EDITORS' CHOICE

ASSOCIATIONS OF GENERAL MENTAL HEALTH SYMPTOMS WITH SUBJECTIVE SLEEP QUALITY AND INDIVIDUAL DAYTIME SLEEPINESS*

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Abstract

Purpose: Sufficient sleep quality plays a significant role for long-term physical and mental health. The aim of this study was to examine the associations of general mental health symptoms with sleep quality and daytime sleepiness. **Materials and Methods:** A cross-sectional survey with 84 included participants (female: n = 42, male: n = 42) was conducted. General mental health symptoms were assessed using the 12-item General Health Questionnaire (GHQ-12), sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI), and daytime sleepiness was evaluated with the Epworth Sleepiness Scale (ESS). Statistical differences were calculated using two-sample t-test and Mann–Whitney U test. For correlation analyses Spearman's rank correlation was used. **Results:** Subjects with poor sleep quality reached higher scores in the GHQ-12 and in the ESS than subjects with good sleep quality, but the difference regarding the ESS was not significant. Higher GHQ-12 scores were associated with higher PSQI scores but not with higher ESS scores. **Conclusions:** Major findings show strong evidence of an association between general mental health symptoms and sleep quality with poor sleepers having a more disturbed mental health than good sleepers. Further evidence of the interrelationship between subjective sleep quality and general mental health symptoms was found.

Keywords: *Mental health, Work ability, Stress, Sleep, Insomnia.*

Introduction

Restorative sleep is important for performance, productivity, and efficiency at the workplace as well as for work ability and mental well-being [1]. However, modern society demands permanent flexibility, mobility, and accessibility of the employee. As a consequence, psychological strain at the workplace appears to be an ever larger health hazard. The number of absences due to mental disorders increased sharply compared to other diseases [2].

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Psychological strain leads to an increased physiological and psychological activation [3]. This matter is in contrast to the physiological and psychological reduction of the activation as a main characteristic of sleep [1]. Sleep satisfaction is reduced by social stress [4]. Several studies could find associations between increased work-related psychosocial stress and poor sleep quality [5–8]. Perceived unfair treatment at the workplace is also associated with an increased risk for poor sleep quality in the long run [9].

Disturbed sleep is a symptom of various mental illnesses including bipolar disorder [10] and psychosis [11]. Some sleep problems even form part of the diagnostic criteria of certain psychic illnesses, e.g. major depression or post-traumatic stress disorder [12, 13]. Moreover, for example, regarding clinical depression and anxiety disorder the association between psyche and sleep

appears to be bidirectional [14–16]. Studies have also shown that sleep disturbances raise the risk for certain mental conditions, e.g. a first episode of psychosis [17], transition to major depression [18], paranoia [19], manic symptoms [20], and burnout [21]. On the other hand, improving sleep problems seem to reduce mental health problems [22].

2. Purposes, subjects and methods:

2.1. Purpose

The purpose of the present study was to further investigate the consequences of poor sleep quality on general mental health symptoms and the other way round. We hypothesised that: (1a) bad sleepers have a higher level of daytime sleepiness; (1b) reduced sleep quality is accompanied by higher daytime sleepiness; (2) poor sleep quality is accompanied by reduced general mental health symptoms.

2.2. Subjects & Methods

Participants and Design

Participants were recruited through the occupational health out-patient department of the Institute of Occupational Medicine of Otto von Guericke University Magdeburg within the context of regular preventive medical examinations of the employees and via advertisement (distribution of leaflets) both on Health Days and among local undergraduate students. In Germany Health Days are regularly offered in companies within the scope of the operational health management. On these days all employees are invited to participate in various health activities. The recruited participants collected the questionnaires in German at the out-patient department and completed them at home receiving a feedback after handing them in again. All participants except for one were native speakers. Exclusion criteria included shift work, chronic medication intake with influence on the heart rhythm, reported diabetes mellitus, untreated thyroid diseases and treated thyroid diseases with thyroid blood parameters outside the normal range, cardiac diseases, use of nocturnal oxygen or nightly continuous positive airway pressure, and reported diseases of the central or peripheral nervous system resulting in a final study sample of 84 participants of various occupational groups. All subjects provided informed consent prior to participation in the study. Participants' anonymity with consideration for data protection was fully ensured. The study was approved by the ethics committee of Otto von Guericke University Magdeburg (registration no. 50/16) in May 2016. The experimental part of the study was carried out until October 2017.

