Title: Skipping Breakfast is Associated with Shorter Sleep Duration in Medical Students

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Discussion Points:

- Breakfast is commonly believed to be “the most important meal of the day”; however, why is it that so many medical students skip breakfast? Skipping breakfast is associated with poor sleep and health. #EatWellSleepMore

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ABSTRACT.

Background: Breakfast skipping is common in young adults, including medical students. Poor sleep quality is also common in medical students. Sleep quality and duration are important determinants of health and wellbeing. The aim of the study is to explore the novel association between medical students' frequency of breakfast consumption with sleep quality and duration.

Methods: Year 3 medical students completed a survey at the end of 2018. Data collection included demographic information, the Pittsburgh Sleep Quality Index (PSQI) and breakfast consumption in the month before their end-of-year clinical assessment.

Results: The response rate for the survey was 76.6% (216/282). Forty-five percent of medical students skipped breakfast at least once in an average week and 56.9% of students had poor sleep quality (as defined by PSQI scores > 5). There was a statistically significant association between a higher frequency of breakfast skipping and shorter sleep duration (Kendall's tau-b, P = 0.012). Regression analysis also showed that breakfast frequency had a statistically significant impact on sleep duration (P = 0.048).

Conclusion: Breakfast skipping is common in medical students. Furthermore, breakfast skipping is significantly associated with a shorter sleep duration. This knowledge could empower medical students to optimize their routines for better sleep and general health.

Key Words: Students Medical; Breakfast; Sleep Quality, Sleep Duration; Lifestyle (Source: MeSH-NLM).

INTRODUCTION.

Breakfast is commonly believed to be "the most important meal of the day";[1] however, in the United States, 24-hour recall data from the National Health and Nutrition Examination Survey (NHANES) showed that 23.8% of young adults (20-39 years of age) consumed no foods/beverages, excluding water, at breakfast.[2] Moreover, rates of breakfast skipping among medical students are reported to be even higher: 26.7% in Japan,[3] 41.7% and 23.5% for males and females, respectively, in China,[4] 60% in Saudi Arabia,[5] and 72% in Ghana.[6]

Good sleep quality and adequate sleep duration are important for the health of medical students as they impact memory,[7, 8] problem-solving,[9] motor skills,[10] emotional regulation,[11] psychological wellbeing,[12, 13] and decrease the risk of adverse outcomes such as accidents.[14] Poor sleep quality is more common in medical students as compared with other university students, and the general population.[15-18] It has been proposed that this may be related to poor mental health, heavy workload, time-demands of the programme, and financial pressures.[19] However, less is known about the impact of eating patterns and meal frequency (which is modifiable) on sleep in medical students.

Epidemiological,[20, 21] interventional,[3] chronobiological,[22, 23] and endocrine evidence[3] supports an association between breakfast skipping and short sleep duration. Firstly, large epidemiological studies have shown that breakfast skipping is associated with shorter sleep duration.[20, 21] Secondly, an interventional study (randomised crossover-design) has shown that breakfast skipping is negatively associated with sleep duration.[3] Thirdly, from a chronobiological perspective, it is known that our circadian clock has a role in activity, sleep, and food intake.[22] In addition to our central clock (located in the suprachiasmatic nucleus), there are also peripheral clocks located in many parts of the body including the gastrointestinal system.[23] Since peripheral clocks follow food cues, irregular eating patterns (such as breakfast skipping) can result in the desynchronisation of the peripheral clocks from the central clock which disrupt sleep-wake cycles.[23] Finally, from an endocrine perspective, breakfast skipping (characterised as 'nocturnal' lifestyle) is associated with a decrease in the night peak for melatonin (which induces and maintains sleep) and decrease in the night peak for leptin (which helps to maintain sleep) as compared with not skipping breakfast (characterised as 'diurnal' lifestyle).[3]

There is limited consensus as to the definition of breakfast; however, it is proposed that for the basis of research, breakfast is defined as "…the first meal of the day that breaks the fast after the longest period of sleep and is consumed within 2 to 3 hours of waking…".[1] There is also no consensus as to the definition of breakfast skipping[1]; however, for the purposes of this paper, we define it as skipping breakfast at least one time per week." We sought to explore the association between medical students' frequency of breakfast consumption and sleep quality/duration.

