

# The Impact of Resident Duty-Hour Limits on Sleep Quality: A Cross-sectional Study

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## Abstract

**Objective:** Resident physicians are particularly prone to sleep disturbance due to long shift hours and excessive workload. Despite the numerous measures undertaken to improve their well-being, it's still unknown if limiting the work shift duration would improve sleep quality.

**Methods:** A self-reported questionnaire was used to obtain data about sleep quality, anxiety and depression using PSQI and PHQ-4 scales, respectively. Using data from previous study, we compared those parameters before and after the implementation of duty hour reduction across several specialties in a tertiary center. Furthermore, we investigated residents' life satisfaction using SWLS scale.

**Results:** 180 residents filled the questionnaire (median age: 26.5 years). Males reported higher rates of poor sleep quality while females had higher rates of anxiety and depression. Decreasing the duration of on-call shifts from 32 to 24 hours decreased the prevalence of poor sleep quality from 91.5% to 83.2% (p: 0.038), and smoking rates decreased from 30.4 to 12.5% (p: <0.0001). More than 6 on-calls per month was associated with poorer quality of sleep. Night float shifts decreased rates of moderate and severe PHQ-4 scores significantly (p: <0.001). In addition, 63.3% of residents were satisfied with life. Life satisfaction was associated with enhanced sleep quality and lower PHQ-4 scores (p: 0.007 and <0.0001, respectively).

**Conclusions:** Optimizing shift scheduling and duration can positively influence rates of sleep quality, anxiety, depression, and smoking rates. More interventions should be tackled along with duty hour limits to optimize residents' satisfaction with life.

**Keywords:** Residency; physicians; sleep quality; workload; night float; on-calls.

## Introduction

Maintaining optimal sleep quality, duration, timing, and regularity is a biological imperative [1]. The American Academy of Sleep Medicine (AASM) and Sleep Research Society (SRS) recommend that adults sleep 7 hours or more per night to avoid adverse health outcomes such as depression, increased risk of death, impaired performance, and increased rates of errors and accidents [2-4]. Resident physicians are particularly vulnerable to sleep deprivation owing to long working hours, frequent on-call shifts, and the demanding nature of their education. Sleep deprivation negatively affects learning, memory consolidation, cognitive performance, physical and psychological well-being, as well as personal life and residents are not an exception [5-7]. One in three residents has reported poor sleep quality in previous studies [8, 9]. One study reported 28.8% prevalence of depression among resident physicians [10]. Depressed residents tend to make more medical errors compared to their non-depressed peers [11]. In Jordan, we previously found that around 90% of residents had poor sleep quality, which marked the highest reported prevalence of poor sleep quality among residents in previous literature [12]. We also found that 21.4% and 18.9% had moderate or severe anxiety and depression respectively.

Extended work shift ( $\geq 24$  hours) is still a common practice in many regions although it was demonstrated to threaten the safety of both residents and patients [13-15]. A study that was conducted in intensive care settings demonstrated that the traditional work schedule was associated with a 36% increase in serious medical errors and a 5.6 times increase in serious diagnostic errors compared with a modified schedule with limited working hours [16]. Therefore, restricting work hours has been advocated since 2003 in order to decrease the adverse effects associated with traditional schedules [17, 18]. Working for more than 80 hours and 100 hours per week have been associated with around 3 folds and 7 folds higher risk of depression, respectively compared to < 60 working hours per week [19]. Currently, the Accreditation Council for Graduate Medical Education (ACGME) limits the clinical and educational work hours to no more than 80 hours per week and 24 hours of continuous work [20]. The Faculty of Medicine at Jordan University of Science and Technology “JUST” has since October of 2019 limited resident working hours in accordance with the requirements of ACGME accreditation. Evidence of the impact of work hour limitation on resident and patient outcomes is still limited [17]. To the best of our knowledge, the impact of reducing work hours on sleep quality and prevalence of anxiety and depression among residents has not been investigated yet. This study compared sleep quality, anxiety, and depression before and after the implementation of duty-hour limits in the same center. . It also seeks to evaluate how the level of satisfaction with life is related with sleep quality, anxiety and depression.

## **Methods**

### **Study design**

A questionnaire based cross-sectional study was conducted among resident physicians from different specialties at King Abdullah University Hospital (KAUH) between September and November 2020. This study was approved by the institutional review board committee at JUST and KAUH (digital proposal number 212/132/2020). Confidential data and informed consents were secured in locked cabinets and handled with research members only. Participants were given serial numbers before data entry and analysis.

### **Study Subjects**

This study targeted resident physicians in the residency program at KAUH who had spent at least six months in residency and signed the informed consent for participation in the study. Residents with diagnosed sleep disorders were excluded. The estimated number of post-graduate physicians who were enrolled at the residency program at the time of the study was around 460 doctors. We have previously evaluated sleep quality among residents in KAUH, which was around 90%. Accordingly, we calculated the minimum required sample size using version 3 of OpenEpi online calculator, assuming the following parameters: The hypothesized prevalence (P):90%, margin of error (d):0.05, confidence interval (CI):95%, and design effect (DEEF): 1 for random sampling; and power set for 80%. The calculated sample size was 107 physicians. Our final sample size was 180. The study participants were randomly selected via systematic sampling using the hospital's resident record. Residents were then contacted to check for their eligibility and signed the informed consent. Response rate was 98.9%."Residency programs in KAUH consist of 4 to 6 training years, while number of on-calls is dependent on specialty as well as the Residency level (R). Until October 2020, an on-call shift lasted a continuous 32 hours. Then, 24-hour shift limits were applied across all departments, except for Neurosurgery which opt for not implementing any changes, and Internal Medicine which applied night float shifts from 10 p.m. to 8 a.m (which also includes some day shifts from 4 pm to 10 p.m). Pathology and Dermatology have no on-call shifts except for PGY1 dermatology residents. Nonetheless, they were involved in this study as a reference to test associations. Residents with no on-calls were excluded from analysis when studying the effects of duty hour limits.

