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Research Article

“EFFECTS OF SLEEP DEPRIVATION DURING ON-CALL ON PHYSICIANS’ MOOD AND ALERTNESS IN A SECONDARY CARE HOSPITAL IN BAHRAIN “

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Abstract:

Background: Sleep deprivation is a problem that faces on-call physicians, due to their extended working hours which will affect both the doctors' and the patients' health. One of the consequences of Sleep deprivation is medical error.

Aim: To determine the effects of sleep deprivation on physicians' mood and alertness during on-call, and patient's safety in order to reduce medical errors and injuries among health care workers in Bahrain.

Setting: Salmaniya Medical Complex – Bahrain

Study design: cross-sectional study

Methods and materials: The research was conducted at Salmaniya Medical Complex in Bahrain and the convenience sample was taken from selective departments: Medicine, Surgery, Pediatrics, and Obstetrics. Hundred and seventy-eight of residents and interns were selected randomly. A self-filled questionnaire was used to evaluate the immediate mood state of individual's pre and post call. Data were entered and analysed using SPSS program version 21.

Results: The vast majority of the sample were alert pre-call [93.2%] while the percentage of alertness post-call was significantly reduced [30.8 %]. The post-call total mood was significantly worse than their pre-call mood [33.6%] and [59.9%] respectively.

Conclusion: Strong associations were found between alertness, mood disturbance and sleep deprivation during on-call. There was a significant reduction in physician's alertness and their mood was negatively affected post-call. However, this study has several limitations. The study design, cross-sectional in nature, can only determine association and not causality.

Key words: Sleep deprivation, on-call, physician, mood, alertness, Bahrain.

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INTRODUCTION:

Physicians' ability to perform their jobs in restoring human health can be adversely by many factors, whether linked to their previous clinical knowledge, nature of the task or the work-overload. In the early 1980's some studies were set suggesting that the nature of the physicians' on-call life can also play a role. [1]

Sleep is a physiologic state that must be satisfied to insure survival; the recommended sleeping duration is 6-8 hours on average, with respect to variations amongst individuals. A person who is said to be sleep deprived is sleeping at least 2 hours less than the normal range. [1]

Sleep deprivation is a problem that faces on-call physicians, due to their extended working hours and circadian rhythm misalignment, significantly affecting the short term memory, attention impairment, alteration of mental status resembling anxiety and depression and sleep inertia the morning after. These all affect the doctor's health and well being on the long run and the patients' health in the mean time. [2]

Sleep deprivation is a recognized hazard in many different fields. In the medical field it threatens both the physician and patients' safety. Adults require 6-10 hours of sleep everyday, 8 hours on average [3]. A decline in peak alertness can be seen after sleeping fewer than 5 hours, and after one night of missed sleep, a significant cognitive decline may occur [4].

Furthermore, physicians with acute sleep loss due to their long on-call shifts will show decreased daytime alertness and their mood state will be negatively altered. Physicians' alertness post-call was reduced comparing to their alertness in pre-call [5]. Workload during on-calls can also sometimes force the physicians to delay prayers or miss meals [5]. Additionally, a 24-hour of wakefulness was found to be equivalent to having blood alcohol level of 0.1% [legally a person should not be operating on a motor vehicle with 0.08% blood alcohol concentration] [6]. Recent studies suggest that the effects of fatigue alone in causing motor vehicle accidents exceed the effects of alcohol and drugs combined. As a matter of fact, sleep deprivation is considered to be the leading cause of car accidents. Studies also have shown an increased risk of car accidents among medical residents who were on call the night before [7].

In addition, medical errors should be considered when talking about sleep deprivation. In the US, more than 100,000 patients die every year from medical errors,

which makes medical errors the third leading cause of deaths in America, inadequate sleep among health providers may be one of the factors [8]. In 1998, a research was conducted to evaluate surgical task performance before and after on call duty. Surgeons who had been on call took longer time to complete a laparoscopic task and made 20% more errors than their colleagues who had slept well the previous night [9]. The emotional effects are considerable as well as other problems including depression, family and marital discord, lack of empathy for patients, cynicism and suicide.

The aim of the study is To determine the effects of sleep deprivation on physicians' alertness and mood during on-call duty, and patients safety in order to reduce medical errors and injuries among health care workers in Bahrain.

