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Sleep quality and burnout: A Singapore study

Zhengyong Chen [a, b, *], Zann Sue Ting Foo [b], Joo Ying Tang [b], Mabel Wan Chi Sim [b], Boon Leng Lim [c], Kok Yong Fong [d], Kok Hian Tan [b]

[a] Duke-NUS Medical School, Singapore
[b] SingHealth Duke-NUS Institute for Patient Safety & Quality, Singapore
[c] Department of Anaesthesiology, Singapore General Hospital, Singapore
[d] Department of Rheumatology & Immunology, Singapore General Hospital, Singapore

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ABSTRACT

Introduction: Improved sleep hygiene is postulated to be protective against burnout. Previous studies assessing a potential association between poor sleep quality and burnout showed incongruent results.
Objective: To investigate the relationship between sleep quality and burnout.
Design: Setting and Participants: A survey was conducted in a large health care cluster in Singapore and included health care staff from different professions (N = 4777). The Maslach Burnout Inventory – Human Services Survey was used to measure burnout across 3 sub-scales: Emotional Exhaustion, Depersonalization and Personal Accomplishment, while the Pittsburgh Sleep Quality Index (PSQI) was used to gauge the participants' sleep quality. Multi-variable general linear model ANOVA was used for correlation analysis.
Results: There is a strong correlation between sleep quality and all 3 burnout sub-scales. PSQI is associated with Emotional Exhaustion (F value = 90.65, P-value <.0001), Depersonalization (F value = 49.46, P-value <.0001) and Personal Accomplishment (F value = 12.29, P-value <.0001). PSQI shows a significant linear upward trend with Emotional Exhaustion (linear contrast = 957.06, P-value <.0001) and with Depersonalization (linear contrast = 521.92, P-value <.0001). With Personal Accomplishment, PSQI shows a significant linear downward trend (linear contrast = 123.61, P-value <.0001).
Conclusion: Poor sleep quality is progressively and linearly associated with burnout and its 3 sub-scales. Future studies that evaluate interventions which improve sleep quality among health care workers may be useful in reducing burnout and improving patient care.

1. Introduction

Burnout is a psychological syndrome that consists of 3 feelings: Emotional Exhaustion (EE), Depersonalization (DP) and low Personal Accomplishment (PA) [1]. Emotional Exhaustion occurs when individuals feel so emotionally drained that they cannot give any more care to their patients [2]. Depersonalization describes feelings of cynicism and negativity towards patients, seeing them as impersonal objects and deserving of their ill health [2]. Individuals with low Personal Accomplishment experience dissatisfaction with themselves and their job achievements [2]. Burnout in health care professionals is widespread among not only physicians but also other health care professionals [3]. Burnout has been linked to many factors: compassion fatigue [4], experience of an earthquake [5], hostile work relationships [6] and adverse patient events. Negative effects on patient care occur when physicians suffer burnout or stress [7–10]. These include increased risk of major medical error [11] and involvement in malpractice suits [12]. The function of the entire medical team can be adversely affected [13]. Nurses suffering from burnout have a lower perception of patient safety [14]. During medication dispensing, increased external mental demands, which result from interruptions, divided attention and rushing, are correlated with increased burnout among pharmacists and pharmacy technicians [15].

Improved sleep hygiene is postulated to be protective against burnout [16]. Health care professionals who achieve sleep of adequate quality and duration are better able to deal with the emotional challenges that arise in their daily work while those who

* Corresponding author. Duke-NUS Medical School, MD Programme Department (Level 3), 8 College Road, 169857, Singapore.
E-mail address: e0408967@u.nus.edu (Z. Chen).

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Table 1
Demographics of study population (n = 4777).