Questionnaires

Socio-Demographical and Medical Data

In the beginning participants were asked to give details about age, height and weight (for body mass index; BMI), waist and hip circumference (for waist-hip ratio; WHR), physical activities, job profile, and tobacco consumption. Furthermore, arterial systolic blood pressure (RR sys) and diastolic blood pressure (RR dias) were taken after a 3 to 5-minute stationary phase.

12-Item General Health Questionnaire (GHQ-12)

The GHQ-12 [23, 24], a short version of the GHQ, is an instrument to evaluate general mental health symptoms. It consists of 12 questions screening for recently experienced dysfunctional symptoms and behaviour on a four-stage answer-scale. There are 4 different possibilities for scoring [25]. In this study the Likert-scoring (0–3 scale; sum score ranging from 0–36) and the dichotomous GHQ-scoring (0–1 scale, 0 in the case of 0 or 1 in the Likert scale or 1 in the case of 2 or 3 in the Likert scale; sum score ranging from 0–12) [26] were used in which a higher value indicates a more disturbed state of psychological health. The cut-off value for disturbed mental health depends on population-specific factors [26–28]. Regarding the GHQ-scoring following Ustun and Sartorius [27] and like in Linden et al. [29] and Seibt et al. [30] a cut-off value of ≥ 5 was used. With regard to diagnostic validity the GHQ-12 has a sensitivity of 83.4 % and a specificity of 76.3 %. The internal consistency is indicated by a Cronbach's alpha coefficient of 0.85 [26].

Pittsburgh Sleep Quality Index (PSQI)

The PSQI [31] is a self-assessment questionnaire capturing subjective sleep quality of the preceding month. It consists of 19 self-rated questions and 5 questions for third-party evaluation not counted in the scoring of the PSQI. The 19 items generate 7 component scores (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, daytime dysfunction), each weighted equally on a 0–3 scale. The sum of the component scores yields the global PSQI score (range of 0–21) in which higher values indicate worse sleep quality. The cut-off value recommended by Buysse et al. [31] to distinguish between good and bad sleepers is > 5. Regarding diagnostic validity the original study shows a sensitivity of 89.6 % and a specificity of 86.5 %, the internal consistency is indicated by a Cronbach's alpha coefficient of 0.83 [31].

Epworth Sleepiness Scale (ESS)

The ESS [32] is a self-administered questionnaire assessing daytime sleepiness in recent times. It consists of 8 questions describing different degrees of soporific daily situations for each to be rated the probability to doze off or fall asleep on a scale of 0–3. If some situations have not been experienced recently subjects are asked to estimate how they might affect them. The 8 selected values are summed to a score (range 0–24) in which higher values indicate a higher level of daytime sleepiness. The determined cut-off value for excessive daytime sleepiness is > 10 [32–35]. The internal consistency determined by the original author of the ESS is indicated by a Cronbach's alpha coefficient of 0.88 [36]. Referring to diagnostic validity for instance in narcolepsy the ESS has a sensitivity of 93.5 % and a specificity of 100 % [37].

Statistical Analysis

Regarding descriptive statistics means (M) and standard deviations (SD) as well as medians and ranges were calculated. To test for normal distribution the Kolmogorov–Smirnov test was used. In case of normal distribution and interval-scaled data the two-sample t-test for independent samples was applied. If variables were ordinal-scaled or interval-scaled but not normally distributed Mann-Whitney U test was used. When comparing groups for outcomes of interest differences in mean or median are reported with the 95 % confidence interval (95%CI) in addition to the p value. Pearson's χ^2 test was applied if all variables involved were categorial. For correlation analyses we used Spearman's rank correlation since the correlated variables were not normally distributed. The significance level for all analyses was set to $p < 0.05$. All analyses were conducted with the statistical software IBM SPSS Statistics 24, IBM, Armonk, USA.

3. Results

On the basis of the reached global PSQI score the participants (n = 84) were divided into the two groups "Good sleepers" (n = 53) and "Bad sleepers" (n = 31) forming the foundation of the examination with regard to the associations of general mental health symptoms with subjective sleep quality and individual daytime sleepiness.

Socio-Demographical and Medical Data

The participants had a mean age of 37.3 ± 15.6 years (median 33 years, range 19 – 71 years), among them 42 females (mean age 38.2 ± 14.5 years, median 38.5 years, range 20 – 71 years) and 42 males (mean age 36.4 ± 16.7 years, median 28 years, range 19 – 71 years). The good sleepers consisted of 52.8 % males and 47.2 % females, the bad sleepers of 45.2 % males and 54.8 %. Table 1 depicts means and standard deviations of the examined socio-demographical and medical variables for both groups separately and the total sample. The 12 current or former smokers of the good sleepers (23.1 %) smoked an average dose of 10.5 py ± 9.5 py while the 8 current or former smokers of the bad sleepers (26.6 %) on average smoked a dose of 17.5 py ± 12.9 py. [*Table 1* near here].

