Prevalence of sleep deprivation and its effect on the performance of family medicine residents in Riyadh, Saudi Arabia

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Abstract:

BACKGROUND: A good night sleep is essential for good health since it supports proper brain functions and its ability to make decisions and to learn and remember new information. The objectives of this study were to assess the prevalence of sleep deprivation (SD) and its effects on the performance of family medicine residents in Riyadh.

MATERIALS AND METHODS: A cross-sectional study design was based on an informative-validated self-assessment questionnaire, especially designed by the Medical Council of Canada, to assess the performance of family medicine physicians. Ethical approval was obtained from the institutional review board. Data was analysed using SPSS; initial analysis included computing frequencies and percentages. Odds ratios were calculated for association between.

RESULTS: Of the total 258 respondents, 32% had low performance, and 41.5% of the sample suffered from SD, with a male/female ratio of 1:1. There were no significant differences between residency level (R1, R2, R3, and R4) and the average number of sleeping hours. However, 45.5% of R1, 47.8% of R2, 32.4% of R3, and 41.5% of R4 suffered from SD. The data showed a significant difference between the performance and the average number of hours of sleep of the respondents on a typical day. SD was associated with the low performance of 48.6% of subjects compared to 18.3% in those who slept for 7–9 h (aOR=3.96).

CONCLUSION: SD negatively affects the performance of family medicine residents. There was no statistically significant difference between males and females in performance. The center for residents’ training should consider adequate sleep as essential for the promotion of health and performance.

Keywords: Deprivation, medical, residents, sleep

Introduction

Sleep is one of the most crucial elements of human life; it is estimated to occupy, on average, one-third of the human life cycle. Sleep is essential for the proper functioning of the human brain. It is as vital to human bodies as breathing and eating and also essential for the maintenance of healthy mental and physical status. Besides, it helps mend and restore our brains, not just our bodies. During sleep, our brain can process what happened during the daytime, such as restoration of information and consolidation of memories.

Sleep hygiene is defined as practices to facilitate sleep and avoidance of all that minimize the quality of sleep. Data from several studies suggest that sleep-related problems are prevalent in the general population and are associated with a number of physical health, mental health, and social disturbances. People, therefore, need to get...
an adequate number of hours of sleep, although some studies suggest that there is no determined number of hours of sleep necessary per night.\[^9\]\[^10\] Many factors affect and control the regularity and timing of sleep habits, such as a regular daily set time for sleep as result of which high-quality and more comfortable, adequate hours of sleep is possible.\[^4\] Therefore, sleep deprivation (SD), also known as insufficient sleep, which can be either chronic or acute,\[^7\]\[^8\] is the condition of inadequate hours of sleep.

Many previous surveys show that SD is a significant problem among medical residents. This could have a negative impact on cognitive functioning and clinical outcome and lead to adverse effects on the performance and the quality of patient care.\[^9\]\[^11\] SD could cause performance errors, reduce punctuality for lectures, and cause low performance.\[^12\] A local study conducted in King Fahad University Hospital found that 63% of medical residents were sleep deprived.\[^13\] The prevalence of SD among Saudi adults was estimated as 33%.\[^14\]

A study from the USA showed that the prevalence of SD in the 1\(^{st}\) - and 2\(^{nd}\)-year family medicine residents was 61%.\[^12\]

To the best of our knowledge, no local or international studies have been conducted on the impact of SD on the performance of family medicine residents. We conducted this study with the following aims: (1) to find out the prevalence of SD among family medicine residents and the reasons for it; and (2) to measure the association between SD and the performance of family medicine residents.

**Materials and Methods**

We conducted an observational cross-sectional study using a validated self-assessment questionnaire after obtaining the permission from the copyright owner to use it. The Medical Council of Canada developed this questionnaire to assess the family medicine physician performance. This questionnaire consists of 31 questions, each on a scale of 1–5. We calculated the total score for all participants. The family physicians were then classified into high and low performers according to their mean score and standard deviation of the performance. Those who scored below the mean score (111.4 ± 19.5) were categorized as low performers while those who scored the mean and above were classified as high performers.

