Effects of Diet Components on the Sleep Quality of First-year Medical Students of a Medical University of Northern India

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ABSTRACT

Aim: The primary aim was to find out the effect of diet components: protein-rich food (represented by the non-vegetarians) or carbohydrate-rich food (represented by the vegetarians) on the sleep quality of first-year medical students. The secondary aim was to find whether the total calorie intake and the sleep quality of the subjects had any relation.

Materials and methods: Students were divided into four groups according to gender and whether they are vegetarians or non-vegetarians. All of them were required to fill their daily food consumption questionnaire, at the end of each day, for 28 days. At the end of this period, they had to fill the Pittsburgh Sleep Quality Index (PSQI) questionnaire. The total calorie intake and PSQI scores were calculated and analyzed.

Results: The average calorie intake and PSQI score of non-vegetarians are $\pm$ SD = 50747.78 $\pm$ 15068.05 kcal and 5.76 $\pm$ 2.57, respectively. The average calorie intake and PSQI score of vegetarians are $\pm$ SD = 60342.63 $\pm$ 18309.56 kcal and 6.02 $\pm$ 2.66, respectively. No significant correlation was found to exist between calorie intake and sleep quality, in any of the individual groups nor overall.

Conclusion: The average calorie intake of vegetarians was higher, but their sleep quality was worse, due to more carbohydrate consumption and less protein consumption as compared to the non-vegetarians. More of carbohydrate and less of protein had resulted into their poorer sleep quality. Boys had overall better sleep quality than girls. Excess intake of snacks and fast food and consuming less variety of foods, as mostly seen in girls, were also found to be the dietary reasons behind their poorer sleep quality.

Clinical significance: This study will help hostellers in finding the balanced combination of food components that are best for them to lead a healthy life and get the very needed sound sleep and can be beneficial for different institutions in designing their balanced hostel mess menu.

Keywords: Calories, Diet components, Medical students, Pittsburgh sleep quality index, Sleep quality.

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INTRODUCTION

Proper sleep is very much an essential factor for having a healthy lifestyle and also important for the overall health of an individual. As per the IMCSMR (US), long and restful sleep sessions of adequate amount per night form an indisputable cornerstone of sound health.¹ There have been quite a few studies emerging lately, suggesting a relation between sleep duration and sleep quality of people and their food choice and consumption of certain dietary components, in both the adult and the pediatric population. Some early studies have shown that certain dietary patterns not only affect the daytime alertness but also have considerable impact on the nighttime sleep, both quantitatively as well as qualitatively. Due to a large number of studies linking sleep duration and obesity, and some of them even stating reduced sleep as a risk factor in the etiology of obesity,²⁻⁴ the interest to assess the impact of sleep on energy intakes has been on the rise recently. In our study, we sought to determine how the diet components, primarily proteins (protein-rich non-vegetarian diet) and carbohydrates (carbohydrate-rich vegetarian diet), influence the various parameters of sleep quality including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, daytime dysfunction, and effect of sleep medications, as well as the overall sleep quality score as derived by the Pittsburgh Sleep Quality Index (PSQI) questionnaire.⁵ Here, the score is inversely proportional to the sleep quality (i.e., higher the score, worse the sleep quality). Our subjects of choice were the first-year medical students of King George's Medical University, Lucknow, India. Medical students are often seen under stress and often have a very irregular diet pattern and sleep pattern. This obviously does

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a lot of harm to their health. Although sleep quality problems have multifactorial causes, diet components are one of the major factors. Hence, this study was a step toward resolving that problem, so that we can get data from these students and try to identify what all components can be added or subtracted from their daily diet to ensure better sleep quality. Our main focus was on the sleep at night and not daytime napping. For this study, we chose to use a subjective method to measure the sleep quality, i.e., by using a questionnaire. This study does not include data of single micronutrients or dietary supplements. Also, an analysis was tried to be made whether it is only the diet components that do have a relationship with the sleep quality or whether the calorie intake also has something to do with the sleep quality. We devised our study in such a way that sex-wise pattern of the effects could be

understood and whether it is same for both males and females, and if they differ, how much do they contrast from each other.

METHODS

Subject Selection

A total of 105 first-year undergraduate MBBS students of King George's Medical University, Lucknow, who were hostellers and were entirely dependent on the respective hostel mess food, were enrolled for this study as subjects. They included both boys and girls, as well as vegetarians (more carbohydrate-dependent) and non-vegetarians (more protein-dependent). All of them were required to fill up the informed consent form, which was available in both English and Hindi.

Inclusion Criteria

- Only first-year medical students enrolled in the MBBS course at King George's Medical University were included in the study.
- Only students of age-group 18–25 years were included in the study.
- Only students residing in the first-year hostels (NEW CV HOSTEL and DK HOSTEL) were included in the study.
- Only students solely consuming hostel mess foods were included in the study.
- Only those non-vegetarian students who consumed at least one non-vegetarian item at least 5 days in a week were considered for the study.

