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Association between Sleep Quality and Health Related Quality of Life among Adult Patients Attending Primary Health Care Centers in Riyadh, Saudi Arabia

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Abstract
Background: *Poor sleep quality is associated with various health outcomes, such as cardiovascular disease, cancer and death. Although the epidemiology of poor sleep has been well described internationally, few studies investigated its prevalence in Saudi Arabia.*
Methods: *We conducted a multicenter, cross-sectional study to investigate the prevalence of poor sleep in three primary healthcare clinics in Riyadh, Saudi Arabia. Sociodemographic and clinical characteristics were collected along with self-reported sleep characteristics, including subjective sleep quality, sleep duration and latency, were also recorded. We used the Pittsburgh sleep quality index (PSQI) to assess sleep quality, with lower scores indicating better sleep quality. We considered an overall PSQI score > 5 to indicate poor sleep quality. We also evaluated health-related quality of life (QoL) via the health-related quality-of-life questionnaire short-form SF-12 Health Survey (SF-12).*
Results: *Between [October], 2020, and [January], 2021, we enrolled 400 participants who met all eligibility criteria. The median (interquartile range [IQR]) age of participants was 36 (26-46) years, and 206 (52%) were male. We found that 49.5% (95% confidence interval [CI]= 44-55%) of 331 participants with valid data were considered as poor sleepers (PSQI>5). The median (IQR) PSQI score was 5 (3-8). Male sex (mean difference [MD]: -0.98, 95% CI = -1.70 to - 0.26, P=0.008), employed participants (MD: -0.78, 95% CI = -1.51 to - 0.05, P= 0.04) and physically active patients (MD:-1.0, 95% CI = -1.72 to - 0.28, P=0.007) were associated with significantly lower mean PSQI scores. QoL was inversely associated with PSQI scores (β: -0.78 units, 95% CI, -0.95 to -0.61, P<0.001).*
Conclusions: *The prevalence of poor sleep quality is high among Saudi patients served by the primary care setting. There is a direct association between sleep quality and QoL. Our results may have implications for health promotion interventions and policy programs to prevent sleep disorders and improve sleep quality in Saudi Arabia.*
Keywords: *Sleep quality, Health related quality of life, Saudi Arabia.*

Introduction

Sleep plays a ubiquitous role in brain function and physiologic processes of almost every system in the body[1]. As a result, adequate sleep is crucial to optimal health and vitality, and sleep quality has been considered one of the principal factors influencing quality of life[1-3].

In this respect, insufficient sleep also impairs health-related quality of life, negatively influencing existing medical disorders. This has been exemplified by Strine et al., who examined a sample of nearly 80,000 participants and concluded that insufficient sleep was associated with increased physical and mental distress scores, depressive symptoms, anxiety levels, and pain intensity[4].

Over the past decades, a growing body of evidence suggests an association of sleep duration with many disorders, including hypertension, type-2 diabetes, metabolic syndrome, obesity, cardiovascular diseases, and cancer[5]. For instance, a recent study that employed a cohort of more than 400,000 individuals from the UK with a follow-up of approximately nine years showed that individuals who sleep less than 5 hours per night were associated with a 25% increase in the risk of all-cause mortality compared to those who sleep 7 hours per night[5]. According to the authors, there is a U-shaped relationship between sleep duration and the risk of mortality and morbidity, which has been strongly supported by independent findings worldwide[6]. Overall, individuals at the extreme of the distributions (e.g., <5 h or > 9 h of sleep per night) are at greater risk of mortality and morbidity[6].

Despite the importance of sleep, the prevalence of poor sleep is still a serious global concern. Approximately 1 in every three individuals in the United States suffers from insufficient sleep or poor sleep quality[7]. In Europe, the estimates indicate a prevalence of poor sleep ranging from 30 to 38%[8,9], with cross-national surveys revealing that 31% of the study participants reported waking up at least three nights per week [10]. Estimates from China[11], South American countries[12], and Australia[12] follow similar trends.

