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ORIGINAL RESEARCH

The Relationship Between Thyroid Dysfunction and Sleep Quality Among Population of Saudi Arabia

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Purpose: Thyroid problems and sleep disturbances are common health problems that impact people of all ages, income levels, and genders. The clinical relationship between these conditions is still not well understood, despite their widespread occurrence. The main objectives of the study were to determine the prevalence of thyroid disorders and evaluate the relationship between them and sleep quality in the Saudi Arabian population.

Patients and Methods: The study employed an observational cross-sectional design and included a representative Saudi Arabian cohort. The Pittsburgh Sleep Quality Index (PSQI) was included in a digital self-administered survey that participants were asked to complete.

Results: There were 1044 responders in the study, most of whom (54%) were between the ages of 21 and 30. Female respondents made up 62% of the sample. Thyroid disorders were diagnosed in 9.2% of cases. A significant correlation was found ($p=0.001$ and $p<0.001$, respectively) between thyroid disorders and sleep disturbances as well as the use of sleep medications.

Conclusion: The study revealed a significant prevalence of poor sleep quality in the Saudi population as a whole, with thyroid disorder diagnosis and female gender emerging as independent risk factors. More extensive longitudinal studies in the area are desperately needed.

Keywords: thyroid disorder, sleep quality, PSQI, Saudi Arabia, patient care

Introduction

People sleep for roughly one-third of their lives. There is evidence from studies that abnormal sleep patterns are associated with a variety of conditions, including thrombotic disease, epilepsy, arthritis, psychiatric disorders, chronic pain, and diabetes.[1–4] The most prevalent sleep-related breathing disease is obstructive sleep apnea (OSA), which poses a significant public health concern when left untreated because of the underlying comorbidities.[5]

Despite the fact that there is a correlation between thyroid issues and irregular sleep patterns. Problems sleeping may be caused by a number of different ailments, and some of the symptoms of thyroid disorders, such as weariness or difficulties falling asleep, might overlap with sleep problems that are caused by other conditions. Thyroid issues may have an impact on the quality of sleep due to a number of different variables. In most cases, thyroid function is assessed by the use of blood tests to determine the levels of hormones.[6,7] The quantity and quality of sleep are crucial for maintaining normal function. Additionally, it aids in the management of hunger and supports the preservation of regular metabolic and hormonal processes. Sleeping for fewer than 6 hours a day is linked to abnormalities in energy metabolism, according to some studies. This suggests that sound sleep is essential for the control and discharge of thyroid hormones. Other metabolic conditions like obesity, insulin resistance, and diabetes are linked to sleep deprivation and circadian clock disruption. With a weight of between 20 and 30 grams in adults, the thyroid gland is one of the biggest endocrine glands in the human body. It is composed of two lobes that are linked inside each other.[8–16] There is an incidence of between 4% and 7% for thyroid lesions, which are often detected on the gland. The vast majority of individuals do not exhibit any symptoms, and their thyroid hormone secretion is typical.[17]

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The relation between hormones and sleep has been acknowledged for quite some time. Research findings suggest that profound sleep significantly impacts the endocrine system. For instance, profound sleep is associated with increased secretion of prolactin (PRL) and growth hormone (GH). It is well acknowledged that obesity is a risk factor for the development of comorbid disorders, including but not limited to cardiovascular disease, type 2 diabetes mellitus, cancer, asthma, osteoarthritis, chronic back pain, obstructive sleep apnea, non-alcoholic fatty liver disease, and gallbladder diseases.[18] In contrast, cortisol and thyrotropin secretion is diminished. Levels of ACTH often rise in response to a decrease in cortisol levels. In the hypothalamic-pituitary-adrenal (HPA) axis, there is a feedback loop that is responsible for this phenomenon. There exists empirical evidence indicating that disruptions in sleep integrity can induce alterations in the circadian rhythm, which subsequently impact the inflammatory system. The thyroxine (T4) and triiodothyronine (T3) thyroid hormones induce physiological changes in the metabolism of every tissue.[19–23]

Thyroid hormones, T3 and T4 alter the physiology of every tissue's metabolism. T4 and T3 secretion from the thyroid gland is regulated by pituitary thyroid-stimulating hormone (TSH) and hypothalamic thyrotropin-releasing hormone (TRH). Sleep disturbances have the potential to disrupt the operation of the hypothalamic-pituitary-thyroid axis in humans, and are correlated with fluctuations in TSH, T4, and T3 levels. A correlation has also been observed between excessive sleep deprivation and subclinical hypothyroidism.

