

Original article

Factors affecting sleep quality in acute coronary syndrome survivors

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Background: Sleep quality is critical for survivors of acute coronary syndrome (ACS). Poor sleep quality increases the functioning of the sympathetic system while decreasing the functioning of the parasympathetic system. In fact, an increase in coronary calcium and narrowing of arteries are indicators of poorer prognosis, putting the patients at risks of recurrence of ACS.

Objectives: The present study aimed to investigate effects of physical activity, perceived angina severity, depression, and fear of dying on sleep quality of ACS survivors.

Methods: The sample consisted of 147 ACS patients, both male and female, who were 18 years old and older and diagnosed with ACS and received treatment for no more than one year at the research settings. Data were analyzed descriptive by statistics and multiple regression statistics.

Results: Physical activity, perceived angina severity, depression and fear of dying were able to jointly explain 26.6 % of the variances in sleep quality in ACS survivors ($R^2 = 0.266$, $P < 0.001$). Physical activity and depression were variables found capable of predicting the sleep quality of ACS survivors with statistical significance ($\beta = -0.300, 0.331$, respectively; $P < 0.01$)

Conclusion: Nurses should assess physical activity and depression in ACS survivors to devise plans to manage depression and promote physical activity to enhance sleep quality of ACS survivors.

Keywords: Acute coronary syndrome survivors, sleep quality, depression, physical activity, perceived angina severity.

Acute coronary syndrome (ACS) is a leading cause of deaths and a major public health problem in Thailand and all over the world. According to the statistics of the World Health Organization, ACS caused as many as 17.7 million deaths in 2016, making up 31.0% of the total deaths worldwide. It has been estimated that in 2030, the total number of deaths will rise to 23 million worldwide.⁽¹⁾ In Thailand, the morbidity and mortality rates caused by ACS have continued to increase. In 2017, the number of ACS patients was 398,714. Of these, 23,469 were dead, or two deaths per hour on average.⁽²⁾ Even though the treatment of ACS with an anticoagulant or angioplasty enables ACS patients to survive, acute myocardial infarction results in sudden chest pain, which is an

unexpected event in the patients' life. They may feel that they almost lose their life, and this can result in posttraumatic stress disorder (PTSD). They tend to relive the events, suffer from insomnia or nightmare, develop intrusive thoughts, become compulsive and obsessive, and be stricken with depressive symptoms.⁽²⁾ Besides this, uncertainty of ACS can lead to abnormal mental status.⁽³⁻⁵⁾ PTSD can be found within one month after onset of ACS in 66.7% of the survivors.⁽⁶⁾

Acute coronary syndrome survivors can be defined differently. In general, acute coronary syndrome survivors refer to individuals who continue to live after having been diagnosed with acute coronary syndrome. There are two phases of survivals from acute coronary syndrome: There are two phases of survivals from acute coronary syndrome: Early survivals referring to the first 30 days after the diagnosis and long-term survivals referring into three periods: 1) survivals more than 30 days to one year after the diagnosis; 2) survivals more than one year

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Received: May 30, 2019

Revised: June 18, 2019

Accepted: August 5, 2019

to three years after the diagnosis and 3) survivals from three years up after the diagnosis⁽⁷⁾. Generally, most of ACS survivors including those who have survived from myocardial infarction and ischemic chest pain experience relapses within five years and one-third of those who have relapses will not survive,⁽⁶⁾ Moreover, it could be seen that ACS survivors have to suffer from their remaining symptoms, particularly poor sleep quality, which is found in 25.4%.⁽⁸⁾ Also, it has been documented that patients with the first onset of ACS or those with similar experiences in the past are not different when it comes to poor sleep quality.