Exclusion Criteria

- Students already suffering from chronic cardiovascular diseases, hypertensive symptoms, diabetes, chronic neurologic disorders, and other such chronic diseases were not considered for the study.
- Students not completing the forms properly were not considered for the study.
- Students violating the categorization due to any reason were immediately excluded from the study.
- Students consuming outside food from restaurants at any point during the study period were also immediately excluded from the study.

Study Design

The subjects were classified into four major groups [non-vegetarian boys ($n = 27$), vegetarian boys ($n = 29$), non-vegetarian girls ($n = 26$), vegetarian girls ($n = 23$)] and each subject was given a unique reference code, to maintain confidentiality of responses. All of these students were added to a WhatsApp group.

Before beginning, we had calculated the amount (in terms of weight in grams) of the various food items that were served in cups (*katoras*), in all hostel messes, so that the calorie calculation could be done accurately.

The period chosen for this study was from February 1, 2021 to February 28, 2021, i.e., a 28-day period. During this period, the subjects received Google forms containing the daily food consumption questionnaire, via the WhatsApp group, at the end of each day. The questionnaire contained three sections: (1) breakfast; (2) lunch and (3) dinner. At the end of this 28-day period, i.e., on February 28, 2021, the subjects were also required to fill the PSQI questionnaire⁵ to assess the quality of their sleep, via a complex scoring system, based on the responses of the subjects. The subjects were required to fill the PSQI questionnaire as per their experience during the study month only.

Analysis of the Data

After this, the total calorie consumption of each and every subject, who had not violated any of the exclusion criteria, was calculated. The calories pertaining to each food item were calculated by using two standardized Government of India data sources: Indian Food Composition Tables (IFCT) 2017 [by the National Institute of Nutrition (ICMR)]⁶ and Dietary Guidelines for Indians—a manual [by the National Institute of Nutrition (ICMR)].⁷ Following this, the PSQI scores of the respective subjects were calculated using the standard set of formulae, as mentioned in the questionnaire's set of calculation guidelines.

Analysis of the data was done and correlation between total calorie intake and sleep quality was assessed; comparison of sleep quality of vegetarians and non-vegetarians and comparison of sleep quality of boys and girls were done.

Ethical Approval

The study was started only after being approved by the Institutional Ethics Committee (IEC) of King George's Medical University, Lucknow (Ref. Code No.: 103rd ECMIIMBBS-S/P1).

OBSERVATION AND RESULTS

The number of students who fulfilled all the criteria to be considered for statistical calculation was 88.

The average age $\pm$ SD of the subjects was 19.42 ± 1.13 years

- The calorie intake of the subjects over the 1-month (=28 days) period, along with their sleep quality scores and final PSQI score:
 - Non-vegetarian Boys ($n = 27$)
The average calorie intake $\pm$ SD and the average PSQI score $\pm$ SD of the non-vegetarian boys were found to be 57389.15 ± 10937.55 kcal (Fig. 1B) and 5.00 ± 1.98 (Fig. 1C), respectively. PSQI and total calorie intake were found to be positively correlated, $r(25) = 0.0595$, $p = 0.772791$ (non-significant at $p < 0.05$) (Fig. 1A).
 - Non-vegetarian Girls ($n = 26$)
The average calorie intake $\pm$ SD and the average PSQI score $\pm$ SD of the non-vegetarian girls were found to be 43804.54 ± 15653.24 kcal (Fig. 2B) and 6.55 ± 2.86 (Fig. 2C), respectively. PSQI and total calorie intake were found to be negatively correlated, $r(24) = -0.1856$, $p = 0.389245$ (non-significant at $p < 0.05$) (Fig. 2A).
 - Vegetarian Boys ($n = 29$)
The average calorie intake $\pm$ SD and the average PSQI score $\pm$ SD of the vegetarian boys were found to be 55829.49 ± 21067.97 kcal (Fig. 3B) and 5.04 ± 1.78 (Fig. 3C), respectively. PSQI and total calorie intake were found to be positively correlated, $r(27) = 0.0071$, $p = 0.96388$ (non-significant at $p < 0.05$) (Fig. 3A).
 - Vegetarian Girls ($n = 23$)
The average calorie intake $\pm$ SD and the average PSQI score $\pm$ SD of the vegetarian girls were found to be 66610.87 ± 10807.39 kcal (Fig. 4B) and 7.39 ± 3.06 (Fig. 4C), respectively. PSQI and total calorie intake were found to be negatively correlated, $r(21) = -0.0943$, $p = 0.682991$ (non-significant at $p < 0.05$) (Fig. 4A).
- Comparison of Non-vegetarian (Boys + Girls) and Vegetarian (Boys + Girls)
The average calorie intake $\pm$ SD of all non-vegetarians was found to be 50747.78 ± 15068.05 kcal (Fig. 5B(i)), whereas that of all

