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Dimensions of sleep characteristics and predictors of sleep quality among heart failure patients

A STROBE compliant cross-sectional study in Jordan

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Abstract

Awareness of poor sleep quality and sleep disturbances, as some of the factors that affect negatively quality of life for patients with the different classes of heart failure (HF) would enable health care providers to offer more comprehensive care. The purposes of this study were to describe sleep quality and predictors of disturbances in sleep in heart failure patients in Jordan. An explanatory cross- sectional design was employed to examine sleep quality, dimensions of sleep characteristics, types of disturbances in sleep within the different classes of HF in Jordan. Data were collected from 2 cardiac clinics and 2 medical clinics at 3 hospitals in Jordan. The most common types of disturbances in sleep in all classes of HF were waking up for urination, waking in the middle of the night or early morning, waking up due to cough and snoring, and difficulty to fall asleep within the 30 minutes. However, waking up due to feeling cold or hot were rarely reported in all classes of patients with HF. Regression analysis revealed that significant correlations were found between sleep quality and gender, disease duration, number of medications currently taken and ejection fraction ($P < .05$). Our findings indicated that sleep quality and disturbances in sleep were worsening with the increase of the New York heart association functional classification sheet class. Moreover, sleep quality had a significant association with gender, disease duration, ejection fraction, and the number of medications currently taken.

Abbreviations: HF = heart failure, NYHA = New York heart association functional classification sheet, PSQI = the pittsburgh sleep quality index.

Keywords: cardiovascular, heart failure, sleep disturbances, sleep quality

1. Introduction

Heart failure is a progressive common disease that still has high morbidity and mortality rates worldwide.[1–3] Patients with heart failure (HF) experience variety of symptoms that negatively affect their quality of life. One of main symptoms that affect 60% to 90% of patients with HF is poor sleep quality. Despite the improved treatment and the decrease in mortality rate after cardiovascular event, the number of patients with HF is increasing all over the world.[4] Nearly 60% of patients with HF had poor sleep quality[5] which associated with depression,[6] reduced physical and cognitive performance,[7] and increased cost due to the increase of unplanned hospitalization.[8]

Many researchers emphasize the importance of studying sleep quality among patients with HF, because of the importance of this topic, many studies were conducted to address the different aspects of sleep in various populations of patients with HF.[9–11] For example, there were studies that addressed sleep quality in chronic hospitalized patients with HF.[5,11] While Dos Santos 2012 and Wang 2010 addressed sleep quality in chronic non-hospitalized patients with HF.[10,12] On the other hand, Redeker's studies which conducted in 2005, 2010 and 2012 addressed sleep quality-in stable patients with HF. However, there were no studies that assess whether or not there are differences in the levels of sleep quality and types of disturbances in sleep between the different classes of HF.[10,12]

Research about sleep quality among Jordanians patients with HF is very limited, the 1st study which done on sleep quality for patients with coronary artery disease was aimed to test the psychometric properties of the Arabic version of the pittsburgh sleep quality index (PSQI) in a sample of coronary artery disease

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

The Institutional Review Boards (IRB) at Jordan University of Science and Technology was approved all recruitment and consent procedures. All data collected from participants were used solely for research purposes. They had the right to withdraw their participation in the study at any time without prejudice.

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patients in Jordan, and not to assess sleep quality and disturbances in sleep among cardiac patients in Jordan.[13] They also added that further studies are needed to assess sleep quality and disturbances in sleep and to identify the proper interventions to decrease disturbances in sleep and promote patients' sleep quality.

Awareness of poor sleep quality and sleep disturbances, as some of the factors that affect negatively quality of life for patients with the different classes of HF, would enable health care providers to offer more comprehensive care.[11] So, the evaluation of sleep quality and types of disturbances in sleep in each class of HF is essential, it would help in building up different protocols to enhance the level of sleep quality. The different protocols could be specific to each class of HF instead of 1 protocol which may be unsuitable for the general population of HF.[10,12] So, the purposes of this study were to describe sleep quality and determine predictors of disturbances in sleep in heart failure patients in Jordan.

2. Method

An explanatory cross- sectional design was employed to examine sleep quality, dimensions of sleep characteristics, types of disturbances in sleep within the different classes of HF in Jordan.