MATERIAL AND METHODS:

This cross-sectional study was conducted at Salmaniya Medical Complex in Bahrain. Taking a convenience sample of residents and interns working in Salmaniya Medical Complex in different specialties [Medicine, Obstetrics, Pediatric and Surgery]. They were recruited in the study to complete a questionnaire post-call. The collected data included their sociodemographic factors, patterns of work and sleep, profile of mood state, Stanford Sleepiness Scale, and their daily activity during on-call [e.g. eating, praying and driving]. All participants [interns and residents] had the same number and duration of on-call shifts in the following departments: Medicine, Surgery, Pediatrics, and Obstetrics. Residents and interns practice medicine in hospital or clinic under the supervision of attending physicians. Internship is a training program, typically lasting one year, to help physicians practically train by coming across all major departments in about two month rotations for each. A physician will not be given the medical license until the internship training is completed. Residency is a post-graduate program, giving an in-depth training of a specific branch of medicine, in which the physician will be given a board license to practice the specialty within 4-5 years. Our population in the study is convenience sample. Inclusion criteria are Residency year [R1-R4] and Interns. Exclusion criteria are Pregnant physician [the physical burden of pregnancy, hormonal changes, and fatigue in pregnant women may interfere with the accuracy of the results.

Statistical analysis:

Questionnaire form was used to evaluate the immediate mood state of individuals [depression, anger, tension, confusion, fatigue and vigor] using the

original English version of profile of mood states [POMS] test which contains 37 self-report items published in 1971, the participants responded using a 5-point Likert scale ranging from 1 [not at all] to 5 [extremely]. To measure the impact of short-term sleep loss, by Stanford Sleepiness Scale, which

consists of seven statements, that describes individual's level of sleepiness and alertness. All data from questionnaires were analyzed using the Statistical Package for Social Sciences [SPSS] version 21. Student's t-test and one-way ANOVA was performed for SPSS.

Degree of Sleepiness	Scale Rating <i>pre-call</i>	Scale Rating <i>post-call</i>
Feeling active, vital, alert, or wide awake	1	1
Functioning at high levels, but not at peak; able to concentrate	2	2
Awake, but relaxed; responsive but not fully alert	3	3
Somewhat foggy, let down	4	4
Foggy; losing interest in remaining awake; slowed down	5	5
Sleepy, woozy, fighting sleep; prefer to lie down	6	6
No longer fighting sleep, sleep onset soon; having dream-like thoughts	7	7
Asleep	X	X

Items 1-3 indicate an alertness status, while items 4-7 indicate a sleepiness status.

RESULTS:

A sample of 178 doctors participated in the study; 109 [61.2%] of them were females and 69[38.8%] were males. The questionnaire was distributed to the following four departments, Medicine 74 [26.4%], Pediatrics 48 [27%], Obstetrics and Gynecology 42[23.6%], and Surgery 41 [23%]. Among all participants, the first year residents 58 [32.6%] and Interns 50 [28.1%] were the highest compared to others, R2 30 [16.9%], R3 21 [11.8%] and R4 and above 19 [10.7%]. [Table 1]

On average working hours per day, most physicians 156[87.6%]worked between 6-9 hours, while 14[7.9%] worked more than 9 hours, and only 8 [4.5] worked less than 6 hours. Approximately half of the physicians [50.6%] have worked between 60-80 hours

weekly, and about one third 59[33.1%] worked 40-60 hours, the rest 29[16.3%] worked 80-100 hours weekly. More than half of the physicians 96[53.9%], had 1-2 over times per week in the last month. Whereas 45[25.3%] residents had 3 and above over times and 37[20.8%] never had over time in the last month.

A good number of the physicians 106[59.6%], had 7 and above on-calls per month. There were 75[42.1%] residents who stayed in hospital post-call for 5-9 hours, 57[32%] stayed for 1-4 hours and 11[6.2%] stayed more than 9 hours. On the other hand, 35[19.7%] of them didn't stay in hospital post-call. Almost half of the residents 91[51.1%], slept between 3-5 hours the night before the call. A lesser number 52[29.2%], have slept 6-10 hours, 25[14%] slept less

than 3 hours and only 3[1.7%] residents slept more than 10 hours. Nonetheless, 7[3.9%] didn't sleep at all. [Table 2]

Majority of the residents [79.8%] strongly agree with missing or holding-up their prayers during on-call hours. On the other hand, only 10[5.6%] claim they don't at all. However, 66[37.1%] and 26[14.6%] of the physicians agreed and disagreed respectively. A fairly good number of the physicians 85[47.8%] were driving home safely after their on-calls, whereas 49 [27.5%] do not, and only 44 [24.7%] preferred going home with a driver.