While the prevalence of poor sleep and its association with health-related quality of life has been widely investigated in many countries worldwide, few studies on that topic have been performed in the Middle East, particularly in Saudi Arabia. Therefore, this study aims to determine the prevalence of poor sleep and its association with health-related quality of life in a population served by the primary care setting in Riyadh, Saudi Arabia.

Material and Methods

Study Design

This was a multicenter, cross-sectional study conducted in three primary healthcare clinics in Riyadh, Saudi Arabia. Ethics committees from the respective institutions approved the study and written informed consent was obtained from all participants. We followed the Declaration of Helsinki, and this study was reported in accordance with the STROBE guideline[13].

Setting

The three participating centers belong to the primary care system of Riyadh, covering different regions of the city. The clinics provide general outpatient care with various medical specialities, targeting primarily armed forces and their families.

Participants

We included patients of both sexes. Patients had to be aged 18 or older. We excluded patients with established cognitive impairment and those with a previous diagnosis of sleep disorders. Sleep disorders were defined as a self-reported presence or proven medical history of any of the following conditions: insomnia, sleep apnea, narcolepsy, restless leg syndrome (RLS), non-24-Hour sleep-wake disorder, and parasomnias.

Variables

Sociodemographic and clinical variables

The following variables were included in the questionnaire: sex, date of birth, marital status, educational level, current employment status, and monthly income. We also assessed pre-existing medical conditions via self-report and recorded variables associated with sleep hygiene, such as caffeine intake, smoking, physical exercise, and use of electronic devices at bedtime.

The questionnaire was pilot-tested and standardized based on a preliminary evaluation of 10 randomly chosen participants.

Sleep Quality

We used the Pittsburgh sleep quality index (PSQI) to assess sleep quality in the studied population[14]. The PSQI is a self-reported questionnaire that captures acute sleep disturbances (previous month). That tool has been widely used to evaluate sleep quality worldwide. It contains 19 items measuring different sleep domains such as subjective sleep quality, sleep latency, duration, sleep disturbance, use of sleeping medications, and daytime dysfunction over the last one month. Each domain is scored from 0 to 3, with higher scores representing worse acute sleep quality. The overall sleep quality can range from 0 (high sleep quality) to 21 (low sleep quality)[14]. As suggested by Shahid et al., we considered an overall PSQI score > 5 as an indicator of poor acute sleep quality[14]. We used the Arabic PSQI version for this investigation, which has been validated previously[15].

Health-related quality of life

We also assessed health-related quality of life via the health-related quality-of-life questionnaire short-form SF-12 Health Survey (SF-12). The SF-12 contains 12 questions assessing mental and physical functioning and overall health-related quality of life over the last month. Higher scores on the examined subscales suggest a better quality of life. The Arabic SF-12 version was used[16].

Sample Size

We distributed the questionnaire to the participants in each center two days per week. Both days and the patients selected to participate were randomly chosen based on computer-generated lists. Under the assumption of infinite population size and between-institution homogeneity (e.g., intraclass correlation coefficient equal to zero), we calculated that 385 participants would allow a 5% margin of error to estimate a variable with 50% prevalence. We increased the number of participants to 400 to allow for possible missing data.

Statistical Methods

We summarized data as mean (standard deviation, SD) for variables with a normal distribution and utilized median (interquartile range, IQR) to describe variables with a skewed distribution. Categorical variables were presented as numbers (percentage or exact 95% confidence intervals, 95% CI). We constructed univariable and multivariable linear regression models to test the association between sociodemographic and clinical characteristics with PSQI and the association between PSQI with health-related quality of life. In multivariable models investigating the association of PSQI with health-related quality of life, we included sex, employment status, and physical exercise only as predictors. Those three variables were defined a posteriori as the minimum set of confounding variables. We carefully performed model diagnostics and calculated the variance inflation factor (VIF). All models had a mean VIF < 2.0, indicating a low risk of multicollinearity.