The average sleeping hours of 6 h or less each night is considered SD, as defined by the Center for Disease Control in the USA.\[^13\]

The questionnaire included demographic data of the respondents such as age, gender, residency level, training center, and marital status. Lifestyle such as smoking, intake of caffeine and tea, and exercise was on the questionnaire. Also included were the questions on medications used as aids for sleep.

The study was conducted on the family medicine residents in training programs in Riyadh, Saudi Arabia, during the period of 2018–2019. Therefore, the target population was all family medicine residents in the training program in Riyadh, Saudi Arabia. The sample size was determined using the following formula: 

\[ N = (Z^2 \times [1 - P]) / d^2, \]

where \(Z\) = 1.96 for 95% confidence interval; proportion of SD is 63%; the accuracy of estimate is 5%. Finally, the sample was determined as \(N = 358\).

A systematic random sampling technique was used to select the study subjects and stratified according to gender, training centers, and level of residency. A list of residents’ names was acquired from the Saudi Commission for Health Specialties, and researchers communicated with participants either through program directors or chief residents of each center. The sample was proportional to the number of residents at each center. The residents were taken according to their level proportionate to their number in each year. The sampling interval (number of family medicine residents in one hospital/number of family medicine residents in the same center needed for the sample) was then calculated. Then, first participant was chosen randomly between 1 and the sampling interval. Finally, the choice of every subsequent participant was based on the sampling interval. We distributed the questionnaires in-person to the participants through the chief residents in the respective training centers.

The authors analyzed the data using Statistical Package for the Social Sciences software (SPSS) version 24.0. (IBM, NY, USA). Data was analysed using SPSS; initial analysis included computing frequencies and percentages. Crude odds ratios (OR) were calculated for association between performance and various factors including sleep deprivation. Logistic regression was used to calculate adjusted odds ratios (aOR); \(P \leq 0.05\) was considered statistically significant.

Ethical approval was obtained from the institutional review board/ethics committee, and informed written consent taken from all participants in the study. Participation was kept confidential, and participants’ anonymity assured.

There were no potential conflicts of interest to affect the outcome of this research.

**Results**

The participants who completed the questionnaires
were 258, giving a response rate of 72%. Table 1 shows that the majority (94%) of the participants in the study were young adults aged 24–30 years; only 6% were aged 31–35 years. There were more female residents than males, 58% and 42%, respectively. More than one-third of the respondents were at R1 level, 18% at R2 level, 28% at R3 level, and 21% at R4 level. The data also showed that around two-thirds of the participants in the study were single, less than one-third of the respondents were married, and a small percentage of the respondents were widowed or divorced. Moreover, Table 1 also shows that 87% of the respondents did not smoke any kind of tobacco products. On consumption of caffeine, half of the respondents consumed 1–2 cups of coffee in their typical day, while a quarter had 3–4 cups of coffee in their typical day. Data also showed that around half of the respondents did not do any vigorous-intense activities for 10 min any day in their typical week. Fifty-five percent of the respondents did not do any vigorous-intense activities for 10 min any day in their typical week. Fifty-five percent of the respondents reported that they slept for 7–9 h daily, 42% slept for <6 h daily (suffered from SD), and only around 4% of the respondents reported that they slept for >9 h daily.

Thirty-two percent of the respondents got low performance scores as illustrated in Figure 1. The reasons for sleeping for <6 h daily are presented in Figure 2. Fifteen percent admitted that watching TV was the main reason for inadequate sleep, 14% reported that reading or studying was the reason, and 11% reported that they went out with friends. Only three residents reported that they used medication/herbs regularly to help them sleep, and seven reported that they sometimes used medication/herbs.