3. Setting

Data were collected from 2 cardiac clinics and 2 medical clinics at 3 hospitals in Jordan. Two of these hospitals are considered as major hospitals. They provided health care services for large number of patients with HF. One of the major hospitals is referral (Jordan University of Science and Technology), located in the North of Jordan. It had a total capacity of 600 beds. This hospital has 2 cardiac clinics with 5 cardiologists, who provided health care for patients with cardiac diseases. The estimated number of patients who visited the clinics were 50 to 80 patients per day. The second major hospital is a governmental hospital which located in Irbid city in the North of Jordan and had a total capacity of 202 beds. The internal medical clinics in the hospital provide health care for patients with cardiac diseases in its local community. Hospital also receives patients from other peripheral hospitals. The third hospital is a governmental hospital in Jerash city in the North of Jordan and had a total capacity of 110 beds. The internal medical clinics in the hospital provide health care for patients with cardiac diseases in its local community. The hospital can refer patients to other major hospitals.

4. Study participants

The target population for this study was all patients with HF in Jordan. While the accessible population included HF who visited the selected hospitals during the study period. Quota sampling technique was used in this study to identify population strata and determine how many participants are needed from each class. Also, to insure achieve of a minimum sample of 50 patients per New York heart association functional classification sheet (NYHA) class of HF, so that adequate assessment could be completed. Sample size was calculated using G* power software.[14] The sample size calculation was based on using of multiple regression analysis and a medium effect size is required for the purpose of this study which is (0.15). The sampling inclusion criteria were: age above18 years old; and patients who were diagnosed with heart failure or cardiac disease for at least 1 year.

4.1. Study instrumentation

The Data collection tool in this study was self-rated questionnaire which consisted of 3 parts. Part 1 was the New York Heart Association functional classification for the patients, part 2 was the Arabic version of Pittsburgh Sleep Quality Index (PSQI), part 3 was the demographic data sheet, and part 4 was the disease characteristics sheet which completed from patient's electronic records.

4.2. New York heart association functional classification sheet

Based on criteria identified by the Criteria Committee of the New York Heart Association functional classification, a question that contained 4 items was generated in Arabic language. Each item of the question described the physical activity limitations, and each item is corresponding to each class of heart failure. Item 1 was corresponding to class 1 and so on. The questions that describe your clinical status in an accurate way:

1. Doing my ordinary physical activity doesn't cause fatigue, palpitation, dyspnea, or anginal pain.
2. Doing my ordinary physical activity causes fatigue, palpitation, dyspnea or anginal pain.
3. Doing < my ordinary physical activity causes fatigue, palpitation, dyspnea or anginal pain, but these symptoms disappear at rest.
4. Even at rest, I have symptoms of fatigue, palpitation, dyspnea or anginal pain, and if any physical activity is undertaken, discomfort increases.

4.3. The pittsburgh sleep quality index (PSQI)

The PSQI is a self-rated questionnaire that was developed by Buysse et al (1989). PSQI was designed to measure sleep quality-in clinical populations. PSQI contains 7 dimensions of sleep characteristics: subjective sleep quality (1 item), sleep latency (2 items), sleep duration (1 item), habitual sleep efficiency (3 items), disturbances in sleep (9 items), use of sleeping medication (1 item) and day time dysfunction (2 items).[15]

The total number of items are 19 items which are summed to a single global PSQI score that can range between 0 and 21. The higher score the worse the sleep quality. In this scale a score of > 5 is classified as poor sleep quality and a score of equal or < 5 is classified as good sleep quality.[15] The Cronbach's alpha was 0.86.[16] The study of Spira et al, 2012 reported that the internal consistency for the PSQI was adequate (Cronbach's alpha = 0.69).[17]Arabic version was used in our study (Cronbach's alpha = 0.78; Suliman et al, 2012).

4.4. Data collection procedure

Data collection took a period of 3 months from August until October 2018. Participants who met the eligibility criteria were invited to participate in this study. Second, at the waiting area of the clinic, the researcher identified himself to the potential participants, explained the nature and purpose of the study and invited them to participate. Those who agreed to participate in the study received a copy of the consent form. Then, the self-reported questionnaire was administered to the participants. After that the researcher read the items, provided explanation if needed and let the patients to fill out the questionnaires, at the same time researcher was available when help was needed.

4.5. Data analysis procedure

The SPSS software version 27, (IBM SPSS Stastics, Chicago) was used for data analysis. The frequency and percentage were used to describe the characteristics of the sample. Linear regression analysis was used to address the relationships between the study variables and sleep quality and to explore the predictors of poor sleep quality. Significant statistical differences assessed using a *P* value of .05.

