



Original Article

Medication adherence among persons with post-acute myocardial infarction

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Abstract

This study was to test a model explaining the influence of financial status, education, social support, symptom severity, barriers, knowledge, depression, and self-efficacy on medication adherence among persons with post-acute myocardial infarction. The use of multi-stage cluster sampling method involved 348 patients from 9 regional hospitals in Thailand. The results revealed the hypothesized model fit to the empirical data and explained 20% of the variance of medication adherence ($\chi^2 = 5.87$, $df = 5$, $p < .43$, Chi-square/ $df = 0.97$, GIF = 0.99, RMSEA = 0.065, AGFI = 0.97). Depression was the most influential factor affecting medication adherence, and had a negative direct effect (-.40, $p < .05$), followed by self-efficacy and barriers (.17 and .10, $p < .05$, respectively). These findings suggest that nurses should understand that depression, barrier, and self-efficacy are important factors to be considerate to improve medication adherence and improve the quality of life of Thai post-myocardial infarction patients.

Keywords: medication adherence, post- acute myocardial infarction

1. Introduction

Medication adherence plays a crucial role in the treatment and maintenance of health of myocardial infarction (MI) patients. Effective medication adherence reduces cardiac events, morbidity, mortality, re-hospitalization rates, healthcare costs, and enhances well-being among patients with MI (Choudhry *et al.*, 2008; Corrao *et al.*, 2010; Dragomir *et al.*, 2010). However, prior studies indicated a low rate of medication adherence in the first three months after hospital discharge, with less than 10% of these patients taking their medication exactly as prescribed (Albert, 2008; Perreault *et al.*, 2009; Polack *et al.*, 2008; Shah *et al.*, 2009). Many reasons have been identified related to poor medication adherence. Polsook *et al.* (2013) indicated the complexity of drugs and their dosages, while Mann *et al.* (2007) revealed that side effects, running out of pills, feeling the pills are a hassle, not believing the pill was necessary, and wanting to try diet

instead also influenced the adherence. In addition, Jackevicius *et al.* (2008) and Perreault *et al.* (2009) also mentioned that lack of understanding of the medication purpose is a key factor for not adhering to medication. Thus, medication adherence remains an important health problem, which is often overlooked and has been linked to increased adverse outcomes (Albert, 2008; Choudhry *et al.*, 2008; Polack *et al.*, 2008).

In Thailand, some research has been conducted on medication adherence in coronary artery disease (CAD) patients, and that study indicated the reasons why nearly 20% patients stopped taking medication (Taepaiboon; 2003). However, the data are too few to draw from conclusions from those findings, as well as there are limited studies conducted on this topic. Therefore, the purpose of this study was to explore potential factors related to medication adherence and test a model to explain how these factors influenced medication adherence in Thai post-MI patients.

2. Review of Literature

The World Health Organization's multidimensional

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adherence model (MAM) has explained the relationship among variables affecting medication adherence (WHO, 2003). According to this model, adherence is determined by the interplay of five sets of factors: 1) socioeconomic (social support, education, and financial status), 2) health care system-related factors, 3) condition-related factors (symptom severity, depression), 4) therapy-related factors (barriers), and 5) patient-related factors (knowledge, and self-efficacy). The common belief that patients are solely responsible for taking their medication is misleading and most often reflects a misunderstanding of how various factors affect people's behavior and capacity to adhere to their treatment (WHO, 2003). This study selected four factors because health care system-related factors related to social support from health care team and researchers focused on factors that are directly relevant to patients and can be manipulated.

Most efforts to understand the remarkably high rates of lack of adherence to general medication have focused on patient related factors, for instance, socioeconomic, condition-related factors, therapy-related factors, and patient attitude or ability related factors. Additional factors have been documented to also be related to medication adherence among post-MI patients. These were financial status, education, social support, symptom severity, depression, barriers, knowledge, and self-efficacy (Gerber *et al.*, 2010; Kayaniyil *et al.*, 2009; Lehane *et al.*, 2008; Molloy *et al.*, 2008). Literature reviews revealed that social support had a significant effect on medication adherence and impact on the progression of MI. It had been positively linked with medication adherence across different chronic illnesses (Molloy *et al.*, 2008; Simoni *et al.*, 2006). Lack of social support was one of the most common factors in poor medication adherence, which meant that patient's low social support was linked to poor medication adherence (Wu *et al.*, 2008). Similarly, Simoni *et al.* (2006) reported that social support is thought to increase self-efficacy, thereby increasing medication adherence. Social support not only enhances self-efficacy, but also affects adherence through physiological mechanisms by improving patient adherence by reducing depression as well (Glanz *et al.*, 2008).