Variable	N	%
Gender		
Female	3947	82.6
Male	830	17.4
Age group		
≤ 29	1136	23.8
30 - 39	1802	37.7
40 - 49	962	20.1
50 - 59	595	12.5
≥ 60	282	5.9
Ethnicity		
Chinese	3157	66.1
Indian	384	8.0
Malay	640	13.4
Others	582	12.1
Not specified	14	0.3
Marital status		
Married	2783	58.3
Not married	1994	41.7
Profession		
Allied health professional	684	14.3
Non-clinical staff	1428	29.9
Nurse	2110	44.2
Physician or Dentist	555	11.6
Years of practice		
<2	424	8.9
2–5	827	17.3
6–10	1230	25.7
11–15	835	17.5
16–20	543	11.4
21–25	317	6.6
26–30	219	4.6
>30	381	8.0
Not specified	1	0.0
Number of persons in household		
1	306	6.4
2	635	13.3
3	893	18.7
4	1341	28.1
5	915	19.2
6–13	653	13.7
Not specified	34	0.7
Number of children		
0	2191	45.9
1	757	15.8
2	1126	23.6
3–12	550	11.5
Not specified	153	3.2
Employs domestic help		
No	3767	78.9
Yes	1009	21.1
Not specified	1	0.0
Caring for young children < 7 years old/elderly/disabled family members		
No	3206	67.1
Yes	1570	32.9
Not specified	1	0.0
Smoking (cigarettes per day)		
Non-smoker	4666	97.7
1–5	70	1.5
6–10	27	0.6
11–15	8	0.2
16–20	2	0.0
>20	3	0.1
Not specified	1	0.0
Alcohol (standard drinks per week)		
Non-consumer	3672	76.9
<5	1035	21.7
5–10	55	1.2
10–20	8	0.2
20–30	2	0.0
>30	4	0.1
Not specified	1	0.0

have poor sleep quality are more vulnerable to the effects of stress and burnout [17]. It is not unusual for health care professionals to get little or poor sleep. Physician training is noted for its gruelling hours; being on-call multiple times a week means sacrificing sleep, among other things. Other health care professionals are not spared. Ward nurses work a few consecutive night shifts before getting a day off. Pharmacists and other allied health professionals are also increasingly involved in overnight duties [18]; 19; [20].

Several studies have been done in different parts of the world to elucidate the relationship between sleep quality and burnout. A survey of 213 physicians, nurses, dietitians and social workers revealed that sleep disturbances correlate with perceived stress and lower self-compassion [21]. Self-compassion is a cornerstone for empathy and compassion towards others [22], which helps the clinician to guard against Depersonalization. A study on shift-work nurses in Italy supports the correlation between lower sleep quality and increased burnout [23]. Brazilian nursing staff who were dissatisfied with their sleep were more likely to experience Emotional Exhaustion and Depersonalization [24]. In Spain, it was found that physicians with high levels of burnout had a higher prevalence of insomnia and poor sleep quality than those who were less burnt out [25]. In an Iranian study, languid nurses, who were less tolerant of sleepiness, had higher Emotional Exhaustion and Cynicism, which is a counterpart of Depersonalization [26]. However, there are studies that failed to find a link between poor sleep and burnout. Marek and colleagues (2019) used a single-item burnout measure and sleep quality tool of their institution's design to survey 28 emergency medicine and general surgery residents in USA. They found no association between burnout and sleep quality [27]. Similarly, an observational study of 59 Canadian medical and surgical residents reported that sleep duration did not predict burnout [28]. So far, the evidence for the association between poor sleep quality and burnout has been inconclusive.

There are very few studies conducted in Asia which surveyed more than one group of health care professionals. Cultural and organisational differences that influence burnout may exist across countries [1], so it is important that we understand this phenomenon and its accompanying effects in Asia. The current study aims to fill this gap by investigating the relationship between sleep and burnout among different groups of health care employees, including non-clinical staff, in a Singapore health care cluster.

2. Materials and methods

The survey was conducted over a period of 6 months from July 18, 2019 to January 24 2020. It was circulated to staff with corporate email accounts and hard copy surveys were provided upon request. The study was reviewed and granted exemption by the SingHealth Centralised Institutional Review Board (CIRB) under the category of Anonymous Educational Tests, Surveys, Interviews or Observation. Staff members were informed about the purpose of the study through various publicity platforms and at the start of the survey. The study respondents were also assured of confidentiality and that data would be kept anonymous.