5. Results

5.1. Demographical data

In this study, a total number of 200 participants with cardiac diseases completed the questionnaires. See Table 1 and Table 2

5.2. Sleep quality for HF patients

Sleep quality dimensions are subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication and daytime dysfunction. Sleep quality dimensions have scores ranged from 0 to 3, where 0 indicated no problem in the dimension and 3 indicated sever problem in the dimension.

5.3. Subjective sleep quality

Close-ended question was used to identify patients' perspective about their level of sleep quality. The result in the dimension of subjective sleep quality was showed that patients reported different levels of sleep quality. The frequency of patients who evaluated their sleep quality as very good or good was decreased with the increase of the NHHA class. In contrary, the frequency of patients who evaluated their sleep quality as bad or very bad was increased with the increase of the NYHA class. Chi-Square test was done to explore if the differences in subjective sleep quality within different classes of heart failure were significant. Results showed that there were significant differences in subjective sleep quality within classes of HF (P = .001), df = 9, Pearson chi-square (178.249). See Table 3

5.4. Sleep latency

Analysis of variance (ANOVA) was used to examine the differences in the scores of sleep latency between different classes of HF. Results showed that there were significant differences in sleep latency between groups, (F (71.104) = (3196), P = .001). This indicated that whenever the class of heart failure progressed

Table 1

Participant characteristics (N = 200).

Variable	Frequency (%)	Mean (SD)	Range
Age		58.49 (11.462)	27–88
Gender			
Male	127 (63.5)		
Female	73 (36.5)		
Marital status			
Single	6 (3.0)		
Married	170 (36.5)		
Divorced	1 (5)		
Widow	23 (11.5)		
Level of education			
Illiterate	38 (19)		
Primary school	14 (7.0)		
Secondary school	96 (48.0)		
Diploma	25 (12.5)		
Bachelor	21 (10.5)		
Higher education	6 (3.0)		
Smoking			
No	115 (57.5)		
Yes	85 (42.5)		
No. of cigarette per d		13.1 (17.23)	
Body mass index		30.14 (5.52)	17.57–60.89

Table 2

Disease characteristics for HF in this study (N = 200).

Variable	Frequency (%)	Mean (SD)	Range
Medical diagnosis			
IHD	143 (71.5)		
HF	36 (18)		
AF	4 (2)		
DCM	6 (3)		
ACS	11 (5.5)		
Medication currently taken			
No. of medication	94 (47.0)	6.64 (1.43)	4–11
Taking ACE inhibitors	69 (34.5)		
Taking ARB	170 (85.0)		
Taking beta blockers	124 (62.0)		
Taking diuretic	60 (30)		
Taking diabetic medication			
Ejection fraction		47.63 (9.91)	17–60
Pittsburgh sleep quality index (0–21)		9.28 (4.61)	1–18
Male		8.89 (4.48)	2–17
Female		9.94 (4.79)	1–18
Duration of cardiac disease (yr)		5.1 (3.72)	1–20

ACE = angiotensin converting enzyme, ACS = acute coronary syndrome, AF = atrial flutter, ARB = angiotensin receptor blocker, DCM = dilated cardiomyopathy, HF = heart failure, IHD = ischemic heart disease.

Table 3

Subjective sleep quality in classes of HF. (N = 50).

Class of HF	Very good No (%)	Fairly good No (%)	Fairly bad No (%)	Very bad No (%)	Total No (%)
Class 1	17 (34)	31 (62)	2 (4)	0 (0)	50 (100)
Class 2	1 (2)	32 (64)	17 (34)	0 (0)	50 (100)
Class 3	0 (0)	8 (16)	26 (52)	16 (32)	50 (100)
Class 4	0 (0)	0 (0)	14 (28)	36 (72)	50 (100)
Total	18 (9)	71 (35.5)	59 (29.5)	52 (26)	200 (100)

HF = heart failure.

the sleep latency scores increased, which indicated longer sleep latency and worse sleep quality. Then Post hoc analysis was done to explore differences in the sleep latency. Results showed that the differences in sleep latency were significant between all classes of heart failure *P* value = .001, except between class II and class III, the difference was not significant *P* value was .368.

5.5. Sleep duration

The overall participants in our study had a short sleep duration hour with a mean of 5.85 hours. Means of sleep duration hours for the 4 classes of HF were as follow: class I HF had a mean of 6.8 (SD = 0.738) hours of sleep duration, class II HF had a mean of 6.2 (SD = 0.840) hours, class III HF had a mean of 5.4 (SD = 0.907) hours and class IV heart failure had a mean of 5.0 (SD = 0.698) hours of sleep duration. Analysis of variance (ANOVA) was used to examine the differences in the scores of sleep duration between different classes of HF. Results showed that there were significant differences in sleep duration dimension between groups, (F (50.027) = (3196), *P* = .001).

