The Relationship between Sleep Quality, Body Composition, Physical Activity and Depression among Female College Students.

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Abstract

There is growing interest in how body composition, physical activity, sleep quality, and depression are interconnected, especially among female college students. This Study aims to enhance current understanding by examining a conceptual model that explores these associations among female college students. This quantitative study involved 132 female college students aged 18 to 24 from the University of Sulaimani (UOS), Kurdistan Region, Iraq. A convenience sampling method was employed, and the public university was selected randomly. Descriptive statistics were computed using SPSS software, and data were analyzed with Partial Least Squares Structural Equation Modeling (PLS-SEM). The results designated an affirmative correlation between Body Mass Index and depression among female college students. Conversely, physical activity exhibited a negative correlation with depression. Additionally, negative correlations were found between sleep duration, sleep efficiency, and depression. Conversely, sleep disturbances and the use of sleep medication were positively correlated with depression. Subjective sleep quality also had a significant negative relationship with depression. However, no significant correlations were observed between body fat, daytime dysfunction, and sleep latency with depression among the participants. This study underscores the complex interplay between Body composition, Physical activity, and sleep quality relative to depression among female college students. Considerably higher depression was associated with elevated BMI and poor sleep-related factors, but better sleep quality and physical activity were linked to lower depression rates. These results point out that interventions aimed at sleep quality, as well as physical training programs, could help minimize depression within this population bracket. However, more research needs to be done to understand these associations better and design precise plans for enhancing mental health.

Keywords: Physical activity, Body composition, Body fat, Body mass index, sleep quality, sleep efficacy, Female college students.

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INTRODUCTION

Mental well-being is a fundamental aspect of general health, especially for college students traversing difficult and, consequently, stressful settings. Despite the frequent prevalence of mental state concerns among college students, effective intervention programs are still lacking. It has been shown that mental, emotional and behavioral disorder rates can go as high as 20% during adolescence life span (Cahuas et al., 2019). Depressive disorder is much more common among all these disorders, making it problematic because it is usually long-term, requires extensive therapy and has serious effects on recovery. Depressive people in colleges feel insufficient, scared or indignant all the time (Shahbaz Alam et al., 2023). Xu et al. reported al. reported rates of depression prevalence among college students in India to vary significantly, with ranges from 21.5% to 71.25% (Xu et al., 2014). Hence, these changes underscore the importance of targeting counseling services mainly for female students who bear the larger burden. This underscores how important it is to have effective mental health interventions for these people, given that the disease affects their academic performance, social well-being and general happiness in life (Wilson et al., 2014). Depression can be influenced by various factors like body composition, physical activity and better SQ. Good sleep can easily prevent depression since it comes with mood disorders (Vanteemar S. Sreeraj et al., 2019). Body composition (BC), which includes body mass and, to some extent, fat spread, is linked to mental wellness too, just as research findings indicate that depression can be influenced by being too skinny or overweight (Lv et al., 2024). Depressive symptoms can possibly be reduced through engaging in exercise, which is thought to have mood-elevating effects (Singh et al., 2023). Although there is significant research has been done in investigating how depression is related to the quality of sleep, the composition of the body and physical activity by separate studies, there is very little corresponding research to show how all these factors are interconnected and contribute to the overall depression. Regularly, studies only consider one variable at a time without considering how others might influence it, as well as not looking at their combined effects or possible interactions among them.