Because thyroid diseases and sleep disorders are two of the major health issues in Saudi Arabia with a wide variety of clinical spectrum, we aim in this observational study is to assess the relationship between these two major clinical factors and to establish baseline incidental findings among the population of Saudi Arabia.

Materials and Methods

This study employed an observational cross-sectional design and included a representative sample of the Saudi Arabian population. The designated demographic was given a self-administered digital questionnaire. The questionnaire contained sociodemographic variables (such as age, gender, marital status, education, etc.) and the Pittsburgh Sleep Quality Index (PSQI) to evaluate the participants' sleep quality. The translation of the questionnaire is validated and the study complies with the Declaration of Helsinki. All participants provided informed consent.

Questionnaire Criteria

The assessment of sleep quality among college students has been conducted utilizing Smith's Pittsburg Sleep Quality Index (PSQI).[20] The objective of this 19-item survey is to assess the subjectivity of sleep quality during the previous month. Seven component scores derived from clinical practice comprise the 19 queries; each item is assigned an equal weight ranging from 0 to 3. A global score of 0–21 is derived by adding the scores of the seven components; greater scores indicate inferior sleep quality. The presence of poor sleep quality was categorized as such using a five-point criterion.[21]

Statistical Analysis

An Excel spreadsheet that was linked with the online survey made data entry easier. The SPSS software, version 26, was used to conduct the statistical evaluation. SPSS Statistics v26 being the inclusion of Data Preparation and Bootstrapping as standard functionality, as part of the SPSS Base module.

The data were shown as counts and percentages for categorical variables, and as averages and standard deviations for continuous variables. The chi-square test was utilized to investigate the association between the socio-demographic features of the participants and their sleep quality. Subsequently, a multivariate regression model was used to determine the main independent risk variables linked with inadequate sleep quality, based on the results made.

Results

The statistical significance level was set at $p<0.05$. The statistical software SPSS edition 26 (Armonk, NY: IBM Corp., USA) was used to analyze all the statistical data. In total, one thousand and forty-four completed questionnaires were received. Table 1 describes the socio-demographic characteristics of participants. 54% were aged between 21 and 30 years old, with nearly two-thirds (62%) being females. Most of the respondents were Saudis (85.1%), and 40.2% lived in

Table 1 Participants' Socio-Demographic Characteristics (n=1044)

Study Variables	N (%)
Age group	
• 18–20 years	205 (19.6%)
• 21–30 years	564 (54.0%)
• 31–40 years	124 (11.9%)
• 41–50 years	110 (10.5%)
• 51–60 years	32 (03.1%)
• >60 years	09 (0.90%)
Gender	
• Male	397 (38.0%)
• Female	647 (62.0%)
Nationality	
• Saudi	888 (85.1%)
• Non-Saudi	156 (14.9%)
Region	
• Central Region	161 (15.4%)
• Western Region	420 (40.2%)
• Eastern Region	95 (09.1%)
• Southern Region	234 (22.4%)
• Northern Region	134 (12.8%)
Marital status	
• Single	709 (67.9%)
• Married	311 (29.8%)
• Separated	17 (01.6%)
• Widowed	07 (0.70%)
Educational level	
• Uneducated	02 (0.20%)
• Elementary school	06 (0.60%)
• Middle school	11 (01.1%)
• High school	221 (21.2%)
• Bachelor degree	745 (71.4%)
• Postgraduate	59 (05.7%)

(*Continued*)

Table 1 (Continued).