Sleep Quality

Table 2 shows descriptively the average global PSQI scores and the 7 separate component scores with standard deviations as well as the medians and ranges of both groups and the total sample. [*Table 2* near here].

The good sleepers needed an average time of 12:13 min ± 07:55 min to fall asleep (median 10 min, range 2 ? 45 min) and actually slept 07:17 h ± 00:50 h per night. In comparison the bad sleepers needed on average 35:00 min ± 42:04 min to fall asleep (median 23 min, range 2 – 240 min) and the actual sleep duration was 05:41 h ± 01:03 h.

Daytime Sleepiness

Although the bad sleepers reached higher scores in the ESS no significant difference between the two groups was found ($p = 0.113$) (*table 2*). Applying the determined cut-off value for excessive daytime sleepiness of > 10 [32, 33] no significant distribution was found either ($p_{\chi 2} = 0.331$) (*table 3*). [*Table 3* near here].

While 9 good sleepers (17.0 %) were categorized as having excessive daytime sleepiness there were 8 bad sleepers (25.8 %), so in total 17 participants scored above the ESS cut-off value.

Correlations between Subjective Sleep Quality and Individual Daytime Sleepiness

Correlating the global PSQI score with the global ESS score no significant association was found ($r = 0.184$, $p = 0.094$) (*table 4*). [*Table 4* near here].

Regarding the 7 separate PSQI component scores only the component daytime dysfunction correlated significantly in terms of a very strong evidence with the global ESS score ($r = 0.365$, $p < 0.001$).

Mental Health Symptoms

With regard to the global scores in the GHQ-12 a significant difference between the two groups which shows strong evidence was found ($p = 0.004$). The bad sleepers on average reached higher scores (*table 2*). The distribution after applying

Table 1

Depiction of the socio-demographical and medical data of both groups

	Good sleepers (n = 53)	Bad sleepers (n = 31)	Total (n = 84)
	M ± SD Median (range)	M ± SD Median (range)	M ± SD Median (range)
Age [years]	35.2 ± 14.3 29 (19 – 64)	40.9 ± 17.2 47 (19 – 71)	37.3 ± 15.6 33 (19 – 71)
BMI [kg/m^2]	24.37 ± 3.94 23.46 (17.63 – 38.57)	24.84 ± 4.20 24.13 (19.33 – 34.36)	24.55 ± 4.02 23.89 (17.63 – 38.57)
WHR	0.88 ± 0.11 0.89 (0.68 – 1.29)	0.89 ± 0.11 0.88 (0.70 – 1.20)	0.89 ± 0.11 0.89 (0.68 – 1.29)
RR sys [mmHg]	125.9 ± 10.8 125 (90 – 158)	124.4 ± 15.6 121 (99 – 167)	125.3 ± 12.7 124 (90 – 167)
RR dias [mmHg]	79.3 ± 8.7 80.5 (60 – 105)	78.8 ± 11.0 78 (57 – 102)	79.1 ± 9.6 79 (57 – 105)
Sport [times/week]	2.3 ± 1.9 2 (0 – 6)	1.8 ± 2.0 1 (0 – 8)	2.1 ± 2.0 2 (0 – 8)
Sport [no. of years]	12.0 ± 12.2 10 (0 – 45)	8.7 ± 8.9 6 (0 – 30)	10.8 ± 11.1 10 (0 – 45)
	Number (%)		
Occupation			
mainly intellectual	40 (75.5)	23 (74.2)	63 (75.0)
mainly physical	5 (9.4)	1 (3.2)	6 (7.1)
physical and intellectual	8 (15.1)	6 (19.4)	14 (16.7)
pensioner	0 (0.0)	1 (3.2)	1 (1.2)
Smoker			
former	8 (15.4)	7 (23.3)	15 (18.3)
current	4 (7.7)	1 (3.3)	5 (6.1)
non-smoker	40 (76.9)	22 (73.3)	62 (75.6)

Table 2

PSQI global and component scores, global ESS scores and global GHQ-12 scores of both groups