Findings indicate that poor sleep quality increases the risk of developing depressive symptoms significantly. People with persistent sleep disturbances are at a higher risk of developing depression (Tanahira et al., 2023). In numerous research, the existence of high amounts of body fat is associated with depression, an aspect that is closely linked to mental health in body composition (Lv et al., 2024) (Rindler, Gries and Freidl, 2023). Besides, some studies have always consistently linked normal Physical activity with reduced depression levels, meaning the activity has protection properties. Protection against the development and worsening of this mental health condition through elevation in Physical activity levels has been recorded (Battalio, Huffman and Jensen, 2020). Depression is multifaceted and has various reasons, making it necessary for a comprehensive technique, which includes SQ, BC, and PA (Viinikainen et al., 2024)(Omichi et al., 2022)(Guo et al., 2020). The intention of this study model is to disentangle the relationship between these aspects and their impact on depression, with the end in view being to provide information that could help design methodical gender-based interventions that are more effective among female undergraduates. Since female college students are in a rite of passage stage, it is critical to study SQ, body composition and PA in the depression context of females. The objective of this research is to explore a new model and present a more comprehensive picture of the contributory effects of these factors on mental health that would help in developing better prevention and intervention programs against depression.

THEORETICAL MODEL

The Biopsychosocial model: Created in the 1970s by Dr. George Engel and Dr. John Romano (Engel, 1977), this approach encompasses an integrated view of health by amalgamating biological, psychological and social dimensions. It shows how body composition affects neurotransmitter levels like serotonin and dopamine, which are essential for mood management. Therefore, any unusual fat circulation in our bodies may lead to these chemicals possibly causing depression. Body image concerns can have subsequent consequences on mood and behavior psychologically. On a social scale, however, emphasis on what a healthy human body should look like may result in certain stresses that can, in turn, aggravate mental illness, such as depression. This design incorporates how physical and psychological elements have affected other parts of health (Merino et al., 2024). From a biopsychosocial perspective, PA exercise has been positively linked to physical, psychological, and social treatments for depression. PA can elevate neurotransmitter control, release endorphins and reduce inflammation, all of which improve mood and lessen depressive symptoms. On a psychological level, it increases self-esteem, enhances cognitive skills and makes stress easier to control. From a social perspective, it enhances positive attitudes among people while making them stick to a daily schedule that promotes general mental health. The thorough approach helps in highlighting the various ways through which physical inactivity may enhance depression (Eime et al., 2013). It is a theory that directly addresses the relationship connecting SQ and depression- The Sleep-Affect Model (Sleep-Wake Model of Depression) developed by scholars (Michael T. Bowers and William P. C. W. Silver). For instance, this model provides an extensive framework through which one can decipher how disturbance in sleep quality worsens depressive symptoms' beginning or duration (Riemann et al., 2020; Luo and Lin, 2024; Luo et al., 2024and Otte and Carpenter, 2009). How do Depression and Poor Sleep Quality (SQ) Interact According to the Model? For example, it has taken into consideration how lower levels of SQ can diminish the ability to handle emotions, hence increasing sensitivity, stress as well and mood instabilities (leading to depression). In contrast, depression often causes sleep problems, such as difficulty falling asleep or waking up too early in the morning. These exacerbate the symptoms, making it even harder for them to break out from themselves. In managing or even preventing depressive disorders successfully then, addressing both slumber times and attitudes becomes crucial (Luo et al., 2024and Luo and Lin, 2024).

Hypotheses of the study

H1: Depression has a positive association with BMI among FCS.

H2: Depression is positively associated with BF among FCS.

H3: Among female college students, PA is negatively associated with depression.

H4: Among FCS, depression is positively associated with sleep latency.

H5: Amongst FCS, sleep duration is negatively associated with depression.

H6: There is a negative correlation between depression and sleep efficiency in female college students.

H7: There is a positive relationship between depressive disorders and sleep disturbance in FCS.

H8: Among FCS, sleep medication is positively associated with depression.

H9: Among FCS, daytime dysfunction is positively associated with depression.

H10: Subjective SQ is negatively associated with depression among FCS.