Study Variables	N (%)
Occupational status	
• Student	553 (53.0%)
• Unemployed	116 (11.1%)
• Employed	315 (30.2%)
• Retired	32 (03.1%)
• Self-employed	28 (02.7%)
Diagnosed with thyroid disease	
• Yes	96 (09.2%)
• No	948 (90.8%)
Type of thyroid disease (n=96)	
• Hypothyroidism	58 (60.4%)
• Hyperthyroidism	38 (39.6%)

the Western Region. Approximately 67.9% of the respondents were single, and 71.4% were bachelor's degree holders. Respondents who were students constituted 53%. The prevalence of participants who had been diagnosed with thyroid disease was 9.2%, and the most common type of thyroid disease was hypothyroidism (60.4%). In Table 2, a higher mean score can be seen in the sleep latency component (mean score: 1.62), followed by sleep disturbance (mean score: 1.45) and sleep efficiency (mean score: 1.45), while the least was the sleep medication component (mean score: 0.27). Additionally, Figure 1 represents the prevalence of poor sleep quality among the study participants, as assessed by the Pittsburgh Sleep Quality Index (PSQI). The overall mean PSQI score was 8.17 (Standard Deviation (SD) 3.56). When comparing patients with or without thyroid disorder, it was found that participants with thyroid disorder were more associated with higher mean scores in sleep disturbances (p=0.001), sleep medication (p<0.001), and global PSQI (p=0.001). When measuring the relationship between sleep quality and the socio-demographic characteristics of

Table 2 Descriptive Chi-Square Statistics of the Components of PSQI According to the Prevalence of Thyroid Disorder (n=1044)

PSQI Components score	Overall Mean ± SD	Thyroid disorder		p-value
		Yes N (%)	NO N (%)	
Subjective sleep quality	0.94 ± 0.87	1.02 ± 0.88	0.93 ± 0.87	0.314
Sleep latency	1.62 ± 0.97	1.66 ± 0.95	1.62 ± 0.98	0.730
Sleep duration	1.42 ± 1.16	1.64 ± 1.21	1.39 ± 1.16	0.057
Sleep efficiency	1.42 ± 1.28	1.60 ± 1.27	1.40 ± 1.28	0.141
Sleep disturbances	1.45 ± 0.64	1.65 ± 0.66	1.43 ± 0.63	**0.001****
Sleep medication	0.27 ± 0.67	0.52 ± 0.89	0.24 ± 0.64	**<0.001****
Daytime dysfunction	1.06 ± 0.87	1.21 ± 0.89	1.04 ± 0.86	0.070
Global PSQI	8.17 ± 3.56	9.29 ± 3.70	8.06 ± 3.53	**0.001****

Notes: **It indicates that it is a statistically significant result with a strong correlation.

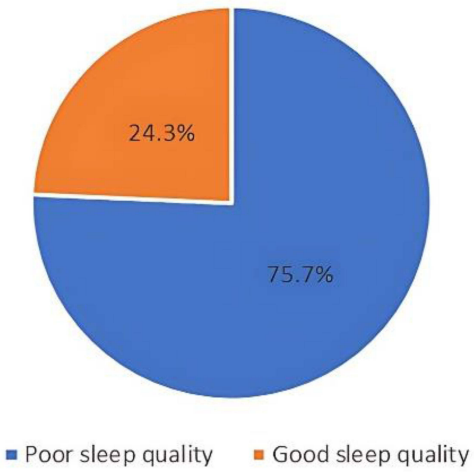

Figure 1 Prevalence of poor sleep quality according to PSQI criteria.

participants (Table 3), it was revealed that the prevalence of respondents who had poor sleep quality was significantly more common among gender females (p=0.006), those who had better education (p=0.020) and those who had been diagnosed with thyroid disease (p=0.010). A multivariate regression model (Table 4) revealed that gender females and diagnosis of thyroid disease were the independent significant risk factors for poor sleep quality. This further suggests that compared to gender males, gender females were predicted to increase the risk of poor sleep quality by at least 1.4 times higher (AOR=1.412; 95% CI=1.057–1.886; p=0.020). Respondents diagnosed with thyroid disorder were 2 times as likely to develop poor sleep quality as compared to patients who do not have thyroid disease (AOR=2.006; 95% CI=1.094–3.678; p=0.024). However, the educational level did not significantly affect poor sleep quality after adjustment to a regression model (p=0.056).

