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Relationship of sleep duration and sleep quality with health-related quality of life in patients on hemodialysis in Neyshabur

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ABSTRACT

Background: As a public health priority, health-related quality of life (HRQoL) is associated with some factors like sleep disorders. Taking this into consideration, this study aimed at investigating the relationship between sleep duration and sleep quality with HRQoL in patients on hemodialysis.
Methods: This cross-sectional study was carried out among 176 patients on hemodialysis who were admitted to the dialysis ward of 22 Bahman hospital and a private renal clinic in Neyshabur (a city in North-East of Iran) in 2021. Sleep duration and quality were measured using an Iranian version of Pittsburgh Sleep Quality Index (PSQI) and HRQoL was evaluated with the Iranian version of a 12-Item Short Form Survey (SF-12). To analyze the data and examine the independent association of sleep duration and quality with HRQoL, multiple linear regression model was performed.
Results: The mean age of the participants was 51.6 ± 16.4 and 63.6% were male. Moreover, 55.1% and 5.7% of subjects reported a sleep duration shorter than 7 h and equal to or more than 9 h, respectively, and the value prevalence of poor sleep quality was reported as 78.2%. Furthermore, the reported overall score of HRQoL was 57.6 ± 17.9. According to the adjusted models, poor sleep quality was negatively associated with the total HRQoL score ($B = -14.5$, $P < 0.001$). Shedding light on sleep duration and Physical Component Summary (PCS), the result indicated that insufficient sleep duration (<7 h) had a borderline negative association with PCS ($B = -5.96$, $p = 0.049$).
Conclusions: Sleep duration and quality have important effects on HRQoL in patients on hemodialysis. Therefore, in line with improving sleep quality and HRQoL among these patients, essential interventions should be planned and performed.

1. Introduction

Health-related quality of life (HRQoL) is considered a public health priority, which deals with how individuals detect their physical and mental health status [1,2]. In this regard, HRQoL is generally assessed by various indicators of self-perceived health status, physical, and emotional functioning [3]. Reviewing the literature, researchers found that sociodemographic variables, chronic illnesses, psychiatric and physical conditions, sleep quality, and sleep-related disorders may affect HRQoL levels [4,5].

Currently, chronic diseases have been supposed to be the most common physical dysfunctions that potentially aggravate patients' HRQoL by imposing a high economic burden and functional limitation [6]. Due to the fact that patients with renal disease have to receive treatments like hemodialysis when they encounter end-stage kidney failure, renal diseases have been turned into a worldwide public health problem. Research has shown that nearly 50–80% of patients on hemodialysis experience a lower level of HRQoL [1,7].

As a health epidemic issue, sleep disorders such as sleep deprivation, insomnia, short or long sleep duration, and poor sleep

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quality have turned into health problems and garnered the attention of world health agencies [8]. Evidences from previous studies have shown that both long and short-sleepers are prone to a higher risk of mortality and disability. Moreover, in comparing long and short-sleep duration with average sleep duration, research findings delineated that excessive or insufficient sleep duration may contribute to health disorders [9,10]. In spite of highlighting the aforementioned problems, getting adequate sleep seems to be vital for all body processes, keeping the mind and body healthy, and affecting the overall quality of life as well [6]. Quality of sleep refers to having enough energy to start a new day, and it is affected by some factors such as social, economic, lifestyle, and general health Relying on study findings, good sleep quality potentially enhances functional capacity and maintenance of kidneys hemostasis through keeping the amount of water balanced, whereas chronic insomnia may increase the risk of chronic kidney disease [11]. Similar to the general population, boosted stress, anxiety, and depression are associated with poor sleep quality in patients on hemodialysis. Casting much light, the adverse state of poor sleep quality negatively affects the immune response and can cause the introduction of cardiovascular diseases, which are the first cause of death in all patients with renal disease [12]. Therefore, concerning findings and evidences from recent studies, short or long sleep duration as well as poor sleep quality impact HRQoL [13]. Consistent with these explanations, well-being assists patients to perform their normal activities appropriately [14]. Highlighting this matter, clinical researchers demonstrated that measuring level of HRQoL can lead to identify poor perceived health and physical dysfunctions in individuals and thus help them in providing the required interventions and strategies to prevent more detrimental consequences [15]. Delineating the significance of HRQoL, we can assert thatunderstanding HRQoL and its contributing factors, including sleep disorders and ways to improve it, enables health providers to perform an appropriate examination on patients and access more acceptable and proper medical treatments and services. Given the above and the importance of HRQoL, this study set out to examine how sleep duration and sleep quality are associated with HRQoL in patients on hemodialysis in the context of Neyshabur, Iran.