5.6. Sleep efficiency

Sleep efficiency was calculated by the percentage of actual hours of sleep duration divided by hours spent in bed. Nearly half (45.5%, n = 91) of participants in the 4 classes had sleep efficiency between 84% to 75%, and only 11% (n = 22) had sleep efficiency < 65%. Analysis of variance (ANOVA) was used to examine the differences in the scores of sleep efficiency between different classes of HF. Results showed that there were significant differences in sleep efficiency scores between groups, (F [22.235] = [3196], *P* = .001). Post hoc analysis was done to detect if this relationship was significant. Results indicated that the differences in sleep efficiency between classes of HF were significant, except between class I and class II, and between class II and class III, *P* value was more than .05.

5.7. Using of sleep medication

Most of our study sample 78.5% (n = 157) not used sleep medication in the last month. Only 2% (n = 4) used sleep medication more than 3 times per week. ANOVA test was done, then post hoc analysis was done to explore if there were significant differences of using sleep medication between classes of HF. Results indicated that the differences in the use of sleep medication between different classes of heart failure was not significant, except between class I with class IV the difference was significant (*P* = .029). this result mean that only participants in class IV had a trend to use sleep medications.

5.8. Day time dysfunction

ANOVA test was used to examine the differences in the daytime dysfunction between different classes. Results showed that there were differences in the dimension of daytime dysfunction between the different classes of heart failure (F [185.222] = [3196] *P* = .001). The results of mean plots showed that daytime dysfunction scores were increased with the progression of the NYHA class. The increase in the scores of daytime dysfunctions mean worse day function and worse sleep quality. Then post hoc analysis was done to explore the differences in the daytime dysfunction. Results showed that there were significant differences in daytime dysfunction scores between all classes of HF.

5.9. Relationship between sleep quality demographic variables and disease characteristics

According to regression analysis, significant relationship was found between sleep quality and gender, disease duration, number of medications currently taken and ejection fraction (*P* < .05). On the other hand, the relationship between sleep quality and age, marital status, number of cigarettes per day, level of education and body mass index were not significant (*P* > .05). The relationship between sleep quality and gender was significant (*P* value = .001), female participants had higher scores of PSQI than males which indicated poorer sleep quality-in females than males. Number of medications currently taken, and disease duration had a significant positive relationship with sleep quality (*P* = .003). The increase in disease duration and number of medications currently taken associated with an increase in total score of PSQI which indicated worse sleep quality. On the other hand, ejection fraction had a significant negative relationship with PSQI scores *P* value = .001. The decrease in ejection fraction associated in an increase in total score of PSQI which mean poorer sleep quality.

In this sample, and with these predictors, the variable ejection fraction was the best predictor of sleep quality (Beta = -0.653), and the variable gender was the second-best predictor (Beta = 0.162). Table 4 showed regression analysis results for demographic and disease characteristics and sleep quality.

The overall regression equation showed that the value of F was 46.556, with 9 and 190 df, was highly significant *P* value = .001. The value of R square was 0.688, adjusted R square was 0.673. Thus, 67% of the variance in sleep quality scores in patients with heart failure in this sample was explained by the combined effect of the 10 predictors.

6. Discussion

In the sleep disturbance dimension, the most common types of disturbances in sleep among all study sample were 90% (n = 180) of patients had disturbed sleeping due to waking up for urination, 89% (n = 178) had difficulty to get back to sleep after awaking during the night, 80.5% (n = 161) of the patients

Table 4

Participants demographic and disease characteristics relationship with sleep quality.

Character test	Standardized *β*	*t*	*P*
age	0.43	0.832	.407
Gender	0.162	3.354	.001
Marital status	–0.73	–1.508	.133
Disease duration	0.161	3.000	.003
Level of education	–0.015	–0.315	.753
Ejection fraction	–0.653	–13.170	.001
Number of medication	0.137	2.981	.003
Number of cigarettes per d	0.041	0.934	.352
BMI	0.004	0.092	.927

BMI = body mass index.

were waking up due to cough or snoring, and the 4th common sleep disturbance was difficulty to fall asleep within the thirty minutes 78% (n = 156). Our findings about the most common types of disturbances in sleep was congruent with the findings of[10–12]