Table 3 p-value Based Analysis Between Sleep Quality and Participants' Socio-Demographic Characteristics (n=1044)

Factor	Sleep Quality		p-value
	Poor N (%) (n=790)	Good N (%) (n=254)	
Age group			
• ≤30 years	576 (72.9%)	193 (76.0%)	0.333
• >30 years	214 (27.1%)	61 (24.0%)	
Gender			
• Male	282 (35.7%)	115 (45.3%)	**0.006****
• Female	508 (64.3%)	139 (54.7%)	
Nationality			
• Saudi	673 (85.2%)	215 (84.6%)	0.832
• Non-Saudi	117 (14.8%)	39 (15.4%)	

(*Continued*)

Table 3 (Continued).

Factor	Sleep Quality		p-value
	Poor N (%) (n=790)	Good N (%) (n=254)	
Marital status			
• Never been married	529 (67.0%)	180 (70.9%)	0.246
• Been married	261 (33.0%)	74 (29.1%)	
Educational level			
• High school or below	168 (21.3%)	72 (28.3%)	**0.020****
• Bachelor or higher	622 (78.7%)	182 (71.7%)	
Occupational status			
• Unemployed	113 (14.3%)	35 (13.8%)	0.632
• Employed	265 (33.5%)	78 (30.7%)	
• Student	412 (52.2%)	141 (55.5%)	
Diagnosed with thyroid disease			
• Yes	83 (10.5%)	13 (05.1%)	**0.010****
• No	707 (89.5%)	241 (94.9%)	

Notes: **It indicates that it is a statistically significant result with a strong correlation.

Table 4 Multivariate Regression Analysis to Determine the Significant Independent Risk Factor for Poor Sleep Quality (n=1044)

Factor	AOR	95% CI	p-value
Gender			
• Male	Ref		
• Female	1.412	1.057–1.886	**0.020****
Educational level			
• High school or below	Ref		
• Bachelor or higher	1.374	0.992–1.902	0.056
Diagnosed with thyroid disease			
• Yes	2.006	1.094–3.678	**0.024****
• No	Ref		

Notes: **It indicates that it is a statistically significant result with a strong correlation.

In this study, we want to arrive at results that are applicable to a specific demographic. In the event that a particular component, such as a specific sleep problem, has a relatively low distribution among the research group, it is possible that the conclusions associated with that factor cannot be generalized to the whole population. For instance, if the

research only comprises young persons, the results on sleep apnea, which is more prevalent in elderly people, could not be applicable to the general population.

In order for statistical tests to be accurate, they need a certain number of observations to be collected within each category (for example, excellent sleep vs poor sleep). It is possible that there are not enough data points in a particular category to carry out an analysis that is statistically sound if a factor has a distribution that is very low. It is possible that this will result in equivocal findings or an increased likelihood of Type II errors, which are mistakes that fail to identify a real effect. The researchers could change their attention to elements that have a more equal distribution among the population in order to arrive at a result that is more generalizable if the study question permits it.

Discussion

This study sought to measure the relationship between thyroid disorder and sleep quality. Our study showed that there was a significant relationship between thyroid disorders and poor sleep quality. Notably, based on PSQI criteria, sleep disturbances, sleep medication, and overall PSQI scores were all statistically significantly higher in participants with thyroid disorders ($p<0.05$). This is comparable to the study of He et al[22] reporting a significantly higher PSQI score, particularly among differentiated thyroid cancers (DTC), and they were also seen to have a higher prevalence of poor sleep quality than any other group. Another study done by Nazem et al[23] noted a significant increase in thyroid function tests such as thyroxine (T4) and thyroid stimulating TSH in patients with poor sleep quality. In addition, they found significant links between poor sleep conditions in relation to sleep score, free thyroxine (FT4), and stress score, suggesting poor sleep quality negatively impacted thyroid hormones. Similarly, Kim et al[24] documented an association between short sleepers and subclinical hypothyroidism (SHYPO), indicating that both longer and shorter sleep durations were associated with an increased risk of subclinical thyroid dysfunction. Contradicting previous reports, several studies documented no association between thyroid dysfunction and sleep quality. For example, Feng et al,[12] found that TSH levels, serum-free triiodothyronine (FT3), and FT4 did not significantly affect children with obstructive sleep apnea-hypopnea syndrome (OSAHS) before and after endoscopic adenoidectomy. This was also documented by the studies done in USA[25] and in Turkey,[26] wherein OSA showed no significant relationship with subclinical or prior hypothyroidism.