Financial status was another predictor of medication adherence in heart failure patients (WHO, 2003). In MI patients, income levels were found that there was a significant association with medication adherence. There was a link between MI patients with high incomes and higher medication adherence because they were able to pay for medications as prescribed (Jackevicius *et al.*, 2008). Patients with low incomes are more likely to have poor adherence with their medication regimen. Among patients with low incomes, medication often becomes a low priority because of competing needs and limited resources. Financial burden is a crucial issue in medication adherence (Ho *et al.*, 2009).

Another factor is education. Low levels of education are more likely associated with poor medication adherence (Ho *et al.*, 2009). High levels of education give patients a deeper knowledge of risk factors for coronary heart disease,

which can lead to improvement in medication adherence (Alm-Roijer *et al.*, 2004). Lower education levels are correlated with poor medication adherence among cardiovascular patients because they often do not understand the importance of medications for their health (Alm-Roijer *et al.*, 2004; Gehi *et al.*, 2007). Additionally, Wu *et al.* (2008) found that heart failure patients with higher education were likely having better medication adherence. High levels of education give patients a deeper knowledge of risk factors for heart disease, which can lead to improvement of medication adherence (Molloy *et al.*, 2008; WHO, 2003). Moreover, Bogner *et al.* (2012) found that low levels of education are also associated with depression and poor medication adherence.

Symptom severity was related to medication adherence in that higher severity was correlated with better medication adherence. It is likely that physical symptoms reminded patients of the importance of taking medication (Wu *et al.*, 2008). Symptom severity might be an important internal cue to action and is therefore related to better medication adherence (Wu *et al.*, 2008). Symptom severity is also an important variable associated with medication adherence in patients with acute coronary syndromes. Asymptomatic and chronic illness that requires long-term therapy is also associated with poor adherence. Studies have shown that patients who had low symptom severity or awareness also exhibited poor medication adherence (Ho *et al.*, 2009).

Depression is another factor that has been associated with failure to adhere to medications (Molloy *et al.*, 2008). In CAD patients, depression was associated with poor medication adherence and seventy percent of increased rate of CAD events including nonfatal myocardial infarction, compared with those who are not depressed (Gehi *et al.*, 2005). Cardiovascular patients suffering depression are less likely to have good medication adherence and are more likely to have increased morbidity and mortality (Bane *et al.*, 2006). Similarly, Ziegelstein and Howard (2010) showed that depressed cardiovascular patients were less likely to adhere to medication. Depressive symptoms also lead to difficulties in self-management as depressed individuals experience lower self-esteem which often leads to decreased attention or even an inability to carry out recommended health-related behaviors such as adherence to medication (Maguire *et al.*, 2008).

Forgetting to take medication on time is a common form of failure to adhere to a medication regime. This may be influenced by an overly frequent medication schedule - the fact that the patient may need to take the drugs several times per day- as well as the cost of medications. Patients who had any of these barriers were less likely to adhere to their medication (Albert, 2008; Wu *et al.*, 2008) leading to low self-efficacy. Self-efficacy is a crucial factor in dealing with the challenge of overcoming barriers to medication adherence, which can be overcome if patients develop greater self-efficacy (Aljasem *et al.*, 2001). The last two factors affecting medication adherence are the patient's own knowledge and

self-efficacy. A low level of knowledge was found to be related to poor medication adherence and general knowledge about coronary artery disease showed a significant relationship with a high level of medication adherence (Molly *et al.*, 2008; Wu *et al.*, 2008). Similarly, Alm-Roijer *et al.* (2004) found significant correlations between general knowledge about coronary artery disease and adherence in taking medication. Cardiovascular patients' knowledge of the disease was linked to a high level of medication adherence because they understood that an effective medication regimen is crucial to decrease the severity of the disease. Thus, lack of this knowledge is a significant factor in poor medication adherence (Cohen, 2009; Wu *et al.*, 2008).