More than 65% of them never been on a car accident post-call, 49 [27.5%] were on a minor car accident and only 10[5.6%] had a major accident. More than half of the residents [58.4%] usually miss their meals during on-call, while 19 [10.7 %] never skipped. a meal before. [Table 3]

Out of 178 physicians, 37 [20.8%] have no sleep during their on-call hours, while 50 [28.1%] have less than 3 hours of sleep. A marked number of the participants 78 [43.8%], have slept within a range of 3-5 hours, and 13 [7.3%] of the physicians have a good sleep of 6-10 hours.

Around two-thirds of the physicians [66.9%], experience interrupted sleep, while 42[23.6%] assured that they're not having any interrupted sleep, and 17[9.6%] stated that they had no sleep at all.

After further questioning about the kind of interruptions, 48[27%] doctors claimed that the interruptions were work related, 33[18.5%] of them specified saying that it was medical related, 16[9%] said it was environmental, while 27 [15.2%] were due to personal reasons.

For more details about the sleep condition and the quantity of hours, residents were asked about their sleep in normal days to compare it with the sleep during their on-calls, 20[11.2%] doctors asserted that they're sleeping more hours than usual during their on-calls, 74[41.6%] have less hours of sleep than usual, 36[20.2%] have the same sleeping hours as usual, and 48 [27%] have much less sleep than they normally do. [Table 4]

Analysis of the results of the entire study population revealed an appreciable difference between pre- and post-call on the Profile of Mood States [POMS] scores [P = 0.000]. There was an increase in depression, fatigue, anger, tension, confusion sub-

score on post-call [P=0.000, P=0.000, P=0.000, P=0.000, respectively] with a decrease in the vigor sub-score, compared to the pre-call scores [P = 0.000]. According to Stanford Sleepiness Scale there was notable difference in alertness score between pre- and post-call [P=0.000]. [Table 5]

In the comparison among doctors working in SMC, in the degree of alertness and the degree of sleepiness during pre-call and post-call. The data showed that the mean degree of alertness was 93.2 pre-call, which strongly decreased post call to 30.5. [Figure 6]

The data shows the degree of alertness pre-call and post-call, with distinction amongst certain variables: the four departments listed, gender, status, working load and normal sleep vs. on-call sleep.

Physicians from Medicine department as well as the Pediatrics department were highly alert pre-call with a score of **95.7** and **95.5** respectively, noticing that alertness score has declined post-call to **21.3** and **27.3** respectively.

Participants from Ob/Gyn department end their call duty with the highest degree of alertness **52.4**, and starting with **90.5**. Whereas the Surgery department started with the least score of alertness **89.7** and ending with **23.1**. the difference in alertness between different department is statistically significant.

Male physicians have slightly higher degree of alertness pre-call and post-call **95.6** and **33.8** respectively than females.

The alertness score vary significantly pre-call depending on the status, where R3 are highly alert pre-call, R1, Interns, R4, and R2 follow accordingly. On other hand, this difference is not statistically significant post-call.

Workload notably changes the alertness status, physicians who have worked for 40-60 hrs/ wk started with higher degree of alertness than those who have worked for 60-80 or 80-100 hrs/ wk, also ending up post-call with higher alertness.

Additionally, physicians who have slept more than usual are the least alert pre-call, however, they have the highest degree of alertness post-call. Whereas physicians who have slept about the same, started with the highest degree of alertness **97.2** and those who have slept extremely less had the least score pre-call [Table 7].

A remarkable difference was found between pre-call

and post-call POMS score in the department of Medicine, Surgery and Pediatric departments [P = 0.001, 0.000 and 0.000 respectively]. On the other hand, pre-call and post-call total POMS score of Ob/Gyn department were both high with no significant difference [P = 0.148].

All departments present with a significant difference of total POMS scores pre-call as well as post-call [P=0.000 and 0.015 respectively]. Participants from medicine and Ob/Gyn departments came with higher score of POMS pre-call than the other departments, which indicates mood disturbance that worsens post-call.

Both male and female show a significant difference between pre and post-call total POMS scores [P=0.000 and 0.000 respectively]. However, both gender have no significance difference POMS scores pre-call [P=0.017 and 0.136], with slightly higher score for females.