Figs 1A to C: Non-vegetarian boys: (A) The XY distribution curve for calorie intake and PSQI score; (B) Histogram showing relation between calorie intake and number of students; (C) Histogram showing relation between PSQI score and number of students

vegetarians was found to be 60342.63 ± 18309.56 kcal (Fig. 5B(ii)). The average PSQI score $\pm$ SD of all non-vegetarians was found to be 5.76 ± 2.57 (Fig. 5C(i)), whereas that of all vegetarians was found to be 6.02 ± 2.66 (Fig. 5C(ii)). PSQI and total calorie intake for non-vegetarians were found to be negatively correlated, $r(51) = -0.2236$, $p = 0.120845$ (non-significant at $p < 0.05$) (Fig. 5A(i)), whereas for vegetarians were found to be positively correlated, $r(50) = 0.1028$, $p = 0.468326$ (non-significant at $p < 0.05$) (Fig. 5A(ii)).

- Comparison of Boys and Girls

The average calorie intake $\pm$ SD of all boys was found to be 56576.83 ± 17003.13 kcal (Fig. 6B(i)), whereas that of girls was found to be 54067.39 ± 17777.93 kcal (Fig. 6B(ii)). The average PSQI score $\pm$ SD of all boys was found to be 5.02 ± 1.88 (Fig. 6C(i)), whereas that of all girls was found to be 6.93 ± 2.98 (Fig. 6C(ii)). PSQI and total calorie intake for boys were found to be positively correlated, $r(54) = 0.0231$, $p = 0.867624$ (non-significant at $p < 0.05$) (Fig. 6A(i)), whereas for girls were found to be negatively correlated, $r(47) = -0.0228$, $p = 0.892671$ (non-significant at $p < 0.05$) (Fig. 6A(ii)).

- OVERALL

The overall average calorie intake $\pm$ SD and the overall average PSQI score were found to be 55436.17 ± 17404.512 kcal (Fig. 7B)

and 5.89 ± 2.62 (Fig. 7C), respectively. PSQI and total calorie intake for all students (overall) were found to be negatively correlated, $r(103) = -0.0292$, $p = 0.769013$ (non-significant at $p < 0.05$) (Fig. 7A).

DISCUSSION

When the vegetarians (boys and girls combined) were compared with non-vegetarians (boys and girls combined), vegetarians' total calorie intake was found to be more, and so was the PSQI score, i.e., sleep quality as experienced by the vegetarians was found to be worse. This finding was similar to a study by Katagiri et al., wherein a Japanese population they found low intake of fish (one of the primary non-vegetarian food items in Japan) was associated with poor sleep quality ($p = 0.04$), i.e., low protein intake resulted in poorer sleep quality. Also, it was noticed that increased carbohydrate content was associated with worsening sleep quality.⁸ Similar results were seen in a study on a population of Mexican American children by Martinez et al., which noted that short sleep duration was associated with more carbohydrate and less dietary fat consumption [mostly polyunsaturated fatty acids (PUFA)]. Short sleep duration proves to be a risk factor for cravings of food rich in carbohydrate, and in a way replace the heart-healthy dietary fat from the diet, increasing the risk of obesity

Figs 2A to C: Non-vegetarian girls: (A) The XY distribution curve for calorie intake and PSQI score; (B) Histogram showing relation between calorie intake and number of students; (C) Histogram showing relation between PSQI score and number of students

among children.⁹ Data from a systematic review suggest that high carbohydrate diet is associated with decreased sleep onset latency (SOL) and slow-wave sleep (SWS) and increased rapid eye movement sleep (REM). On the contrary, diet having a high-fat content induces lower sleep efficiency (SE) and REM and higher SWS and arousals. Certain food items were seen to be promoting sleep; these included dairy items, fishes, fruits, and vegetables.¹⁰ A trend that was noticed in our study was that the amount of vegetables, pulses, and fruits consumed by the vegetarians and non-vegetarians were relatively quite similar, but the component where they differed was in the amount of carbohydrate sources they consumed (including rice and bread or Indian bread): the vegetarians in a way to make up for the calories that they could not derive from non-vegetarian sources, including meat, fish, and egg, were seen to take extra amounts of carbohydrates, and sometimes even exceeded in their calorie intakes from the non-vegetarian groups, which was especially noticed in the case of vegetarian girls. In addition, vegetarian girls were seen to be dependent a bit more toward extremely high-calorie fast food and snacks, which have high calorific values not just because of their carbohydrate content but because of the high amount of fat they possess due to the oily cooking process that they undergo. On detailed analysis, it came to our knowledge that the average calorie intake was maximum among the vegetarian girls, followed by the