Sleep is of critical importance for patients with ACS. If ACS survivors have poor sleep quality, their sympathetic nervous system increases its functioning while the parasympathetic nervous system decreases its functioning, catecholamine will be secreted, leading to constriction of blood vessels, and an increase in coronary calcium and narrowing arteries both indicate poor prognosis of the disease, hence more risks of relapses of ACS.⁽⁹⁾

Physical activity refers to all kinds of movements that result from constriction of muscles and cause the body to exert more energy than when the body is resting. It is found associated with duration and quality of sleep in patients with heart disease.⁽¹⁰⁾ A study reported that within the first three months after the onset of ACS and after entering the physical rehabilitation program, 50.4% of the survivors have sedentary behavior, 43.9% have moderate activity, and 5.7% have vigorous activity. In addition, it has been found that physical activity is associated with sleep quality of ACS survivors with statistical significance.⁽¹⁰⁾

Perceived angina severity refers to patients' perception of the level of angina severity caused by myocardial infarction. It has been found associated with sleep quality.^(11, 12) Depression refers to a group of symptom with depressive symptom as the most distinctive symptom accompanied by other major symptoms such as boredom, loss of interest, despair, loss of appetite, fatigue, sense of worthlessness, loss of will power, and entertainment of suicidal thoughts. Andrechuk CRS, *et al.*⁽¹⁰⁾ have reported that there is a statistically significant relationship between depression and poor sleep quality in patients with myocardial infarction. Additionally, fear of dying affects sleep quality in patients with ACS.⁽¹³⁾

In Thailand, there is a study on physical activity and its relationship with poor sleep quality of patients

with acute myocardial infarction within six months after the diagnosis.⁽¹⁴⁾ In fact, there are more restrictions in physical activity of patients with acute myocardial infarction compared to ACS survivors. One study conducted in Thailand investigated the relationship between perceived angina severity and sleep quality, but it was carried out with patients who had been discharged from the intensive care unit for two weeks.⁽¹²⁾ There is no study that explored the relationship between perceived angina severity and sleep quality in ACS survivors who are outpatients. As regards depression, there is no study done specifically with ACS survivors, and most of the studies were done with inpatients after they had experienced heart disease symptoms. Also, most of the studies have been undertaken in the western hemisphere such as Europe whose populations mostly live in a nuclear family with different sociocultural contexts from those in Thailand. Therefore, depressive symptoms of Westerners and Thais may be different. In terms of fear of dying, a review of literature has shown that most of the studies have been done with patients undergoing a heart surgery and inpatients. They do not encompass ACS survivors who constitute the target population of this study including patients with non-ST myocardial infarction, unstable angina, and ST-elevation myocardial infarction. Also, the study sample consisted of outpatients who had first experienced ACS as well as those who had previous experienced and had been diagnosed with ACS within the past year, including those who with early survival and medium-term survival. The factors influencing sleep quality in ACS survivors of interest in this study included physical activity, perceived angina severity, depression, and fear of dying. Further understanding of these factors is still needed, and they are considered factors that nurses can independently work on to directly solve the problems and assist the survivors. It was anticipated that the findings of this study would subsequently be used to develop a clinical nursing practice guideline to enable nurses to promote sleep quality in ACS survivors.

Materials and methods

Study design and population

After the institution review board (IRB) having approved the study project, researchers performed predictive correlation study by collection data from the medical outpatient department of Siriraj Hospital and King Chulalongkorn Memorial Hospital (KCMH) (Certificate of Approval no. Si 838/2018 and COA

no. 210/2019, respectively) from February to March 2019. Patients were eligible if they were aged 18 years and over who had been diagnosed and received treatment for no more than one year and able to communicate and read Thai language. The patients must not have obstructive sleep apnea, screening by Modified Berlin Questionnaire. Sample group selection use quota sampling method, the researcher determined the proportion of patients with ACS contain with NSTEMI, UA and STEMI groups of 45, 15 and 40, respectively.⁽²⁾ Therefore, the sample group 147 cases contain with NSTEMI, UA and STEMI groups of 66, 22 and 59 respectively.

The research instruments consisted of three parts, two screening instruments, a questionnaire to collect data regarding demographic and clinical characteristics of the subjects, and five data collection questionnaires.

Screening instruments

The Modified Berlin Questionnaire (Thai version)⁽¹⁵⁾

Thai version was translated and back-translated in Kanokon Santichatsak's study. The questionnaire was used to screen. There were 11 items which were designed to screen patients who were at risk of obstructive sleep apnea. The items were divided into three parts as follows: 1) snoring; 2) tiredness; and 3) history of hypertension and body mass index. Patients with high risks were those whose positive scores were equal to or higher than 2 parts.