METHODS

Participants

Participants were Year 3 undergraduate medical students from the University of Auckland, New Zealand, at the end of 2018. The students (n=282) were invited to complete a questionnaire directly after their end-of-year clinical assessment. Auckland has a six-year Medical Programme; Year 1 being a common health science year and Year 2 being the start of the formal MBChB. Year 3 involves mostly campus-based teaching and learning, including clinical skills in a simulated environment such as a dedicated Clinical Skills Centre.

Study design

Immediately after completion of an end-of-of year clinical assessment, a consent form and structured self-complete questionnaire were administered by a research assistant. Approval was obtained from the University of Auckland Human Participants Ethics Committee (UAHPEC; Reference Number 022024).

Measures

The questionnaire comprised of demographic information (age, gender, ethnicity), sleep measures, and questions related to breakfast consumption. We asked: “In the past month, how many days in an average week did you usually have something for breakfast (food or nutritional drink/food replacement such as a smoothie)?”. We used the Pittsburgh Sleep Quality Index (PSQI), a validated sleep measure commonly used to measure sleep quality in medical students.[12] The PSQI comprises of seven component scores for sleep quality, sleep onset latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. These component scores are added to give an overall score (range 0-21) where higher scores indicate poorer sleep quality. The overall PSQI score is categorised into good sleep quality (0-5) and poor sleep quality (6-21).[12] Sleep duration was categorised into $\leq$ 6 hours (short sleep duration) and > 6 hours (based on thresholds for neurobehavioral dysfunction).[10]

Statistical analyses

Descriptive statistics were used to report the frequency of breakfast consumption, sleep quality, and sleep duration. Frequency of breakfast consumption in an average week was categorised into ‘Breakfast Skippers’ (skipped breakfast at least once a week) and ‘Breakfast Eaters’ (ate breakfast every day). We also investigated the impact of the regularity of breakfast consumption; categorising students into a ‘Regular Breakfast Pattern’ (those who *never* ate breakfast or *always* ate breakfast) and ‘Irregular Breakfast Pattern’ (those who ate breakfast 1-6 times a week).

The measure of association used to study variables that were both discrete (for example, breakfast skippers/eaters and good/poor sleep quality) was Fisher’s Exact Test. The measure of association used to study the association between a discrete variable (for example, frequency of breakfast consumption) and a continuous variable (for example, sleep duration) was Kendall's tau-b. Ordinal regression was also undertaken to better understand the relationship between the dependent ordinal variable (frequency of breakfast consumption) and key independent ordinal variables (sleep duration [short/normal] and sleep quality [good/poor]). Goodness-of-fit statistics (Pearson Chi Square) was used to determine whether the model adequately describes the data. Data were analysed using IBM SPSS Statistics; Version 28.

RESULTS.

The response rate was 76.6% (216/282). Demographic data are shown in **Table 1**.

Breakfast consumption

Forty five percent of students skipped breakfast at least once a week **(Table 2)**. Eight percent of students never ate breakfast on any day of the week. There was no significant association between breakfast skipping and gender (Fisher's Exact Test, P = 0.273 [2-sided]).

Sleep duration

In the month before the survey, 22.7% (49/216) of students slept ≤ 6 hours per night, and the average sleep duration was 7.1 hours per night (median 7 hours per night, standard deviation 1.1 hours per night, range 7 hours per night [3 to 10 hours per night]). There was a statistically significant association between lower frequency of breakfast consumption and shorter sleep duration (Kendall's tau-b, P = 0.012).

When looking at regularity, there was no statistically significant association between the Irregular Breakfast Pattern (ate breakfast 1-6 times per week) as compared with Regular Breakfast Pattern (*always* ate or *never* ate breakfast) and short sleep duration (Kendall's tau-b, P = 0.619).

