues for the homebound and bedbound elder and have environmental responsibility and consciousness of environmental preservation and problem-solving[18,35].

The authors' suggestions are as follows, 1) the public sectors should use the EHL scale to assess needs for designing activities and program content to develop EHL and EMB for elder by health volunteers to enhance their performance and fulfill what is lacking, 2) the experimental studies should be conducted integrating EL and EHL concepts to test the effectiveness of integrated programs towards EMB for elder, and 3) the EHL scale should be widely used on a national level and data should be collected from samples of VHVs across the country.

Conclusion

The newly developed EHL scale for VHVs can be used for assessment of EHL levels, which are important to VHVs in practicing EMB for the homebound and bedbound elder in the communities.

What is already known in this topic?

It is well-known that the people who have high HL additionally have healthy behaviors. The limitation of the homebound and bedbound elderly

patients in community is the inability of taking care behavior by themselves. Therefore, VHVs serve active role in conducting EMB to prevent elderly patient from infection and provide safety. According to Gray (2018)[9], EHL of an individual is an important factor in the development of community health. The authors developed the newly EHL scale and model to distribute worldwide, thereby leading to EHL promotion's program for people of all age in the future.

What this study adds?

The study also found that EHL scale had high quality, which could be used for developing causal relationship model of EMB. The factors such as EL, EHL, and awareness affect the EMB towards the homebound and bedbound elder among VHVs. Therefore, using the EHL scale in training program for VHVs should improve these factors as well.

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Conflicts of interest

The authors declare no conflict of interest.

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