The general practitioner assessment of cognition: GP-COG (Thai version)⁽¹⁶⁾

Which was a form for assessing knowledge and understanding of patients aged more than 60 years. Jiranan Griffiths translated into Thai with two parts consisting of assessment forms for patients and caregivers. It was composed of two parts to screen the patients and their caregivers. In this study, only the patient part was used, totaling six open-ended items. The total score was nine points, lower than nine points indicated impaired cognitive.

Demographic data and illness data record forms

Which was composed of response-choice and fill-in-the-blank items with responses completed by the subjects and retrieved from existing medical records including gender, age, marital status fifteen items and illness data records form such as diagnosis, ECG nine items.

The pittsburgh sleep quality index [PSQI] (Thai version)

The form was translated and modified by Jirapramukpitak T, *et al.*⁽¹⁷⁾ There were 19 items which could be divided into seven components of subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. Possible total scores ranged from 0 to 21 points. As for interpretation of scores, the scores lower than or equal to 5 points referred to good sleep quality, whereas the scores between 6 and 21 points referred to poor sleep quality. In the present study, Cronbach's alpha correlation coefficient was 0.766.

Duke activity status index (Thai version)

Namphonrang P.⁽¹⁸⁾ translated into Thai and modified. There were 12 items with two-response type items of "can do" and "cannot do." If the subjects indicated that they had the functional capacity to do the activity in each item, they would receive the amount of energy equal to the energy needed to do that particular activity (MET). The possible total energy needed to do all activities ranged from 0 to 58.20 MET. In the present study, Cronbach's alpha correlation coefficient was 0.837

An 11- point numeric pain rating scale (NRS)

It was a pain numeric rating scale (NRS) with only one item in the form of a straight line 10 centimeters in length, with the left end representing "0" or "no angina severity" and the right end representing "10" or "most severe angina severity", in the present study, Cronbach's alpha correlation coefficient was equal to 0.989.

Center of epidemiologic scale depression (CES -D) (Thai version)

Kupniratsaikun W, *et al.*⁽¹⁹⁾ translated into Thai. It consisted of 20 items related to emotions and behaviors related to depression, with four positive items and 16 negative items. Each of the items was arranged in a four-point rating scale. Possible total scores ranged from 0 to 60 points, with scores equal to or higher than 16 points reflecting depressive symptoms. In the present study, Cronbach's alpha correlation coefficient was equal to 0.855.

Distress and fear of dying

Which was developed in 2005 by Whitehead DL, *et al.*⁽²⁰⁾ There were three items in the questionnaire which encompassed fear that occurred when the symptoms developed, fear of dying, and fear of emergency situations caused by heart disease. The items were arranged in a five-point Likert scale with the scores ranging from 1 to 5 points, with the score of 1 representing “least true” and 5 representing “most true.” As for interpretation of scores, higher scores indicated more fear of dying, while lower scores reflected less fear of dying. The possible total scores ranged from 3 to 15 points. In the present study, Cronbach’s alpha correlation coefficient was equal to 0.794.

Statistical analysis

The SPSS computer program was used to analyze data in the present study. Descriptive statistics of frequency, percentage, mean, and standard deviation (SD) were used to analyze data regarding demographic and clinical characteristics of the subjects. In addition, enter multiple linear regression analysis was used to determine predictive power of physical activity, perceived angina severity, depression, and fear of dying to predict sleep quality of ACS survivors. $P < 0.05$ was considered as significant difference.

Results

Almost two-thirds of the subjects, or 63.9%, were

male. The ranged in age between 70 and 79 years old, with the mean age of 63.4 years old (SD = 13.6). Most of the subjects, or 80.3%, were married, and more than one quarter, or 29.3%, were unemployed. Approximately one-third of the subjects, or 31.3%, earned 5,000 to 10,000 baht per month. In terms of sufficiency of income, 39.5% had sufficiency income with no savings, while 39.5% had sufficient income with savings. Moreover, nearly half of the subjects, or 45.6%, had the right to medical reimbursements as government officials or public enterprise employees. Almost all of them, or 98.0%, were Buddhists, and 32.0% completed elementary education.