### **Data collection**

A self-report English questionnaire was used to collect data on demographics (age, gender), specialty, PGY level (i.e. year of residency), number of on-call shifts per month, smoking status (smoker, never smoked, ex-smoker), sleep quality (PSQI), anxiety and depression (PHQ-4), and Satisfaction with life (SWLS). We compared our previous data on sleep quality as well as anxiety and depression, which was collected in early 2019 prior to the implementation of duty hour limits, with this study's new data. Two new work schedules have been implemented at KAUH since October 2019. The first includes a 24-hour limit on the on-call shift, while the other involves rotating night floating shifts (working 12 hours daily for one week every two months, with otherwise normal 8 hours work schedules and intermittent 6-hour on-calls from the end of a normal workday until 10 p.m).

## Key measures

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), which measures seven domains: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping pills, and daytime dysfunction over the past month. Poor sleep quality was determined by a cutoff PSQI score of at least 5. Higher scores implied worse sleep quality [21]. We utilized the four-item patient health questionnaire for anxiety and depression (PHQ-4), which is a brief, valid tool to assess the prevalence of anxiety and depression among residents. The scale comprises of four questions, each with four possible answers that correspond to specific points. Total score is calculated by adding the scores of individual items. Subsequently, scores are rated as normal (0-2), mild (3-5), moderate (6-8), and severe (9-12). Besides, total score  $\geq 3$  for the first 2 items suggests anxiety, whereas the same score for the last two implies depression [22]. Satisfaction With Life Scale (SWLS) was implemented as a measure of the life satisfaction among resident physicians. It incorporates 5 items, each with possible 7-point Likert style response scale. Range of scores is between 5-35 (20 is the neutral point). Scores between 5-9 indicate extreme dissatisfaction with life, whereas scores between 31-35 indicate extreme satisfaction [23].

## Statistical Analysis

Data were presented as frequencies and proportions (%) for categorical variables, and as median (IQR) for continuous data (age and SWLS). Univariate and multivariable analyses of the associations between sleep quality (poor, adequate) or PHQ-4 stages (normal, mild, moderate, severe) with several factors were implemented using binary logistic regression and ordinal logistic regression, respectively. To analyze predictors of SWLS, a Kruskal-Wallis test was done, followed by Dunn's pairwise tests for multiple comparisons. Two proportions Z test and chi-square test were used to compare sleep quality and PHQ-4 scores before and after working hours limitations, respectively. Statistical significance was established at  $p < 0.05$ . Statistical analysis was performed using SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.).

## Results

A total of 180 resident physicians from different specialties completed the survey. Median age (IQR) was 26.5 (3) years and females constituted 52.2% of the sample. **Table 1** lists the personal characteristics of study sample.

**Table 1:** Personal characteristics of study subjects (n=180).

Characteristic	n (%)
Age (median, IQR)	26.5 (25-28)
Gender	
Male	86 (47.8)
Female	94 (52.2)
Number of oncalls/month	

<b>No oncalls</b>	21 (11.7)
<b>1-2</b>	4 (2.2)
<b>3-4</b>	19 (10.6)
<b>5-6</b>	48 (26.7)
<b>&gt;6</b>	88 (48.9)
<b>Residency level</b>	
R1	53 (29.4)
R2	47 (26.1)
R3	33 (18.3)
R4	33 (18.3)
R5	14 (7.8)
<b>Smoking status</b>	
<b>Never smoked</b>	138 (76.7)
<b>Smoker</b>	29 (16.1)
<b>Ex-smoker</b>	13 (7.2)
<b>Sleep quality (PSQI)</b>	
<b>Adequate</b>	31 (17.2)
<b>Poor</b>	149 (82.8)
<b>PHQ-4</b>	
<b>Normal</b>	49 (27.2)
<b>Mild</b>	54 (30)
<b>Moderate</b>	46 (25.6)
<b>Severe</b>	31 (17.2)
<b>SWLS</b>	
<b>Extremely satisfied</b>	48 (26.7)
<b>Satisfied</b>	35 (19.4)
<b>Slightly satisfied</b>	31 (17.2)
<b>Neutral</b>	6 (3.3)
<b>Slightly dissatisfied</b>	28 (15.6)
<b>Dissatisfied</b>	22 (12.2)
<b>Extremely dissatisfied</b>	10 (5.6)
<b>IQR, interquartile range; R, Residency year; PHQ-4, the four-item patient health questionnaire for anxiety and depression; PSQI, Pittsburgh Sleep Quality Index; SWLS, Satisfaction With Life Scale.</b>	

### **Sleep quality of study sample (PSQI)**

Poor sleep quality was prevalent in 82.8% of resident physicians. After multivariable regression, male gender and having more than 6 monthly on-call shifts were significantly associated with poor sleep quality (p: 0.001, OR: 9.4, 95% CI: 2.5-35.4 and p: 0.003, OR: 10.4; 95% CI: 2.2-48.7; respectively). On the other hand, SWLS score was negatively associated with poor sleep quality (p: 0.007, OR: 0.9, 95% CI: 0.8-0.96) as mentioned in **Table 2**. Fifth year residents showed lesser

odds for poor sleep quality although this finding did not reach statistical significance (p: 0.07, OR: 0.2, 95% CI: 0.02-1.2).