Self-efficacy refers to the confidence of post-MI patients in their ability to actually conform to self-administration of medication according to prescriptions. Self-efficacy is a well-known predictor of health-related behavior and was found to be the strongest predictor of medication adherence (Cohen, 2009). It had the greatest single effect on complying with the medication regimen in coronary artery disease patients. Coronary artery disease patients with good self-efficacy had better medication adherence (Chiou *et al.*, 2009). Self-efficacy has also been proposed as a mediating factor between knowledge attainment and healthy behavior. It is a significant predictor of adherent behaviors in various groups of people diagnosed with other chronic illnesses. Moreover, patient knowledge can increase self-efficacy and lead to greater adherence in a variety of diseases (Chiou *et al.*, 2009).

3. Methods

3.1 Study sample

A modified multi stage sampling using multi-stage process was used to yield a probability sample of post-MI Thai patients. Participants were drawn from four region hospitals of Thailand; North, Northeast, Central, and South (National Statistics Organization, 2011). A total of 348 post-MI patients were recruited in this study, with the subject inclusion criteria of: (1) Thai post-MI patients who attended follow-up programs at cardiology outpatient departments for three months post discharge; (2) age ≥ 20 years; (3) no cognitive impairment and no disease complications such as heart failure or subsequent MIs; (4) willingness to participate in the study.

3.2 Instrument

1) Translation process

The instruments used translation-back translation method. 1) The tools were translated from English into Thai by two instructors who have expertise in the English language at the Language Institute of Chulalongkorn University and an independent translator who is a nurse instructor with expertise in cardiovascular nursing and had studied abroad for more than 5 years. 2) Two Thai/English bilingual people

evaluated the Thai version of the tools. 3) Two Thai-English independent translators who each had taught English to graduate students for more than 10 years and a nurse instructor with expertise in cardiovascular nursing who had studied abroad for more than 5 years translated the instrument back into English. 4) Then, the investigators compared, checked, and discussed the differences both versions in the original language and produced a final consensus version. 5) The final Thai version was tested content validity by two cardiologists and three nursing instructors, to ensure that it was acceptable and that the meaning of each item was correctly reflected. Then, a pilot study was performed with Thai post MI patients for the final Thai version of the instrument (Polsook *et al.*, 2014).

2) Content validity

Content validity in this study was determined by five experts: two cardiologists and three nursing instructors. The Content Validity Index (CVI) was calculated for each instrument. The CVI of the Morisky's Self-reported Measure of Medication Adherence, Barriers to Medication Adherence, Self-efficacy for Appropriate Medication Use Scale, and Coronary Heart Disease Knowledge Questionnaire were 1.0, 0.91, 1.0, and 1.0 respectively.

3) Reliability of instrument

Symptom severity based on Canadian Cardio-vascular Society Classification used to classify angina. Class I – Angina only during strenuous or prolonged physical activity; Class II – Slight limitation, with angina only during vigorous physical activity, Class III – Symptoms with everyday living activities, i.e., moderate limitation; Class IV – Inability to perform any activity without angina or angina at rest (Sangareddi *et al.*, 2004)

Modified ENRICH Social Support Instrument (MESSI) assesses social support. The researchers modified the ESSI to assess social support specific to medication adherence among Thai post-MI patients. Item responses are rated on a Likert scale, ranging from 1 to 5 (Vaglio *et al.*, 2004). Items are then summed for a total score, ranging from 12 to 60 points. A higher MESSI score indicates higher social support in medication adherence. The Cronbach's alpha coefficient was 0.92 (Polsook *et al.*, 2013).

Center for Epidemiologic Studies Depression Scale (CES-D) measures the current level of depressive symptomatology. This instrument is a 20-item tool, on which respondents' rate answers on a 4-point Likert-type scale from 0 to 3. The total CES-D score is 60 in which a score of 16 or more is indicative of symptoms of depression (Tawatchai *et al.*, 1990). The Cronbach's alpha coefficient was 0.72 (Polsook *et al.*, 2013).

Barriers to Medication Adherence measures barriers to taking medication. It consists of 11 items, on which participant's rate how much they agree or disagree with each item on a scale from 0 to 10. Items are then summed for a total score, ranging from 0 to 110 (Wu *et al.*, 2008). A higher barrier to

medication adherence score indicates barriers in medication adherence. The Cronbach's alpha coefficient was 0.86 (Polsook *et al.*, 2013).

