An analytical cross-sectional study on the association between weight changes and stress levels among first to fourth year medical students of a private medical school from A.Y. 2023-2024

Sabrina Rae Aquino[1], Roy Benedict Arceo[1], Shannele Adrielle Ariz[1], Zarina Mae Aves[1], Christhon Marc Cocjin[1], Michaela Crisostomo[1], Kimberly Joyce Cruz[1], Ron Jay Cuaresma[1], Jennifer M. Nailes, MD, MSPH[1], Kim Elizabeth Ong, MD, DPPS[1]

Abstract

Introduction The demanding nature of medical school causes students to experience stress, anxiety, and depressive episodes that may cause students to gain or lose weight. This study aimed to determine the association of weight changes and stress levels among a private medical school students.

Methods Data were collected two times with an interval of 30 days through on-site measurement of the students' anthropometrics using a stadiometer and utilization of online survey questionnaires accessed via QR code. Demographics and disease states were identified in the first round of data collection while the Perceived Stress Scale-10 (PSS-10) and identification of stressors was integrated in the second round of data collection.

Results Among the 212 individuals, 69.8% were categorized into having perceived moderate stress levels, 22.2% with high stress, and 8% with low stress. Of the 212 cases, 86 gained weight, 91 lost weight, and 35 had no change in weight. Fear of failure, poor motivation, and difficulty understanding lectures are among the top overall stressors. The study noted that there is a moderate association between stress and weight changes but it is not enough to reach statistical significance (0.161), as the sample size was not reached. The study revealed that the prevailing diseases were Polycystic Ovarian Syndrome, Hypothyroidism, and Hypertension, which have varying degrees of impact on weight change.

Conclusion There is an association between weight changes and stress levels among first to fourth year medical students of a private medical school from A.Y. 2023-2024.

Key words: Weight gain, weight loss, stress levels, medical students

When pressure surpasses one's apparent capacity to cope, the end-result is stress. Stress is the body's response to a change that necessitates an adjustment or response on mental, physical, or emotional level. The depth and complexity of the topics that must be learned, as well as the on-going demands on students' time, have been cited as reasons why studying medicine is perceived to be stressful. Given the demanding nature of the curriculum in medical school, medical students have been found to have higher levels of stress, anxiety, and depressive episodes. The prevalence of stress among medical students is estimated to be around 28.5%–78%, with an overall prevalence rate of 31.7%, with varying degrees per year level as each level's demands vary.[1]

It has been demonstrated that stress causes medical students to have more negative consequences in both

Correspondence:
Shannele Adrielle V. Ariz email at arizs5867@uerm.edu.ph

[1]University of the East Ramon Magsaysay Memorial Medical Center

personal and professional levels. In fact, numerous studies have discovered a significant correlation between high levels of stress and anxiety, and a decline in class performance, student interactions, clinical practice, and overall poor academic performance.[2] In general, a person's eating habits may change as a result of extreme stress, which may then change how they react to stress by affecting their weight. Depending on a person's body mass index or level of stress, the results may vary. Under stressful conditions, some students may gain weight as a result of these factors, while others may lose weight due to the same factors.[3]

The present study was carried out to determine the association of stress levels and weight changes among private medical school students, specifically, (a) categorized the stress levels of first to fourth year Medical Students enrolled in a private medical school for the academic year 2023-2024 according to the Perceived Stress Scale, (b) compared the baseline weight from their current weight, which is measured 30 days after (c) determined which academic year level in medical school experienced the most stress and (d) determined the top stressors that medical students experienced.

Methods

Study Design

The researchers utilized an analytical-cross sectional study design. This study ran for a duration of 10 months with data collection spanning 3 months. This study was approved by the UERMMMCI RIHS Ethics Review Committee with RIHS ERC Code: 1458/C/2023/030.

First to fourth year medical students of a private medical school enrolled for A.Y. 2023-202 were selected through convenience sampling. However, irregular students, as well as students who worked part-time or full-time and, thus, were experiencing varying levels of stress, were excluded from the study. Their heights and weights were measured and they were given survey questionnaires composed of their socio-demographic profile, anthropometrics, questions from the Perceived Stress Scale, and identification of their stressors. The data collected were then analyzed and the procedures were followed.