Demographic data, consisting of gender, age group, ethnicity, marital status, profession, years in practice, household size (excluding domestic help), number of children, employment of domestic help, whether the respondent has caregiving duties at home (caring for children below 7 years of age, elderly or disabled family members), tobacco (number of cigarettes per day) and alcohol use (number of standard drinks per week), were collected. A standard drink is defined as 1 can of beer, half a glass of wine or 1 shot of spirit. Respondents completed the Maslach Burnout

Table 2
Relationship of PSQI/demographic variables with burnout sub-scales (ANOVA).

Variable	Degree(s) of freedom	Emotional Exhaustion		Depersonalization		Personal Accomplishment	
		F Value	P-value	F Value	P-value	F Value	P-value
PSQI	13	90.65*	<.0001	49.46*	<.0001	12.29*	<.0001
Gender	1	7.15*	0.0075	6.67*	0.0098	21.58*	<.0001
Age group	4	14.08*	<.0001	8.6*	<.0001	0.72	0.5772
Ethnicity	3	18.47*	<.0001	41.06*	<.0001	30.98*	<.0001
Marital Status	1	0.52	0.4707	0.04	0.8408	0.43	0.5126
Profession	3	24.63*	<.0001	33.03*	<.0001	38.24*	<.0001
Years in practice	7	1.02	0.4121	1.73	0.0982	1.1	0.3627
Household size	6	1.87	0.0815	2.04	0.0573	1.89	0.0790
Number of children	4	6.07*	<.0001	2.07	0.0826	1.52	0.1926
Employs domestic help	1	0.94	0.3334	0.05	0.8260	3.25	0.0713
Caregiving duties at home	1	0.03	0.8717	6.69*	0.0097	1.17	0.2789
Smoking	5	0.28	0.9229	1.32	0.2531	0.9	0.4795
Alcohol	5	0.9	0.4817	1.09	0.3655	1.75	0.1204

Table 3
Adjusted means of Emotional Exhaustion, Depersonalization and Personal Accomplishment.

PSQI	Emotional Exhaustion Mean	Depersonalization Mean	Personal Accomplishment Mean
0 to 1	8.28	3.06	36.28
2	10.80	4.09	35.20
3	11.13	4.45	32.75
4	13.78	4.92	32.35
5	16.80	5.91	31.21
6	18.08	6.46	31.53
7	19.66	6.87	30.91
8	22.06	7.82	30.48
9	23.65	8.50	29.79
10	24.73	8.99	28.22
11	26.57	9.78	29.01
12	28.16	10.32	28.72
13	30.97	11.38	29.41
14 to 19	34.56	13.60	27.38

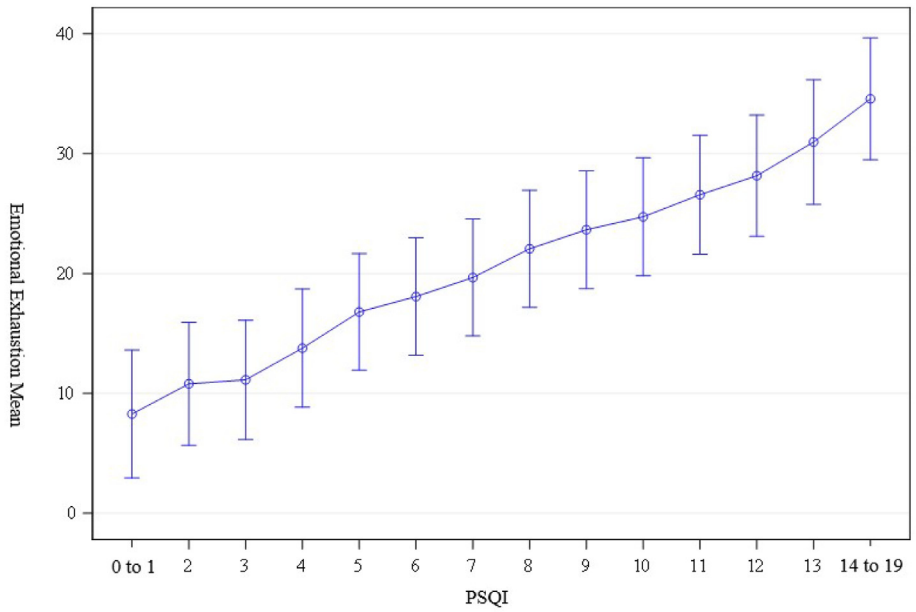

Fig. 1. Emotional exhaustion means against PSQI Scores
(linear contrast = 957.06, P-value <.0001).