Coronary Heart Disease Awareness and Knowledge Questionnaire (CHDAKQ) was used to measure cardiac knowledge. This instrument consists of 20 items and each correct answer is scored one point and each incorrect answer scored zero points. The total CHDAKQ score ranges from 0 to 20 points (Kayaniyil *et al.*, 2009). A higher CHDAKQ score indicates greater CAD knowledge. The test-retest was used to test reliability, which was $r = 0.86$ (Polsook *et al.*, 2013).

Self-efficacy for Appropriate Medication Use Scale was used to measure self-efficacy. Patients were asked about their level of confidence about taking medication correctly (1 = not confident, 2 = somewhat confident, and 3 = very confidence). The potential score for the 13-item scale ranges from 13 to 39 (Risser *et al.*, 2007). Higher scores indicate higher levels of self-efficacy for medication adherence. The Cronbach's alpha coefficient was 0.90 (Polsook *et al.*, 2014).

Morisky's Self-reported Measure of Medication Adherence assesses adherence to medication regimens. The rating is based on a Likert-type scale, 1 to 4. The total score ranges from 5 to 20 (Bosworth *et al.*, 2006). A higher score indicates a higher medication adherence. The test-retest was used to test reliability, which was strong ($r = 1.0$) (Polsook *et al.*, 2014).

3.3 Data collection

This study was approved by the ethics committee of Chulalongkorn University and the Institutional Review Board (IRB) of each hospital before data collection commenced. The researcher trained and tested the research assistants to make sure of their understanding in using the questionnaires. The researcher and research assistant presented the benefits/risks of the intervention and the protection of human rights in nontechnical terms, to obtain approval from the patients to participate in the study. All subjects agreed to participate and signed a consent form after being given a written description and further verbal information about the research project. Participants were asked to complete questionnaires. During data collection, participants were able to refuse or leave without any consequence. Data collection took place from December, 2011 to February, 2013.

3.4 Data analysis

The Statistical Package for Social Science (SPSS) program version 17 was used to analyze data and provide descriptive statistics. Linear Structural Relationship (LISREL) version 8.72 was employed for the path analysis. An alpha level of .05 was set as the accepted level of significance for this study. The researcher selected some statistical criteria to evaluate the overall model-fit-index and hypothesize model as follows: (Hair *et al.*, 2010) 1) The χ^2 test statistics was used in hypothesis testing to evaluate the appropriateness of the

hypothesized model. A good model fit is that χ^2 is non-significant ($p > .05$), and χ^2/df should be less than 2. 2) The Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) are descriptive measures of overall model fit. RMSEA values $\leq .05$ can be considered as a good fit model, while values between .05 and .08 as an adequate fit model. SRMR values should be less than .05 for a good fit model. 3) The last criteria for testing a goodness of fit statistic are $GFI \geq .95$ and $AGFI \geq .90$. 4) In the present study, once it was determined that the hypothesized model fit the data, path coefficients and R^2 were estimated and the effects of the independent variables were determined to answer the research questions and test the hypotheses. The goodness-fit-indices were used to determine whether the model adequately fit the data.

4. Results

4.1 Characteristics of sample

A total of 348 participants were included in this analysis. The findings revealed the participants' age range as ≥ 61 years old (47.70%), 41-60 years (44.8%), and 20-40 years (7.5%), respectively. 60.9% were male and 39.1% female, 71.3% married, and more than half (56%) had completed primary school (6 years). Moreover, almost one-third of the participants (39.4%) were no longer working. In addition, more than three quarters of the participants (78.1%) had income of less than 5,000 baht (1 US dollar = 30 baht) per month. Most of the participants (71.5%) used the Thai Universal Coverage Scheme (the "30-Baht Scheme"). Score the Canadian Cardiovascular Society Classification, 55.5% of participants were in class I, 22.7% in class II, 14.0% in class III, and 7.8% in class IV. Most of the participants had been diagnosed with hypertension; diabetes mellitus, diabetes mellitus and hypertension; hypertension and dyslipidemia; diabetes mellitus and hypertension and dyslipidemia as comorbidities (16.7, 6.0, 6.0, 5.2, and 4.6%, respectively).