Data from our study suggest that female gender and thyroid disorder diagnosis were the independent significant risk factors for poor sleep quality. In China,[19] studying patients with SHYPO, they also detected women with younger age and lower body mass index were at significant risk for having poor sleep quality. Incidentally, in a conducted among patients with DTC,[27] they found that the Insomnia Severity Index (ISI) was significantly correlated with various Thyroid-specific Patient-Reported Outcome (ThyPRO) scales, with anxiety and emotional susceptibility being the most correlated significantly with PSQI and ISI. In a large study done by US National Health and Nutrition Examination Survey between 2007 and 2008,[28] after adjustment to confounders, respondents on thyroid hormone replacement were predicted to increase the risk of sleep apnea (SA) diagnosis by at least 2.51 times higher compared to euthyroid subjects, while respondents with elevated TSH who were not taking medication were predicted to have decreased risk of SA diagnosis. In a report published by Song et al[19] they found that subclinical hypothyroidism (SHYPO) patients have significantly higher total PSQI scores than euthyroid patients (control group), and they were likewise associated with longer sleep latency, shorter sleep duration, and poorer sleep quality.

Notably, our results indicate that the prevalence of poor sleepers was relatively high, constituting 75.7%. Among those who had been diagnosed with thyroid dysfunction (n=96), the prevalence of poor sleepers was 86.5% ($p=0.010$). This result is slightly higher than the study of Nazem et al,[23] reporting a prevalence of low sleep quality of 49.4%. However, among patients diagnosed with OSA,[29] evidence suggests that subclinical hypothyroidism was more common among this group of patients, but the number of OSA patients who were newly diagnosed with clinical hypothyroidism was minimal. Moreover, the proportion of patients with thyroid dysfunction was relatively low in this investigation, considering the whole study population.

Conclusion

The purpose of this observational study was to clarify how Saudi Arabian population thyroid disorders and sleep quality are related. According to our research, a significant proportion of participants (75.3%) reported having poor quality sleep, which is significantly correlated with being diagnosed with a thyroid condition and being female. Interestingly, our

analysis showed that people with thyroid disorders were more likely to have sleep disturbances, as indicated by higher Pittsburgh Sleep Quality Index (PSQI) scores, especially in the areas of sleep disturbances, use of sleep medications, and overall PSQI scores. Particularly noteworthy is the significant impact of thyroid disorders on sleep latency, sleep disturbances, and duration in our study cohort. This provides important insights into the complex nature of thyroid disorders and their implications for day-to-day functioning. It is essential to recognize the limitations of our research, chief among which being the dependence on self-reported data that could potentially introduce biases. This emphasizes the need for additional investigation using a wider range of approaches in order to confirm and build upon our results. Subsequent research endeavors ought to focus on defining the mechanisms that underlie the correlation between thyroid function and sleep quality. This may involve investigating interventional strategies aimed at ameliorating the deleterious impact of thyroid disorders on sleep. Eventually, this study adds to the increasing amount of research that shows a connection between thyroid dysfunction and inadequate sleep quality. It highlights the necessity for medical practitioners to treat patients with thyroid disorders holistically, taking into account the possible effects on sleep and general quality of life. Our results highlight the value of a multidisciplinary approach in treating complex, interrelated health issues and support the inclusion of sleep quality assessment in the management of thyroid disorders. To fully understand this relationship and open the door to more complete, effective treatment options, more research in this area is essential.

Data Sharing Statement

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval Statement

The study was approved by the review committee of our ethics committee. All patients and their families gave informed consent. The study adheres to the principles outlined in the Declaration of Helsinki. Title: "The relationship between thyroid function disorder and sleep quality among population of Saudi Arabia" has been reviewed and approved by the Research Ethics Committee (REC) at University of Hail dated: 11/9/2023 under the reference number H-2023-362.

We thus consent to the oversight and examination conducted by the Ethics Committee. Moreover, we guarantee the veracity and comprehensiveness of all the information supplied inside this application.

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Disclosure

The authors report that there are no competing interests in this work.

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