Inventory – Human Services Survey (MBI-HSS), Pittsburgh Sleep Quality Index (PSQI), Patient Health Questionnaire, Jefferson Scale of Empathy, one question on what they thought contributed to burnout, and another on how to reduce burnout and improve

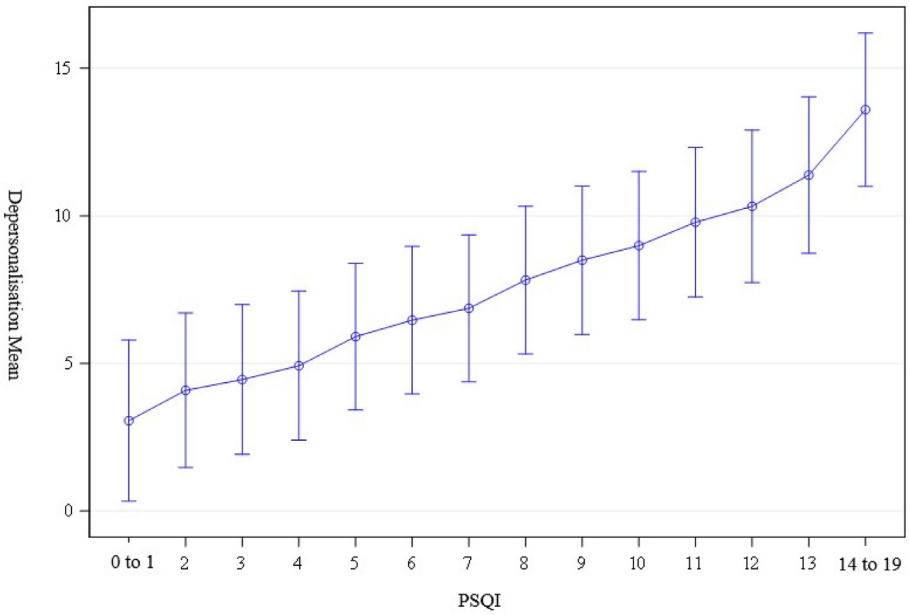

Fig. 2. Depersonalization means against PSQI Scores (linear contrast = 521.92, P-value <.0001).

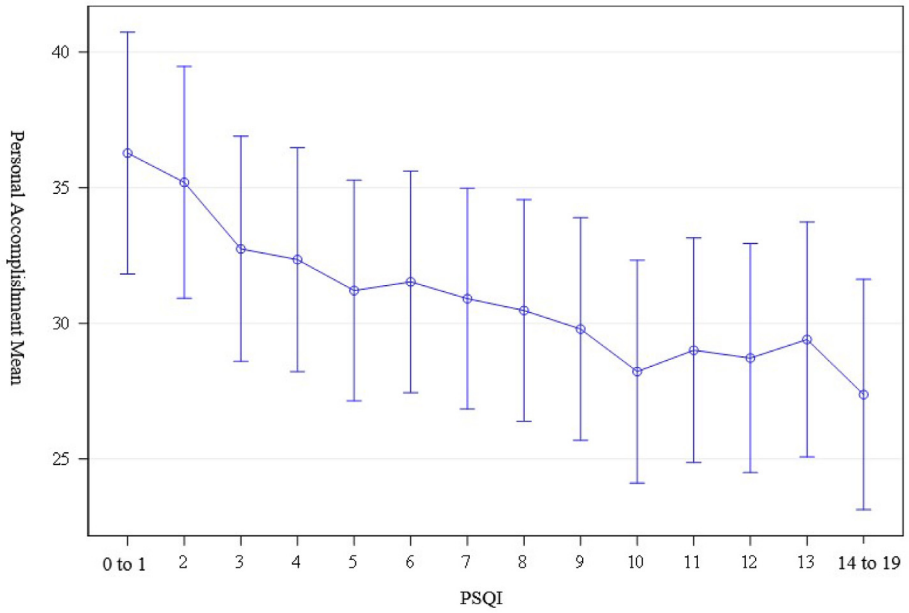

Fig. 3. Personal accomplishment means against PSQI Scores (linear contrast = 123.61, P-value <.0001).

resilience. This thesis focuses on the results from the MBI-HSS and PSQI.