We performed all analyses in the Statistical Package for Social Sciences (version 21, SPSS Inc, Chicago, Ill). All tests were two-sided, and *P*-values < 0.05 were considered statistically significant.

Results

Characteristics of the studied participants

Overall, 400 participants completed the survey and were included in the analysis. The median (IQR) age of participants was 36 (26 to 46) years; 206 (52%) were male, with a mean (SD) BMI of 27.6 (5.7) kg/m^2. Most participants were employed (208 of 391, 53%), with approximately two-thirds married (273 of 398, 69%). **Table 1** summarizes the demographic and clinical characteristics of the participants.

Table 1 Demographic characteristics of the study sample (N = 400).

Variable	**Descriptive statistic**
Education status, No. (%)	
No formal education (illiterate)	5 (1)
Primary to secondary education	147 (37)
Tertiary education	248 (62)
Monthly income in SAR*, No (%)	
< 5000	53 (19)
5000-10000	96 (35)
10001-15000	66 (24)
> 15000	59 (21)
Marital Status¶, No. (%)	
Single	109 (27)
Married	273 (69)
Widow	7 (1.8)
Divorced	9 (2.2)
Smoking¶, No. (%)	68 (17)
Coffee/tea drinking†, No. (%)	338 (86)
Physical exercise‡, No. (%)	163 (41)
BMI status#, No. (%)	
Underweight (BMI <18.5 kg/m^2)	6 (1.6)
Normal weight (BMI 18.5 to 24.9 kg/m^2)	126 (33)
Overweight (BMI 25.0 to 29.9 kg/m^2)	134 (35)
Obesity (BMI ≥ 30 kg/m^2)	115 (30)
Reported having a history of chronic diseases, No. (%)	103 (26)
Arterial hypertension**, No. (%)	56 (19)
Type-2 diabetes¶¶, No. (%)	44 (15)
Cardiovascular disease††, No. (%)	5 (1.7)
COPD/asthma‡‡, No. (%)	12 (4)
Stroke##, No. (%)	1 (0.3)
Any Cancer##, No. (%)	6 (2.1)
Any Arthritis‡‡, No. (%)	11 (3.8)
Chronic kidney disease##, No. (%)	2 (0.7)

SAR denotes Saudi Arabian Riyal. BMI denotes body mass index in kg/m^2.
* 274 participants with complete data.
¶ 398 participants with complete data
† 392 participants with complete data
‡ 397 participants with complete data
# 381 participants with complete data
** 298 participants with complete data
¶¶ 288 participants with complete data
†† 289 participants with complete data
‡‡ 287 participants with complete data
286 participants with complete data

Sleep medications, sleep quality and sleep duration

Of the 399 participants with complete subjective assessments, 172 participants (43%, 95% CI = 38 to 48%) scored their sleep quality as "very good", and 164 (41%, 95% CI = 36 to 46%) as "fairly good". However, based on a PSQI score > 5, we found that 49.5% (95% CI = 44 to 55%, 331 participants with valid data) were considered as having a poor sleep quality.

Regarding sleep duration (per 24-hour period) in 382 participants with complete data, 148 (39%) reported seven or more hours, 152 (40%) reported six to seven hours, and 82 (21%) reported less than five hours of sleep.

A total of 66 (17%) of 388 participants with complete data reported using sleep medications at least once a week. The median (IQR) latency sleep score was 1 (1 to 2), with 70 participants (19%) reporting a score of 0. The median (IQR) PSQI score (computed using 331 participants with valid information) was 5 (3 to 8).

Table 2 displays more details on the usage of sleep medications sleep quality and duration.

