

HEALTH LITERACY, MEDICATION ADHERENCE, AND BLOOD PRESSURE LEVEL AMONG HYPERTENSIVE OLDER ADULTS TREATED AT PRIMARY HEALTH CARE CENTERS

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Abstract. We conducted this study to explore the causal relationships between health literacy, individual characteristics, literacy, culture and society, cognitive ability, medication adherence, and the blood pressure levels of hypertensive older adults receiving health care services at Primary Health Care Centers in Sa Kaeo Province, Thailand. Six hundred hypertensive older adults had their blood pressure level recorded and were interviewed using questionnaires. Structural Equation Modeling (SEM) was used to determine the effect size, both direct and indirect, among factors. Almost half (48.7%) of studied subjects had inadequate health literacy, 98.3% had good medication adherence, and 80% had good blood pressure levels. The highest effect size on health literacy was literacy, followed by cognitive ability, and culture and society. Medication adherence was affected directly and indirectly by cognitive ability, literacy, and culture and society. Health literacy had not only a direct effect on medication adherence but was also the mediator. Finally, the highest effect size on blood pressure level was critical and communicative health literacy. These findings suggest that health literacy should be considered in the Health Literacy Program of the National Public Health Policy and Plan, Ministry of Public Health.

Keywords: blood pressure, health care center, health literacy, hypertensive older adults, medication adherence, Thailand

INTRODUCTION

Hypertension (HT) remains an increasing global health concern in both

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economically developed and developing countries. Associated major risks include hospitalization, morbidity, and mortality (WHO, 2013). HT decreases older adults' quality of life and increases health care costs (Vierck and Hodges, 2003; CDC and the Merck Company Foundation, 2007). The 2004 National Health Examination Survey III, Thailand reported the highest HT group comprised older adults (Po-rapakham *et al*, 2008).

Adherence to prescribed antihyper-

tensive medications was found to be a potential major factor to adequately control systolic and diastolic blood pressure (Krousel-Wood *et al*, 2004). To reduce blood pressure sufficiently, hypertensive patients should have $\geq 80\%$ medication adherence (Guerrero *et al*, 1993). However, evidence indicates medication adherence among the elderly ranges from 26% to 59% (Botelho and Dudrak, 1992; Van Eijken *et al*, 2003) and adherence declines consistently over time (Caro *et al*, 1999). Rates of medication adherence among hypertensive older adults are not optimal (Klootwyk and Sanoski, 2008), and Thai older adults have shown much concern about their medication adherence problems (Assantachai *et al*, 1998).

Health literacy (HL) has been indicated as producing vigorous effectiveness on improving health practices and health outcomes (Baker *et al*, 2007). Older adults with low HL levels expressed their difficulty to understand and act upon health information (Baker *et al*, 1998) resulting in nonadherence to medical instructions (Kalichman *et al*, 1999). Inadequate HL skills of older adults caused higher rate nonadherence to their medical regimens (Ingram, 2010). Older adults are concerned to improve their HL (Cutilli, 2005).

Due to the rigors of attaining effective HL on health practices and health outcomes of chronic patients, many studies have been conducted in developed countries to improve HL levels in various groups of patients (Schaefer, 2008). Improving HL is a complex issue and related to many internal and external factors (Pawlak, 2005; Kwan *et al*, 2006). Specifically, the early framework of the Institute of Medicine (2004) has stated that the potential points of improving HL comprised of culture and society, and health and education systems. Although

the frameworks of HL have existed for a long time, none of the frameworks were systematically tested.

Particularly, most of the existing literature focused on the different contexts of each country possibly resulting in different factors related to the HL of people. Research is needed on Health Literacy and its associated factors to determine the nature of the causal relationships between and among these internal and external factors (Institute of Medicine, 2004).