The mean duration of diagnosis of ACS was 4.5 months (SD = 3.9). More than two-thirds of the subjects, or 68.0%, had been diagnosed with the syndrome for more than one to 12 months, so they were considered long-term survivors and 32.0% had been diagnosed at 1 month. Furthermore, 38.8% of the subjects had Canadian Cardiovascular Society (CCS) Classification II, while 29.9% were categorized in Classification III. With regard to comorbidity, almost all of the subjects, or 95.2%, had comorbidity. Most commonly found comorbidities were hypertension at 75.5%, followed by hyperlipidemia at 71.4%. Finally, more than half of the subjects had triple vessels (three narrowed arteries), and more than half, or 57.8%, received PTCA/PTCA with stent to treat their condition, 80.3% had a poor sleep quality (Table 1).

Table 1. Number, percentage, means, standard deviation (SD) of sleep quality, physical activity, perceived angina severity, depression and fear of dying (n = 147).

Variables	Number	Percentage	Mean	SD	Interpretation
Overall sleep quality (0 - 21)	147	100.0	9.3	4.2	Poor
Good sleep quality (0 - 5)	29	19.7	3.9	1.3	
Poor sleep quality (6 - 21)	118	80.3	10.6	3.6	
Physical activity (0 - 58.20)			27.3	15.5	Fair
Poor physical activity (0 – 14.55)	32	21.8			
Fair physical activity (14.56 – 29.10)	53	36.1			
Good physical activity (29.11 – 43.65)	38	25.9			
Very good physical activity (43.66 – 58.20)	24	16.3			
Perceived angina severity (0 - 10)			5.3	3.2	Moderate
No angina pain (0)	21	14.3			
Mild angina pain (1 - 3)	25	17.0			
Moderate angina pain (4 - 6)	38	25.9			
Severe angina pain (7 - 10)	63	42.8			
Depression (0 – 60)			9.9	8.0	No depression
No depression (0 - 15)	123	83.7			
Depression (16 - 60)	24	16.3			
Fear of dying (1 – 5)			2.7	0.8	Moderate
No fear of dying (1 – 1.99)	20	13.6			
Moderate level of fear of dying (2 – 3.99)	121	82.3			
High level of fear of dying (4 – 5)	6	4.1			

According to the study findings, physical activity was negatively related to sleep quality with statistical significance at a moderate level ($r = -0.411$, $P < 0.01$), while depression and fear of dying were positively related to sleep quality with statistical significance at a moderate level and a low level, respectively ($r = 0.413$, $P < 0.01$ and $r = 0.202$, $P < 0.05$, respectively). However, perceived angina severity was not related to sleep quality with statistical significance ($r = -0.024$, $P > 0.05$), as presented in Table 2.

Enter multiple linear regression analysis showed that the variables of physical activity, perceived angina severity, depression, and fear of dying could predict poor sleep quality of ACS survivors by 26.6% ($R^2 = 0.266$, $P < 0.001$). Physical activity and depression could predict sleep quality of ACS survivors with statistical significance at 0.01 with regression coefficient (β coefficient) equal to -0.300 and 0.331 , respectively. On the other hand, perceived angina severity and fear of dying could not predict sleep quality of ACS survivors with statistical significance, as shown in Table 3.

Discussion

The study findings revealed that most of the subjects, or 80.3%, had poor sleep quality. This may have been because most of the subjects were older adults with the mean age of 63.4 years old ($SD = 13.6$). An increase in age generally means declined functioning of the central nervous system, hence less blood that goes to the brain, fewer neurons, and slower neurotransmission. In addition, changes in secretion of neurotransmitters and hormones mean less secretion of hormones that assist sleep like serotonin and melatonin. In the present study, more than one-third of the subjects, or 37.4%, had diabetes mellitus. A higher level of plasma glucose means the body has to expel sugar through osmotic diuresis, leading to polyuria and frequent urination. Also, older adults may have autonomic neuropathy, so they are more susceptible to urge to urinate more often even though the amount of urine is small.⁽¹⁶⁾ As a result, sleep quality can be affected.