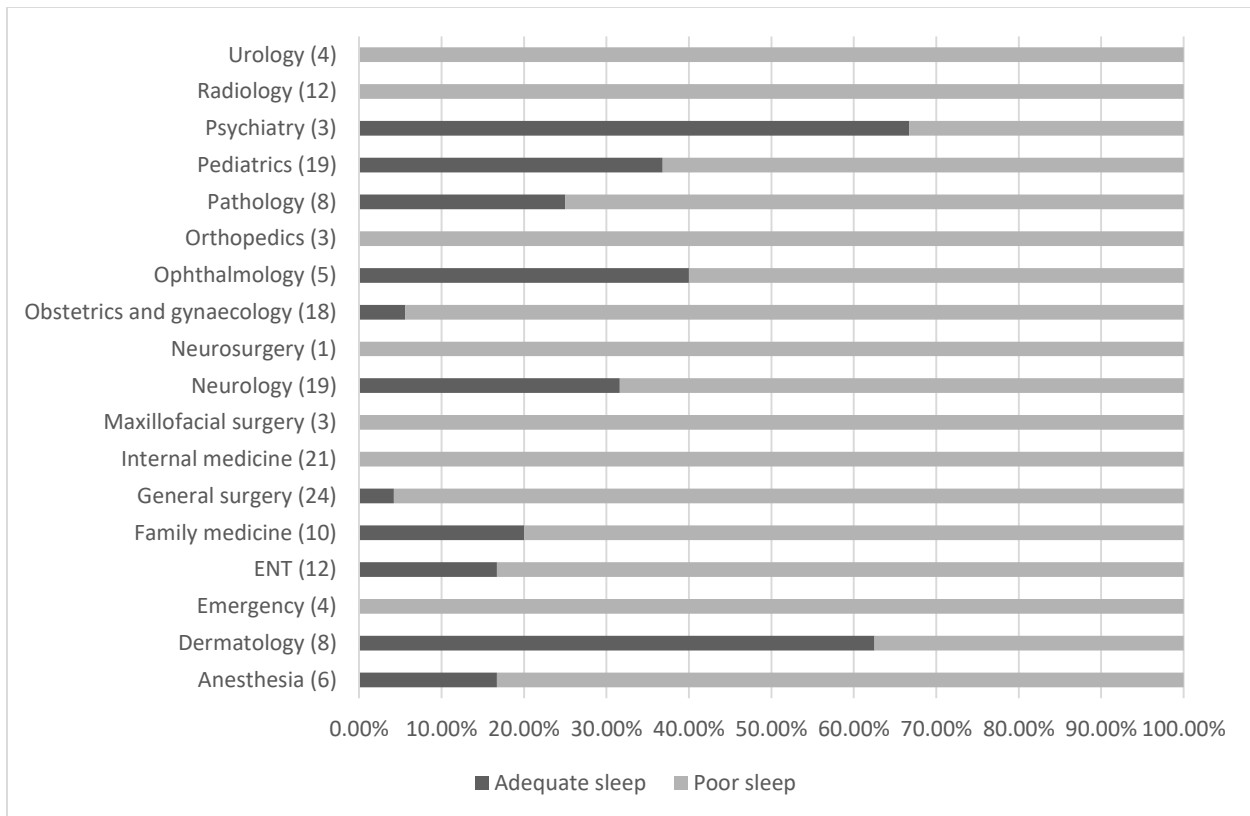
**Table 2:** Univariate and multivariable binary logistic regression analysis of predictors for sleep quality (PSQI), n=180.

Factor	Univariate			Multivariable		
	p value	OR	95% CI	p value	OR	95% CI
Gender						
Female	ref	ref	ref	ref	ref	ref
Male	0.001*	4.8	1.9-12.5	0.001*	9.4	2.5-35.4
PHQ-4						
Normal	ref	ref	ref	ref	ref	ref
Mild	0.8	1.1	0.5-2.8	0.85	1.1	0.3-4.3
Moderate	0.03*	3.8	1.1-12.7	0.82	1.3	0.1-18.2
Severe	0.026*	10.8	1.3-87.7	0.44	4.9	0.1-278.6
PHQ-4						
Anxiety	0.001*	5.7	2-15.7	0.18	3.5	0.6-22.8
Depression	0.003*	4.6	1.7-12.6	0.98	0.98	0.1-6.9
SWLS	<0.0001*	0.86	0.8-0.92	0.007*	0.9	0.8-0.96
Number of oncalls/month						
No oncalls	ref	ref	ref	ref	ref	ref
1-2	0.6	1.8	0.16-20.9	0.16	8.4	0.4-156.8
3-4	0.2	2.3	0.6-9.4	0.051	12.1	0.989-148.2
5-6	0.02*	4.3	1.3-14.7	0.199	3.1	0.6-17.2
>6	0.013*	3.9	1.3-11.4	0.003*	10.4	2.2-48.7
Residency level						
R1	ref	ref	ref	ref	ref	ref
R2	0.14	2.2	0.8-6.4	0.49	1.7	0.4-7.7
R3	0.085*	3.3	0.9-12.4	0.1	4.4	0.7-25.6
R4	0.042*	5	1-24	0.2	3.7	0.5-28.2
R5	0.07	0.3	0.1-1.1	0.07	0.2	0.02-1.2
<b>PHQ-4, the four-item patient health questionnaire for anxiety and depression; R, year of residency; ref, reference group; SWLS, Satisfaction With Life Scale.</b>						