The prevalence rates of HT, stroke, and heart disease have increased in Sa Kaeo Province; recording hospitalization rates for HT (962.76), heart disease (173.3), and stroke (199.87). At the same time, the controllable blood pressure rate of hypertensive patients was not over 60% (Sa Kaeo Provincial Public Health Office, 2011). Many projects have been conducted to promote health practices of HT patients in Primary Health Care Centers to reduce this problem. Although HL projects of the Ministry of Public Health in 2013 were implemented; however, only focusing on life style modification practices of people at risk of HT and diabetes mellitus. HL concerning medication adherence of hypertensive older adults has not been conducted yet.

Sa Kaeo Province has not been explored regarding the medication adherence rate of hypertensive older adults, and evidence from in-depth interview and group discussions with hypertensive older adults and health care providers at a Primary Health Care Center have indicated that hypertensive older adults have both intentional and unintentional nonadherence. They have a misunderstanding about medication adherence practice. They do not receive enough health information regarding medication adherence. It was suspected that hypertensive older

adults have limited health literacy concerning medication adherence that might affect medication adherence practices and blood pressure control.

This study aimed to explore the health literacy regarding medication adherence, medication adherence, and blood pressure of hypertensive older adults. Moreover, to optimize health care service and response, the direct and indirect relationships of the interested factors on health literacy and health literacy on medication adherence and blood pressure were explored using structural equation modeling (SEM) analysis. Our findings could provide evidence to identify the gaps in current health literacy of hypertensive older adults and to inform on the development of effective health education programs for the prevention the complication of hypertension.

MATERIALS AND METHODS

Respondents and study site

This study employed a cross-sectional survey. The data were collected from older adults aged 60-to-70 years of age with a diagnosis of HT and who receive health care services at a HT clinic provided by a Primary Health Care Center in Sa Kaeo Province, Thailand. Older adults, who had mental or physical disorders such as severe senile dementia or paralysis or were unable to participate, were excluded. An appropriate sample size was calculated based on 20 respondents for each variable (Costello and Osborne, 2005), and, to obtain more accurate results and reduce any error of analysis, an additional 20% of the subjects were added (Comrey and Lee, 1992). Six hundred hypertensive older adults were selected using multi-cluster sampling.

Instruments

The study instrument constituted an

interview questionnaire to collect data from hypertensive older adults. The instrument was designed to assess six constructed factors through the measurable variables including 1) individual characteristics (age, income, perception of health, and duration of diagnosed HT), 2) literacy (reading ability, and understanding ability), 3) cognitive ability (knowledge about HT and medication use, perceived susceptibility, and perceived severity), 4) culture and society (social support, belief in other treatments, and media), 5) health literacy (functional, communicative and critical health literacy) and 6) medication adherence and the record of blood pressure level.

To overcome the limited ability in reading and writing skill of the older adults to obtain and understand the question, the instrument to measure health literacy about medication adherence of hypertensive older adults did not focus on reading ability, but other skills were assessed based on the classification of Nutbeam (2000).

This study adopted the questionnaire to assess the functional, communicative, and critical skills of the samples similar to the study of Ishikawa *et al* (2008) that assessed three levels of health literacy of type 2 diabetes in Japan. This study adapted the hospital-based view to the community health care center setting, and the language of the questionnaire was simplified for the Thai context.

Functional health literacy focused on assessing the ability of hypertensive older adults in reading and understanding texts and numbers on drug packages and patient handbooks to facilitate medication adherence with seven items. Communicative health literacy emphasized applying communicative skills to seek and understand health information from various

sources and adjusted their daily life to harmonize with medication adherence using five items. Critical health literacy assessed their ability to analyze health information critically from various sources, apply to their medication adherence and lead other people to practice better medication adherence with five items. Each item used a four-point Likert scale from 'Never' (1) to 'Regular' (4). A higher score meant higher health literacy. The Cronbach's alpha coefficient score was 0.85.