non-vegetarian boys, and then the vegetarian boys, the minimum being the non-vegetarian girls. Although the average PSQI scores showed altogether a different pattern: vegetarian girls > non-vegetarian girls > vegetarian boys > non-vegetarian boys, i.e., the best sleep quality was experienced by the non-vegetarian boys and then the vegetarian boys, followed by the non-vegetarian girls and the worst sleep quality was experienced by the vegetarian girls. Hence, the overall sleep quality of the boys was better than the girls, irrespective of whether they are vegetarians or non-vegetarians. But, both in case of boys and girls, it was worth noting that non-vegetarians had experienced better sleep quality than the vegetarians, just like the overall trend. But in neither of the four groups nor in overall was any significant correlation (Figs 1A, 2A, 3A, 4A, 5A (i and ii), 6A (i and ii) and 7A) found between the total calorie intake and the PSQI scores, just like in most of the past epidemiologic studies conducted in this field, which failed to address causality or direction of the relation between calorie intake and sleep quality scores. These studies also found a link between diet and sleep but were undecided whether it is sleep that affects dietary intakes or dietary intakes that affect sleep.^{8,11-14} So, what can be understood from here is that it is not the calories which actually affect one's sleep quality, but it is the proportion of the various dietary components which one consumes that somehow affects his/her sleep quality, although gender does play

Figs 3A to C: Vegetarian boys: (A) The XY distribution curve for calorie intake and PSQI score; (B) Histogram showing relation between calorie intake and number of students; (C) Histogram showing relation between PSQI score and number of students

Figs 4A to C: Vegetarian girls: (A) The XY distribution curve for calorie intake and PSQI score; (B) Histogram showing relation between calorie intake and number of students; (C) Histogram showing relation between PSQI score and number of students

Figs 5A to C: (A) The XY distribution curve for calorie intake and PSQI score: (i) Non-vegetarians, (ii) Vegetarians; (B) Histogram showing relation between calorie intake and number of students: (i) Non-vegetarians, (ii) Vegetarians; (C) Histogram showing relation between PSQI score and number of students: (i) Non-vegetarians, (ii) Vegetarians

a role here, as described in the following lines: we also went on to compare boys and girls separately, wherein it was found that boys overall had a much more high-calorie intake as compared to girls, although the sleep quality of girls was worse than the boys to quite an extent. Similar data can also be seen from other researches that

used the PSQI questionnaire. In a cohort study by Fatima et al., the prevalence of poor sleep quality in females was 65.1%, as compared to males (49.8%), confirming poor sleep quality in young females as compared to young males.¹⁵ Similar trends were also seen in studies by Hung et al. and Afandi et al.^{16,17} One more major thing that was

Figs 6A to C: (A) The XY distribution curve for calorie intake and PSQI score: (i) Boys, (ii) Girls; (B) Histogram showing relation between calorie intake and number of students: (i) Boys, (ii) Girls; (C) Histogram showing relation between PSQI score and number of students: (i) Boys, (ii) Girls

noted in our study was that boys consumed a greater variety of food items as compared to the girls [as per the NHANES data, short sleepers (<7 hours sleep/night) consumed a lesser variety of food, with relatively lower protein, carbohydrate, fiber, and fat intakes as compared to normal sleepers (7–8 hours sleep/night)].¹⁸ This can also be seen as one of the factors toward the poor sleep quality of the girls, and girls are more inclined toward fast food consumption

as compared to boys. This can be attributed as one of the reasons behind girls experiencing poor sleep quality, as was also found in another study, which said that sleep curtailment was found to be associated with an increased calorie intake from snacks.¹⁹ Certain studies also observed the association of decreased sleep duration with consumption of more fatty foods^{14,20–22} or excess snack consumption.²³

Figs 7A to C: Overall: (A) The XY distribution curve for calorie intake and PSQI score; (B) Histogram showing relation between calorie intake and number of students; (C) Histogram showing relation between PSQI score and number of students

CONCLUSION

This study will help hostellers in finding the balanced combination of food components that are best for them to lead a healthy life and get the very needed sound sleep. Overeating of any food item is not good, as was also seen in this study. Also, this study can be beneficial for different institutions in properly designing their everyday hostel mess menu, as this study was conducted on those students who were entirely dependent on hostel mess food, but still, many had unusual and unhealthy eating habits, thus leading to a very poor sleep experience. Fast food items in breakfast or evening need to be made healthier and those with less calorific value due to PUFA fat. This study did not go into the level of identifying each and every micro- and macronutrients that might influence sleep quality. Studies with larger sample size and considering these individual nutrient components can be conducted in future, for getting a clearer picture.

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