Participants from different status have a significant difference between pre-call and post-call of total POMS scores, and because they have approximately similar scores there is no significant difference pre-call and post-call [P=0.067 and P=0.285]

It appears that no matter how long the participants work they all have similar post-call total POMS scores [P=0.176]. However, it has been found there is quite a difference pre-call.

All working load groups [40-60hrs, >60-80hrs and >80-100hrs] were found to have differences between pre-call and post-call of total POMS scores [P=0.000, 0.000 and 0.001 respectively].

Their sleeping patterns will not affect the final result as all will score high, and there is no significant difference between pre and post call total POMS scores [P=0.054 and 0.529 respectively] [Table 8]

Table1: Demographic data of physician working in Salmaniya Medical Complex in 2016.

Demographic			
Variable		No	%
Gender	male	69	38.8
	female	109	61.2
Department	Medicine	47	26.4
	Surgery	41	23.0
	OB/Gyn	42	23.6
	Pediatrics	48	27.0
Status	Interns	50	28.1
	R1	58	32.6
	R2	30	16.9
	R3	21	11.8
	R4 and above	19	10.7

Table 2: Number of working and sleeping hours on regular days among physician working at Salmaniya Medical Complex in 2016.

Working duration			
Variable		No	%
Average working hours per day	<6 h	8	4.5
	6-9 h	156	87.6
	>9 h	14	7.9
Average working hours per week	40-60 h	59	33.1
	60-80 h	90	50.6
	80- 100 h	29	16.3
Over-time working last month	Never	37	20.8
	1-2 time/week	96	53.9
	3 and above time/week	45	25.3
On-calls per month	4-6	72	40.4
	7 and above	106	59.6
Stay in hospital post-call [h]	0	35	19.7
	1-4 h	57	32.0
	5-9 h	75	42.1
	>9	11	6.2
Sleep last night [pre-call]	No sleep	7	3.9
	< 3 hrs	25	14
	3-5 hrs	91	51.1
	6-10 hrs	52	29.2
	> 10 hrs	3	1.7

Table 3: The general effects of call on physician daily activity working in Salmaniya Medical Complex 2016.

Variable		No	%
Delay pray or miss it [on-call]	agree	66	37.1
	S.agree	76	42.7
	disagree	26	14.6
	S.disagree	10	5.6
Drive home safely after [on-call]	yes	85	47.8
	no	49	27.5
	Prefer driver	44	24.7
Car accident [Post-call]	Yes, Major	10	5.6
	Yes, Minor	49	27.5
	No	119	66.9
Skip meals [on-call]	Never	19	10.7
	Not so often	55	30.9
	Usually miss	104	58.4

Table 4: The sleeping pattern during on-calls among physician working in Salmaniya Medical Complex 2016.

Sleeping pattern			
Variable		No	%
Sleeping hours last call	No sleep	37	20.8
	<3 h	50	28.1
	3-5 h	78	43.8
	6-10 h	13	7.3
Interrupted sleep on-call	yes	119	66.9
	no	42	23.6
	No sleep	17	9.6
Type of interruption	Medical	33	18.5
	Personal	27	15.2
	Work related	48	27
	environmental	16	9

	others	8	4.5
sleep during call v.s normal sleep	More than usual	20	11.2
	About the same	36	20.2
	Less than usual	74	41.6
	Extremely less	48	27

Table 5: pre- and post-call mean score for different component of scale and alertness for physician working at Salmaniya Medical Complex 2016.

Mood			
Variable	Pre-call Mean	Post-call Mean	P-value
Depression	12.5	17.3	0.000
Vigor	19.1	13.3	0.000
Anger	10.4	13.6	0.000
Tension	11.5	13.1	0.000
Confusion	8.2	11.9	0.000
Fatigue	10.1	17.3	0.000
Mood total	33.6	59.9	0.000

Fig 6: Comparison of pre- and post-on-call effects on the degree of alert and the degree of sleep among residents working in Salmaniya Medical Complex 2016 based on Stanford Sleepiness Scale.