Medication adherence measurement was similar to the Adherence to Refills and Medications Scale (ARMS) tool (Kripalani *et al*, 2009) that aimed to assess the coronary heart disease patient's ability to correctly self-administer the prescribed regimen and the assessment the patient's ability to refill medications on schedule. Nevertheless, this study focused on assessing medication adherence of hypertensive older adults in the Thai context. The questionnaire involved taking a specific kind of drug for their symptoms (two items), taking the correct dose (five items), taking at the correct time (two items) and continuously taking medicine as prescribed (five items). The measurements used a four-item Likert scale ranging from 'Never' (4) to 'Often' (1). Negative items scores were reversed before data analysis. A higher score meant better medication adherence. The Cronbach's alpha coefficient score was 0.76.

An upper arm digital blood pressure monitor measured blood pressure that provided an accurate reading and the ability to store readings over time. It was used to measure blood pressure of hypertensive older adults at all Primary Health Care Centers of Sa Kaeo Province.

The content validity was reviewed and tested by the experts on health lit-

eracy, behavioral sciences, and statistics. The data and forms were checked for completeness before analyzing by SPSS and AMOS. Descriptive statistics and the structural equation modeling (SEM) (Joreskog and Sorbom, 1996) were employed in this study.

Ethical considerations

The Ethics Committee of Mahidol University, Bangkok, Thailand (Ref N^o MUPH 2014-091; 2014 Apr 4) approved this study. Before participating in the study, the respondents were asked to provide written informed consent.

RESULTS

Descriptive variables

The response rate was 100%. Most respondents were female (75.8%) with an average age of 65.3 years (Table 1). The majority of respondents were married. Almost all had attained primary school level education. Their perceptions of health, including visual, hearing, and mental health were mostly at moderate-to-good levels. Most respondents had a comorbidity of at least one disease, specifically hypercholesterolemia and diabetes mellitus (51.2%). The average duration of diagnosed HT was 7.2 years. The respondents' literacy levels were not high. One-third of respondents could not read but had good understanding.

Most respondents had a fairly good level of perceived social support (Table 2). Almost all respondents had a low level of belief in alternative treatments (Mean=8.3, SD=3.7). Most accessed media using only one channel (Mean=1.2, SD=0.6). The majority (46.8%) had knowledge about HT and medication use at a low level (Mean=20.3, SD=4.7) but they had a high mean score of perceived susceptibility

Table 1
 Number and percentage of individual characteristic variables (N=600).

Individual characteristics	<i>n</i> (%)
Gender	
Male	145 (24.2)
Female	455 (75.8)
Age (years)	
60-65	316 (52.7)
66-70	284 (47.3)
Marital status	
Single	16 (2.7)
Married	392 (65.3)
Widowed/Divorced/Separated	192 (32)
Income per month (THB)	
600-2,600	421 (70.2)
2,601-4,600	93 (15.5)
4,601-6,600	47 (7.8)
6,601-8,600	39 (6.5)
Mean=2,527.3; SD=3,507.7; Min=600; Max=30,000	
Education level	
Primary school levels 1-4	461 (76.8)
Secondary school	14 (2.3)
High school	1 (0.2)
Occupation	
Homemaker/Unemployed	321 (53.5)
Agriculturist	191 (31.8)
Laborer	49 (8.2)
Retailer	39 (6.5)
Perception on vision	
Poor	80 (13.3)
Fair	332 (55.3)
Good	188 (31.3)
Perception on hearing	
Poor	54 (9.0)
Fair	265 (44.2)
Good	281 (46.8)
Perception on mental health	
Poor	30 (5.0)
Fair	271 (45.2)
Good	299 (49.8)
Duration of diagnosed HT (years)	
1-3	161 (26.8)
4-6	168 (28.0)
7-10	162 (27.0)
>10	109 (18.2)
Mean =7.2, SD =5.2, min=1, max=30	