Ordinal regression showed that for the frequency of breakfast consumption (dependent variable), there was a statistically significant result for sleep duration (P = 0.048). The value of the sleep duration coefficient was negative (-0.929), which suggests that if you are in the category "short sleep duration" (≤ 6.0 hours), you are more likely to have a lower frequency of breakfast consumption. Goodness-of-fit statistics confirmed that the regression model adequately describes the data (Pearson Chi-Square, P = 0.949).

Sleep quality

On average, in the month before their clinical assessment, 123 out of 216 (56.9%) students reported poor sleep quality (PSQI > 5). The PSQ1 range was 15 (1-16), mean 6.4, median 6. Figure 1 is a scatter plot of PSQI and frequency of breakfast consumption. A higher proportion of Breakfast Skippers had poor quality of sleep (61/96 = 63.5%) as compared with Breakfast Eaters (62/119 = 52.1%); however, there was no statistically significant association between Breakfast Skippers and poor sleep quality (Fisher's Exact Test, P = 0.098 [2-sided]).

When looking at regularity, there was no statistically significant association between the Irregular Breakfast Pattern (ate breakfast 1-6 times per week) as compared with Regular Breakfast Pattern (always ate or never ate breakfast) and poor sleep quality (Fisher's Exact Test, P = 0.116 [2-sided]).

Ordinal regression showed that for the frequency of breakfast consumption (dependent variable), the value of the sleep quality coefficient was positive (0.420), which suggests that if you are in the category "poor sleep quality" (PSQI > 5), you are more likely to have a lower frequency of breakfast consumption; however, this was not a statistically significant result (P = 0.331). Goodness-of-fit statistics confirmed that the regression model adequately describes the data (Pearson Chi-Square, P = 0.949).

DISCUSSION.

This is the first study we are aware of that found a significant association between reduced frequency of breakfast consumption and shorter sleep duration in medical students. Given that the impact of sleep duration on health and wellbeing is documented in the literature, this finding has practical implications. Importantly, frequency of breakfast consumption is a modifiable habit. It is also important due to the recognition of how circadian rhythms can be entrained by regularity of meals.[23] Furthermore, it has been shown that students' own habits correlate with the frequency with which they promoted those habits to patients.[24] Thus, setting up good habits of eating and sleep may lead to improving student health as well as promoting awareness of sleep habits and meal regularity to patients in the future.

We found that approximately half of the participants reported skipping breakfast at least once a week. This is similar to what is reported in Saudi Arabia (60%)[5] and falls somewhere in between the two extremes reported in the literature (26.7% in Japan[3] and 72% in Ghana).[6] We also found that a higher proportion of Breakfast Skippers had poor quality of sleep as compared with Breakfast Eaters; however, this was not statistically significant. This finding is similar to an interventional study in young adults which showed that breakfast consumption tended to improve perceived sleep quality (as compared with breakfast skipping), but this was also not statistically significant.[25]

The key finding, based on correlation analysis, is that a lower frequency of breakfast consumption is significantly associated with a shorter sleep duration. Furthermore, regression analysis statistically confirmed that the frequency of breakfast consumption affects sleep duration, implying a functional relationship. There are large epidemiological studies,[20, 21] interventional studies,[3] chronobiological evidence,[23] and mechanistic endocrine evidence[3] that support these findings.