Table 2 Characteristics of sleep quality and duration in the studied sample (N = 400)

Variable	Descriptive statistic
Sleep duration (per 24-hour period), median (IQR)	7 (6 to 8)
Subjective sleep quality*, No. (%)	
Very good	172 (43)
Fairly good	164 (41)
Fairly poor	44 (11)
Very poor	19 (5)
Sleep latency¶, No. (%)	
0	70 (19)
1–2	145 (39)
3–4	115 (31)
5–6	45 (12)
Sleep efficiency in %†, No. (%)	
>85	255 (70)
75–84	46 (13)
65–74	22 (6)
<65	41 (11)
Sleep disturbances score, No. (%)	
0	20 (11)
1-9	87 (50)
10-18	61 (35)
19-27	7 (4)
Sleep medication usage‡, No. (%)	
Not during the past month	322 (83)
Less than once a week	29 (7)
Once or twice a week	15 (4)
Three or more times a week	22 (6)
Daytime dysfunction score‡, No. (%)	
0	151 (39)
1-2	171 (44)
3-4	59 (14)
5-6	7 (2)

IQR denotes interquartile range.
* 399 participants with complete data.
¶ 375 participants with complete data
† 364 participants with complete data
‡ 388 participants with complete data

Quality of life

The mean (SD) SF-12 score among 388 participants with complete data was 47.1 (6.1). The corresponding estimates for the SF-12 mental and physical components were 47.8 (10.4) and 46.3 (8.2), respectively. Based on the SF-12 global, mental and physical components, poor quality of life was identified in 253 (34.5%), 205 (53%) and 232 (60%) of the participants, respectively.

Associations of sociodemographic characteristics with PSQI

Figure 1 shows results for univariable association analyses. Male participants were associated with significantly lower mean PSQI scores than female participants (mean difference: -0.98, 95% CI = -1.70 to - 0.26, P = 0.008). Employed participants had significantly lower mean PSQI scores than non-Employed participants (mean difference: -0.78, 95% CI = -1.51to - 0.05, *P* = 0.04). Similarly, participants who reported being physically active were associated with significantly lower mean PSQI scores than those that did not (mean difference: -1.0, 95% CI = -1.72 to - 0.28, *P* = 0.007).