The MBI-HSS consists of a 22-item self-administered 7-point Likert scale questionnaire organised into the following 3 subscales: 9 questions on emotional exhaustion (EE), 5 questions on depersonalization (DP) and 8 questions on personal accomplishment (PA). Based on a normative sample of 1104 medical workers, responses in the upper third were considered high scores for each scale, that is, EE $\geq$ 27, DP $\geq$ 10 and PA $\leq$ 33 [29].

The PSQI is a scale which respondents use to assess themselves on the subjective quality of sleep [30]. This scale is a validated, standardized and reliable tool that assesses the following seven areas: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disorders, hypnotic drug use and quality of everyday life. The final ranges from 0 (better sleep) to 21 (worst sleep). A score more than 5 indicates the presence of a sleep disorder.

Descriptive analyses were performed. PSQI and demographic variables were included in a multi-variable general linear model ANOVA with EE, DP and PA as the outcome variables. The frequency of some of the PSQI scores and demographic responses were too low for meaningful analysis. Therefore, these scores and responses were combined into umbrella categories. The range of PSQI scores in this sample is from 0 to 19. The scores 0 and 1 are combined into

Table 4
Estimated benefits of low PSQI score on burnout sub-scales.

PSQI	Emotional Exhaustion				Depersonalization				Personal Accomplishment			
	Estimated benefit	95% Confidence Limits		P-value	Estimated benefit	95% Confidence Limits		P-value	Estimated benefit	95% Confidence Limits		P-value
0 to 1	−26.28	−29.23	−23.33	<.0001	−10.54	−12.04	−9.03	<.0001	8.90	6.44	11.36	<.0001
2	−23.77	−26.31	−21.22	<.0001	−9.51	−10.81	−8.21	<.0001	7.82	5.69	9.95	<.0001
3	−23.43	−25.72	−21.14	<.0001	−9.14	−10.31	−7.97	<.0001	5.37	3.46	7.28	<.0001
4	−20.79	−22.93	−18.64	<.0001	−8.67	−9.77	−7.58	<.0001	4.97	3.18	6.77	<.0001
5	−17.77	−19.83	−15.70	<.0001	−7.69	−8.75	−6.63	<.0001	3.83	2.11	5.56	<.0001
6	−16.49	−18.53	−14.44	<.0001	−7.13	−8.18	−6.09	<.0001	4.16	2.45	5.86	<.0001
7	−14.90	−16.95	−12.86	<.0001	−6.73	−7.78	−5.69	<.0001	3.54	1.83	5.24	<.0001
8	−12.50	−14.58	−10.43	<.0001	−5.78	−6.84	−4.72	<.0001	3.10	1.37	4.83	0.0005
9	−10.92	−13.03	−8.80	<.0001	−5.10	−6.18	−4.02	<.0001	2.41	0.65	4.18	0.0073
10	−9.83	−12.03	−7.63	<.0001	−4.61	−5.73	−3.49	<.0001	0.85	−0.99	2.68	0.3652
11	−7.99	−10.29	−5.70	<.0001	−3.82	−4.99	−2.65	<.0001	1.63	−0.28	3.55	0.0945
12	−6.41	−8.85	−3.97	<.0001	−3.28	−4.52	−2.03	<.0001	1.34	−0.69	3.38	0.1951
13	−3.60	−6.30	−0.89	0.0091	−2.22	−3.60	−0.84	0.0017	2.03	−0.23	4.29	0.0781
14 to 19	0	.	.	.	0	.	.	.	0	.	.	.

one category while the scores 14 to 19 are combined into another category due to low frequencies in these ranges. The remaining scores from 2 to 13 are kept in separate categories. Household sizes from 6 to 13 and number of children from 3 to 12 were treated similarly and combined into single categories.

After adjusting for the other demographic variables, the means of EE, DP and PA were reported for all PSQI categories. All data were recorded electronically. Statistical analysis was completed with SAS version 9.4. P-values $\leq$.05 were considered significant.