There are several proposed mechanisms that could explain why breakfast skipping impacts sleep duration in medical students. Firstly, breakfast skipping is associated with a 'later' chronotype (preference for later bed and wake times or "night owls").[26] Since wake times are constrained by academic and social commitments, later bedtimes probably lead to shorter sleep duration and might also lead to later timing of evening meal/food which might then impact bed/sleep time. Secondly, irregular eating times may produce chronodisruption (when the peripheral clocks are desynchronised from the central clock) which might induce a disruption in the circadian system and affect sleep duration.[23] Chronodisruption is part of a vicious cycle impacting adipose tissue, organs of digestion, food components, genetic background, energy input and output, adaptive hyperlipogenesis, food intake control (leptin and ghrelin), and changes in hormones (insulin, corticoids).[23] Furthermore, there is emerging research on the relationship between circadian rhythm and brain cognitive functions showing that chronodisruption affects attention, working memory, cognitive inhibition, and task switching.[27] Thirdly, breakfast skipping is associated with increased snacking of high-fat, high-sugar foods in the evening which also impacts sleep duration.[25] Fourthly, there is growing evidence that breakfast may affect sleep through the brain-gut-microbiome axis (BGMA).[28] Bacteria have shown to affect immune, hormonal, and neural responses, as well as the permeability of both the gut barrier and blood-brain barrier.[28] One study found that total microbiome diversity was positively correlated with increased sleep

efficiency and total sleep time and was negatively correlated with wake after sleep onset.[28] Additionally, the macronutrient composition of the breakfast may also affect sleep given that there is a strong link between food, the gut microbiome, and health, as shown in the landmark PREDICT 1 study,[29]

Breakfast skipping has been shown to have an impact on health. A recent meta-analysis showed that skipping breakfast is associated with increased risk of heart disease and cardiometabolic risks such as obesity, hypertension, and diabetes, dyslipidaemia, and insulin resistance.[30] Furthermore, a large prospective cohort study showed that breakfast skipping is associated with an increase in cardiovascular and all-cause mortality.[31] There are several postulated mechanisms that may explain the increase in cardiovascular morbidity and mortality. Firstly, breakfast skipping is associated with a worse glycaemic control.[26] Secondly, breakfast skipping is associated with disrupted cortisol rhythm due to a longer period of fasting which results in an increase in blood pressure.[32] In contrast, eating breakfast has also been shown to help lower blood pressure which may result in the prevention of the clogging of blood vessels, haemorrhage, and cardiovascular events.[31] Thirdly, breakfast skipping in adolescents is associated with an unhealthy lifestyle such as consuming snacks, foods high in sugar, and fast foods as compared to those who regularly eat breakfast.[33] Frequently eating fast foods is associated with endothelial dysfunction, inflammation, and cardiovascular disease.[33]

Another argument against skipping breakfast is that a long overnight fasting period is associated with an increased risk of gallstones.[34] A prospective study showed that a long overnight fast is one of the most important independent dietary risk factors for hospitalisation with gallstone disease.[34] The mechanism for the increased risk of gallstones with long period of fasting is through reduced gallbladder motility and/or changes in bile composition.[34]

The counter argument for the negative impact of breakfast skipping is the concept of intermittent fasting. The three most widely studied are daily time-restricted feeding (eating within a specified window), 5:2 intermittent fasting (fasting two days each week) and alternate day fasting.[35] Preclinical studies and clinical trials have shown that intermittent fasting is associated with a broad range of benefits related to obesity, diabetes, cardiovascular disease, neurological disorders, and cancer; however, these studies have focused on overweight participants, so the generalisability, safety, and benefit to the general population are in question.[35]

Time-restricted eating (TRE) is a specific protocol of intermittent fasting that is relevant to breakfast skipping because people find it culturally easier to skip breakfast than dinner.[36] The TREAT randomised study showed no significant difference in self-reported sleep measures with TRE (skipping breakfast [only eating from 12:00 PM until 8:00 PM]) as compared with eating three structured meals a day (eating breakfast [between 7:00 AM and 11:00 AM].[36] To try and investigate a potential pattern for those who practiced intermittent fasting, we also looked at the regularity of breakfast consumption. We found no significant association with either sleep duration or quality when we looked at the regularity of the breakfast eating pattern.