Figure 3 shows the SD (sleeping 6 h or less daily vs. residency level). According to the data presented in Table 2, there was no significant relationship between residency level (R1, R2, R3, and R4) and the average number of hours of sleep. The data also showed that the respondents at R1 were more likely to have 7–9 h of sleep on average. With regard to R2, 48% of them slept for <6 h, but another 48% had 7–9 h of sleep on average. It seems that the majority of the sample was more likely to sleep for 7–9 h, regardless of their residency level.

There was no significant relationship between gender and the average number of hours of sleep. From the data, both genders tended to sleep for 7–9 h on average and <4% of both genders slept for >9 h. Almost 41.5% of them had SD as they slept for 6 h or less every day. However, since the total male/female ratio of the sample is 3:4, the male/female ratio who suffered from SD was almost 1:1.

Table 3 shows a logistic regression analysis of the relationship between performance and respondent age groups, gender, marital status, smoking status, average number of coffee cups drunk on a regular day, average number of days of vigorous-intensity activity, and the average sleeping hours. However, the

### Table 1: Characteristics of family medicine residents in Riyadh, Saudi Arabia (n=258)

| Background characteristics          | N (%)       |
|-------------------------------------|------------|
| Age (years)                         |            |
| 24-30                               | 243 (94.2) |
| 31-35                               | 15 (5.8)   |
| Gender                              |            |
| Male                                | 108 (41.9) |
| Female                              | 150 (58.1) |
| Residency level                     |            |
| R1                                  | 88 (34.1)  |
| R2                                  | 46 (17.8)  |
| R3                                  | 71 (27.5)  |
| R4                                  | 53 (20.6)  |
| Marital status                      |            |
| Single                              | 168 (65.1) |
| Married                             | 83 (32.2)  |
| Widowed                             | 1 (0.4)    |
| Divorced                            | 6 (2.3)    |
| Smoking status                      |            |
| Not smoking                         | 225 (87.2) |
| Smoking                             | 33 (12.8)  |
| Average number of coffee cups drunk in a day |        |
| None                                | 60 (23.3)  |
| 1-2                                 | 128 (49.6) |
| 3-4                                 | 66 (25.6)  |
| 5 or more                           | 4 (1.5)    |
| Average number of days of vigorous intensity activities | |
| None                                | 125 (48.4) |
| 1-2                                 | 72 (27.9)  |
| 3-4                                 | 50 (19.4)  |
| 5 or more                           | 11 (4.3)   |
| Average sleeping hours              |            |
| 6 or less                           | 107 (41.5) |
| 7-9                                 | 142 (55.0) |
| >9                                  | 9 (3.5)    |

Figure 1: Overall performance family medicine residents in Riyadh, Saudi Arabia, 2018-2019
data showed a statistically significant relationship only between performance and SD (aOR=3.96), performance and age (aOR=0.26), and between performing vigorous-intensity activity and average sleeping hours of the respondents (aOR=2.02). Besides, the data did not show any statistically significant difference in the performance of males and females. Of the residency levels, the high performance of the residents ranged from 50% to 52%, but the differences among the residency levels were not statistically significant.

**Discussion**

The response rate of our participants was 72%, which was relatively acceptable compared to the survey of physicians.[16] It is better than a previous study response rate of 54.3%, which improved with the five reminders sent to the participants and the modest incentives given to about 70%,[17-19] We tried to avoid a low response to prevent the introduction of bias into the survey results.[20] We did not investigate the reasons for nonresponders and the lack of participation as it was beyond the scope of this study and could have breached confidentiality.

Fortunately, the study showed that the majority, about 60% of residents of all levels, both genders have adequate sleep. Even though the female residents had more sleep than male residents, 55.84% compared to 53.85%, there was no statistically significant difference in their performance.