Among the different specialties, Dermatology and Psychiatry showed the highest rates of adequate sleep (62.5% and 66.7%; respectively), while all residents (100%) in Urology, Radiology, Orthopedics, Maxillofacial surgery, internal medicine, and emergency reported poor sleep quality (Figure 1).

**Table 3:** Univariate and multivariable ordinal logistic regression of predictors for PHQ-4, n=180.

Factor	Univariate				Multivariable			
	p value	Regression Coefficient	95% CI		p value	Regression Coefficient	95% CI	
			lower bound	Upper bound			lower bound	Upper bound
<b>Gender</b>								
<b>Female</b>	ref	ref		ref	ref	ref		ref
<b>Male</b>	0.038*	-0.56	-1.095	-0.032	0.002*	-0.889	-1.461	-0.317
<b>SWLS</b>	<0.0001*	-0.158	-0.198	-0.118	<0.0001*	-0.161	-0.204	-0.119
<b>Number of oncalls/month</b>								
<b>No oncalls</b>	ref							
<b>1-2</b>	0.086	-1.816	-3.889	0.256				
<b>3-4</b>	0.075	-1.025	-2.155	0.105				
<b>5-6</b>	0.6	-0.246	-1.167	0.674				
<b>&gt;6</b>	0.21	-0.55	-1.407	0.307				
<b>Residency level</b>								
<b>R1</b>	ref							
<b>R2</b>	0.008*	0.968	0.25	1.687	0.385	0.34	-0.427	1.106
<b>R3</b>	0.33	0.391	-0.395	1.176	0.984	0.009	-0.816	0.833
<b>R4</b>	0.1	0.657	-0.13	1.444	0.479	0.308	-0.545	1.16
<b>R5</b>	0.62	-0.27	-1.349	0.81	0.185	0.185	-0.918	1.288
<b>R, Residency year; PHQ-4, the four-item patient health questionnaire for anxiety and depression; ref, reference group; SWLS, Satisfaction With Life Scale.</b>								



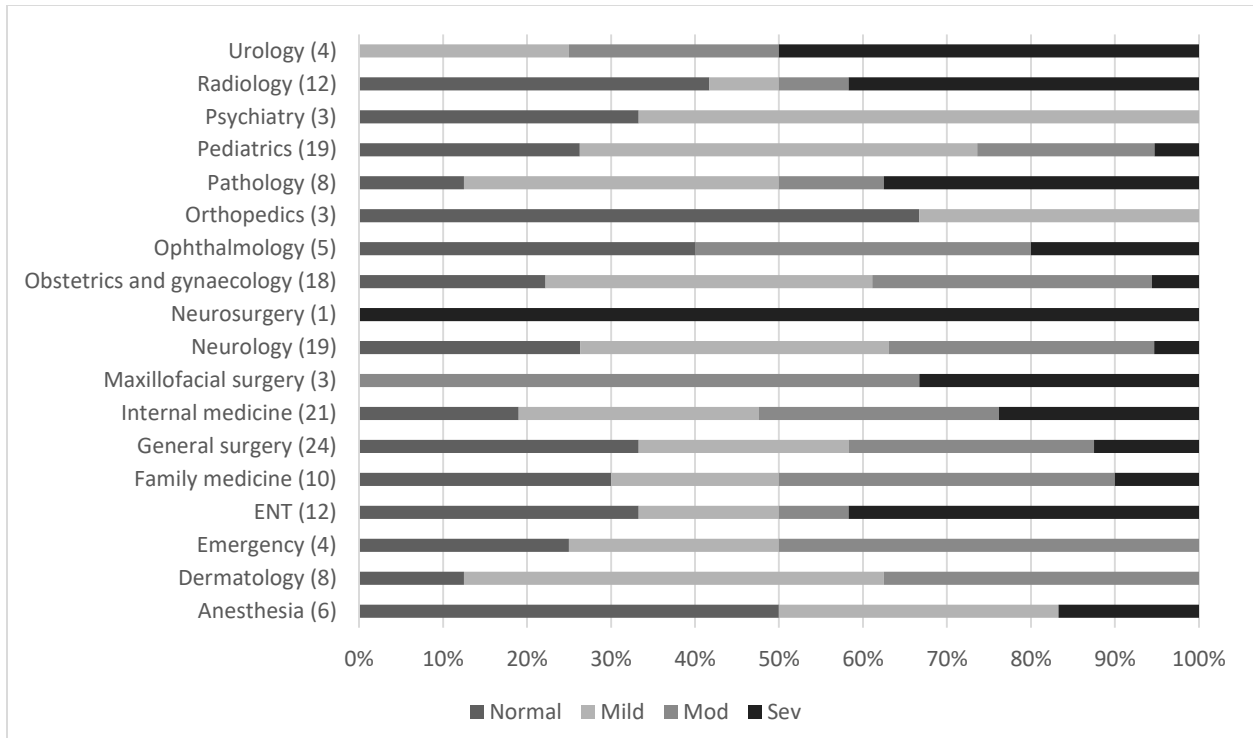
**Figure 1:** Sleep quality among physician residents across different specialties (frequency) presented as percentage per specialty. ENT, ears nose throat.