4.2 The relationships between variables

To evaluate the relationships between social support, financial status, education, symptom severity, depression, barriers, knowledge, self-efficacy, and medication adherence, Pearson's correlations were used. The results showed that a moderate positive correlation existed between self-efficacy and medication adherence ($r = .32$, $p < .05$) and barriers and depression had low negative correlation with medication adherence ($r = -.23$ and $-.28$, $p < .05$). Depression had a moderate negative correlation with self-efficacy ($r = -.34$, $p < .05$). Financial status, social support, and symptom severity had low positive correlation with self-efficacy ($r = .16$, $.16$, $.12$, $p < .05$, respectively), while barriers had a low negative correlation with self-efficacy ($r = -.22$, $p < .05$). Additionally, financial status, education, and knowledge had a low negative correlation with depression ($r = -.19$, $-.24$, $-.13$, $p < .05$,

respectively) and social support had a moderate negative correlation with depression ($r = -.45, p < .05$). Moreover, financial status and education had a low positive correlation with knowledge ($r = .23$ and $.14, p < .05$). Financial status had a low negative correlation with barriers ($r = -.13, p < .05$) and social support had a low positive correlation with barriers ($r = .12, p < .05$). Social support had a low positive correlation with symptom severity ($r = .11, p < .05$). Furthermore, financial status and education had a low positive correlation with social support ($r = .19$ and $r = .15, p < .05$). Finally, financial status had a moderate positive correlation with education ($r = .36, p < .05$) (Table 1).

4.3 Model testing

In the hypothesized model, the exogenous variables were financial status, education, social support, symptom

severity and barriers, while the endogenous variables were knowledge, depression, self-efficacy, and medication adherence. The results of the Linear Structural relationship analysis showed that the model was a good fit with the empirical data (Table 2), and the path analysis model was able to explain 20% of variance in medication adherence. The total effect, direct effect, and indirect effect among variables are shown in Table 3. A summary (Figure 1) of the model testing is as follows:

1. Financial status had a negative direct effect ($-.05, p < .05$) on medication adherence.
2. Education had a positive direct effect ($.03, p < .05$) on medication adherence, positive indirect effect ($.10, p < .05$) through knowledge, positive indirect effect ($.05, p < .05$) through knowledge and self-efficacy, and negative indirect effect ($-.01, p < .05$) on medication adherence through depression and self-efficacy.

Table 1. Pearson’s correlation among medication adherence, social support, financial status, education, symptom severity, depression, barriers, knowledge, and self-efficacy.

	FS	EDU	SS	CCS	BAR	KCAD	DEPR	SE	MA
FS	1.00								
EDU	.36**	1.00							
SS	.19**	.15**	1.00						
CCS	-.01	-.08	.11*	1.00					
BAR	-.13*	.06	.12*	.03	1.00				
KCAD	.23**	.14**	.05	.01	-.01	1.00			
DEPR	-.19**	-.24**	-.42**	-.06	.87	-.13*	1.00		
SE	.16**	.08	.16**	.12	-.22	-.08	-.34**	1.00	
MA	.09	-.00	.05	.03	-.23**	.08	-.28**	.32	1.00

* $p < .05$, ** $p < .01$

MA = medication adherence, FS = financial status, EDU = education, SS = social support, CCS = symptom severity, BAR = barriers, KCAD = knowledge, DEPR = depression, SE = self-efficacy

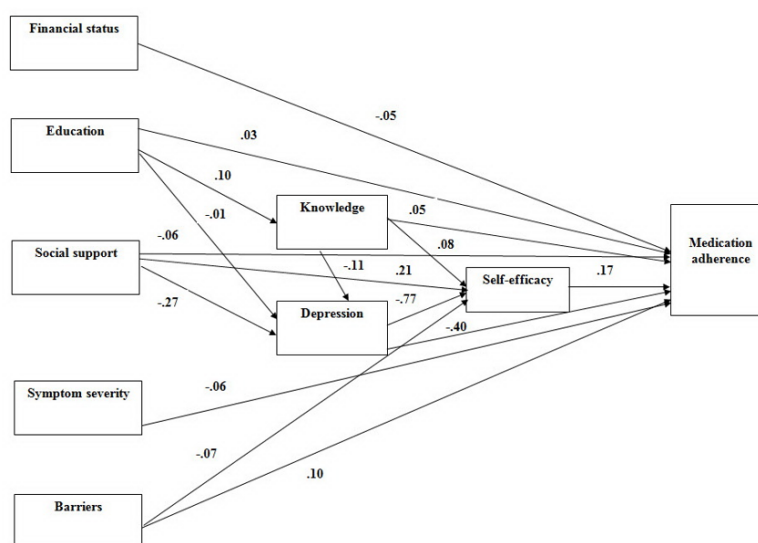


Figure 1. A hypothesized model testing medication adherence among post- acute MI patients