Even though our study has a high response rate for this type of survey, there are several limitations. Firstly, our data were retrospective and are based on students' recall over a period of one month. This may have resulted in self-reporting bias, more specifically, recall bias (where students responses depend on their ability to remember their eating and sleeping habits over the last month.) Objective measures of sleep (for example actigraphy or polysomnography) were not undertaken. Secondly, the sleep patterns in the month before the clinical assessment were reflective of an end-of-year assessment period. The stress associated with upcoming assessment could impact eating habits. Future research is required to investigate sleep patterns in a non-assessment period which would give a picture of breakfast and sleep patterns throughout the year. Thirdly, due to the quantitative nature of the data, we were not able to ascertain why some students chose not to eat breakfast at all (for example, lack of time, intentional intermittent fasting, food scarcity, nocturnal eating reducing morning hunger), eating less due to other health conditions (for example, depression), and other practicalities such as not having any food at home, lack of money, or poor organisation. Further studies with qualitative data are required to explore breakfast consumption (when and what is eaten) as it is a potentially modifiable factor which could improve sleep health. Additionally, we have not investigated and ruled out other explanations for the associations we found. Finally, given that the data were obtained from a single institution in New Zealand, wider extrapolation may not be possible.

Future research ideas include (i) using objective measures of sleep quality, such as actigraphy or polysomnography to add to self-reported data, (ii) collaborating with other institutions across different regions to improve the generalisability of results, (iii) conducting a controlled prospective study to add weight to the causality of the relationship between nutrition and sleep, (iv) determining the impact of social determinants such as family and children, (v) exploring the nuances of napping, and (vi) collecting data on other confounding factors that are relevant to medical students such as stress levels and workload.

Going forward, it is also important to explore real-world practical and policy implications. Specific strategies include (i) educating students on the importance of breakfast on sleep and health; (ii) involving students in creative ways such as instituting a breakfast club; (iii) bringing breakfast to the students (if institutional funding is available); (iv) giving breakfast a second chance within their timetable (similar to how lunchtime is scheduled) given that many medical students do not have time in the morning, (v) inviting institutional staff to promote and model healthy behaviours.

In conclusion, we found that approximately half of medical students skip breakfast at least once in an average week during an end-of-year assessment period. Importantly, we found a statistically significant functional association between a lower frequency of breakfast consumption and shorter sleep duration. Given the importance of sufficient sleep duration for wellbeing and performance, this knowledge could empower medical students to optimize their routines for better sleep and general health.

SUMMARY - ACCELERATING TRANSLATION

Title: Skipping Breakfast is Associated with Shorter Sleep Duration in Medical Students

Main problem to solve: Breakfast is commonly believed to be “the most important meal of the day”; however, it is common for medical students to skip breakfast. Skipping breakfast is associated with poor sleep. Good sleep quality and adequate sleep duration are important for the health of medical students; however, poor sleep quality is more common in medical students as compared with other university students and the general population.

Aim of study: To explore the association between how often medical students eat breakfast and how well they sleep.

Methodology: Year 3 medical students at the University of Auckland, New Zealand, completed a survey at the end of 2018. Data collection included information about students’ age, gender, ethnicity, the quality and duration of sleep, and breakfast consumption in the month before their end-of-year examinations.

Results: Seventy-seven percent of the Year 3 students completed the survey. Forty-five percent of those medical students skipped breakfast at least once in an average week and 57% of students had poor sleep quality. There was a clear association between how often students ate breakfast and how long they slept.

Conclusion: Approximately half of medical students skipped breakfast at least once in an average week. The more often medical students skipped breakfast, the fewer hours they slept. Given the importance of getting enough sleep for wellbeing and performance, this knowledge could help medical students to optimize their lifestyle for better sleep and general health.

REFERENCES.