	Good sleepers (n = 53)	Bad sleepers (n = 31)	Total (n = 84)	Significance
	M ± SD Median (range) 95%CI	M ± SD Median (range) 95%CI	M ± SD Median (range)	p-value 95%CI
PSQI Global PSQI score	 3.5 ± 1.3 4 (0 – 5) 3.15 – 3.92	 9.0 ± 2.6 8 (6 – 14) 8.08 – 10.06	 5.5 ± 3.3 5 (0 – 14)	
Subjective sleep quality	0.83 ± 0.47 1 (0 – 2)	1.61 ± 0.56 2 (1 – 3)	1.12 ± 0.63 1 (0 – 3)	
Sleep latency	0.58 ± 0.50 1 (0 –1)	1.58 ± 0.93 1 (0 – 3)	0.95 ± 0.84 1 (0 – 3)	
Sleep duration	0.32 ± 0.51 0 (0 – 2)	1.58 ± 0.96 2 (0 – 3)	0.79 ± 0.94 1 (0 – 3)	
Sleep efficiency	0.13 ± 0.40 0 (0 – 2)	1.29 ± 1.11 1 (0 – 3)	0.56 ± 0.93 0 (0 – 3)	
Sleep disturbances	0.92 ± 0.34 1 (0 – 2)	1.35 ± 0.49 1 (1 – 2)	1.08 ± 0.45 1 (0 – 2)	
Sleeping medication	0 ± 0 0 (0 – 0)	0.26 ± 0.73 0 (0 – 3)	0.10 ± 0.46 0 (0 – 3)	
Daytime dysfunction	0.72 ± 0.61 1 (0 – 2)	1.35 ± 0.84 1 (0 – 3)	0.95 ± 0.76 1 (0 – 3)	
ESS Global ESS score	 7.1 ± 3.3 7 (1-14) 5.89 – 8.16	 8.8 ± 4.8 8 (0 - 20) 6.68 – 10.08	 7.7 ± 4.0 7 (0-20)	 0.113 0,040 – 3,475
GHQ-12 Global GHQ-12 score	 9.1 ± 3.7 9 (3-18) 8.45 – 10.88	 12.9 ± 6.1 11 (7 - 26) 10.43 – 14.81	 10.5 ± 5.0 9 (3-26)	 **0.004** 1,360 – 6,182

p-value: Mann–Whitney U test.

Table 3

Classification of both groups by applying the ESS cut-off value

		Good sleepers	Bad sleepers	Total	
		Number (%)			*p*-value
ESS	normal	44 (83.0)	23 (74.2)	67 (79.8)	0.331
	increased	9 (17.0)	8 (25.8)	17 (20.2)	

p-value: Person's χ^2 test.

Table 4

Correlations of PSQI global and component scores with ESS global score and GHQ-12 global score

		PSQI components							
		Global PSQI score	Subjective sleep quality	Sleep latency	Sleep duration	Sleep efficiency	Sleep disturbances	Sleeping medication	Daytime dysfunction
Global ESS score	r	0.184	0.115	0.017	0.066	0.070	0.211	0.011	0.365
	p	0.094	0.300	0.880	0.550	0.530	0.054	0.921	**< 0.001**
Global GHQ-12 score	r	0.414	0.401	0.263	0.226	0.186	0.304	0.113	0.380
	p	**< 0.001**	**< 0.001**	**0.016**	**0.039**	0.090	**0.005**	0.304	**< 0.001**

r: Spearman's rank correlation.

the cut-off value for disturbed mental health of ≥ 5 with regard to the GHQ-scoring [27] shows *table 5*. [*Table 5* near here].

was correlated with the global GHQ-12 score a positive and significant association indicating very strong evidence was found (r = 0.414, p < 0.001).

Table 5

Classification of both groups by applying the GHQ-12 cut-off value

		Good sleepers	Bad sleepers	Total
		Number (%)		
GHQ	stable	51 (96.2)	22 (71.0)	73 (86.9)
	disturbed	2 (3.8)	9 (29.0)	11 (13.1)

The subjects categorised as being good sleepers with stable mental health reached on average a score of 1.1 ± 1.3 in the GHQ and 3.5 ± 1.3 in the PSQI while the subjects categorised as being bad sleepers with disturbed mental health reached on average a score of 7.7 ± 2.3 in the GHQ and 11.0 ± 2.2 in the PSQI. Categorised good sleepers with disturbed mental health reached on average a score of 7.0 ± 0.0 in the GHQ and 4.0 ± 1.5 in the PSQI, categorised bad sleepers with stable mental health reached on average a score of 1.0 ± 1.0 in the GHQ and 8.2 ± 2.3 in the PSQI.