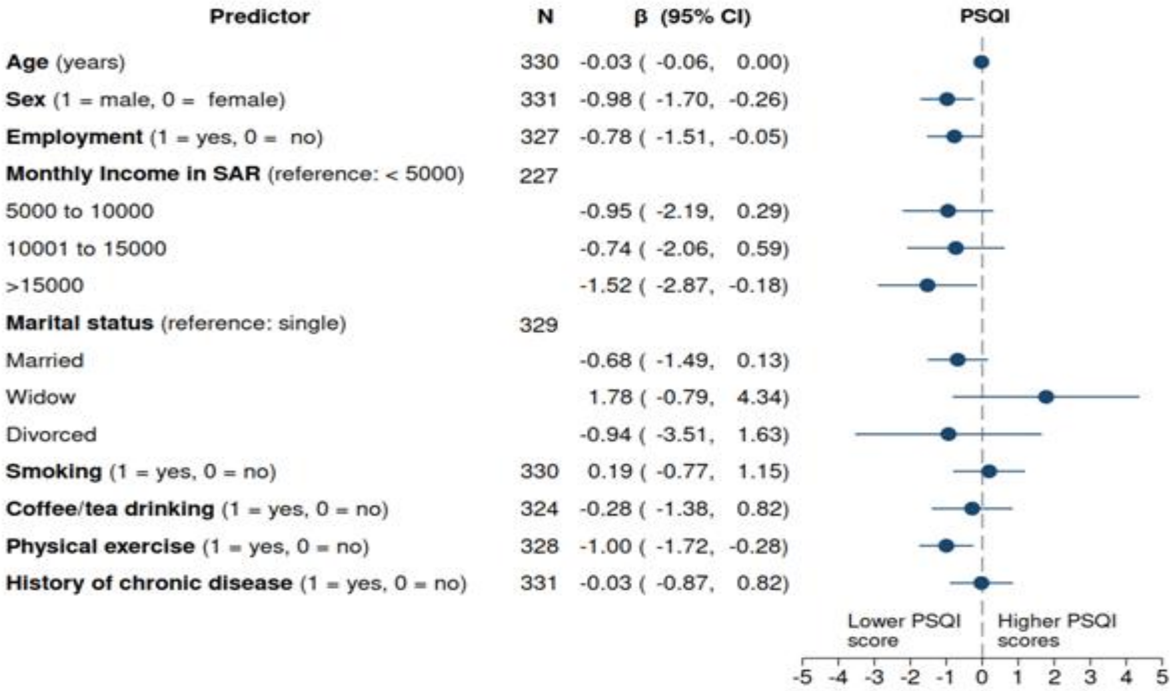

Figure 1. Caterpillar plot showing univariable linear regression coefficients. β denotes the change in the PSQI score per unit increment in the predictor. SAR denotes Saudi Arabian Riyal. For binary predictors (e.g., male [1] vs female [0]), β denotes the mean difference between the groups. Circles indicate the β estimates, and horizontal lines represent their corresponding 95% confidence intervals (CI). Results are considered statistically significant when 95% CIs do not cross the dashed vertical line at α = 5% (e.g., $P < 0.05$). N denotes the sample size (i.e., the number of patients with complete data) for the analysis.

In a multivariable model (**Table 3**), only physical exercise remained a statistically significant independent predictor of PSQI scores (Physically active vs sedentary participants, mean difference: -0.97, 95% CI = -1.89 to - 0.07, P = 0.03, controlling for all other variables in the model).

Table 3 Multivariable linear regression model for PSQI scores (N = 220)*.

Variable	β (95% CI)	*P*
Age (year)	-0.020 (-0.0008, 0.04)	0.48
Sex (1 = male, 0 = female)	-0.83 (-1.92, 0.26)	0.13
Monthly income in SAR*, No (%)		
< 5000	Reference	
5000-10000	-0.016 (-1.58, 1.52)	0.98
10001-15000	0.81 (-0.91, 2.52)	0.35
> 15000	-0.046 (-1.82, 1.73)	0.96
Marital Status¶, No. (%)		
Single	Reference	
Married	-0.26 (-1.65, 1.12)	0.71
Widow	1.31 (-2.69, 5.31)	0.52
Divorced	-3.96 (-8.22, 0.30)	0.07
Smoking(1 = yes, 0 = no)	0.61 (-0.61, 1.82)	0.32
Coffee/tea drinking (1 = yes, 0 = no)	0.27 (-1.34, 1.88)	0.74
Physical exercise (1 = yes, 0 = no)	-0.97 (-1.88, -0.07)	0.03
Reported having history of chronic diseases (1 = yes, 0 = no)	-0.57 (-1.76,0.62)	0.34

SAR denotes Saudi Arabian Riyal. β denotes the change in the PSQI score per unit increment in the predictor. For binary predictors (e.g., male [1] vs female [0]), β denotes the mean difference between the groups.

The coefficient of determination was 2%, meaning that the predictors explained 2% of the variance in PSQI scores in the study sample.

* The total sample size is less than the initial number of participants due to missing data.

Association of PSQI with quality of life

In univariable analyses, quality of life was inversely associated with PSQI scores (**Table 4**). Each additional unit in the Pittsburgh Sleep Quality Index was associated with an average reduction of 1.4 units (95% CI, 1.09 to 1.70, *P*< 0.001) in the SF-12 mental component scale (**Figure 2)**. Similar results were observed for the SF-12 global component, in which a unit increase in PSQI was associated with an average reduction of 0.78 (95% CI = 0.61 to 0.95, *P*< 0.001) in the SF-12 global score. No evidence of an association was identified between PSQI score and the SF-12 physical component scale (beta = -0.17, 95% CI = -0.43 to 0.09, *P* = 0.19).

In multivariable analyses, results were similar after adjustment for sex, employment status or physical exercise (**Table 4**).

Table 4 Association of PSQI with quality of life.