Table 2. The goodness of fit statistics.

Relative fit index	Final model	Goodness of Fit Statistics
χ^2 - test	5.87 (p=0.43)	(p<0.05) non significant
χ^2 / df	5.87/6=0.97	<2.00
CFI	1.00	≥ 0.95
GFI	0.99	≥ 0.95
AGFI	0.97	≥ 0.95
RMSEA	0.00	<0.05
SRMR	0.01	<0.05
PGFI	0.13	<0.50
Largest s.	1.97	± 2.00
Smallest s.	-2.28	± 2.00
R ²	0.20	> 0.50

χ^2 = Chi-square, df = degree of freedom, CFI = Comparative Fit Index, GFI = Goodness of Fit Index, AGFI = Adjust Goodness of Fit Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residual, Smallest s = Smallest standardized residual, Largest s = Largest standardized residual

Table 3. The total, direct, and indirect effects of influencing variables on affected variables (n=348).

Dependent Variables	R ²	Influencing Variables	TE	IE	DE
MA	.20	FS	-0.05	-	-0.05
		EDU	0.056	0.03	0.03
		SS	-0.01	0.05	-0.06
		CCS	-0.06	-	-0.06
		BAR	-0.09	-0.01	0.10
		K	0.05	-0.00	0.05
		DEP	-0.27	-0.13	-0.40
		SE	0.17	-	0.17
SE	-.19	EDU	0.05	0.05	0.00
		SS	0.04	0.21	-0.16
		BAR	-0.07	-	-0.07
		K	-0.09	0.08	-0.02
		DEP	-0.77	-	-0.77
DEP	.22	EDU	-0.09	-0.01	-0.08
		SS	-0.27	-	-0.27
		K	-0.11	-	-0.11
K	.02	EDU	0.10	-	0.10

EDU=Education, FS=Financial status, CCS=Symptom severity, DEP=Depression, BAR=Barriers, K=CAD knowledge, SE=Self-efficacy, MA=Medication adherence
TE=Total effect, IE=Indirect effect, DE=Direct effect

3. Social support had a negative direct effect (-.06, p < .05) on medication adherence, positive indirect effect (.21, p < .05) through self-efficacy, negative indirect effect (-.27, p < .05) through depression and self-efficacy.

4. Symptom severity had a negative direct effect (-.06, p < .05) on medication adherence.

5. Barriers had a positive direct effect (.10, p < .05) and negative indirect effect (-.07, p < .05) on medication adherence through self-efficacy.

6. Knowledge had a positive direct effect (.05, p < .05), positive indirect effect (.08, p < .05) through self-efficacy, and negative indirect effect (-.11, p < .05) on medication

adherence through depression and self-efficacy.

7. Depression had a negative direct effect (-.40, $p < .05$) and a negative indirect effect (-0.77, $p < .05$) on medication adherence through self-efficacy.

8. Self-efficacy had a positive direct effect (.17, $p < .05$) on medication adherence.

5. Discussion

This study was based on a modified version of the World Health Organization's multidimensional adherence model (MAM) (WHO, 2003). Modified versions included socioeconomic factors, condition-related factors, therapy-related factors and patient-related factors. Based on this model, this study found the following:

1) Socioeconomic factors

Financial status had a negative direct effect on medication adherence. This means that even though most (78.1%) post-MI patients had low financial status (income < 5,000 baht/month), they were more likely to have a higher level of medication adherence because 71.6% were covered by Universal Coverage Scheme (the 30-Baht Scheme) (Coronini-Cronberg *et al.*, 2007). Thus, they did not have to pay for medications prescribed out of pocket. This result contrasts with previous studies by Kronish and Ye (2013) who investigated adherence to cardiovascular medications and found that low income was a significant predictor of poor adherence in cardiovascular patients. This was true of other myocardial infarction patients of low financial status also because they had to pay for prescribed medications by themselves (Perreault *et al.*, 2008; Laba *et al.*, 2013).