The sample size needed for the study was calculated using the formula for stratified random samplingwith the maximum tolerable error set at 5%.[1]. The calculated minimum number of needed participants was 233 individuals with the additional 20% number of participants as a buffer. The total calculated sample size was 283 participants.

Anthropometrics of the students were obtained using a stadiometer and online survey questionnaires was used. The researchers conducted on-site measurements of the anthropometric data, specifically of the weight and height to ensure that they were accurate and based on a uniform scale using Indoplas Dial Type Weighing Scale.

The study involved a second round of data collection (30 days after first collection) to assess the link between stress levels and weight change. Subsequently, the Perceived Stress Scale-10 (PSS-10), a 10-item questionnaire was used to gauge the stress levels of the participants by rating each item (0) Never, (1) Almost Never, (2) Sometimes, (3) Fairly Often, or (4) Very Often. The internal consistency of the PSS-10, has been found to be mostly good, with Cronbach's alpha values ranging from 0.82 to 0.89 as calculated in a study.[4] Following the PSS-10 assessment, participants were asked to mark their stressors such as academic factors, psychosocial factors, and teaching-related factors, allowing them to select as many stressors as they felt applied to them.[1]

Descriptive and inferential statistics were done, while Chi-square, Likelihood ratio, Linear-by-linear association and Prevalence Odds Ratio were utilized to test for the association and likelihood between stress levels and weight changes.

Confounding variables were identified that may affect the study, specifically, the existing disease states of the participants as certain diseases may cause one to unintentionally gain or lose weight. The existence of such conditions may have an impact on the study's findings since the researchers would be unsure whether the weight change was caused by stress or by the underlying ailment. Although such individuals could have been removed from the study, the researchers chose to include them because there are many diseases that could impact one's weight. Other issues that could not be accounted for were the undiagnosed ones.

Results

The primary aim was to explore the relationships between stress levels and various variables, such as

emotional reactions, academic demands, and health issues, specifically among medical students.

There were 212 participants, where 152 were females (71.7%) and 60 males (28.3%).

The prevalence of academic stressors, which was identified by 210 participants, is exhibited in Figure 1. Fear of failure (83.8%), heavy workload (78.1%) and tight schedule (72.9%) were identified as the top 3 academic stressors.

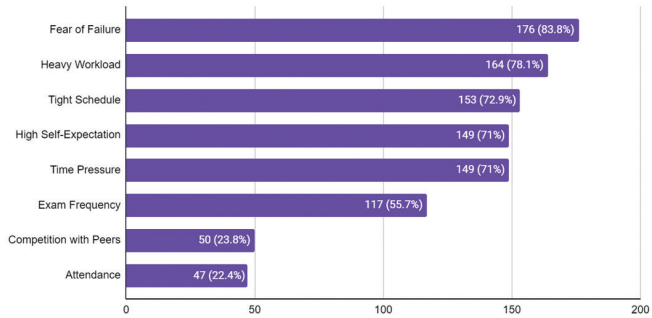

Figure 1. Prevalence of academic stressors.

The prevalence of psychosocial stressors found among 196 respondents, as found in Figure 2, shows poor motivation (68.9%) as the top source of psychosocial stress followed by loneliness (52%). Lack of family support (7.7%) was the least identified psychosocial stressor.

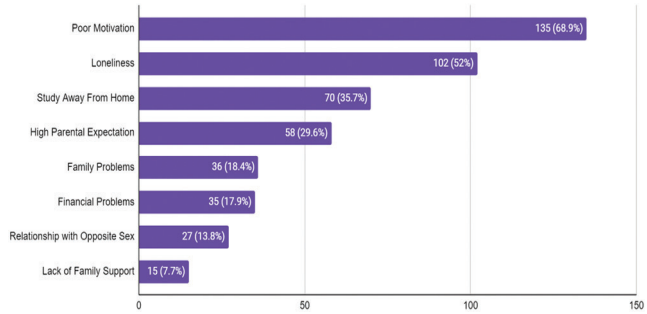

Figure 2. Prevalence of psychosocial stressors.

Teaching-related stressors were identified by the 169 participants as presented in Figure 3. Among these, difficulty understanding lectures (85.8%) was the highest. This is followed by poor teaching skills (32.5%) and poor teacher support (30.8%).