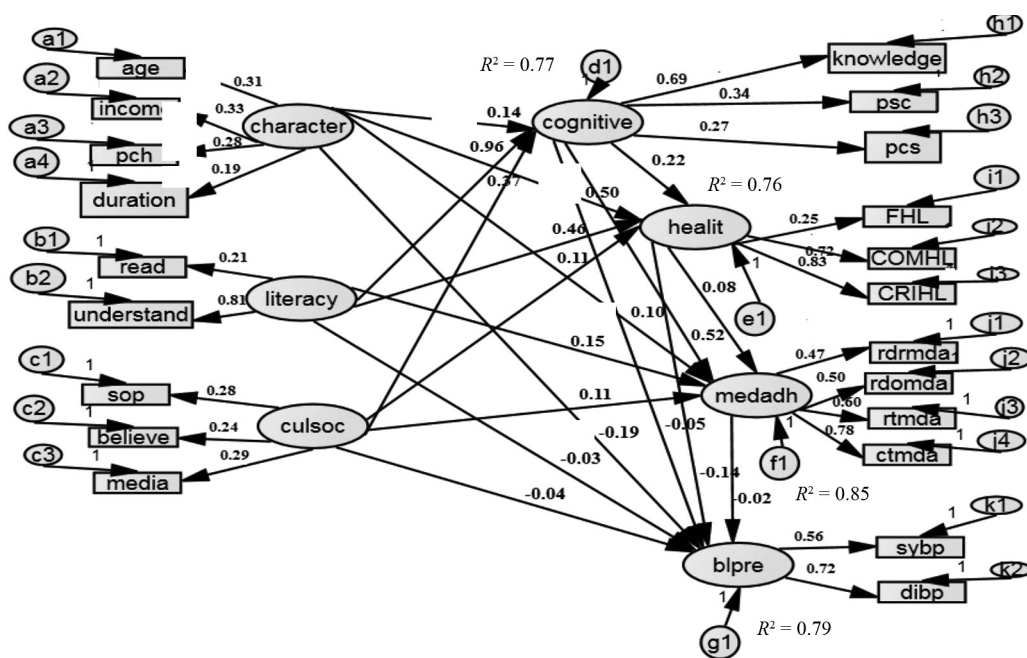


Fig 1–The causal relationship model among factors.

(Mean=24, SD=3.7) and perceived severity (Mean=25.31, SD=4.0). Health literacy was a little above average (Mean=40, SD=10.4). In all, 48.7% of respondents had inadequate HL, followed by marginal health literacy (43.8%) and adequate health literacy (7.5%). In contrast to our stated expectations, most respondents had good medication adherence (98.3%). Mean systolic blood pressure was 132.17 and mean diastolic blood pressure was 75.99. The reasons for this high level of medication adherence were investigated and discussed below.

The causal relationships of health literacy, medication adherence, and blood pressure level

The results suggested that the causal relationship model among factors of this study (Fig 1) was empirically supported to sufficiently explain the phenomenon of health literacy of our hypertensive older

adults (CMIN and degree of freedom ratio=0.85, $p=0.89$, GFI=0.98, AGFI=0.97, RMSEA=0.00).

The effect of literacy, cognitive ability, and culture and society on health literacy

Literacy had the most significantly positive direct effect on health literacy ($\beta=0.46$), followed by cognitive ability ($\beta=0.22$) and culture and society ($\beta=0.11$), ($p<0.05$) (Fig 1). Cognitive ability was also the mediator on health literacy that raised the effect of literacy, culture and society, and individual characteristics. These causal factors could predict the variance of health literacy at 76% (Table 3).

The effect of health literacy on medication adherence

Health literacy had a significantly positive direct effect on medication adherence with a small effect size. The largest results were derived from cognitive ability

Table 2
Mean, standard deviation and range of factors and variables.

Factors / Variables ^a	Possible	Mean	SD
Literacy	2-20	13.5	3.6
Reading ability (read)	2-8	4.4	2.2
Understanding ability (understand)	2-12	9.1	2.6
Cognitive ability (cognitive)			
Knowledge of HT and medication use (knowledge)	0-30	20.3	4.7
Perceive susceptibility (psc)	6-30	24.1	3.7
Perceive severity (pcs)	6-30	25.3	4.0
Culture and society (culsoc)			
Social support (sop)	39-156	98.7	20.9
Belief in alternative treatments (believe)	4-20	8.3	3.7
Media (media)	1-5	1.2	0.6
Health literacy (healit)	17-68	40.0	10.4
Functional HL			
Functional HL (FHL)	7-28	19.0	7.2
Communicative HL (COMHL)	5-20	10.8	3.5
Critical HL (CRIHL)	5-20	10.2	4.2
Medication adherence (medadh)	24-56	52.8	3.1
Type (rdmda)	4-8	7.6	0.7
Dose (rdomda)	8-20	19.2	1.3
Time (rtmda)	2-8	7.3	0.7
Continuing taking (ctmda)	10-20	18.7	1.5
Blood pressure (BP)			
Systolic BP (sybp)	-	132.17	14.47
Diastolic BP (dibp)	-	75.99	8.07