Education was found to have a positive direct effect on medication adherence indicating that post-MI patients who had higher education also had higher medication adherence. The reason for this was that patients with more education have a better understanding of the disease, treatment, and need for medication adherence. In the current study, nearly one fourth of participants had higher education levels (17.8%). This finding supported previous studies showing that coronary heart disease (CHD) patients with poor medication adherence had a lower educational attainment (Gehi *et al.*, 2007). Additionally, post-MI patients who had higher levels of education, unsurprisingly, had higher levels of knowledge (Laba *et al.*, 2013; Risser *et al.*, 2007). This result supports the finding of a previous study by Castillo *et al.* (2010) who found that diabetics who have higher education tend to have a deeper understanding of the disease and significantly increased self-efficacy. Additionally, Berben *et al.* (2012) found that cardiovascular patients with more education had better knowledge leading to greater self-efficacy in medication adherence. Post-MI patients with a high level of education and greater knowledge also had greater self-efficacy, which associated with better medication adherence (Berben *et al.*, 2012; Kayaniyil *et al.*, 2009). However, more than two thirds (74.1%) of the participants in the current study

had no middle or higher education (Coronini-Cronberg *et al.*, 2007). Most poorly educated patients also had lower self-esteem and more stress when they experienced myocardial infarction (Molly *et al.*, 2008; Negash and Ehlers 2012). As a result, these patients tended to exhibit anxiety and depressive symptoms (Negash and Ehlers 2012). This supports previous studies by Negash and Ehlers (2012) who found that patients with higher educational attainment cope better with their illness and have less depression and also are more likely to adhere to their medications.

Participants in this study had moderate levels ($\bar{x} = 43.83$; $SD = 12.39$) of social support because most of participants were elderly people aged ≥ 61 years and married, and Thai people generally have extended families, so most participants lived with family members. It is likely that family members participated in their care and supported medication adherence for these patients (Polsook *et al.*, 2013). Additionally, most of participants had Universal Coverage Scheme (the 30-Baht Scheme) which means Thai health care covers all citizens, therefore they do not pay for medication (Polsook *et al.*, 2013). This result contrasts with other studies where social support had a positive correlation with medication adherence. For example, Kronish and Ye (2013) studied adherence to cardiovascular medications and found that social support provided powerful support (Kronish and Ye, 2013). The strong relationship between social support and depression is shown to decrease depressive symptoms, which in turn increases medication adherence.

2) Condition-related factors

Symptom severity had a negative direct effect on medication adherence. The Canadian Cardiovascular Society Classification was used to categorize symptom severity. This study found that more than half of the participants (55.5%) were in symptom severity class I, and only 7.8% showed high symptom severity (class IV). Because they only got angina if they do a lot of strenuous activities, they could live normal lives. This result contrasts with previous studies (Wu *et al.*, 2008) in which symptom severity was consistently related to medication adherence and higher severity of symptoms correlated with medication adherence. Severity of disease is an important variable associated with medication adherence, which means that patients with high symptom severity tended to have higher medication adherence (Wu *et al.*, 2008).

Depression had a negative direct effect on medication adherence through self-efficacy. In our study, participants did not exhibit depressive symptoms ($\bar{x} = 12.49$; $SD = 7.71$). Thus they took their medications as prescribed resulting in a high level of medication adherence (Coronini-Cronberg *et al.*, 2007; Ho *et al.*, 2009). This result supports the study by Cohen (2009) who investigated adherence in the context of cardiovascular risk reduction and demonstrated that poor adherence occurs in patients with depression who tend to take their medication incorrectly. Moreover, Castillo *et al.* (2010) studied a community-based diabetes empowerment education program for Latinos and found that depressive symptoms

were negatively correlated with medication adherence and self-efficacy to take medications.