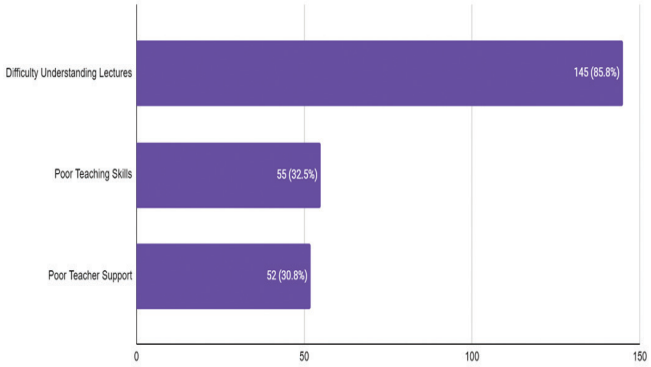

Figure 3. Prevalence of teaching-related stressors.

An in-depth exploration of the relationship between perceived stress levels and various emotional states among the 212 medical students is seen in Table 1. The study scrutinized ten different aspects of stress, ranging from feelings of being upset to challenges in coping with overwhelming situations.

A consistent pattern of reported stress levels was observed across all year levels, with the majority (69.8%) experiencing moderate stress, followed by high stress (22.2%) and low stress (8%) as presented in Table 2.

The perceived stress scores of each year level are presented in Table 3. It shows that first year medical students have the highest stress levels, while second, third and fourth-year medical students have slightly lower stress levels.

Table 4 categorizes BMI distribution across the year levels. Only 37.26% had a normal BMI, with the remaining 25.47% categorized as obese I, 16.04% as overweight, 11.32% as obese II, and 9.91% as underweight.

The relationship between perceived stress levels and weight changes among the student population is seen in Table 5. Majority of the students have moderate stress levels while the minority have either high or low levels of stress.

Table 6 shows that with a POR of 0.99 or close to 1, there was almost no difference in the weight gain between medical students with high stress levels compared to those with moderate stress levels.

Table 7 indicates that medical students who gained weight are two times less likely to be the ones who were experiencing moderate stress levels compared to those with low stress levels.

Table 1. Description of the sample characteristics stratified by the Perceived Stress Scale-10 (PSS-10)

Perceived Stress	Never		Almost Never		Sometimes		Fairly Often		Very Often		Chi-Square [a]	
	N	%	N	%	N	%	N	%	N	%	X^2	p-value
1. In the last month, how often have you been upset because of something that happened unexpectedly?	1	0.5	16	7.5	73	34.4	80	37.7	42	19.8	**0**	1
2. In the last month, how often have you felt that you were unable to control the important things in your life?	8	3.8	29	13.7	64	30.2	77	36.3	34	16	**0**	1
3. In the last month, how often have you felt nervous and stressed?	0	0	9	4.2	27	12.7	89	42	87	41	**0**	1
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	21	9.9	0	0	76	35.8	93	43.9	22	10.4	**0**	1
5. In the last month, how often have you felt that things were going your way?	17	8	68	32.1	94	44.3	31	14.6	2	0.9	**0**	1
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	8	3.8	47	22.2	69	32.5	72	34	16	7.5	**0**	1
7. In the last month, how often have you been able to control irritations in your life?	21	9.9	77	36.3	80	37.7	30	14.2	4	1.9	**0**	1
8. In the last month, how often have you felt that you were on top of things?	7	3.3	46	21.7	108	50.9	44	20.8	7	3.3	**0**	1
9. In the last month, how often have you been angered because of things that happened that were outside of your control?	16	7.5	49	23.1	63	29.7	65	30.7	19	9	**0**	1
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	9	4.2	33	15.6	57	26.9	87	41	26	12.3	**0**	1

[a] *The Pearson Chi-square revealed that there is no statistically significant difference in these emotional responses across different levels of perceived stress.*

Table 2. Distribution of students according to year level and their corresponding perceived stress level.

Parameters	Year Level								Total	
Stress Level	First Year		Second Year		Third Year		Fourth Year			
	N	%	N	%	N	%	N	%	**N**	**%**
High (27-40)	18	25	6	16.7	13	22.4	10	21.7	**47**	**22.2**
Moderate (14-26)	50	69.4	30	83.3	37	63.8	31	67.4	**148**	**69.8**
Low (0-13)	4	5.6	0	0	8	13.8	5	10.9	**17**	**8**
Total	**72**	**100**	**36**	**100**	**58**	**100**	**46**	**100**	**212**	**100**

Table 3. Perceived stress scores of each year level.