^aThe abbreviations in parentheses represent the factors and variables of the causal model (Fig 1).

Table 3
Effects of causal variables on affected variables.

Causal factors	Affected factors								
	Health literacy			Medication adherence			Blood pressure		
	DE	IE	TE	DE	IE	TE	DE	IE	TE
Characteristics	0.5	0.03	0.53	0.10	0.00	0.10	-0.19	0.00	-0.19
Literacy	0.46	0.21	0.67	0.15	0.17	0.32	-0.03	0.00	-0.03
Culture and society	0.11	0.08	0.19	0.11	0.00	0.11	-0.04	0.00	-0.04
Cognitive ability	0.22	0.00	0.22	0.52	0.02	0.54	-0.05	0.00	-0.05
Health literacy	-	-	-	0.08	0.00	0.08	-0.14	0.00	-0.14
Medication adherence	-	-	-	-	-	-	-0.02	0.00	-0.02
R ²		0.76			0.85			0.79	

p<0.05; DE, direct effect; IE, indirect effect; TE, total effect.

($\beta=0.52$) and literacy ($\beta=0.15$). However, health literacy could be the mediator on medication adherence by slightly elevating the effect of literacy and cognitive ability. Medication adherence was predicted by literacy, cognitive ability, culture and society, and health literacy at 85% (Table 3).

The effect of health literacy on blood pressure

Health literacy had the significantly largest negative direct effect on blood pressure level ($\beta=-0.14$, $p<0.05$) (Table 3). The highest effect came from CRIHL, followed by COMHL and FHL (Fig 1). Although this study analyzed individual characteristics as causal factors of the affected factors, the real effect of individual characteristics was calculated from the effects of age, income, perception of health, and duration of diagnosed HT, which had a very small effect size, notably less than other factors. Therefore, the results of overall individual characteristics shown in Table 3 and Fig 1 were not used in direct interpretation.

DISCUSSION

Health literacy was affected by the variables of literacy, cognitive ability, culture and society, and individual characteristics. This study contributed to the previous proposed frameworks that indicate health literacy was linked to many factors (Institute of Medicine, 2004; Pawlak, 2005; Kwan *et al*, 2006). It has been well recognized as a complex phenomenon that could not be fully explained (WHO, 2009). However, the largest total effect on HL was literacy. The foundations of health literacy provide the required skills to enable people to access and communicate health information (Gillis, and Quigley, 2004; IOM, 2004; Kwan *et al*, 2006; Canadian Council on Learning,

2008). The effect of cognitive ability was consistent with Nutbeam (2000) who noted that cognitive ability and social skills determine the motivation and ability of individuals to gain access to, understand, and use information in ways that promote and maintain good health. It signifies that cognitive ability is a crucial resource of individuals to improve health literacy.

Additionally, respondents applied their cognitive ability regarding knowledge about HT and medication use, and their perceived susceptibility and severity from HT when answering health literacy questionnaire items, particularly critical health literacy. Ishikawa *et al* (2008) found that knowledge on diabetes was associated with both overall health literacy and critical health literacy. Moreover, culture and society may enhance the ability to obtain and understand health information directly and should be a consideration to improve health literacy (IOM, 2004; Pawlak, 2005; Kwan *et al*, 2006; Lee *et al*, 2009).