### **Anxiety and depression in the study sample (PHQ-4)**

Mild, moderate, and severe anxiety and depression as measured by PHQ-4 score were reported by 30%, 25.6% and 17.2% of resident physicians respectively. Females recorded significantly higher PHQ-4 scores than males ( $p: 0.002$ ) as demonstrated in **Table 3**. Additionally, higher SWLS scores were associated with lower PHQ-4 scores ( $p: <0.0001$ ). Post-graduate residency level and the number of monthly on-calls were not found to be significantly associated with PHQ-4 scores (**Table 3**).

The specialties in which more than 50% of residents reported moderate or severe PHQ-4 scores were internal medicine, maxillofacial surgery, ophthalmology, and urology (**Figure 2**). Neither orthopedics nor psychiatry residents reported moderate or severe PHQ-4 scores.





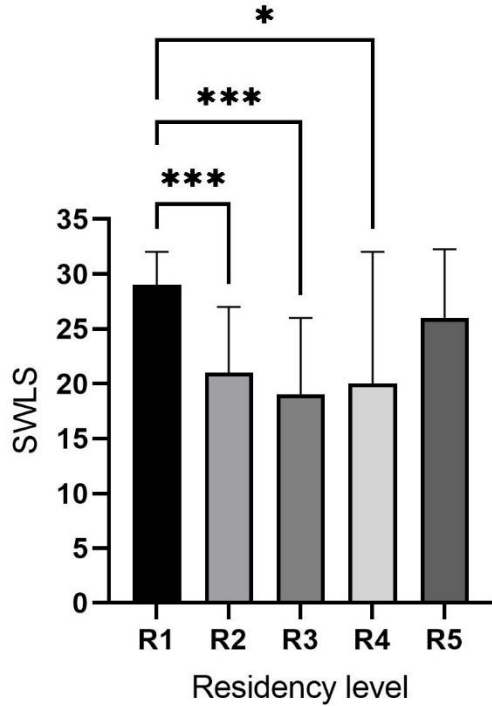
**Figure 2:** PHQ-4 stages for physician residents across different specialties (frequency) presented as percentage per specialty. ENT, ears nose throat.

### Use of sleep aid medications among sample of resident physicians

Only 13 (7.2%) of residents reported that they used sleep aid medication during the past month. Medications that were used are Alprazolam (n=5), diphenhydramine (n=4), melatonin (n=3), chlorpheniramine (n=2), and amitriptyline (n=1), respectively.

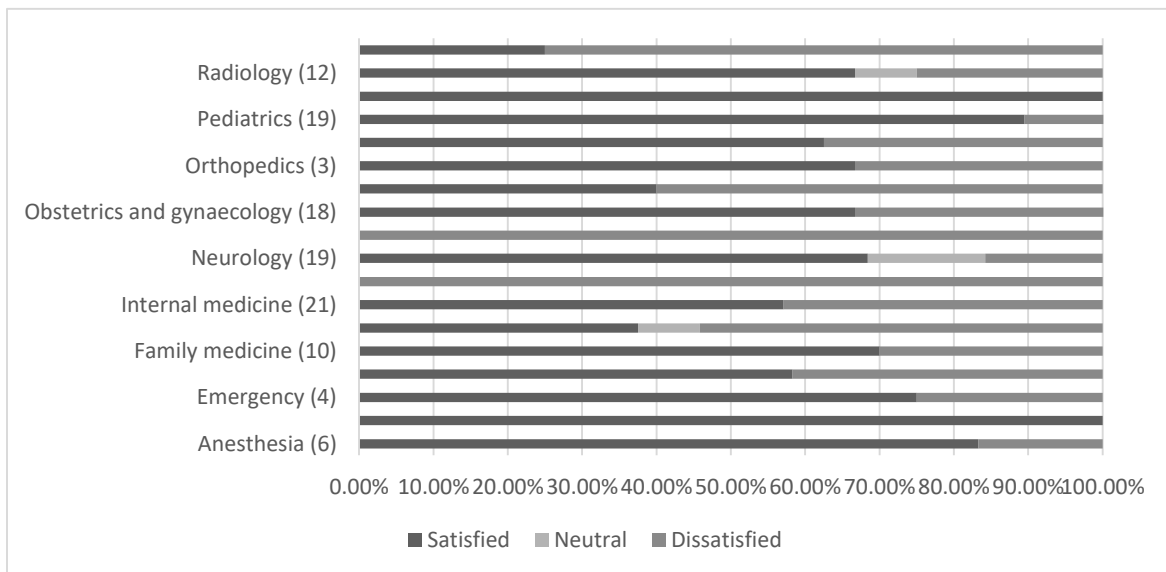
### Life satisfaction

The median [IQR] SWLS score for all 180 physicians was 25 [14]. Satisfaction with life (sum of “extremely satisfied”, “satisfied”, and “slightly satisfied”) was reported by 63.3% of residents in the sample. SWLS score was significantly lower for residents at their R2, R3, and R4 yaers compared to their first year (p: 0.001, 0.0004, and 0.0497, respectively, , Dunn’s test) as shown in **Figure 3**. Gender and number of on-calls per month were not significant predictors of SWLS score (p: 0.53 and 0.66, Mann Whitney U and Kruskal-Wallis tests; respectively).