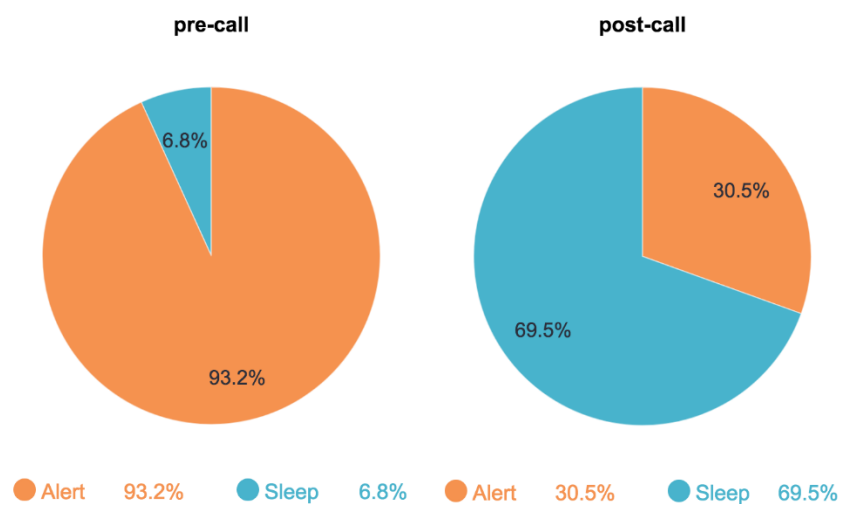


Table 7: The degree of alertness pre-call and post-call among residents working in Salmaniya Medical Complex 2016.

		Alertness		
Variable		Pre-call %	Post-call %	P-value*
Department	Medicine	95.7	21.3	0.000
	Surgery	89.7	23.1	0.000
	Ob/Gyn	90.5	52.4	0.000
	Pediatrics	95.5	27.3	0.000
P-value**		0.533	0.004	
Gender	Male	95.6	33.8	0.000
	Female	91.4	28.9	0.000
P-value **		0.299	0.443	
Status	Interns	94.0	40.0	0.000
	R1	98.2	24.6	0.000
	R2	82.1	28.6	0.000
	R3	100	21.1	0.000
	R4	83.3	38.9	0.002
P-value **		0.018	0.326	
Working load [Working hours per week]	40-60 hrs	100	33.3	0.000
	>60-80 hrs	87.5	30.7	0.000
	> 80-100 hrs	96.3	25.9	0.000
P-value **		0.009	0.785	
Normal sleep v.s on-call sleep	More than usual	84.2	47.4	0.031
	About the same	97.2	33.3	0.000
	Less than usual	95.7	30.0	0.000
	Extremely less	89.4	23.4	0.000
P-value **		0.177	0.263	

*P-value on column refers to specific variable pre- and post-call [T-test]. **P-value on row refers to group of variable pre or post on-call [one-way ANOVA test].

Table 8: The effect of on-call and post-call on the resident's mood [POMS scores] in Salmaniya Medical Complex 2016.

		Mood		
Variable		Pre-call Mean	Post-call Mean	P-value *
Department	Medicine	43.1	66.5	0.001
	Surgery	21.2	49.9	0.000
	Ob/Gyn	40.8	62.6	0.148
	Pediatrics	28.8	59.7	0.000
P-value **		0.000	0.015	
Gender	Male	29.7	56.4	0.000
	Female	36.1	62.1	0.000
P-value **		0.071	0.136	
Status	Interns	33.1	60.1	0.000
	R1	31.4	58.3	0.000
	R2	29.2	53.7	0.000
	R3	34.6	66.7	0.000
	R4	47.7	66.6	0.006
P-value **		0.067	0.285	
Working load [Working hours per week]	40-60 hrs	34.9	57.7	0.000
	>60-80 hrs	28.6	58.8	0.000
	> 80-100 hrs	46.8	67.8	0.001
P-value **		0.001	0.176	
Normal sleep v.s on-call sleep	More than usual	45.8	65.5	0.009
	About the same	31.5	60.1	0.000
	Less than usual	30.4	57.1	0.000
	Extremely less	35.3	61.8	0.000
P-value **		0.054	0.529	

*P-value on column refers to specific variable pre- and post-call [T-test]. **P-value on row refers to group of variable pre or post on-call [one-way ANOVA test].

DISCUSSION:

This study was set to find the relation between physicians' sleeping pattern, alertness, and resultantly, its consequent effect on their work and mood.

It has been long known that fatigue resulting from work overload; lack of sleep and stress can affect person's cognitive and motor function. [10] In other words; a tired person is more likely to make mistakes. Since therapeutic interventions necessitate a high level of psychomotor performance, cognitive function, and emotional equilibrium, physicians should be highly alert during that time, having quick judgment of the situation, and both can be impaired by sleep loss.