Cognitive ability and literacy affected medication adherence with the largest total effect. Cognitive ability included knowledge about HT and medication use, perceived susceptibility and perceived severity that respondents could apply in medication adherence practice. Patients lacking sufficient knowledge and information regarding HT and its treatment did not take medication as prescribed (Osterberg and Blaschke, 2005). Poor cognition was associated with both over- and underadherence to a prescribed medication regimen (Leirer *et al*, 1991; Jeste *et al*, 2003). In addition, literacy affected medication adherence by helping patients to read and understand medication labels or instructions on packages.

The study of Lile and Hoffman (1991) reported that the inability to read medication labels was associated with nonadher-

ence to long-term medications among the elderly. Lower literacy was associated with a greater chance of poor adherence (Kalichman *et al*, 1999). Although culture and society and individual characteristics, especially health literacy, had a significant yet small effect on medication adherence, these factors should be considered in promoting medication adherence among hypertensive older adults. Two cultural factors influenced medication adherence.

Thai patients traditionally pay high respect to doctors and health professionals; obeying their advice strictly, fearing the consequences of refusing to comply. Moreover, Thai patients typically are more accepting of taking medicine rather than changing their lifestyle such as through exercise and diet control. In addition, many patients have witnessed the severe consequences of nonadherence of others in their community and reported they were afraid to experience a similarly negative outcome.

Health literacy had the largest effect on blood pressure ($\beta=-0.14$, $p<0.05$). Considering overall health literacy, the highest effect came from CRIHL, and COMHL, followed by FHL (Fig 1). This could be explained by Nutbeam's health literacy concept that CRIHL is the highest degree of individual capacity that a person attains to use advanced cognitive and social skills (Nutbeam, 2000). Hypertensive older adults at this level are proactive and capable of finding and critically analyzing health information and providing feedback on the health information from health care providers.

For COMHL, the second effect on blood pressure, Nutbeam (2000) clarified that COMHL requires higher cognitive, literacy, and social abilities that individuals could apply to health practices and

comprehend differing types of health messages as well as to better manage and adapt to new conditions. The person at this level is not only using FHL skills, but also other skills such as gaining knowledge of risk and probability. This increases awareness of how local beliefs influence perceptions of health messages, understanding health systems, developing ability to search and understand information, and analyze the credibility of an advertisement (Sorensen *et al*, 2012). Health literacy could demonstrate its positive effect on health outcome in terms of increased blood pressure control.

This was congruent with previous HL frameworks that proposed that health literacy was related to health outcome (Gillis and Quigley, 2004; IOM, 2004; Canadian Council on Learning, 2008). Williams *et al* (1998) found that patients with low health literacy had higher systolic blood pressures than those with higher literacy (155 mmHg *vs* 147 mmHg; $p=0.04$; $n=408$). Low health literacy was associated with extremely elevated blood pressure (McNaughton *et al*, 2014). Reduced health literacy increased the risk for mortality among older adults and constituted another health outcome related to health literacy. Participants with inadequate health literacy had higher risk-adjusted rates of cardiovascular death (Baker *et al*, 2007).

One limitation of this study was the random subject selection by recruiting hypertensive older adults who came to receive medication and health care services at Primary Health Care Centers with at least six follow-ups; thereby, increasing the chance of enrolling patients demonstrating adherence to treatment. Their medication adherence and blood pressure levels were more likely to be already at good levels. Additionally, the findings from

this study may not be generalized to all hypertensive older adults who receive health care services in other settings.

The medication adherence measuring method involved self-reporting by older adults that might have under- or over-reported due to declining memory and difficulty answering questionnaire items and rating the scaled level. Further studies may apply a more direct method or other kinds of indirect methods to measure medication adherence more reliably.

In conclusion, this study suggested possible causal relationships of health literacy, medication adherence, and blood pressure levels of Thai HT older adults receiving health care services at HT Clinics in Primary Health Care Centers. Health care providers should be encouraged to further research about appropriate health education for older adults focusing on three key areas: managing the teaching and learning environment, improving written communication and evaluating comprehension levels to improve HL particularly, CRIHL, and COMHL.

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