**Figure 3:** SWLS score as a function of residency level. error bars represent IQR.. \* $p < 0.05$ , \*\*\* $p < 0.001$ .

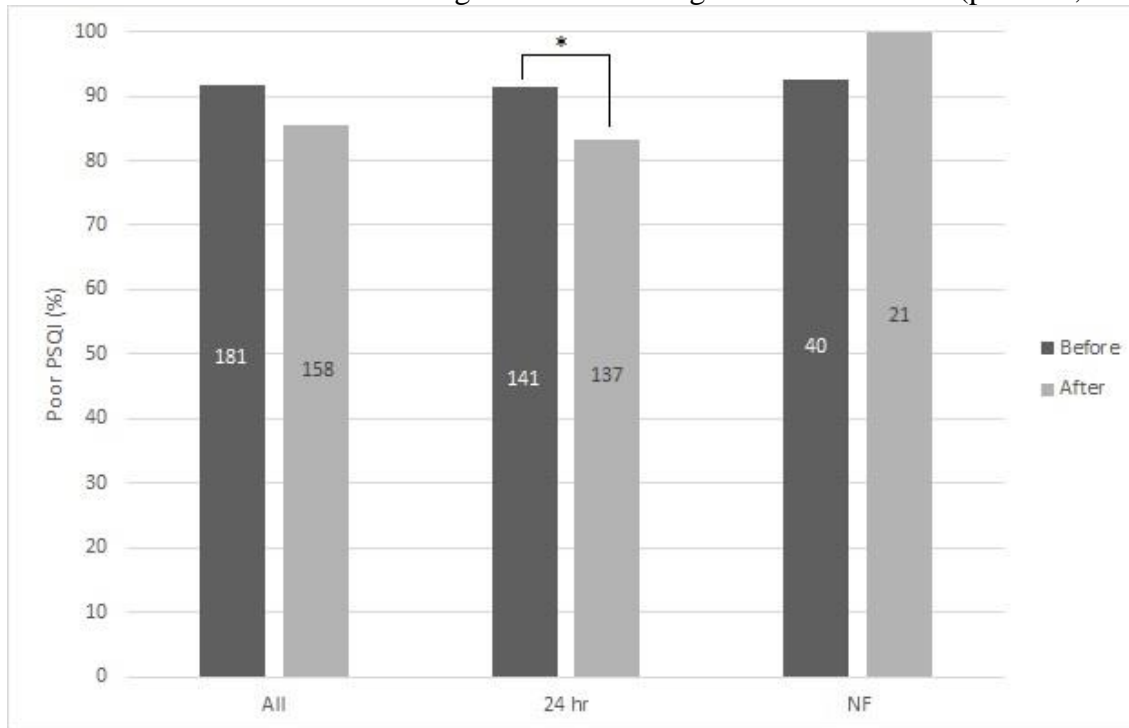
All (100%) of psychiatry and dermatology residents were satisfied with their lives, while all (100%) of maxillofacial surgery residents were dissatisfied. Urology and ophthalmology residents also reported high rates of dissatisfaction (75% and 60%) (**Figure 4**).



**Figure 4:** Satisfaction with life among residents across different specialties (frequency) presented as percentage per specialty. ENT, ears nose throat.

### Sleep quality before and after duty-hour limits

A new sample was created after excluding residents from departments that either did not implement the new limitations or did not operate on-calls. **Figure 5** compares sleep quality scores between this new sample and the older sample surveyed before work-hour limitations were introduced. The bar charts compare scores between night floaters, residents working 24-hour shifts, and both groups summed together. Sample sizes are listed on the bars. Briefly, the implementation of 24-hour shifts (as opposed to the previous 32-hour long shifts) significantly decreased the percentage residents who reported poor sleep quality ( $p: 0.038$ ,  $Z: 2.08$ ), while night-float shifts did not change poor PSQI percentage significantly ( $p: 0.2$ ,  $Z: 1.29$ ). Overall, limitation of work hours either by night float or 24-hr shifts decreased poor sleep quality among residents from 91.7% to 85.4% but this change did not reach significance threshold ( $p: 0.067$ ,  $Z: 1.83$ ).



**Figure 5:** Percentage of poor sleep quality as measured by PSQI among residents with regular on-call shifts. Number on each bar represent sample size of residents before and after the implementation of 24-hr shift limit, night float, or both added together (all). \* $p < 0.05$ , two proportions Z test. NF, night float.