The severity and frequency of the most common types of disturbances in sleep among our study population were increased with the progression of NYHA class. class I patients were often complained of these disturbances in sleepless than once time per week. While class IV patients were often complained of these disturbances in sleep more than 3 times per week. These results could be explained by the findings of Albert et al,[18] and Zuurbier et al,.[4]

Albert et al,[18]reported that the severity of clinical manifestations of heart failure was associated positively with the progression of the NYHA class. They compared signs and symptoms for 261 patients in the different classes of HF, their study sample included a minimum of 40 patients per NYHA functional class. The study reported that orthopnea and fatigue were increased from < 25% of patients in class I to more than 80% of patients in class IV (P = .001). They also reported that paroxysmal nocturnal dyspnea and cough were rarely reported by patients in class I, but their frequency increased to > 45% for patients in class IV(P = .001).[18]

Zuurbier et al 2015 reported that the severity and frequency of orthopnea, fatigue, and paroxysmal nocturnal dyspnea were associated positively with the severity of disturbances in sleep in patients with HF. Dyspnea and fatigue caused delay in falling asleep. Orthopnea caused difficulty breathing and cough, difficulty breathing and cough were leading to frequent awaking up at night and difficulty to maintaining sleep in patients with HF.[4]

Almost all participants in this study complaining of waking up at night for urination. This result was congruent with the findings of several previous studies which indicated that waking up at night for urination is common among patients with HF, and it is often a reported cause of poor sleep quality.[7,10–12] Our study results showed that waking up at night for urination was increased with the increase of the NYHA class. This result might be related be to the reduction of cardiac output with the progression of heart failure disease. The decrease of the cardiac output led to congestion of the systemic capillaries. This congestion causes excessive fluid accumulation in the body which redistributed to the systemic circulation in the supine position led to waking up at night for urination.[18,19]

Waking up at night for urination. also associated with sleep disturbances. Redeker et al, 2012 reported that disturbances in sleep increased the probability of waking up at night. The awaking up itself increased the perception to the need for urination.[7] And because our study findings revealed that types of disturbances in sleep were being more frequent and sever with the progression of NYHA class. So, the increase in NYHA class was associated with the increase of nocturia frequency.

Regarding waking up due to pain, our findings showed that 6% of class I, 38% of class II, 80% of class III and 96% of class IV patients with HF were waking up due to pain. These results might be explained by finding of Azevedo et al Azevedo addressed that patients with heart failure started to express different types of pain as well as their general health condition being worse and more complicated. Waking up due to feel cold or due to feel hot were rarely reported by our study population of heart failure regardless of their NYHA class. This result was congruent with the findings of the literature. There was a consensus in the literature that waking up due to feel cold and due to feel hot were rarely reported by patients with HF.[5,10–12,18]

Sleep quality was determined by the total score of PSQI. In the scoring of PSQI, 7 sleep dimensions scores were derived, each dimension has a score of 0 to 3, where 0 indicated no problem and 3 indicated sever problem in the dimension. The 7 dimensions were subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction.[15]

Our study result showed that the subjective description of our participant for their sleep quality moves from very good or good in class I to very bad in class IV. The subjective sleep quality for our participants was consistent with their total score of PSQI and their levels of sleep quality. This patient's perspective toward their sleep quality may be a valid way to assess sleep quality-in patients with HF. So, the subjective evaluation of sleep quality-in patients with HF can be enough to enhance sleep quality in those patients.

Sleep latency scores were increased with the progression of NYHA class, this indicated more difficulty to fall asleep. Sleep latency may be related to the symptoms of fatigue and orthopnea which contribute to a delay in falling asleep for patients with heart failure.[4,20] And because fatigue and orthopnea are increased in severity whenever the NYHA class increase.[18] So therefore, more delay to fall asleep would be found with the progression of the classes of heart failure.

The sleep duration means for all patients in this study was 5.88 hours. This result was congruent with sleep duration means of the previous studies which were conducted for patients with HF in the outpatients clinics.[10,12] Our participants also have a shorter sleep duration with the increase in the NYHA class. This can be explained by that our study population showed an increasing in the severity and frequency of disturbances in sleep with the increase of NYHA class HF. disturbances in sleep in patients with HF cause frequent awaking during night, the increase in the frequent awaking at night is leading to further short sleep duration for those patient.[11]

Nearly half of our study sample had sleep efficiency between 75% - 84%, but most of them were in class I and class II HF. Despite that not all the differences in sleep efficiency within the different classes were significant, but data showed that sleep efficiency was decreased with the progression of the class. The mean of sleep efficiency for the participants in this study (76%) was consistent with the findings of Dos Santos et al and Wang et al who reported sleep efficiency of 72% and 75%.[10,12] In comparison of the means of sleep efficiency scores within the NYHA classes for our sample, data reveals that sleep efficiency scores are associated positively with classes. Where class IV and class III had higher sleep efficiency scores than class I and class II patients.