Correlations between General Mental Health Symptoms and Subjective Sleep Quality as well as Individual Daytime Sleepiness

Correlation analyses were performed to find further associations of general mental health symptoms with subjective sleep quality and daytime sleepiness. When the global PSQI score

Apart from the components sleep efficiency and sleeping medication the component scores correlated significantly with the global GHQ-12 score as well (*table 4*). However, correlating the global ESS score with the global GHQ-12 score no significant relation was found (r = 0.118, p = 0.285).

4. Discussion

There is a rise of mental strain in the world of work [2]. Sleep disturbances and problems falling asleep are often associated with occupational stress as well as problems and social conflicts at the workplace [5–9].

Restorative sleep plays a significant role for health, subjective well-being, and quality of life [38, 39]. Due to the unconscious experience sleep and its quality can subjectively only be assessed in retrospect [40]. In this study the PSQI was used for that which distinguishes between good and bad sleepers. This distinction was used to

divide the total sample into two groups ("Good sleepers" and "Bad sleepers").

General mental health symptoms assessed with the GHQ-12 differed significantly in terms of a strong evidence between both groups whereby the bad sleepers had a worse psychological state in form of higher scores in the GHQ-12. In the correlation analyses significant positive associations between the global GHQ-12 score and the global PSQI score as well as most PSQI component scores were found, too. These associations were both of weak, strong, and very strong evidence.

Given the cross-sectional design of this study it is not possible to draw any conclusions regarding the causality of the associations. It might both be conceivable that subjective sleep quality had an influence on mental health and that mental health influenced subjective sleep quality. It is probable that there is a bidirectional relationship since on the one hand disturbed sleep is symptom of various psychic illnesses [16], but on the other hand it also causes psychic illnesses [14, 15]. Short sleep duration is associated with burnout [41], depression, and suicidal tendency [42, 43]. Kahn–Greene et al. [44] could show that there is an increase of depressive symptoms already after 56 hours of sleep deprivation. The association of psyche and sleep could also be illustrated by the fact that behavioural therapy procedures are superior to hypnotics in the treatment of particular sleep disorders [45, 46]. Cognitive behavioural therapy for insomnia also improves comorbid anxiety and depression [22, 47]. Mental health can be influenced by work-related psychosocial stress. Various studies found a significant association between social stress as well as work-related psychosocial stress and sleep quality [4–6, 8]. A specific problem could be the current development towards permanent availability of the employee. After regular work working is virtually continued due to permanent availability what leads to qualitative and quantitative disturbance of sleep [48]. The results of this study show that poor mental health is associated with reduced sleep quality. Improving sleep might enhance mental health and thus the work ability of the employee. On the other hand, improving mental health could lead to better sleep and thus to a better recovered and more efficient employee.

A possibility of distortion of the described associations in this study could be that a subject with poor mental health or poor subjective sleep quality might have a negative and pessimistic general attitude and therefore estimates the respective other factor intentionally or unintentionally worse than it actually is. In comparison the subject with good psychological health or good subjective sleep quality possibly could have a positive and optimistic general attitude and evaluates the respective other factor intentionally or unintentionally better than it actually is.

The GHQ-12 is an instrument to assess recently experienced mental dysfunctional symptoms and behaviour. A further more precise psychopathological exploration was not performed. Therefore, it cannot be estimated if psychological health was disturbed before recent times or since when it was damaged. That is why we are not able to say from what period of time the association of mental health and sleep quality might possibly exist.

To our knowledge there are few studies which examine the associations of subjective sleep quality and daytime sleepiness with the GHQ score or the GHQ classification. One study which examined students in southern Thailand confirmed the association between poor sleep quality and mental health problems in their sample [49]. The prevalence of poor sleep quality in this study was 42.4 %. Sepehrmanesh [50] also showed that sleep quality might play a significant role in various aspects of mental health. There were significant correlations between general mental health symptoms, physical symptoms, states of anxiety, depression and sleep quality. Both studies used a relatively young sample.

Limitations of this study are the cross-sectional design and the relatively small sample size, especially for the categorical group comparisons. Moreover, the study relied on self-report questionnaires which were completed at home. The clinical relevance of the 95%CI of the results of this study is small. Extended diagnostics (e.g. sleep laboratory) might be necessary to evaluate them sufficiently. Further research on this topic including studies with longitudinal design and larger sample sizes is required. On the whole the findings of this study might provide further evidence of the inter-relationship between subjective sleep quality and mental health and could emphasise the important role of restorative sleep for psychological well-being and the other way round.

Declaration

The authors report no conflicts of interest.

Data Availability

The data that support the findings of this study are available from the corresponding author, RSS, upon reasonable request.

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