2. Materials & methods

2.1. Participants

This cross-sectional study was conducted in 2021. The participants included all the patients on hemodialysis (n = 191) of the dialysis ward of 22 Bahman hospital and a private renal clinic in Neyshabur (Razavi Khorasan province, northeastern Iran). Among the 191 participants available to participate in the current study, 15 were not eligible to participate in the study. All the participants resided in the region and received dialysis for at least 6 months The study population was enrolled based on the access list in the two mentioned settings (the dialysis ward of Bahman 22 hospital and the private renal clinic). Prior to completing the qualified interviewer-administered survey questions, the participants were explained their rights and the purpose and procedures of the study. The ethical approval for this study was obtained from the Ethical committee of Neyshabur University of Medical Sciences (IR.NUMS.REC.1398.024).

2.2. Measurements

In order to collect data, Pittsburgh Sleep Quality Index (PSQI) questionnaire and a twelve-item Short-Form Health Survey (SF-12) along with a checklist were administrated.

2.3. Sleep duration and quality assessment

Given that the participants of this study were Iranian patients with renal disorders, the Persian version of the PSQI questionnaire validated by Farrahi Moghadam et al. was employed to check their sleep duration and quality over the past month (Cronbach's alpha = 0.77) [16]. This nineteen-item questionnaire adapted from Buysse consists of seven components of subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction [17]. Each component was assigned a score ranging from 0 (no difficulty) to 3 (severe difficulty), and the total score ranged from 0 to 21 which was considered the global PSQI score. According to Chiu and Hsu, the quality of sleep is significantly lowered when the global PSQI scores are over 5 [18]. Another component of PSQI in the current study is sleep duration, which is classified into insufficient (<7 h), sufficient (≥7 to <9), and excessive (≥9 h) [19].

2.4. Health-related quality of life (HRQoL)

As one of the most widely used instruments, SF-12 was employed to measure the self-reported HRQoL. This questionnaire is a valid and reliable tool that encompasses all the dimensions related to HRQoL. SF-12 includes eight health dimensions namely physical functioning (PF), limitations related to role-playing due to physical problems (RP), bodily pain) BP), general health (GH), vitality (VT, (social functioning (SF), limitations due to role-emotional problems (RE), and mental health (MH), adapted based on a 36-item Short-Form Health Survey (SF-36) [20]. The first four dimensions (PF, RP, BP, and GH) and the remaining dimensions (RE, VT, SF, and MH) are aggregated to assess the Physical Component Summary (PCS) and Mental Component Summary (MCS), respectively. The questionnaire enjoys parallelism and internal consistency. The reliability of the questionnaire and its subscales were calculated with Cronbach's alpha in the Iranian context (Cronbach's alpha for PCS and MCS were 0.89 and 0.90, respectively). The validity of the questionnaire for the Iranian sample was confirmed by Pakpour et al. [21]. To show the respondents' health status, the score ranged from zero (worst) to 100 (best) [22].

2.5. Covariates

Sociodemographic and clinical data included age (<54 vs ≥ 54 years, the median value), gender (male vs female), marital status (single vs married), BMI (<25 vs ≥ 25 kg/m^2), family local residency (urban vs rural), education (<diploma vs ≥ diploma), smoking status (no vs yes), chronic diseases (no vs yes), alcohol consumption (no vs yes), history of drug use (no vs yes), and wealth index (WI) (poorest, poor, moderate, rich and the richest) and were considered covariates in this study. Drug use included illegal drugs (such as opioid, hashish, marijuana and other illegal drugs that mentioned by participants). The data on WI were collected using easy-to-collect in terms of properties belonging to patients' families including telephone, mobile phone, fridge, microwave, personal computer, washing machine, bathroom, kitchen, toilet, car, motorcycle, house, and the number of rooms per capita as well as the infrastructure of the house [23,24].