Year Level	Median Perceived Stress Score
First Year	23
Second Year	22
Third Year	22.5
Fourth Year	22

Table 4. Distribution of students according to year level and their BMI.

Parameters	Year Level								Total	
BMI	First Year		Second Year		Third Year		Fourth Year			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Obese II	7	9.72	5	13.89	6	10.34	6	13.04	**24**	**11.32**
Obese I	20	27.78	9	25	16	27.59	9	19.57	**54**	**25.47**
Overweight	9	12.5	5	13.89	11	18.97	9	19.57	**34**	**16.04**
Normal	24	33.33	14	38.89	21	36.21	20	43.48	**79**	**37.26**
Underweight	12	16.67	3	8.33	4	6.9	2	4.35	**21**	**9.91**
Total	**72**	**100**	**36**	**100**	**58**	**100**	**46**	**100**	**212**	**100**

Table 5. Cross tabulation analysis between the stress levels and weight changes.

Stress Level		(+), (-), (0) Weight Changes			Total
		(+) Weight Gain	(-) Weight Loss	(0) No Change	
PSS VALUES	High	17	19	11	47
	Moderate	61	68	19	148
	Low	8	4	5	17
Total		86	91	35	212

Table 6. Prevalence odds ratio for high and moderate stress levels and weight changes.

	(+) Weight Gain	(-) Weight Loss	Total
(3) High Stress Level	17	19	36
(2) Moderate Stress Level	61	68	129
Total	78	87	165
Prevalence Odds Ratio	**0.997411562**		

Table 7. Prevalence odds ratio for moderate and low stress levels and weight changes.

	(+) Weight Gain	(-) Weight Loss	Total
(2) Moderate Stress Level	61	68	129
(1) Low Stress Level	8	4	12
Total	69	72	141
Prevalence Odds Ratio	**0.448529412**		
1/POR	**2.229508196**		

Table 8 indicates that medical students who gained weight are two times less likely the ones who were experiencing high stress levels compared to those with low stress levels.

As displayed in Table 9, there is a moderate relationship between stress levels and weight changes among medical students, but the association is not statistically significant.

The identified disease states among participants are detailed in Table 10. Out of the 212 participants, 49 reported being diagnosed with various disease states. The 12 identified disease states were as follows: Polycystic Ovarian Syndrome (PCOS) was the most common, reported by 35 participants, followed by hypothyroidism with 8 participants, and 3 participants each with bronchial asthma and hypertension. Irritable Bowel Syndrome (IBS) was reported by 2 participants, and the remaining diseases had single participants each.

Table 8. Prevalence odds ratio for high and low stress levels and weight changes.

	(+) Weight Gain	(-) Weight Loss	Total
(3) High Stress Level	17	19	36
(1) Low Stress Level	8	4	12
Total	25	23	48
Prevalence Odds Ratio	**0.447368421**		
1/POR	**2.235294118**		

Table 9. Cross tabulation test of association between the stress levels and weight changes among the participants.

Test of Association	Value	df	Asymptotic Significance (2-sided)	Level of Association	Decision	Conclusion
Pearson Chi-Square	6.565[a]	4	0.161	Moderate	Not Significant	There is no Significant Association
Likelihood Ratio	**6.472**	**4**	**0.167**	**Moderate**	**Not Significant**	
Linear-by-Linear Association	0.578	1	0.447	Weak	Not Significant	
N of Valid Cases	212					

a. 1 cell (11.1%) has expected count less than 5. The minimum expected count is 2.81, which means that the assumption has been violated. Therefore, the likelihood ratio will be respected and used to tell the level of significant relationship between the weight changes and perceived stress level at 0.05 level of significance.

Table 10. Disease states of participants and weight changes.