Unfortunately, It was revealed that a non-negligible number of the participants end their call with a high degree of sleepiness and a much lesser degree of alertness, In contrast to their status pre-call. Additionally, decrease in cognitive function not only compromises patients' safety but physicians' as well. In fact, it was found that the number of self-reported percutaneous injuries in interns increased after working for extended hours duration and Injuries were more frequent during the nighttime than during the daytime when the degree of alertness declines. [11]

This study revealed that 41.6% of the participants sleep less than their usual sleep within a range of 3-5 hours pre-call. Similarly, a research conducted in Saudi Arabia showed a similar result where 50% of the participant reported sleeping less than 5 hours the night preceding their on-call shift. [5]

In addition to sleeping less hours, many physicians experience fragmented sleep during their calls. All of this alter not only the total number of hours they're sleeping, quality of their sleep, and their mood, but it can also keep them fatigue for periods after their on-call duty. Interestingly, studies are showing that the quality of sleep is just as important as duration of sleep. This has been stated in previous studies which indicated that interrupted sleep impacts mood more than lack of sleep, he demonstrated that interrupted sleep led to 31% reduction in positive mood compared to 12% reduction with lack of sleep for healthy individuals. [12] Reduction in positive mood can affect other feelings such as sympathy, friendliness, and gentleness. Adding to that, studies have shown that it takes a post-call physician two to three nights of adequate, uninterrupted sleep to make up for their lack of sleep on on-call hours, which makes it difficult for physicians to cope with their social life and catch up with their home activities and duties. [13]

Among the studied departments, Medicine and Ob/Gyn began their call with a disturbed mood, having the highest Profile of Mood State scores, which also have been noticed to increase post-call, this is an indication of mood worsening, and could be explained by their heavy workload and job stress, affecting their sleep the night before.

All participant regardless of their status, were observed to have similar degrees of alteration in their mood post-call. As predicted, senior residents [R4] presented with the highest Profile of Mood State scores pre-call, implying that they have higher responsibilities and more job tasks.

We studied the mood disturbance and degree of alertness of physicians with different working load [40-60hrs/wk,60-80hrs/wk and 80-100hrs/wk],Regardless to these variations in working hours, all the participants have ended their calls with altered mood and higher degree of sleepiness [P=0.176 and P=0.785 respectively]. Supporting that, a study published in Baylor College of Medicine, Houston, on sleepiness in medical ICU residents, mentioned that despite the reduction of working hours, residents still showed a severe degree of sleepiness post-call, which means that other factors can affect the alertness. [14]

Many studies over the years have found a relation between the lack of sleep, fatigue and car accidents. As a matter of fact, it has been explored that a large number of traffic accidents globally, are due to lack of or inadequate sleep. In the US, 56,000 motor vehicle accidents annually are caused by sleep deprivation. Harvard Work Hours, Health and Safety Group confirmed by stating that, every extended work shift that was scheduled in a month, increased the motor vehicle crash by 9.1%. [15] Whereas in our study 27.5% of the participants have experienced minor car accidents, and 5.6% of them have gone through major car accidents. Furthermore, Truman Medical Center, University of Missouri-Kansas City support the findings, where 75% of motor vehicle accidents incurred by emergency residents happened after having long night shifts. [16]

For that, we are not surprised about a quarter of the participants prefer going home with a driver. In closure, the relation between car accidents and near misses after insufficient sleep post-call is undeniable.

Despite the extensive studies about sleep deprivation, specific studies concerning sleep deprivation among physicians and assessment of their performance were sparse. Studies about residents' nature of work and its

effect on their sleep and confidence in reasoning were few as well. For better understanding this study's effect in the future, medical errors can be studied and linked to the causes of sleep deprivation, as this study is a cross-sectional study, studying the association not causality.

In conclusion, no matter how long the participants have slept the preceding night of their call and during their call, or how long they have worked, they all ended up sleepy, and mood disrupted, compromising the health care system, beginning with patients and ending with doctors. For that, following the shift system could have a good impact on the quality care, the service provided, and the employees' satisfaction. As the on-call system had a notable effect on compromising physicians' performance and health in this study. However, we suggest that the idea needs further investigations and researches could be conducted to compare both systems and study the effects of each.

CONCLUSION:

Strong associations were found between alertness, mood disturbance and sleep deprivation during on-call. There was a significant reduction in physicians alertness and their mood was negatively effected post-call. However, this study has several limitations. The study design, cross-sectional in nature, can only determine association and not causality.

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