Variable	N	β (95% CI)	*P*
Univariable model			
SF-12 global component	324	-0.78 (-0.95, -0.611)	< 0.001
SF-12 mental component	324	-1.40 (-1.70, -1.09)	< 0.01
SF-12 physical component	324	-0.17 (-0.43, 0.09)	0.19
Multivariable model*			
SF-12 global component	318	-0.72 (-0.90, -0.55)	< 0.001
SF-12 mental component	318	-1.32 (-1.63, -1.00)	< 0.001
SF-12 physical component	318	-0.13 (-0.40, 0.14)	0.34

β denotes the change in the SF-12 components per unit increment in the PSQI scores. 95% CI denotes 95% confidence intervals. N denotes the sample size, which may be less than the total number of participants due to missing data.

* Multivariable linear regression model adjusted for sex, employment status and exercise.

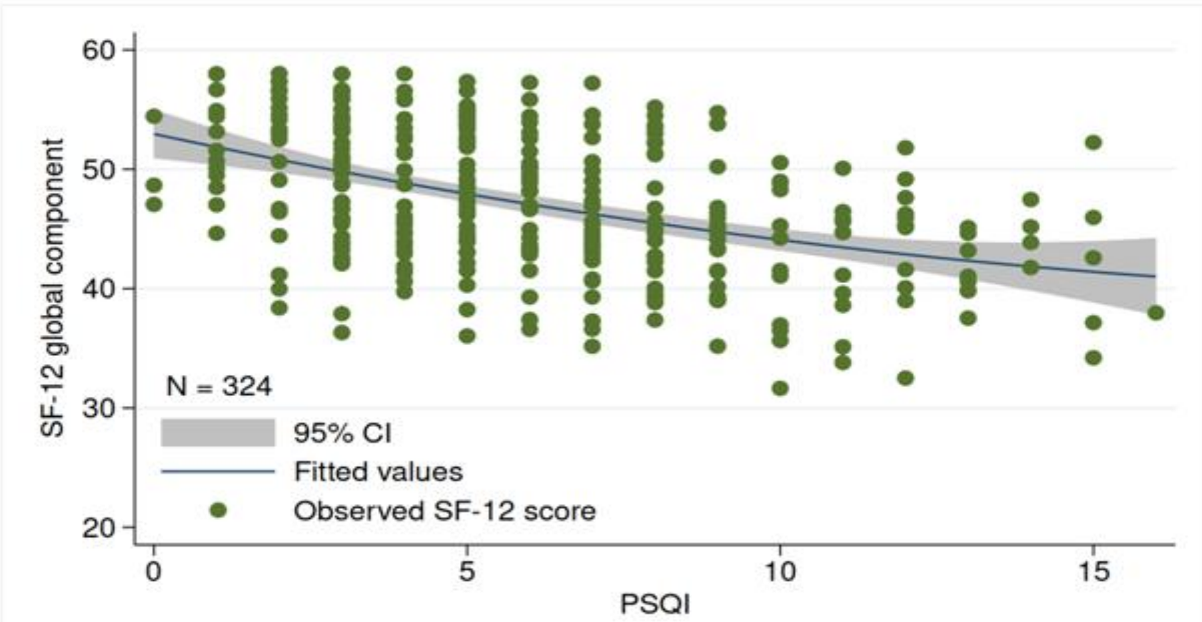

Figure 2. Scatter plot with imposed linear regression line. Results show in inverse association of PSQI with SF-12 global scores (univariable model). Higher PSQI scores are associated with lower SF-12 global scores (*P*< 0.001). 95% CI denotes 95% confidence interval. PSQI denotes. PSQI denotes the Pittsburgh Sleep Quality Index. SF-12 denotes the 12-Item Short Form Health Survey.

Discussion

Principal findings

This survey characterized the sleep profile of a young adult population served in the primary care setting in Riyadh, Saudi Arabia. Overall, our results indicated that one in every six patients reported poor sleep quality. Of note, both modifiable and non-modifiable factors seemed to be associated with sleep quality. In this regard, women were associated with lower sleep quality than men. Conversely, higher monthly income and practice of physical exercise were correlated with better sleep quality. We also found a statistically significant inverse association between health-related quality of life and PSQI scores.