1. O'Neil C, Byrd-Bredbenner C, Hayes D, Jana L, Klinger S, Stephenson-Martin S. The role of breakfast in health: definition and criteria for a quality breakfast. J Am Diet Assoc. 2014;114(12 Suppl):S8-26.
2. Deshmukh-Taskar P, Nicklas TA, Radcliffe JD, O'Neil CE, Liu Y. The relationship of breakfast skipping and type of breakfast consumed with overweight/obesity, abdominal obesity, other cardiometabolic risk factors and the metabolic syndrome in young adults. The National Health and Nutrition Examination Survey (NHANES): 1999–2006. Public Health Nutr. 2013;16(11):2073-82.
3. Qin L, Li J, Wang Y, Wang J, Xu J, Kaneko T. The effects of nocturnal life on endocrine circadian patterns in healthy adults. Life Sci. 2003;73(19):2467-75.
4. Sun J, Yi H, Liu Z, Wu Y, Bian J, Wu Y, et al. Factors associated with skipping breakfast among Inner Mongolia Medical students in China. BMC Public Health. 2013;13:42.
5. Javaid A, Munir I. Breakfast skipping and its effects on emotional and academic behaviour of a group of Saudi medical students. J Nutr Food Sci. 2018;8(6):1-4.
6. Ackuaku-Dogbe EM, Abaidoo B. Breakfast eating habits among medical students. Ghana Med J. 2014;48(2):66-70.
7. Girardeau G, Lopes-Dos-Santos V. Brain neural patterns and the memory function of sleep. Science. 2021;374(6567):560-4.
8. Peigneux P, Fogel S, Smith C. Memory Processing in Relation to Sleep. In: Kryger, M, Roth T, Dement WC, editors. Principles and Practice of Sleep Medicine. 6th ed. Elsevier; 2017:229-238.
9. Lewis PA, Knoblich G, Poe G. How Memory Replay in Sleep Boosts Creative Problem-Solving. Trends Cogn Sci. 2018;22(6):491-503.
10. Van Dongen HPA, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep. 2003;26(2):117-26.
11. Gruber R, Cassoff J. The interplay between sleep and emotion regulation: conceptual framework empirical evidence and future directions. Curr Psychiatry Rep. 2014;16(11):500.
12. Buysse DJ, Angst J, Gamma A, Ajdacic V, Eich D, Rössler W. Prevalence, course, and comorbidity of insomnia and depression in young adults. Sleep. 2008;31(4):473-80.
13. Pigeon WR, Pinquart M, Conner K. Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. J Clin Psychiatry. 2012;73(9):e1160-7.
14. Kecklund LG, Axelsson J. Health consequences of shift work and insufficient sleep. BMJ. 2016;355:i5210.
15. Falloon K, Bhoopatkar H, Moir F, Nakatsuji M, Wearn A. Sleep well to perform well: the association between sleep quality and medical student performance in a high-stakes clinical assessment. Sleep Adv. 2022;3(1):zpac019.
16. Azad MC, Fraser K, Rumana N, et al. Sleep disturbances among medical students: a global perspective. J Clin Sleep Med. 2015;11(1):69-74.
17. Seoane HA, Moschetto L, Orliacq F, Orliacq J, Serrano E, Cazenave MI, et al. Sleep disruption in medicine students and its relationship with impaired academic performance: A systematic review and meta-analysis. Sleep Med Rev. 2020;53:101333.