3. Results

The target survey population was set at 15 000 staff members. 6048 responded. Out of these responses, 1271 participants provided incomplete answers in the PSQI and a global score could not be computed. These responses were omitted. 4777 respondents remained.

The overall characteristics of the analysed sample are summarised in Table 1. A total of 4777 participants, who provided complete data on sleep quality and burnout, were included in the study. 3947 (82.6%) of the study sample were females. 37.7% of the sample were between 30 and 39 years old while 23.8% were less than 30 years old. Chinese employees (66.1%) made up the majority of the sample, followed by Malays (13.4%), Indians (8.0%), reflecting the ethnic make-up of the local population. The “Others” category (12.1%) in the ethnic distribution consisted of Eurasians and an international mix of Filipinos, Burmese, Sri Lankans, Caucasians and more. 0.3% of the respondents chose not to disclose their ethnicity. Nurses, who form the majority of the health care workforce, also made up the largest portion of the sample (44.2%). 11.6% of the sample were physicians or dentists, while 14.3% were allied health professionals. Non-clinical staff, consisting of administrators, researchers and ancillary workers, made up the remaining 29.9%.

The breakdown of social and lifestyle variables are as follows. 66% of respondents had a household size of 3–5. Almost half (45.9%) did not have children; 15.8% had one child; 23.6% had two. One fifth (21.1%) employed domestic help while almost a third (32.9%) cared for young children, elderly or disabled family members at home. 76.9% did not drink alcohol while 21.7% drank less than 5 standard drinks per week.

Table 2 shows the relationship of PSQI and demographic variables with burnout sub-scales. The multi-variable general linear model ANOVA showed significant associations between PSQI scores and the burnout sub-scales. PSQI is associated with Emotional Exhaustion (F value = 90.65, P-value <.0001), Depersonalization (F value = 49.46, P-value <.0001) and Personal Accomplishment (F value = 12.29, P-value <.0001). Gender, ethnicity, and profession are confounders for all 3 burnout sub-scales. Age is a confounder for Emotional Exhaustion and Depersonalization. Number of children is a confounder for Emotional Exhaustion only, while caregiving duties at home is a confounder for Depersonalization.

After adjusting for demographic variables, Table 3 displays the adjusted means for the 3 burnout sub-scales. With increasing PSQI scores, the means of Emotional Exhaustion and Depersonalization show an upward trend, while the means of Personal Accomplishment shows a downward trend. Fig. 1 is a graph of Emotional Exhaustion means against PSQI and it shows a statistically significant linear upward trend (linear contrast = 957.06, P-value <.0001), reflecting the increase in Emotional Exhaustion with worsening sleep quality. Fig. 2 is a graph of Depersonalization means against PSQI and it also shows a statistically significant linear upward trend (linear contrast = 521.92, P-value <.0001), reflecting the increase in Depersonalization with worsening sleep quality. Lastly, Fig. 3 plots Personal Accomplishment means against PSQI and it displays a statistically significant downward trend (linear contrast = 123.61, P-value <.0001), reflecting the decrease in Personal Accomplishment with worsening sleep quality.

The estimated benefits of better sleep quality are shown in Table 4. The estimated benefits were calculated with reference to the score category that indicates the worst sleep quality in this sample, which is 14–19. The estimated benefits decrease as sleep quality worsens i.e. as PSQI scores increase. The lowest PSQI scores elicit the largest benefits in burnout reduction. For PSQI scores 0 to 1, Emotional Exhaustion is estimated to decrease by 26.28 points (95% confidence interval = 23.33–29.23, P-value <.0001), Depersonalization decreases by 10.54 (95% confidence interval = 9.03–12.04, P-value <.0001) and Personal Accomplishment increases by 8.90 (95% confidence interval = 6.44–11.36, P-value <.0001), with reference to the highest PSQI score category (14–19).

A chi-squared test was performed to determine significant differences between the included and excluded samples. Results are shown in Table 5. Age, ethnicity, marital status, profession, years in practice, household size, number of children, employment of domestic help, caregiving duties at home and smoking differ significantly between the two samples.

4. Discussion

Data analysis, using multi-variable general linear model ANOVA, allowed us a more comprehensive understanding of how sleep

Table 5
Chi-squared test between included and omitted samples.