2.6. Statistical analysis

All statistical analyses were performed using STATA, version 14. Descriptive statistics included frequencies, percentages, means, and standard deviations (SD). In line with assessing the relationship between patients' HRQoL and their characteristics, the univariate linear regression model was used. Having used the multiple linear

regression model, the association of sleep duration and quality with HRQoL and its dimensions was established after adjusting for the studied covariates. The variance inflation factor (VIF) was used to check multicollinearity amongst the independent variables and all the VIF values were less than 3. The significant level for the statistical tests was set at $P < 0.05$.

3. Results

A total of 176 patients on hemodialysis were examined for the HRQoL level and its association with sleep duration and quality. All characteristics of the recruited patients in the study are presented in Table 1. The mean age of the participants was 51.6 ± 16.4 and 63.6% of the participants were male. Three-quarters (75.0%) were married and 53.9% reported a chronic disease history. Of the total number, 58.3% reported moderate to the richest level of WI, while the rest had poor or the poorest level of WI. The prevalence of poor sleep quality among the patients was 78.2%. It was established that most of the participants (55.1%) reported a sleep duration of less than 7 h; however, those who got an average of 7−9 h and greater than or equal to 9 h of sleep made up about 39.2% and 5.7% of the participants, respectively.

The overall score of HRQoL was reported in the range of 57.6 ± 17.9. Table 2 shows the mean scores of HRQoL dimensions involved in the study population based on sex, age, marital status, education, family residency, smoking, chronic diseases history, BMI, history of drug use, alcohol consumption, WI, sleep duration, and sleep quality. Compared to other participants, those with no history of chronic disease had higher HRQoL scores. Concerning some subscales and components of HRQoL including PF, RE, MCS, and PCS ($p < 0.05$), results of the analysis indicated a significant difference between females and males. Besides, the patients with poorer sleep quality scores suffered lower scores of HRQoL. Interestingly, considering patients' education, BMI, family residency, smoking, history of drug use, WI, and sleep duration ($p < 0.05$), no significant differences were found between HRQoL scores. Finally, the analysis revealed that patients aged 54 and older had lower SF scores ($p < 0.05$). The second phase of the analysis included the results of multiple linear regression models which are presented in Table 3. According to the adjusted models for other variables, compared to good sleep quality, poor sleep quality was negatively associated with RP ($B = -26.1$, $p < 001$), RE ($B = -19.8$, $p = 0.008$), VT ($B = -16.0$, $P = 0.009$), MH ($B = -13.0$, $P = 0.023$), BP ($B = -19.6$ $P = 0.001$), MSC ($B = -15.0$, $P = 0.001$), PCS ($B = -13.8$, $P < 0.001$), and total HRQoL score ($B = -14.5$, $P < 0.001$). In addition, in comparing the sufficient (7-<9 h) and insufficient (<7 h) sleep duration, insufficient sleep duration had a borderline negative association with PCS ($B = -5.96$, $p = 0.049$), though insufficient sleep duration was not associated with other subscales of HRQoL and its total score ($p > 0.05$). At the final stage of statistical analysis, in comparing the long sleep duration (≥9 h) and sufficient sleep duration (7-<9 h), results of multiple linear regression models indicated that longer sleep duration was not associated with the subscales of HRQoL and its total score ($p > 0.05$).

Table 1
Descriptive analysis of the variables.