### Anxiety and depression before and after duty-hour limits

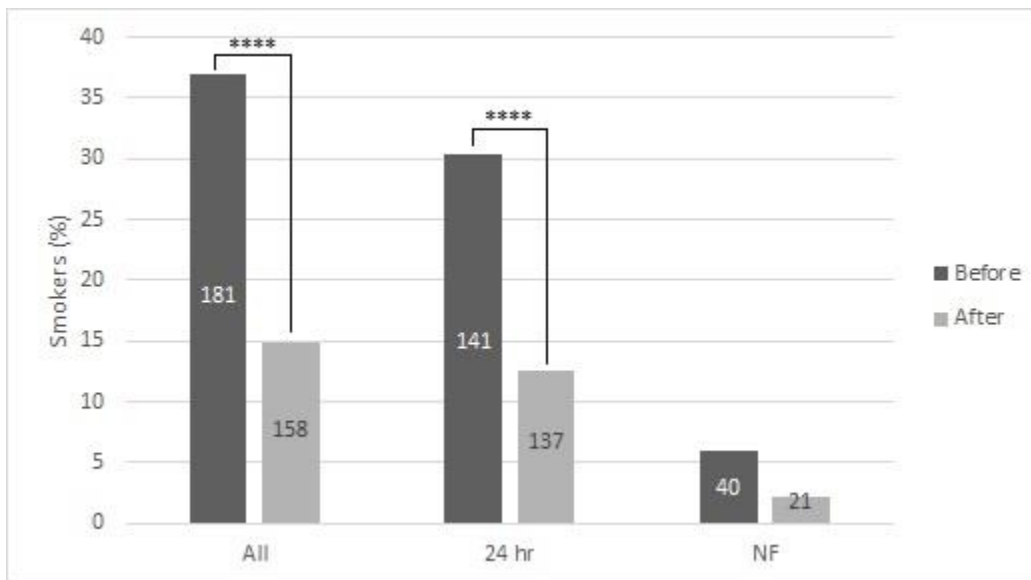
As explained above, only residents who implemented an effective reduction of working hours were included in this analysis. Limiting work shifts to a maximum of 24-hours decreased the prevalence of mild and severe PHQ-4 scores, while increasing both normal and moderate percentages (**Table 4**). However, these changes were not significant ( $\chi^2: 7.72$ ,  $df:3$ ,  $p: 0.052$ ). For night float shifts, prevalence of moderate and severe PHQ-4 scores was lower as compared to the older 32-hour shifts, while normal and mild PHQ-4 scores were higher ( $\chi^2: 18.89$ ,  $df:3$ ,  $p: < 0.001$ ).

**Table 4:** Comparison of prevalence of PHQ-4 stages in residents before and after the implementation of duty hour limits.

Work schedule/ PHQ-4 Stage	All (%)		24-hr (%)		Night float (%)	
	After (n= 158)	Before (n= 181)	After (n= 137)	Before (n=141)	After (n= 21)	Before ( n= 40)
<b>Normal</b>	29.7 %	18.8 %	32.80%	22.00%	38.10%	7.50%
<b>Mild</b>	29.1%	39.2%	33.60%	40.40%	57.10%	35.00%
<b>Moderate</b>	24.7%	22.1%	23.40%	19.10%	4.80%	32.50%
<b>Severe</b>	16.5%	19.9%	10.20%	18.40%	0.00%	25.00%
$\chi^2$	7.53		7.72		18.89, Fisher's exact test	
<b>p value</b>	0.057		0.052		<0.001	

### Prevalence of smoking before and after duty-hour limits

In our sample, 32.6% of males and 1.1% of females were current smokers. Among residents with regular on-call shifts, proportion of smokers dropped significantly from 37% to 14.9% upon the implementation of work hour limitations ( $p < 0.0001$ ,  $Z: 4.1$ ). Same results were obtained for the 24-hour shift limit ( $p < 0.0001$ ,  $Z: 4.2$ ). For night float shifts, there was a decrease in the prevalence of smoking from 6% to 2.2%, but the difference was not significant ( $p: 0.47$ ,  $Z: 0.7$ ). Among males, smoking rates had dropped from 56.4% to 31.4% after implementation of 24-hour shift limits ( $p: 0.002$ ,  $Z: 3.17$ ).



**Figure 6:** Prevalence of smoking among residents with regular on-call shifts. Number on each bar represent sample size of residents before and after the implementation of 24-hr shift limit, night float, or both added together (All). \*\*\*\* $p < 0.0001$ , two proportions Z test. NF, night float.

## Discussion

It is now evident that resident physicians are exposed to excessive workload leading to sleep deprivation, which in turn poses threats to both physician and patient health and safety [24]. Many efforts are undertaken worldwide to optimize residents' work schedules in order to enhance their well-being to the level that does not compromise their training efficiency and continuity of patient care. While many studies are debating the effect of work hours' limitation on financial implications, patient care, and physician education, its effect on residents' well-being is undervalued [25]. Burnout, which is a state of mental and physical exhaustion, has been gaining more attention among resident physicians recently particularly during the first two years with prevalence up to 74% of residents [26, 27]. Insufficient sleep is a risk factor for burnout among residents that is under-studied [28]. In this study, we evaluated how reducing the working hours of medical residents influenced the quality of their sleep and their levels of anxiety and depression by evaluating those parameters before and after the duty hour limits.