Category	Included n = 4777		Omitted n = 1271		Chi-Squared	P-value
	Number of respondents	Percentage	Number of respondents	Percentage		
Gender						
Female	3947	82.6	1077	84.7	3.18	0.0745
Male	830	17.4	194	15.3		
Age group*						
≤29	1136	23.8	483	38	107.13	<.0001
30–39	1802	37.7	421	33.1		
40–49	962	20.1	190	14.9		
50–59	595	12.5	120	9.4		
≥60	282	5.9	57	4.5		
Ethnicity*						
Chinese	3157	66.1	591	46.5	165.92	<.0001
Indian	384	8	143	11.3		
Malay	640	13.4	276	21.7		
Others	596	12.5	261	20.5		
Marital status*						
Married	2783	58.3	578	45.5	66.43	<.0001
Not married	1994	41.7	693	54.5		
Profession*						
Allied health professional	684	14.3	77	6.1	327.58	<.0001
Non-clinical staff	1428	29.9	213	16.8		
Nurse	2110	44.2	922	72.5		
Physician or Dentist	555	11.6	59	4.6		
Years of practice*						
<2	424	8.9	131	10.3	38.46	<.0001
2 to 5	827	17.3	266	20.9		
6 to 10	1230	25.7	366	28.8		
11 to 15	835	17.5	223	17.5		
16 to 20	543	11.4	97	7.6		
21 to 25	317	6.6	61	4.8		
26 to 30	219	4.6	40	3.1		
>30	381	8	87	6.8		
Not specified	1	0	0	0		
Household size*						
1	306	6.4	76	6	31.24	<.0001
2	635	13.3	134	10.5		
3	893	18.7	243	19.1		
4	1341	28.1	317	24.9		
5	915	19.2	247	19.4		
6 to 13	653	13.7	245	19.3		
Not specified	34	0.7	9	0.7		
Number of children*						
0	2191	45.9	709	55.8	66.21	<.0001
1	757	15.8	175	13.8		
2	1126	23.6	194	15.3		
3 to 12	550	11.5	129	10.1		
Not specified	153	3.2	64	5		
Employs domestic help*						
No	3767	78.9	1064	83.7	14.91	0.0006
Yes	1009	21.1	207	16.3		
Not specified	1	0	0	0		
Caregiving duties at home*						
No	3206	67.1	913	71.8	10.5	0.0052
Yes	1570	32.9	358	28.2		
Not specified	1	0	0	0		
Smoking*						
Non-smoker	4666	97.7	1192	93.8	59.36	<.0001
1 to 5	70	1.5	41	3.2		
6 to 10	27	0.6	19	1.5		
11 to 15	8	0.2	10	0.8		
16 to 20	2	0	5	0.4		
>20	3	0.1	4	0.3		
Not specified	1	0	0	0		
Alcohol						
Non-consumer	3672	76.9	962	75.7	12.4365	0.0529
<5	1035	21.7	276	21.7		
5 to 10	55	1.2	21	1.7		
10 to 20	8	0.2	7	0.6		
20 to 30	2	0	2	0.2		
>30	4	0.1	3	0.2		
Not specified	1	0	0	0		

quality affects Emotional Exhaustion, Depersonalization and Personal Accomplishment. After adjusting for confounders, our model clearly shows a linear, progressive association between sleep quality and the means of EE, DP and PA (Table 3). Figs. 1–3 highlights this relationship graphically: the trajectories of EE, DP and PA display a deteriorating pattern with worsening PSQI scores.

This is consistent with the majority of prior studies that demonstrated an association between a high PSQI score i.e. poor sleep quality, and high burnout [23]. The present findings are also consistent with studies on nurses, showing that individuals dissatisfied with their sleep are more likely to suffer Emotional Exhaustion and Depersonalization [24]. A previous study on ophthalmology residents found that poor sleep is associated with increased Emotional Exhaustion and reduced Personal Accomplishment [31]. A recent survey of physicians, which used the Personal Fulfillment Index to measure burnout, reported a correlation between sleep-related impairment with interpersonal disengagement and work exhaustion [32]. The present study's finding that sleep quality has a significant association on all 3 burnout sub-scales adds to the current knowledge in the literature.