Variables	Number		Percent
Gender	Female	64	36.36
	Male	112	63.64
Age (years)	<54	88	50.00
	≥54	88	50.00
Marital Status	Single	44	25.0
	Married	132	75.0
BMI	<25	112	63.64
	≥25	64	36.36
Family local residency	Urban	124	70.45
	Rural	52	29.55
education	<diploma	126	71.59
	>=diploma	50	28.41
Smoking	No	149	84.66
	Yes	27	15.34
Chronic disease	No	81	46.02
	Yes	95	53.9
History of drug use	No	156	88.64
	Yes	20	11.36
Alcohol consumption	No	164	93.18
	Yes	12	6.82
WI	Poorest	35	20.23
	Poor	37	21.3
	Moderate	32	18.5
	Rich	35	20.2
	Richest	34	19.6
Sleep quality	Good	38	21.7
	Poor	137	78.2
Sleep Duration (hours)	<7	97	55.1
	≥7 to <9	69	39.2
	≥9	10	5.68

Abbreviations: Body Mass Index (BMI), and Wealth Index (WI).

4. Discussion

The primary purpose of the present study was to examine the association between both duration and quality of sleep and HRQoL in patients on hemodialysis. Fulfilling the aim of the study, the participants were administrated two questionnaires (SF-12 and PSQI) as well as a checklist to report their sociodemographic characteristics. By analyzing the data, the study found several findings. A major finding of this study is that poor sleep quality is negatively associated with total HRQoL, its components, and most of the dimensions. Also, sleep duration had a borderline negative association with PCS. Complementary to the study findings, the findings showed that the mean score of HRQoL was 57.6; however, existing research findings have documented better total scores for HRQoL [25,26]. Finding academic traces to confirm our findings, in a study conducted on adult patients dealing with type-2 diabetes, the total score of HRQoL was reported as 51.2 [27]. Likely, results from a study on 245 patients on hemodialysis in Iran indicated a total HRQoL score of 56.6, which is consistent with our study finding [6]. Contrary to the reported total score of HRQoL which was 57.6, there are studies in which the HRQoL scored lower [28,29]. These discrepancies for HRQoL can be attributed to the differences in the standard indicators of wealth, employment, the environment, physical and mental health, education, social belonging, religious beliefs, safety, and security.

Regarding the classification of sleep duration, a considerably higher portion of participants (55.1%) reported having short sleep duration (<7 h), which is consistent with the results of a study on New Zealanders that examined the association between short sleep duration and psychological well-being [30]. In a similar vein, our finding can be supported by previous research conducted on Chinese adults, which found the same percentages of sleep duration [31]. On contrary, our findings indicated a small percentage (5.6%) of longer sleepers (≥9 h) as compared to the percentage found in the study by Leger et al. [32].

To date, the association between the duration of sleep and HRQoL in patients on hemodialysis has been scarcely reported in the related literature. Referring to Table 3, this study didn't identify any associations between sleep duration with all dimensions and components of HRQoL except in PCS ($p = 0.049$). This differs considerably from previous studies, where a relationship was found between sleep duration and HRQoL [33,34]. A survey on Korean adults with Chronic Kidney Disease (CKD) suggested a strong

Table 2
The mean scores of quality of life subscales according to the characteristics of dialysis patients.