18. Li L, Wang Y, Wang S, Zhang L, Li L, X D, et al. Prevalence of sleep disturbances in Chinese university students: a comprehensive meta-analysis. J Sleep Res. 2018;27(3):e12648.
19. Rao W, Li W, Qi H, Hong L, Chen C, Li C, et al. Sleep quality in medical students: a comprehensive meta-analysis of observational studies. Sleep Breath. 2020;24(3):1151-65.
20. Kant AK, Graubard BI. Association of self-reported sleep duration with eating behaviors of American adults: NHANES 2005–2010. Am J Clin Nutr. 2014;100(3):938-47.
21. Kim S, DeRoo LA, Sandler DP. Eating patterns and nutritional characteristics associated with sleep duration. Public Health Nutr. 2011;14(5):889-95.
22. Gill S, Panda S. A amartphone app reveals erratic diurnal eating patterns in humans that can be modulated for health benefits. Cell Metab. 2015;22(5):789-98.
23. Garaulet M, Gómez-Abellán P. Timing of food intake and obesity: A novel association. Physiol Behav. 2014;134:44-50.
24. Moir F, Patten B, Yielder J, Sohn CS, Maser B, Frank E. Trends in medical students' health over 5 years: Does a wellbeing curriculum make a difference? Int J Soc Psychiatry. 2023;69(3):675-88.
25. Gwin JA, Leidy HJ. Breakfast consumption augments appetite, eating behavior, and exploratory markers of sleep quality compared with skipping breakfast in healthy young adults. Curr Dev Nutr. 2018;2(11):nzy074.
26. Reutrakul S, Hood MM, Crowley SJ, Morgan MK, Teodori M, Knutson KL. The relationship between breakfast skipping, chronotype, and glycemic control in type 2 diabetes. Chronobiol Int. 2014;31(1):64-71.
27. Xu S, Akioma M, Yuan Z. Relationship between circadian rhythm and brain cognitive functions. Front Optoelectron. 2021;14(3):278-87.
28. Smith RP, Easson C, Lyle SM, Kapoor R, Donnelly CP, Davidson EJ, et al. Gut microbiome diversity is associated with sleep physiology in humans. PLoS One. 2019;14(10): e0222394.
29. Berry SE, Valdes AM, Drew DA, Asnicar F, Mazidid M, Wolf J, et al. Human postprandial responses to food and potential for precision nutrition. Nat Med. 2020;26(6):964–73.
30. Takagi H, Hari Y, Nakashima K, Kuno T, Ando T. Meta-analysis of relation of skipping breakfast with heart disease. Am J Cardiol. 2019;124(6):978-86.
31. Rong S, Snetselaar LG, Xu G, Sun Y, Liu B, Wallace RB, et al. Association of skipping breakfast with cardiovascular and all-cause mortality. J Am Coll Cardiol. 2019;73(16):2025-32.
32. Witbracht M, Keim NL, Forester S, Widaman A, Laugero K. Female breakfast skippers display a disrupted cortisol rhythm and elevated blood pressure. Physiol Behav. 2015;140:215-21.
33. Park S, Rim SJ, Lee JH. Associations between dietary behaviours and perceived physical and mental health status among Korean adolescents. Nutr Diet. 2018;75(5):488-93.
34. Sichieri, R, Everhart JE, Roth H. A prospective study of hospitalization with gallstone disease among women: role of dietary factors, fasting period, and dieting. Am J Public Health. 1991;81(7):880-4.
35. de Cabo R, Mattson MP. Effects of Intermittent Fasting on Health, Aging, and Disease. N Engl J Med. 2019;381(26):2541-51.
36. Lowe DA, Wu N, Rohdin-Bibby L, Moore AH, Kelly N, Liu YE et al. Effects of time-restricted eating on weight loss and other metabolic parameters in women and men with overweight and obesity. JAMA Intern Med. 2020;180(11):1491-9.

FIGURES AND TABLES.

Table 1: Age, Gender, and Ethnicity of Medical Students

Characteristic	n (%)
Age (years)	
15-19	5 (2.3)
20-24	182 (84.3)
25-29	24 (11.1)
30-34	4 (1.9)
35-39	1 (0.4)
Gender	
Male	94 (43.5)
Female	122 (56.5)
Gender Diverse	0 (0.0)
Ethnicity[a]	
New Zealand European	116 (53.7)
Māori	32 (14.8)
Pacific peoples[b]	15 (6.9)
Chinese	38 (17.6)
Indian	18 (8.3)
Other	53 (24.5)

Legend: [a] Some participants identified as more than one ethnic group; [b] Samoan, Cook Island Māori, Tongan

Table 2: Frequency of Breakfast Consumption in an Average Week

Breakfast consumption (per week)	Frequency (n)	Percentage (%)
No days	17	7.9
1-2 days	19	8.8
3-4 days	31	14.4
5-6 days	29	13.5
Everyday	119	55.3
Total	215[a]	100.0

Legend: [a] Data for breakfast consumption was missing for one student out of the 216 respondents

Figure 1: Scatter Plot of Sleep Quality and Frequency of Breakfast Consumption