In contrast with previous small-scale surveys that showed no association between sleep and burnout [27,28], our novel study clearly demonstrates the strong progressive association between poor sleep quality and all three burnout sub-scales. The contradictory results may be due to the difference in how sleep was assessed. Marek and colleagues (2019) measured sleep quality as part of an institution-designed wellness factors survey, which might not have surveyed the same factors as the PSQI. Mendelsohn and colleagues (2019) measured only sleep duration, not comprehensive sleep quality as defined in the PSQI. In addition, these studies [27,28] did not adjust for a wide range of demographic variables, which may have confounded the results. Our current study, having a much larger sample, detected statistically significant associations between sleep and burnout sub-scales.

However, whether sleep quality or burnout is the antecedent in this relationship is as yet undetermined. Vela-Bueno and colleagues (2008) investigated this association by starting with a low-burnout group and a high-burnout group of primary care physicians. They showed that the high-burnout group had worse sleep quality, compared to the low-burnout group. From our data, what we can theorize is the estimated benefits of better sleep quality on reducing burnout (Table 4), when considering a hypothetical scenario in which sleep quality affects burnout in a unidirectional manner. However, based on the evidence in the literature, we cannot rule out the possibility of a bidirectional relationship between sleep quality and burnout.

To our knowledge, this current study is the largest survey on sleep quality and burnout in Southeast Asia. Most prior studies were conducted in other regions of the world, like the Americas [21,24,27,28], Europe [23,25], and the Middle East [26,33]. Few, if any, studies with a similar focus on sleep quality and burnout have been done in Southeast Asia. Since different cultural and institutional norms may have different effects on burnout [1], the present study adds an Asian perspective on the topic and extends the understanding of burnout and its associated factors in the local context.

Previous studies in Singapore focused on measuring the prevalence of burnout among physicians [34,35] or nurses [36] only. One study of registered nurses investigated the influence of demographic variables and personal characteristics on burnout, in addition to the prevalence of burnout [37]. Our study is the first South East Asian survey to include different health care professionals and non-clinical staff, increasing our understanding of the association between sleep quality and burnout in a much wider segment of the population.

There are limitations of the present study. 1271 participants were excluded because of incomplete PSQI responses. Many respondents might have found it challenging to answer the questionnaire because shift work made it difficult for them to identify a regular bedtime. Even though the instructions on the PSQI asks respondents to recall the majority of their bedtimes in the previous month, some of them might have had day shifts for half the month and night shifts for the remaining half, therefore making it impossible to adhere to the instructions. Perhaps future versions of PSQI can make allowances for shift work workers. Other incomplete responses came from participants who do not usually engage in shift work (16.8% of omitted responses). We can only postulate other reasons for their non-responses on an online survey about their sleep quality: they lost interest, the survey took too long or they became tired or sleepy. We recognise that the omission of these non-responses made the sample of completed responses less representative of the recruited sample. This may affect the generalizability of the results . In addition, recall bias may have affected the accuracy of the data because some respondents might have found it challenging to correctly recall their sleep pattern for the previous month. Although this study measured a number of demographic variables, it does not cover all possible confounders, for instance, income, frequency of overnight duties or caffeine intake. Finally, since temporality of association is needed to establish causality, the cross-sectional nature of this study means that we are unable to prove the exact direction of the association between sleep quality and burnout. This can be an area of inquiry for future studies.

In conclusion, poor sleep quality is progressively and linearly associated with all 3 burnout sub-scales, manifested as high Emotional Exhaustion, high Depersonalization and low Personal Accomplishment. Future studies on interventions which improve sleep quality among health care workers may help decrease burnout. This reduction may lead to safer patient outcomes.

CRediT authorship contribution statement

Zhengyong Chen: Conceptualization, Formal analysis. **Zann Sue Ting Foo:** Data retrieval. **Joo Ying Tang:** Data retrieval. **Mabel Wan Chi Sim:** Data retrieval. **Boon Leng Lim:** Funding acquisition. **Kok Yong Fong:** Funding acquisition. **Kok Hian Tan:** Conceptualization, Formal analysis, Funding acquisition.

Declaration of competing interest

No conflict of interest declared.

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