	PF	RP	BP	GH	VT	SF	RE	MH	MCS	PCS	Total
Total	45.1	24.7	52.2	75.9	58.2	77.2	58.8	68.2	65.6	49.6	57.6
Sex											
Female	32.0	20.5	51.1	78.6	52.7	76.5	48.6	63.2	60.3	45.5	52.9
Male	52.6	27.2	52.9	74.4	61.3	77.6	64.7	71.0	68.7	51.9	60.3
P-value	<0.001	0.195	0.734	0.192	0.091	0.828	0.010	0.096	0.022	0.030	0.008
Age											
<54 years	53.9	33.5	48.5	75.6	61.0	73.2	60.2	68.75	65.8	52.9	59.3
≥54 years	36.3	16.1	55.9	76.3	55.3	81.2	57.5	67.7	65.4	46.3	55.8
P-value	0.002	<0.001	0.130	0.825	0.250	0.106	0.658	0.827	0.920	0.020	0.197
Marital status											
Single	47.1	22.2	52.2	74.5	52.8	74.4	50.8	64.7	60.7	51.5	58.1
Married	44.5	32.3	52.2	76.4	60.0	78.2	61.5	69.4	67.3	49.0	56.1
P-value	0.697	0.078	1.000	0.600	0.207	0.507	0.127	0.375	0.108	0.431	0.528
education											
<diploma	42.4	23.7	53.7	75.7	55.3	81.1	55.2	66.6	64.6	49.05	56.8
>=diploma	52	27.5	48.5	76.6	65.5	67.5	68	72.2	68.3	51.15	59.7
P-value	0.144	0.495	0.331	0.801	0.063	0.012	0.058	0.266	0.347	0.507	0.331
BMI											
<25	47.0	27.0	53.3	76.4	56.6	76.7	58.5	68.6	65.1	50.9	58.0
≥25	41.7	20.8	50.3	75.07	60.9	78.1	59.3	67.5	66.5	47.2	56.8
P-value	0.387	0.239	0.561	0.671	0.409	0.794	0.902	0.822	0.720	0.213	0.666
Family residency											
Urban	44.5	24.2	52.2	74.8	57.2	78.02	62.5	69.9	66.9	51.2	57.9
Rural	46.6	25.9	52.4	78.7	60.5	75.4	50.2	64.1	62.6	48.9	56.8
P-value	0.748	0.761	0.972	0.262	0.540	0.639	0.065	0.244	0.267	0.459	0.717
Smoking											
No	44.2	25.1	51.3	76.3	56.8	76.1	57.3	66.7	64.3	49.4	56.8
Yes	50	22.6	57.4	74.07	65.7	83.3	67.1	76.3	73.1	51.0	62.0
P-value	0.486	0.721	0.371	0.607	0.196	0.133	0.248	0.126	0.072	0.678	0.161
Chronic disease											
No	58.6	35.4	55.2	73.9	63.2	77.7	62.6	73.1	69.2	55.8	62.5
Yes	33.6	15.6	49.7	77.7	53.9	76.8	55.6	64.0	62.6	44.3	53.4
P-value	<0.001	<0.001	0.261	0.233	0.059	0.850	0.251	0.045	0.064	<0.001	0.001
History of drug use											
No	44.5	25	53.2	75.6	56.4	76.6	60.0	68.4	65.3	49.7	57.5
Yes	50	23.1	45	78.2	72.5	82.5	50	66.8	67.9	49.0	58.5
P-value	0.558	0.812	0.286	0.604	0.038	0.449	0.296	0.828	0.642	0.888	0.814
Alcohol consumption											
No	68.7	28.1	54.1	70.8	64.5	75	58.3	72.9	67.7	55.4	57.3
Yes	43.4	24.5	52.1	76.3	57.7	77.4	58.9	67.9	65.5	49.2	61.5
P-value	0.030	0.718	0.834	0.376	0.487	0.804	0.961	0.578	0.755	0.268	0.431
WI											
Poorest	33.5	26.0	54.2	75.7	60	78.5	60.7	65.7	66.2	47.8	56.9
Poor	39.1	23.6	50.6	80.9	55.4	77.0	52.7	62.5	61.9	48.6	55.2
Moderate	47.6	17.5	52.3	76.0	54.6	82.0	49.2	68.3	63.5	48.4	55.9
Rich	51.4	22.8	55.7	74.2	58.5	76.4	64.2	77.5	69.1	51.0	60.1
Richest	55.8	32.7	48.5	71.4	64.7	74.2	68.0	68.3	68.8	52.1	60.4
P-value	0.104	0.442	0.901	0.41	0.730	0.906	0.272	0.302	0.629	0.853	0.646
Sleep quality											
Good	57.8	48.3	65.7	73.02	71.7	84.2	75.9	78.2	77.5	61.2	69.4
Poor	41.9	18.4	48.9	76.7	54.1	75.1	54.5	65.6	62.3	46.6	54.4
P-value	0.025	<0.001	0.001	0.334	0.003	0.133	0.003	0.021	<0.001	<0.001	<0.001
Sleep duration											
<7 h	41.4	21.6	48.7	76.2	56.4	78.0	57.8	66.1	64.6	47.02	55.8
≥7 to <9 h	51.4	27.1	56.1	75.7	60.8	77.5	61.5	70.2	67.5	52.9	60.2
≥9 h	37.5	38.7	60	75	57.5	67.5	50	75	62.5	52.8	57.6
P-value	0.21	0.222	0.901	0.977	0.691	0.620	0.651	0.518	0.664	0.118	0.301