	Weight Loss		No Change		Weight Gain		Total
Disease State	**N**	**%**	**N**	**%**	**N**	**%**	
Hypothyroidism	2	25	2	25	4	50	8
Bronchial Asthma	0	0	0	0	3	100	3
Atopic Dermatitis	0	0	0	0	1	100	1
Polycystic Ovarian Syndrome (PCOS)	17	48.57	6	17.14	12	34.3	35
G6PD deficiency	0	0	0	0	1	100	1
Irritable Bowel Syndrome (IBS)	1	50	0	0	1	50	2
Type 2 Diabetes Mellitus	0	0	1	100	0	0	1
Depression	0	0	0	0	1	100	1
Psoriasis	1	100	0	0	0	0	1
Anemia	0	0	0	0	1	100	1
Hyperacidity	0	0	0	0	1	100	1
Hypertension	2	66.67	0	0	1	33.3	3

Discussion

Medical Students and Stress

Medical students encounter an increased amount of stress during their studies due to various factors. A survey was conducted to assess sources of stress among medical students and categorized these into three: academic factors, psychosocial factors, and teaching-related factors.[1] They were broken down into specific stressors. The participants in this study were likewise asked to identify the stressors that affect them.

As shown in the study, the top three academic stressors identified were fear of failure, heavy workload, and a tight schedule. A study in Germany similar to these results has reported as stressor such as fear of failure among medical students because this may result in expulsion from the medical school as well as not having time to studying.[5]

Among the psychosocial stressors, the following were the most prevalent among medical students: poor motivation, loneliness, and studying away from home. As shown in a study, family ties were perceived as an important support system against permanent stress, hence loneliness and studying away from home entailed participants to encounter personal challenges from transitioning to living with family to living alone.[5]

Among the top teaching-related stressors, majority of the medical students rated difficulty comprehending lectures as their top stressor. This could be ascribed to heightened difficulty in the subject matter and the increased number of topics that need to be mastered within a given time.

Perceived Stress

The data revealed that across all year levels, students experienced varying degrees of stress. The first-year students were found to have the highest level of stress. The sudden shift in complexity of topics from their undergraduate studies may have caused a high increase in stress. Similar findings can be seen in a study conducted among medical students in Ethiopia.[6] A decline in high stress level is seen as the year progresses (exception for the second year students) which is reflected in similar studies with medical students.[2,7] Although the obtained stress levels in the other year levels were only slightly lower.

Relationship between Stress and Weight

Only 37% of the participants fell under the category of a normal BMI. Majority have abnormal BMI: Overweight, Obese I, and Obese II, and underweight with a percentage of 16.04%, 25.47%, 11.32%, and 9.91%, respectively.

Table 5 presents a comprehensive analysis of the relationship between stress levels and weight changes among students. The data are organized into three stress levels (High, Moderate, and Low) and three weight change categories (Weight Gain, Weight Loss, and No Change). The values provided highlight the different responses of students to stress levels, with varying weight changes.[3]

It was shown that medical students who gained weight were two times less likely to have high stress level. Those who gained weight were likely those who were moderately stressed. This implied that people who experience high levels of stress are not likely to have major changes in comparison to others who experience moderate levels of stress.

This suggests that stress does not completely shield individuals from weight changes but may have a protective effect against weight loss.

Medical students with moderate stress levels are two times less likely to experience weight gain compared to those with low stress levels. This finding implies that moderate stress levels may provide some level of protection against weight gain as compared to low stress levels. A moderate level of stress in comparison to a low level of stress, may account for why those with low levels of stress are more likely to gain weight. This is explored in past research where higher levels of stress may cause one to develop unconscious habits such as foot tapping or finger clicking that result in unanticipated weight loss bccause these tics can actually burn calories.[10] In times of stress, the body enters the "fight or flight" mode, also referred to as the "acute stress response." It is also possible that because of the stress, the body releases adrenaline which can also reduce the appetite. The lower likelihood of weight gain among students with high stress may be influenced by various factors such as stress-induced changes in eating habits, metabolism, or other lifestyle factors.

Higher levels of stress can also cause one to gain weight as a result of the stress hormone cortisol which is known to decrease metabolism and has a direct relationship with stress-induced eating and binge eating.[8] However it is also important to note that while stress at a moderate level appears to be linked to weight gain, various other factors could contribute to this relationship.

In simpler terms, this means that students with moderate stress levels are significantly more likely to lose weight when compared to their counterparts with low stress. This finding indicates a strong association between moderate stress and weight loss among students. Higher stress levels were found to be significantly associated with meal skipping, which may

contribute to weight loss.[9] However it is essential to recognize that while stress at a moderate level appears to be linked to weight loss, various other factors may influence this relationship.