Treatment of ACS is one of the factors that may affect sleep quality of ACS survivors. The subjects of this study received some medications for heart

Table 2. Correlation between physical activity, perceived angina severity, depression, fear of dying and sleep quality in the subjects ($n = 147$).

Variables	1	2	3	4	5
Physical activity	1				
Perceived angina severity	0.033	1			
Depression	-0.316**	0.221**	1		
Fear of dying	-0.197*	0.218**	0.440**	1	
Sleep quality	-0.411**	-0.024	0.413**	0.202*	1

* $P < 0.05$, ** $P < 0.01$

Table 3. Predictive ability of physical activity, perceived angina severity, depression, fear of dying on sleep quality in the subjects (Enter multiple linear regression) ($n = 147$).

Variables	B	SE _b	β	t	P-value	95% CI	
						Lower	Upper
Constant	10.174	1.333		7.631	<0.001	7.538	12.809
Physical activity	-0.082	0.021	-0.300	-3.920	<0.001	-0.123	-0.040
Perceived angina severity	-0.119	0.098	-0.091	-1.217	0.226	-0.313	0.075
Depression	0.175	0.044	0.331	3.927	<0.001	0.087	0.262
Fear of dying	0.032	0.146	0.018	0.218	0.828	-0.257	0.320

Constant = 10.174; SE = +3.667, $R = 0.516$, $R^2 = 0.266$, $R^2_{adj} = 0.245$, $F = 12.853$; $P < 0.001$

disease that could have disturbed sleep such as Beta-adrenergic receptor antagonist (Beta-blockers) (79.6%), angiotensin converting enzyme inhibitor (ACEIs) (29.3%), and diuretics (20.4%). Some of the subjects even took more than two of these medications. This could be explained that Beta-blockers including Carvedilol, Bisoprolol, Metoprolol, and Atenolol have an effect on nighttime release of melatonin and increased secretion of norepinephrine through stimulation of Beta1-adrenoreceptors, so the patients who take these medications can experience nightmares, they may wake up frequently during the night, and their REM sleep can be suppressed.^(21, 22) A study has shown that administration of Beta-blockers is related to poor sleep quality of ACS survivors.⁽²³⁾ As for angiotensin converting enzyme inhibitor (ACEIs) such as Enalapril and Ramipril, they cause accumulation of bradykinin and Substance P which are mediators that stimulate coughing. Patients who take these medications may wake up in the middle of the night or near dawn because of dry coughing.⁽²⁴⁾ Furthermore, diuretics such as Furosemide and Spironolactone cause the patients to wake up often in the middle of the night to urinate. Even though drug administration may take this into account by having the patients take diuretics in the morning and at noontime, but the effects of the drugs can last as long as eight to 14 hours in older adults. For this reason, diuretics have an effect on sleep quality of patients.⁽²²⁾ According to a study by Greenberg J, *et al.*⁽²⁵⁾ has revealed that diuretics is related to frequent nighttime urination in patients with heart failure.

Poor sleep quality occurs after the onset of ACS. Bah TM, *et al.*⁽²⁶⁾ carried out a study with patients after two weeks after onset of ACS and found that blood deprivation adversely affects the apoptosis, hence poor quality of sleep. In the present study, more than half of the subjects, or 56.4%, were in the early survival group (one-three months), and the severity was in class II or III, so their symptoms were not stable and had to be closely monitored, so they may not have been able to have good sleep quality. Likewise, Da Costa D, *et al.*⁽²⁷⁾ carried out a study with 209 survivors of myocardial infarction within five weeks after onset and found that 36.0% of the survivors had poor sleep quality with the insomnia severity index $\geq 10.0\%$ and 9.0% of them reported having non-severe sleep problems (insomnia severity index $\geq 8.0\%$).

In this study, 36.1% and 25.9% of the subjects had physical activity scores at a moderate and good level, respectively. Also, physical activity was found to be negatively related to sleep quality with statistical significance at a moderate level, and could predict sleep quality of ACS survivors. In other words, more physical activities mean better sleep quality. Similarly, Wongguan D, *et al.*⁽²⁸⁾ conducted a study and found that there was a negative relationship between physical activity and poor sleep quality of acute myocardial infarction survivors with statistical significance and could predict poor sleep quality of acute myocardial infarction survivors with statistical significance, meaning less physical activity caused poor sleep quality.