This proves that SD was not a problem in this sample. Therefore, our participating family physicians seem to be maintaining their well-being with regard to the recommended sleeping hours and sleep hygiene. However, almost half of the respondents did not do any exercise. More than half of the participants had 1–2 cups of coffee daily, and a significant relationship was found between drinking coffee, the playing of videogames, smoking status, the level of education (residency level), and SD. Furthermore, in conformity with another study,[15] no significant relationship was found between the number of hours of sleep and sleep hygiene behaviors, such as drinking coffee and smoking. Insignificant relationships were also revealed in a previous study, while the only significant relationship found was between sleeping hygiene, consumption of power drinks, and the playing of video games.[21] SD in about 40% of our participating doctors may be attributed to some other reasons reported in previous study such as the intake of power drinks and playing video games, which needs further investigation.

Another study showed that around 90% of the respondents had adequate sleep hygiene, while roughly 10% having poor sleep hygiene. However, the variation of sleep hygiene of the respondents with a variety of background characteristics was not statistically significant. In contrast to our finding, a previous study found a significant relationship between sleeping hours and older age groups and married participants.[22]

In the current study, the performance of 48.6% of the participants was low on account of SD compared to 18.3% who had adequate night sleep. This finding is similar to another study conducted on senior medical students and residents in which the investigators found a significant correlation between SD and low professional

**Table 2: The relationship between average hours of sleep, residency level, and gender**

| Residence level | 6 h or less N (%) | 7-9 h N (%) | >9 h N (%) | Percentage | N |
|----------------|------------------|------------|------------|------------|---|
| RI             | 40 (45.5)        | 45 (51.1)  | 3 (3.4)    | 100        | 88 |
| R2             | 22 (47.8)        | 22 (47.9)  | 2 (4.3)    | 100        | 46 |
| R3             | 23 (32.4)        | 46 (64.8)  | 2 (2.8)    | 100        | 71 |
| R4             | 22 (41.5)        | 29 (54.7)  | 2 (3.8)    | 100        | 53 |
| P-Value        |                  |            |            | 0.63       |    |

| Gender         | 6 h or less N (%) | 7-9 h N (%) | >9 h N (%) | Percentage | N |
|----------------|------------------|------------|------------|------------|---|
| Male           | 46 (42.31)       | 58 (53.85) | 4 (3.85)   | 100        | 108|
| Female         | 61 (40.91)       | 84 (55.84) | 5 (3.25)   | 100        | 150|
| P-Value        |                  |            |            | 0.64       |    |
| Total (%)      | 41.5             | 55.0       | 3.5        | 100        | 258|

**Figure 2: The reasons for Sleep deprivation (sleeping 6 hour or less daily)**

**Figure 3: Sleep deprivation (sleeping 6 hour or less daily) by residency level**
Table 3: Logistic regression analysis: Association between performance and various characteristics of family medicine residents in Riyadh