In this study, there was no significant difference in the likelihood of weight gain and no change in weight between those with high and low stress levels. These stress categories did not significantly influence weight gain or maintenance. This finding implies that other factors beyond stress levels may be at play in determining weight changes among students. While stress management remains crucial for overall well-being, this particular study indicates that stress levels alone may not be a decisive factor in predicting weight changes among students.

Impact of Stress and Weight on Health

The present study determined the association between stress levels and weight changes among first to fourth year medical students of a private medical school enrolled for the A.Y 2023-2024. The data revealed interesting patterns in weight fluctuations within different medical states. For example, those with Hypothyroidism showed varying results, with 50% reported weight gain, while others either lost weight or maintained their weight. On the contrary, individuals diagnosed with Bronchial Asthma and Atopic Dermatitis consistently gained weight in all recorded cases. In one study, they found a correlation between an increase in asthma severity and changes in gastrointestinal function brought on by weight gain.[10]

Among individuals with various diseases, such as Polycystic Ovarian Syndrome (PCOS), a noteworthy number reported experiencing weight loss, indicating a potential correlation between PCOS and weight reduction. Similarly, individuals with Hypertension demonstrated weight loss, suggesting a potential association between managing hypertension and losing weight. In the early stages of life, there is an observable relationship between blood pressure and weight, with the correlation coefficient rising to approximately 0.4 in young people and subsequently declining in older age groups.[11] Other disease states were identified, including Type 2 diabetes mellitus, where one medical student maintained his weight, and psoriasis, which resulted in weight loss. These outcomes may be attributed to efforts aimed at improving overall health and alleviating disease symptoms.[12,13] Additionally, diseases like depression, anemia, and hyperacidity have been associated with weight gain due to various physiological factors, as indicated in previous studies.[14,15]

Conclusion

In conclusion, it is worth noting that there is an association between stress levels and weight changes among first to fourth year medical students of a private medical school. The year level that is categorized as having the highest stress level are the first year, but the difference between year levels was not too marked. The majority of the medical students experienced having moderate stress and have shown to gain and lose weight almost equally. Fear of failure, heavy workload, and tight schedules were the top academic stressors identified by the majority of medical students across all academic levels. Poor motivation and loneliness were the most prevalent psychosocial stressors, while difficulty understanding lectures was the leading teaching-related stressor.

Limitations and Recommendations

In this study, the following were considered to be some of the limiting factors: (1) weight changes were only measured within a month, which may present with minimal differences as the PSS-10 scale utilized is only valid in measuring perceived stress over the preceding month; (2) medical students' environment has drastically changed since the first measurement compared to the second, which may greatly affect their stress levels; (3) due to conflict of schedule, some students were not exactly measured after the same number of days (e.g. 30 days), as well as some being difficult to contact after the first data collection; (4) the use of analog stadiometers limited the measurement of weight to increments of 500 grams, thus preventing a more accurate measurement of changes in weight. Though the researchers attempted to minimize its effects, non-response bias was identified in the study, thus sample size was not reached and presented as a limitation of this study.

Moreover, for future similar studies, it is recommended to have a longer period of data collection as 30 days may not be enough to accurately depict weight change. A questionnaire that is more apt for measuring long-term stress may be used in this circumstance. It is also recommended that there be a minimum value for the change in weight for it to

be considered as actual weight change as weight can fluctuate daily due to a variety of reasons (e.g. food and beverage intake, bowel movements, hydration levels, weather). In relation to this, it would be better to follow a stricter data collection schedule so that such confounding variables may be accounted for. Having a specified data collection schedule would likewise make all data comparable and standardized. Future studies may also adopt a more systematic and strategic planning on data collection by arranging medical students per year level and section for a more efficient data collection.

Another recommendation is to employ a higher-quality and more portable stadiometer, preferably one that doesn't require frequent re-calibrations, to minimize errors in data collection. Due to scheduling differences between participants and researchers, the data collection location varied for the sake of participant convenience, emphasizing the importance of instrument portability. Additionally, it is advisable to include more specific individuals within the target population, such as students residing in dormitories near the school or those commuting between their homes and the school, as they may experience different stressors. Using a more detailed questionnaire to explore participants' coping mechanisms is recommended to understand the observed changes in weight. For future studies, a more comprehensive examination of disease states affecting stress and weight, integration of lifestyle factors, social interactions, stress management techniques, and manifestations of stress can contribute to a deeper understanding of the interactions among these factors and stress.