Appropriate physical activity during the day affects core temperature of the body, raising it too above 37 degrees Celsius, leading to homeostasis. The functioning of the neurons at the frontal hypothalamus increases the temperature of the circulation system, so the blood vessels become dilated and sweat is secreted to release the heat. On the other hand, when the body temperature reduces before bedtime, slow wave sleep will be increased and continuity of sleep can also be lengthened.⁽²⁹⁾

Depression was positively related to sleep quality with statistical significance at a moderate level. Put another way, depression resulted in poor sleep quality. Depression could also predict sleep quality of ACS survivors. Similar findings have been reported by previous studies. For example, Olarnwat K, *et al.* have found that depression is positively related to poor sleep quality with statistical significance at a high level in ACS survivors.⁽³⁰⁾ In fact, depression affects the functioning of the central nervous system, reducing the functioning of serotonin which controls the sleep cycle, hence changes in sleep patterns of patients. Such findings were consistent with the findings of Rafael B, *et al.*⁽³¹⁾ Who have found that depression was related to insomnia in 100 patients with acute myocardial infarction participating in the rehabilitation program.

Fear of dying had a significant low-level of positive correlation with sleep quality but could not significantly predict the sleep quality in ACS survival which differs from the study in Thailand, Sonpala S., who found fear of dying to be correlated with poor sleep quality in 24 and 48 hours from admission to an intensive care unit.⁽³²⁾ According to study abroad, fear of dying has a positive correlation with sleep quality and can be

used to predict poor sleep quality in patients with ACS who have undergone coronary artery bypass grafting (CABG). Sleep quality decreases as the fear of dying increases, but the predictive power of fear of dying in predicting sleep quality in the above study differs from the findings of the current study, possibly because the samples have severity of CCS ranging from Class 3 to 4. The level of fear of dying is higher than in the current study, which was moderate. Moreover, the sample consisted of outpatients who were only receiving continuous symptom monitoring in follow-up appointments who had no active symptoms, exacerbations or complications. Based on the findings of the present study, therefore, sleep quality could not be predicted in ACS survivors.

Perceived angina severity was not found to be significantly correlated with sleep quality and was not able to significantly predict sleep quality in ACS survivors), possibly because the subjects were outpatients who had been diagnosed for no more than a year and perceived angina severity is based on experience with chest pain. In this studied, perceived angina severity in which the patients selected the most severe chest pain since being diagnosed with acute coronary syndrome. In addition, angina was usually perceived only occasionally and not constantly, and angina usually occurred while subjects were engaged in daytime activities. Hence, the sensation of chest pain did not affect sleep quality during the night. The subject in the present study had chest pain severity at Classes 2 - 3, which differs from the study in Thailand, Tanmanee Y. who studied patients with ACS and a history of admission to cardiac critical care units within two weeks after discharge and inquired about patients' perceived angina severity during the aforementioned time period. According to the findings, it can be concluded that perceived angina severity is correlated with sleep quality with statistical significance⁽¹¹⁾ and McCathy S, *et al.* studied in patients with ACS dwelling in the countryside and waiting for coronary angiography. Patients with ACS had a high level of chest pain within the first 2 hours, class 4 (40.5%) and the perceived angina severity could predict sleep quality with statistical significance.⁽¹²⁾

Conclusion

The present study investigated physical activity, perceived angina severity, depression, and fear of dying and their effects on sleep quality of ACS survivors. The findings showed that physical activity

and depression could predict sleep quality of ACS survivors. Therefore, physical activity and depression of all ACS survivors should be assessed so as to more effectively devise a plan to manage depression and promote physical activity to ensure good quality of sleep of ACS survivors. The findings of the present study could be utilized to devise a clinical nursing practice guideline and develop a program to enhance sleep quality of ACS survivors.

Acknowledgements

The researchers would like to acknowledge all participants and express deep gratitude to the King Chulalongkorn Memorial Hospital The Thai Red Cross Society for supporting of this research.

Conflict of interest

The authors, hereby, declare no conflict of interest.

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