3) Therapy-related factors

In addition to the factors discussed, there are positive direct effects on barriers and negative indirect barriers to medication adherence through self-efficacy. In this study barriers included poor communication and education about the importance of medications, complexity of medication regimen, medication costs, adverse side effects, and lack of knowledge about possible adverse effects (Wu *et al.*, 2008). The current study's results are in contrast with previous studies, which may be due to the new Thai health care plan that guarantees coverage for all citizens. Participants can now have access to health care services without paying for medications (Coronini-Cronberg *et al.*, 2007), which has had a positive effect on patient compliance. Other barriers included forgetting the time and amount of medication to take as well as not bringing them to work. Stopping long-term medications after symptoms have improved is also a barrier (Aljasem *et al.*, 2001; Cohen, 2009; Wu *et al.*, 2008). Thailand now has advanced practical nurses (APNs) that have responsibility to take care of and manage patients with chronic problems (Hanucharurkkul, 2007). For example, Khan Kaen Hospital had APNs provide direct care for those patients. Kronish and Ye (2013) and Bogner *et al.* (2012) studied adherence to cardiovascular medications and found that these barriers are a key component of poor medication adherence in cardiovascular patients. Barriers to medication adherence such as regimen complexity and polypharmacy were associated with medication adherence.

4) Patient-related factors

Patient knowledge had a positive direct effect and a positive indirect effect on medication adherence through self-efficacy. Nearly one fifth (17.8%) of participants in this study had higher education levels resulting in better understanding about the disease and treatment adherence which was linked to medication adherence (Coronini-Cronberg *et al.*, 2007; Wu *et al.*, 2008). In Thailand, advanced practice nurses are responsible for prevention and management of chronic illness. They are key health care professionals to assist in improving the health and well-being of the population. They manage medication adherence through the application of health assessments of individuals, family and community. They are able to detect and manage problems early by intervening through telephone or home visits to evaluate clients and find out the source of poor medication adherence including providing patients with information or knowledge about medication regimens. Through good practice (Hanucharurkkul, 2007), patients are more likely to adhere to their medication regimes. This study supports those by Wu *et al.* (2008) and Berben *et al.* (2012), which found that poor knowledge levels resulted in low self-efficacy and the perpetuation of poor medication adherence. In addition, self-efficacy was signifi-

cantly correlated with medication adherence by increasing patients' confidence and belief in the importance of cardiovascular medications in the successful management of their health (Berben *et al.*, 2012; Kronish and Ye, 2013).

Self-efficacy was a mediator in medication adherence. It can be explained that financial, depression, and barriers had negative effects on self-efficacy which means Thai health care policy guarantees coverage for all citizens. The participants did not worry about medication cost (Polsook *et al.*, 2013). If participants had depressive symptom it can lead to low self-efficacy (Castillo *et al.*, 2011; Jacevicius *et al.*, 2008; Laba *et al.*, 2013). Regarding barriers, which included poor educate the importance of medications and adverse side effects etc. These barriers lead to participant's low self-efficacy (Wu *et al.*, 2008). Education had positive indirect effect on self-efficacy through knowledge, which means if participants had higher education then they would have better knowledge about taking care of themselves and taking medication, leading to high self-efficacy (Polsook *et al.*, 2013).

5. Conclusions

The present study was conducted based on the Multi-dimensional Adherence Model (MAM) of the WHO which was used as a theoretical framework to gather empirical data to conduct a path model to test the effects of financial status, education, social support, symptom severity, barriers, knowledge, depression, and self-efficacy on medication adherence. The findings support the MAM and empirical literature, which shows that depression, barriers, and self-efficacy are correlated with medication adherence for post-MI patients. No prior studies have examined the relationships between barriers and depression on medication adherence in post-MI patients. Thus, this study has contributed to the field by explaining the influence of each variable in the model on medication adherence in post-MI patients in the Thai context.

6. Limitations and Recommendation

A limitation of the study is that data were based on self-reports, which could have caused overestimated or underestimated values. The instruments to measure these variables were used only one time in the Thai context. Testing of psychometric properties within the Thai context is needed gauge the reliability of the instruments. Based on these findings, a longitudinal study should be conducted to assess the change of these variables and medication adherence in post-MI patient's over time so as to provide a more causal explanation regarding medication adherence in post-MI patients and its predictors. An intervention study to promote medication adherence in post-MI patients should be developed and tested as well. It should incorporate promotion of self-efficacy, and decreased barriers to enhance medication adherence in post-MI patients.

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