Funding

This study was funded by UERMMMCI.

References

1. Ragab EA, Dafallah MA, Salih MH, Osman WN, Osman M, Miskeen E, et al. Stress and its correlates among medical students in six medical colleges: An attempt to understand the current situation. Middle East Curr Psychiatr 2021;28(1). doi: 10.1186/s43045-021-00158-w
2. Abdulghani HM, AlKanhal AA, Mahmoud ES, Ponnamperuma GG, Alfaris EA. Stress and its effects on medical students: A cross-sectional study at a College of Medicine in Saudi Arabia. J Health Pop Nutr [Internet] 2011 Nov 13 [cited 2022 Oct 14];29(5). doi: 10.3329/jhpn.v29i5.8906
3. Goswami B. Prevalence of stress and its association with body weight among the medical students of Jorhat Medical College and Hospital, Jorhat. Int J Stud 2017;4(11):1-3. doi: 10.17354/ijss/2017/36
4. Lee, EH. Review of the psychometric evidence of the perceived stress scale. Asian Nurs Res 2012 Dec;6(4):121-7. doi:10.1016/j.anr.2012.08.004
5. Bergmann C, Muth T, Loerbroks A. Medical students' perceptions of stress due to academic studies and its interrelationships with other domains of life: a qualitative study. Med Educ Online 2019 Dec;24(1):1603526. doi: 10.1080/10872981.2019.1603526.
6. Melaku L, Mossie A & Negash A. (2015a, December 2). Stress among medical students and its association with substance use and academic performance. Journal of Biomedical Education. https://www.hindawi.com/journals/jbe/2015/149509/#discussion
7. Guthire E, Black D, Bagalkote H, Shaw C, Campbell M, Creed F. Psychological stress burnout in medical students: a five-year prospective longitudinal study. J R Soc Med 1998;91:237–43.
8. Chao AM, Jastreboff AM, White MA, Grilo CM, Sinha R. Stress, cortisol, and other appetite-related hormones: Prospective prediction of 6-month changes in food cravings and weight. Obesity 2017Mar28;25(4):713–20. doi: 10.1002/oby.21790
9. Geiker NR, Astrup A, Hjorth MF, Sjödin A, Pijls L, Markus CR. Does stress influence sleep patterns, food intake, weight gain, abdominal obesity and weight loss interventions and vice versa? Obes Rev 2017 Aug 28;19(1):81–97. doi: 10.1111/obr.12603
10. Parenti C, Murphy AM, Lad N, McTernan PG, Nelson CP, Sharpe GR, et al. Investigating the effect of obesity on gut damage, systemic inflammation, enhanced asthma severity due to gut derived bacteria, endotoxin. In: Endocrine Abstracts [Internet]. Bioscientifica; 2022 [cited 2023 Oct 31]. Available from: https://www.endocrine-abstracts.org/ea/0086/ea0086p211
11. Havlik, Richard MD, et al. Weight and hypertension. Ann Int Med 2008; 98(5): 855-9. https://doi.org/10.7326/0003-4819-98-5-855. Accessed 1 Nov. 2023
12. Feldman AL, Griffin SJ, Ahern AL, et al. Impact of weight maintenance and loss on diabetes risk and burden: a population-based study in 33,184 participants. BMC Public Health 2017; 17: 170. https://doi.org/10.1186/s12889-017-4081-6
13. Alotaibi HA. Effects of weight loss on psoriasis: A review of clinical trials. Cureus 2018 Oct 24;10(10):e3491. doi: 10.7759/cureus.3491.
14. Sutin AR, Zonderman AB. Depressive symptoms are associated with weight gain among women. Psychol Med 2012 Nov;42(11):2351-60. doi: 10.1017/S0033291712000566. Epub 2012 Apr 5.
15. Yoshikawa I, Nagato M, Yamasaki M, Kume K, Otsuki M. Long-term treatment with proton pump inhibitor is associated with undesired weight gain. World J Gastroenterol 2009 Oct 14;15(38):4794-8. doi: 10.3748/wjg.15.4794.