Comparison with previous studies

Several large cohort studies from China[17], Europe[18] and the United States[19] have shown that sleep deprivation generates deleterious effects on metabolism, immune system and quality of life. Meta-analysis studies concur with this notion. For example, Itani et al. (2017) evaluated data from over 5 million participants via a meta-analysis of 153 observational studies[20]. Using primarily information from subjective sleep duration, the authors concluded that short sleep duration was associated with a statistically increased risk of all-cause mortality, type-II diabetes, arterial hypertension, obesity and cardiovascular diseases[20].

Besides the link between sleep patterns and the development of cardiovascular-related chronic diseases, it has been shown that sleep quality can influence mental health. By employing a sample of over 25,000 participants, Dong et al. reported a significant U-shaped association between sleep duration and depression[21]. Furthermore, the data from Sella et al. suggested a positive correlation between self-reported sleep quality and quality of life[22]. Their conclusions have been extensively substantiated in a wide range of populations, from individuals with chronic pain conditions[23], pregnant women[24] to patients with chronic kidney disease[25].

Despite growing international evidence on the ubiquitous role of sleep quality in human health, over the past decade, few studies have been conducted regarding the sleep quality in the general Saudi population, with a scarcity of information regarding the population served in the primary care setting. Most published investigations have characterized the sleep profile of Saudi university students and specific disease populations. For instance, Al-khani et al. (2019) demonstrated that approximately 63% of medical students in Saudi Arabia report poor sleep quality[26]. The authors found that a higher proportion of "poor sleepers" were among those physically inactive than among those physically active. In the same vein, Darraj et al. (2018) evaluated a population of Saudi type-2 diabetes patients from Jazan[27]. According to the authors, the prevalence of poor sleep quality was 55%, and women were almost four times more likely to report low sleep quality than men[27].

By including a more generalizable and representative population, the present study extends these previous investigations highlighting the favourable impact of physical activity on sleep quality, the positive association between sleep quality and quality of life, and the female gender as a prognostic factor for low sleep quality.

Notably, the importance of a greater awareness regarding sleep medicine in Saudi Arabia, particularly among primary care physicians, has been highlighted by recent reports[28,29]. Thus, besides providing new data recognizing that poor sleep quality can be a public health concern in Saudi Arabia, our findings reveal a pertinent niche for future experimental research in this country, especially in relation to investigating non-pharmacological interventions [30] that can improve sleep quality among Saudi patients served in the primary care setting.

Limitations

Our investigation has important limitations that should be acknowledged. First, our survey was restricted to the Saudi primary care setting and is not necessarily generalizable to other centres, particularly to the general population. Second, a significant proportion of participants refrained from reporting complete information regarding some variables, generating missing data in the analysis. Missing data is known to reduce statistical power and diminish the precision in the estimates (e.g., larger confidence intervals). Third, our study was based on a cross-sectional assessment. Therefore, we could neither infer the long-term consequences of poor sleep nor establish causal effects of low sleep quality on quality of life. Fourth, our analysis was primarily based on self-report questionnaires and described participants' subjective perceptions rather than laboratory-documented physiological data on sleep quality.

Conclusions

The findings of this survey demonstrated that poor sleep quality is highly prevalent in the primary care setting in Riyadh, Saudi Arabia, with one in every six patients reporting poor sleep quality. Both modifiable (e.g. the practice of physical exercise) and non-modifiable (e.g. gender) factors seemed to be associated with sleep quality. Women were associated with worse sleep quality than men, whereas higher monthly income and practice of physical exercise were correlated with better sleep quality. More studies are needed to elucidate the long-term consequences of poor sleep quality in health outcomes and the benefits population-wide and/or targeted interventions to improve sleep in the Saudi population.

Disclosure

Authors have no conflict of interest, and the work was not supported or funded by any drug company.

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