Abbreviations: Health-related quality of life (HRQoL), Physical functioning (PF), Role limitations due to physical problems (RP), Bodily pain (BP), General health (GH), Vitality (VT), Social functioning (SF), Role limitations due to emotional problems (RE), Mental health (MH), Physical Component Summary (PCS), Mental Component Summary (MCS), Body Mass Index (BMI), and Wealth Index (WI).

adverse association between long sleep duration and HRQoL [35]. The results of a study on predialysis CKD showed that short and long sleepers suffered lower HRQoL compared to individuals with a 7-h sleep duration [10]. To the best of our knowledge, as relatively few studies have been conducted to examine the potential association(s)between sleep duration and HRQoL among patients on hemodialysis, there is a lack of enough reliable statistics about the rate of sleep duration among this group of patients.

Concerning the PSQI score (>5), the results demonstrated that the total prevalence of poor sleep quality among the patients undertaking dialysis was 78.2%. Similar results are found in a study by Parvan et al. suggesting that the prevalence of poor sleep quality in patients undertaking hemodialysis was higher (83.3%) compared to our study.

[6]. Comparable to our findings, a recent study reported that 70% of patients on hemodialysis suffered from poor sleep quality [36]; also poor sleep quality was a stronger predictor of poor HRQoL than seep duration. Simply put, according to the results of the presents study, it seems plausible that the higher rate of poor sleep quality can in turn lead to severe impairment of HRQoL [37]. Along with

Table 3
Adjusted relationship of sleep quality and duration using multiple linear regression model.

HRQoL dimensions	Variables		Beta	SE	T	P-Value	R^2
PF	Poor Sleep quality		−13.22	6.86	−1.92	0.056	0.21
	Sleep duration	<7 h	−9.01	5.99	−1.51	0.134	0.21
		≥9 h	−22.61	13.16	−1.72	0.088	
RP	Poor Sleep quality		−26.10	5.64	−4.62	<0.001	0.26
	Sleep duration	<7 h	−6.23	5.21	−1.20	0.23	0.17
		≥9 h	−1.50	11.45	−0.13	0.896	
RE	Poor Sleep quality		−19.77	7.40	−2.67	0.008	0.15
	Sleep duration	<7 h	−6.01	6.56	−0.92	0.361	0.12
		≥9 h	−21.72	14.43	−1.51	0.134	
VT	Poor Sleep quality		−15.99	6.06	−2.64	0.009	0.14
	Sleep duration	<7 h	−4.52	5.39	−0.84	0.402	0.11
		≥9 h	−4.16	11.85	−0.35	0.726	
MH	Poor Sleep quality		−13.00	5.66	−2.30	0.023	0.12
	Sleep duration	<7 h	−4.05	4.99	−0.81	0.419	0.10
		≥9 h	4.32	10.98	0.39	0.694	
SF	Poor Sleep quality		−11.37	6.26	−1.82	0.071	0.08
	Sleep duration	<7 h	−1.62	5.49	−0.30	0.76	0.06
		≥9 h	−9.33	12.08	−0.77	0.441	
BP	Poor Sleep quality		−19.60	6.03	−3.25	0.001	0.13
	Sleep duration	<7 h	−7.78	5.41	−1.44	0.152	0.09
		≥9 h	4.24	11.89	0.36	0.722	
GH	Poor Sleep quality		3.41	4.01	0.85	0.396	0.07
	Sleep duration	<7 h	0.28	3.51	0.08	0.936	0.06
		≥9 h	1.57	7.68	0.20	0.838	
MCS	Poor Sleep quality		−15.03	4.33	−3.47	0.001	0.15
	Sleep duration	<7 h	−4.05	3.89	−1.04	0.300	0.09
		≥9 h	7.72	8.56	−0.90	0.368	
PCS	Poor Sleep quality		−13.81	3.28	−4.20	<0.001	0.22
	Sleep duration	<7 h	−5.96	3.00	−1.98	0.049	0.16
		≥9 h	−4.69	6.57	−0.71	0.476	
Total HRQoL	Poor Sleep quality		−14.45	3.17	−4.56	<0.001	0.21
	Sleep duration	<7 h	−4.96	2.92	−1.70	0.092	0.12
		≥9 h	−6.19	6.40	−0.97	0.335	