| Variable                              | Total (n=258) | Performance | Crude OR | P-Value | aOR   | P-Value | 95% CI for aOR |
|---------------------------------------|--------------|-------------|----------|---------|-------|---------|----------------|
|                                      | N (%)        | Low (n=126) |          |         | High (n=132) |          |                |
| Age (years)                           |              |             |          |         |        |         |                |
| 24-30                                 | 243 (94.2)   | 115 (47.3)  |          | 0.579   | 128 (52.7) | 0.051   | 0.258 0.04 0.071-0.940 |
| 31-35                                 | 15 (5.8)     | 11 (73.3)   |          | 1.073   | 4 (26.7)  | 0.85    | 0.939 0.82 0.531-1.661 |
| Gender                                |              |             |          |         |        |         |                |
| Male                                  | 108 (41.9)   | 52 (48.1)   |          | 1.026   | 56 (51.9) | 0.71    | 0.928 0.44 0.767-1.124 |
| Female                                | 150 (58.1)   | 74 (49.3)   |          | 1.578   | 70 (52.2) | 0.22    | 1.528 0.18 0.822-2.839 |
| Residence level                       |              |             |          |         |        |         |                |
| RI-R2                                 | 134 (51.9)   | 64 (47.8)   |          | 1.564   | 70 (52.2) | 0.02    | 0.537 0.15 0.227-1.269 |
| R3-R4                                 | 124 (48.1)   | 62 (50.0)   |          | 2.327   | 62 (50.0) | 0.33    | 1.177-3.462 |
| Marital status                        |              |             |          |         |        |         |                |
| Not married                           | 175 (67.8)   | 90 (51.4)   |          | 1.483   | 85 (48.6) | 0.42    | 1.502 0.21 0.790-2.856 |
| Married                               | 83 (32.2)    | 36 (43.4)   |          | 2.237   | 47 (56.6) | 0.006   | 2.019 0.01 1.177-3.462 |
| Smoking status                        |              |             |          |         |        |         |                |
| No                                    | 225 (87.2)   | 104 (46.2)  |          | 2.327   | 121 (53.8) | 0.006   | 2.019 0.01 1.177-3.462 |
| Yes                                   | 33 (12.8)    | 22 (66.7)   |          | 2.327   | 11 (33.3) | 0.006   | 2.019 0.01 1.177-3.462 |
| Average number of coffee cups drunk in a day |          |             |          |         |        |         |                |
| None                                  | 60 (23.3)    | 32 (53.3)   |          | 1.483   | 28 (46.7) | 0.42    | 1.502 0.21 0.790-2.856 |
| 1-5                                   | 198 (76.7)   | 94 (47.5)   |          | 2.327   | 104 (52.5) | 0.006   | 2.019 0.01 1.177-3.462 |
| Average number of days doing vigorous-intensity activities |          |             |          |         |        |         |                |
| None                                  | 125 (48.4)   | 72 (57.6)   |          | 2.327   | 53 (42.4) | 0.006   | 2.019 0.01 1.177-3.462 |
| Active                                | 133 (51.6)   | 54 (40.6)   |          | 2.327   | 79 (59.4) | 0.006   | 2.019 0.01 1.177-3.462 |
| Average sleeping hours                |              |             |          |         |        |         |                |
| 6 h or less                           | 107 (41.5)   | 72 (67.3)   |          | 4.213   | 35 (32.7) | 0.000   | 3.958 0.0001 2.267-6.911 |
| 7 and more                            | 151 (58.5)   | 54 (35.8)   |          | 2.327   | 97 (64.2) | 0.000   | 3.958 0.0001 2.267-6.911 |

OR=Odds ratio, aOR=Adjusted OR, CI=Confidence interval

Another similar study showed a decrease in over-stepping performance and impaired cognitive functioning with participants who were deprived of sleep.[7,8] Another study done in Riyadh, Saudi Arabia, on consultants and residents, which concluded that SD was one of the critical risk factors that caused burnout and the resultant low performance, further supported the results of our study.[9‑11]

Limitation of the study
The response rate of our participants (72%) is comparable to previous surveys of physicians (54.3%).[10] However, although previous studies tried to increase the response rate by sending reminders and the giving of modest incentives, they did not achieve 70%. We tried to avoid low response, which can introduce bias into results, by sending five reminders to participants.[20] The reasons for nonresponders and the lack of participation were not investigated as that was beyond the scope of this study and could have breached confidentiality. Therefore, the characteristics of responders and nonresponders could not be compared.

Conclusion
Most of the residents in the current study had adequate sleep. The reasons for SD in some of our study participants were not because of the demands of the specialty, but rather because of the residents’ own habits. Although SD negatively affects the performance of family medicine residents, there were no statistically significant differences between male and female residents in performance, average number of hours of sleep, and residency level. The residents and their training centers should be mindful of the importance of adequate sleep and its effect on performance and physical and mental health. Further studies are needed to discover the other associated reasons for inadequate sleep, such as power drinks and video games.

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Conflicts of interest
There are no conflicts of interest.

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