Overall, the prevalence of poor sleep quality among the study sample remained high (82.8%), although it represented a decline from the prevalence recorded in our earlier survey (90%) that was conducted in the same institution before the new work-shift limitations [12]. Such high prevalence of poor sleep is not unusual among resident physicians [29, 30]. For instance, prevalence of poor sleep quality was 86.3% and 85.7% among residents from the KSA and India, respectively [30, 31]. This study found a significant association between male gender and poor PSQI scores, which has been demonstrated in another cohort of residents [32]. In addition, high frequency of on-call shifts per month (more than 6) was significantly associated with ten times more risk of having a poor sleep quality. Similarly, several previous studies have shown an inverse relationship between sleep quality and the number of monthly on-calls, illustrating the impact of night-shifts on residents' sleep [30, 33]. Residents in dermatology and psychiatry departments reported the highest prevalence of adequate sleep quality in comparison with other, mostly surgical specialties consistent with previous findings [12]. This could be related to the stressful lifestyle inherent to surgical training where emergencies are abundant, work hours are longer, and caffeine intake is higher [33]. In our institution, dermatology residents have no on-calls except in the first year and psychiatry residents tend to have more quiet and less busy on-calls compared to other departments.

Residents with on-call shifts limited to 24 hours had significantly lower poor sleep quality than residents with 32-hour on-call ( $p: 0.038$ ). However, night floating residents did not demonstrate a similar trend although the new arrangement meant that they worked shorter hours overall, possibly due to small size of both before and after samples (40 and 21 residents, respectively). It is also likely that the benefits of these shorter hours were offset by the disruption of endogenous circadian rhythms and the atypical sleep-wake schedules precipitated by this work system [34]. Previous studies have illustrated that night floating residents suffered from significant impairments in sleep duration, sleep latency, and an increased frequency of sleep interruptions in addition to higher prevalence of cognitive slowing in comparison with residents in normal daytime rotations [35, 36].

Thirteen residents (7.2%) used sleep aid medications during the past month such as first generation antihistamines (chlorpheniramine and diphenhydramine), benzodiazepines (alprazolam), melatonin, and tricyclic antidepressants (amitriptyline). Other previous studies found that 46% of 602 emergency medicine residents and 54.2% out of 59 psychiatry residents regularly used medications or alcohol to induce or maintain sleep [37, 38]. Poor sleep quality was significantly

associated with lower life satisfaction, suggesting that the relationship between human wellbeing and sleep goes beyond sleep quantity itself and includes the different measures of sleep quality and sleep variability [39]. Moreover, satisfaction with life was significantly higher among junior residents compared to second year residents in our survey, which could be a reflection of the cumulative impacts of residency-related lifestyle changes over time.

Our survey found an overall prevalence of 72.8% for mild, moderate, and severe anxiety and depression among residents as measured by the PHQ-4 scale. This percentage marked a marginal decrease in comparison with the earlier survey that reported an overall prevalence of 78.6% among residents in the same institution [12]. Other studies have also reported high prevalence of depression and anxiety (41.85 to 83.9%) [8, 40, 41]. The fact that these figures are much higher than the prevalence of both disorders in the general population underscores the significant psychological impact of residency lifestyle and highlights the need for appropriate interventions to prevent lasting impacts later in life [41, 42]. Although night floater shifts didn't reduce rates of poor sleep quality, they were associated with a significant reduction in the prevalence of moderate and severe PHQ-4 scores in our sample in comparison with scores obtained during the older, traditional 32-hour shifts, which could indicate a possible positive effect of the night float system on residents [43]. Setting aside its impacts on residents' wellbeing, it is noteworthy that the effects of night float system on clinical performance are still debated nearly thirty years after its introduction [44].

Smoking rates are alarmingly high in Jordan especially among men [45]. In our previous sample, 37% of resident physicians who perform regular on-call duties were smokers [12]. This study shows that smokers' proportion was significantly decreased to 14.9% after duty hour limits. However, males' proportion was higher in the previous study (60.7% as compared to 47.8% in this sample). To ensure that this association is not influenced by gender, we conducted the analysis among men before and after work hour limitation to 24-hrs, association remain significant ( $p: 0.002$ ). Increased levels of stress resulting from increased shift hours and workload can increase the prevalence of smoking [46, 47].

This study offered a rare insight into the impact of work-hour limitation on resident sleep quality and levels of anxiety and depression. However, in order to better understand the effect of night float shift on sleep quality, we might need larger sample size for this category of residents especially that they showed insignificant trend for increasing rates of poor sleep quality. Additionally, conduction of study was deferred until 3 months after the country's lockdown was over because of the coronavirus disease (COVID-19) pandemic to minimize the effects pandemic dictated on the changes in the workday schedule. We also cut subjects' recruitment immediately when the second wave of COVID-19 approached the country. Nonetheless, effects might not be fully minimized.

## **Conclusions**

Poor sleep quality, depression and anxiety remain highly prevalent among resident physicians. This study shows that these rates can be reduced by optimizing shift scheduling and duration, which may have a positive effect on the efficiency of their training and continuity of patient care. We also recommend public health authorities to specifically tailor sleep hygiene practices to

address residents' needs as well as to increase medical workforce to better enhance sleep quality, psychological and physical well-being of resident doctors.

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