Abbreviations: Health-related quality of life (HRQoL), Physical functioning (PF), Role limitations due to physical problems (RP), Bodily pain (BP), General health (GH), Vitality (VT), Social functioning (SF), Role limitations due to emotional problems (RE), Mental health (MH), Physical Component Summary (PCS), and Mental Component Summary (MCS).

those reported in the literature, this finding suggested that the prevalence of poor sleep quality and its association with lower HRQoL in patients on hemodialysis was considerable, and those with poor sleep quality were more likely to have lower MCS and PCS scores than those with good sleep quality as well [38].

The results closely matched those obtained by Parvan et al., in which the researchers reported that the presence of poor sleep quality in patients on hemodialysis could degrade the HRQoL and subsequently result in higher mortality [6]. This was explained by Edalat-Nejad (2013) who maintained that HRQoL level, particularly mental dimension decreases as poor sleep quality increases [39]. As statistical results of a survey among 135 patients have shown that probably due to renal treatments, patients experienced poor quality of sleep [40]. The results agreed by and large with those reported by Abdalla et al., this investigation on sleep quality in elders reflected that poor sleep quality remained associated significantly with lower HRQoL [41].

By investigating the sleep quality association with mental and physical health, Carpi found that university students experienced higher HRQoL when they have better sleep quality [42]. Taken together, our examination confirmed that people with poor sleep quality had relatively 15 scores of HRQoL lower than individuals with good sleep quality. Notwithstanding the fact that the methods and measurements concerning sleep quality and HRQoL vary, the conclusions drawn from the analyses of the results were similar. The findings provided conclusive supports to suggest that quality of sleep may be an important contributor to the low HRQoL whilst sleep duration probably can't be an important factor for HRQoL among patients on hemodialysis.

5. Limitations and strengths

As with all such studies, there are limitations that offer opportunities for further research. First and foremost, the data were provided from the self-reports of sleep-related phenomena and HRQoL. Sleep quality and duration were assessed most accurately by polysomnography. Nonetheless, we selected a sleep quality measure that has been validated and compared with polysomnography and is widely used in studies in this domain. Second, our study was a cross-sectional study instead of a controlled study or prospective one that can be extracted causative findings. Third, measuring sleep duration is not easy, as discontent between subjective and objective and intraindividual variability of sleep duration has been reported. Fourth, the study population of this study is relatively low, which can affect the obtained results such as the association between sleep duration and HRQoL. Another limitation of the present study is the subjectivity of the Pittsburgh questionnaire. Nevertheless, it should be emphasized that our study enjoys some strengths, by using a multiple linear regression model, we could consider various confounding factors and up to our knowledge few studies that simultaneously examine the duration of sleep, sleep quality, and HRQoL related to patients on hemodialysis.

6. Conclusion

In summary, the results of this study have indicated that there is an inverse association between sleep quality and HRQoL; meaning that, deteriorating sleep quality decreases patients' HRQoL level. The discussion so far has focused on a borderline negative association between sleep duration and HRQoL; thus, it seems necessary

to design and implement the essential interventions by the involved officials and healthcare providers to improve sleep quality, sleep duration, and HRQoL in patients on hemodialysis.

CRediT authorship contribution statement

Minasadat Hosseini: Writing – Data curation. **Ali Gholami:** Writing – original draft, Formal analysis, Data curation. **Maryam Nasrabadi:** Writing – original draft. **Ensiyeh Mollanoroozy:** Writing – original draft. **Fatemeh Khani:** Data curation. **Zahra Mohammadi:** Data curation. **Faeze Barzanoni:** Data curation. **Asieh Amini:** Writing – original draft.

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