These results can be explicit by Sharma et al explanation. He reported that patients who woke up at night and could not fall back to sleep would lie on bed until falling asleep again. This time which spent in bed without sleeping, increases sleep efficiency score.[21] And because the majority (94%) of class III and all (100%) of class IV patients in this study had difficulty getting back to sleep after awaking during night, time without sleeping were increased. So, consequently hours spent in bed without sleeping will increased causing higher sleep efficiency scores.

More than 3 quarter of our study population didn't have a trend to use sleep medication at the last month. This result is consistent with the finding of DoSantos who reported that 89.5% of patients were not using any medication to sleep at the last month. On the hand, other previous studies showed that nearly 30% of their patients were using sleep medication more than 3 times per week.[6,10,11] This variation in the using of sleep medication might be due to that sleep quality didn't take the needed concern from the health care providers, or due to the differences between cultures in the issue of valuation of sleep quality and its treatment.[12]

Our study result regarding daytime dysfunction showed that daytime functioning was worse with the progression of the class. Our finding was congruent with the previous study results. Many researchers indicated that day time dysfunction was significantly correlated with disturbances in sleep and poor sleep

quality for patients with HF. Whenever disturbances in sleep and the level of poor sleep quality were worsened, day time dysfunction was being more worse.[7,20,22]

Regression analysis showed that age, gender, marital status, disease duration, level of education, ejection fraction, number of medications currently taken, smoking, and BMI explained 67% of the variance in sleep quality. Among these variables a significant relationship was found between sleep quality and gender ($P < .001$), disease duration ($P < .003$), ejection fraction ($P < .001$), and number of medications currently taken ($P < .003$). Age, marital status, level of education, smoking, and BMI hadn't a significant relationship with sleep quality.

Females reported worse sleep quality comparing to male counterparts. This finding was congruent with literature where several authors addressed that female patients had poorer sleep quality than males.[5,6,10,11] Nasir et al, and Wang et al, rationalized this finding due to depression. Females had higher degree of depression than males, and because depression was associated with poor sleep quality, females had worse sleep quality than males.[6,23]

Among our study sample, the patients who had a longer disease duration and a greater number of medications were having poorer sleep quality than those who were less. This result was consistent with the findings of Javadi et al, and Wang et al stated that patients who suffered from heart failure for a long period of time and taken more number of medication were reported worse sleep quality.[10,11]

There was a significant negative relationship between the ejection fraction and the sleep quality among our study population. Our study findings were consistent with the findings of Javadi et al, and Moradi et al who reported in their studies that there was a negative relationship between ejection fraction and sleep quality.[10,12] This result could be explained by that the decrease in ejection fraction led to cerebral hypo perfusion. Cerebral hypo perfusion impact sleep regulation center in the brain which worsen sleep quality in patients with HF.[24]

Ejection fraction was the best predictor of sleep quality in this current study. However, Zuurbier et al indicated that there was no relationship between ejection fraction and sleep quality. They add that the main influence on sleep quality is the clinical manifestation of HF rather than ejection fraction.[4]

7. Limitations

There are many limitations that facing this study. First of all, this study using cross-sectional design which limits the cause-effect relationship. Another limitation, establishing sleep disorders through reviewing questionary PSQI, but not due to performing somnography and this is related to the expense of using such technology.

8. Implication of the study

Identifying the prevalence of poor sleep quality among each NYHA class of patient with HF, help the nurses to easily assess the level of sleep quality for those patients and to offer more comprehensive care plan according to their NYHA class.[25] Also, when health care providers are understanding the relationship between the severity of the clinical manifestations and the types of disturbances in sleep in each class of HF, they can enhance sleep quality by the effective managing for these manifestations.

9. Conclusion

The results of this study imply that patients with HF continue to have high prevalence of poor sleep quality and sleep disturbances. Despite that sleep quality in patients with HF is a complicated issue more than typically believed, our findings indicated that sleep quality and disturbances in sleep were worsening with the increase of the NYHA class. Moreover, sleep quality had a significant association with gender, disease duration, ejection fraction, and the number of medications currently taken.

Author contributions

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