The Relationship between SQ, BC, and PA and depression among Female college students is not covered soundly in the literature. Especially in the Middle East, this type of research needs to be given greater attention, and inferior studies focused on the association between these factors, especially among female college students. The previous studies were conducted in America, Germany, India, China, and Saudi Arabia. The reviewed studies investigated the interplay between SQ, BC, PA and depression among college students across various contexts. Previous studies conducted in China (Guo et al., 2020) (Zhang, Zheng and Hu, 2022) (Zhou et al., 2021) (Xiang et al., 2020) the studies collectively highlight the connection between PA and mental health outcomes among college students. The study (Guo et al., 2020) demonstrates a link between PA intensity and reductions in depressing symptoms. Furthermore, The study (Zhang, Zheng and Hu, 2022) explores how exercise impacts depression through mediators like self-concept and social support. A study (Zhou et al., 2021) focuses on how sedentary behavior and PA relate to depressive indications in a specific population of sports College students. Additionally, The research (Xiang et al., 2020) " "examines the effects of PA on depression and anxiety in the background of the COVID-19 epidemic. Each study focuses on specific subgroups or contexts, such as sports university students, college students during a pandemic, or students involved in particular projects, which may limit the applicability of their results to the broader college student population. The findings may not generalize to other groups due to differences in demographics, cultural contexts, or unique situational factors. Previous research conducted in China and India (Cahuas et al., 2019) (Zhang, Cheng and Zhao, 2024)'(Shahbaz Alam, Sheetal Kalra, Sadhu Charan Mohapatra, Richa Rai1, 2023) has collectively highlighted the connections between PA, SQ and depression outcomes among college students. A study conducted in China (Cahuas et al., 2019) investigates how PA and sleep are related to depression in college students. It suggests that both regular PA and quality sleep are associated with lower levels of depression. Another Chinese study (Zhang, Cheng and Zhao, 2024) focuses on the impact of PA on anxiety, depression, and SQ among college students following the COVID-19 pandemic. It emphasizes that PA can moderate the effects of the pandemic on mental health and SQ. Research executed in India (Shahbaz Alam et al., 2023) examines the frequency of PA and sleep and their associated factors in relation to depression among college students. It finds that both the frequency of PA and SQ are linked to depressive symptoms, highlighting the importance of consistent healthy behaviors. These studies (Cahuas et al., 2019) (Zhang, Cheng and Zhao, 2024) (Shahbaz Alam, Sheetal Kalra, Sadhu Charan Mohapatra, Richa Rai1, 2023) highlight specific aspects or contexts (such as frequency of activity, post-pandemic conditions, or combined effects of PA and sleep), which may limit how well the results apply to other groups of college students or different demographic populations. The findings may not be fully generalized due to these focused contexts and varying methodological approaches. A study that was done in the U.S. looked at how the combination of neighborhood aspects, individual practices, and sleep patterns affected cases of depression in college girls. It identified significant correlations between disrupted sleep and increased depressive symptoms, highlighting social and behavioral influences. However, the study, conducted at a secretive women's university in the southeast U.S., may have limited generalizability to other settings (Wilson et al., 2014). Furthermore, previous studies (Yousef D Alqurashi, Ali H. Al Qattan, 2022) (Zhang et al., 2023) (Dudo et al., 2022) have collectively underscored the link between sleep patterns and depression in college students. The study undertaken in Saudi Arabia investigated (Yousef D Alqurashi, Ali H. Al Qattan, 2022) how sleep period and quality affect depression amongst US and faculty. It found that shorter sleep length and poorer

SQ are strongly linked to higher depressive symptoms, underscoring the need for better sleep management. Research carried out in China (Zhang et al., 2023) Focused on the long-term effects of healthy sleep patterns on depressive trajectories among college students. It revealed that maintaining consistent, healthy sleep patterns can mitigate depressive symptoms over time, suggesting a preventive approach to mental health. An investigation in Germany (Dudo et al., 2022) examined sleep patterns and depressive symptoms, specifically in medical students, emphasizing the high prevalence of sleep disturbances and their association with depression. A significant gap across these studies(Yousef D Alqurashi, Ali H. Al Qattan, 2022) (Zhang et al., 2023) (Dudo et al., 2022) is the limited focus on specific dimensions of sleep, such as daytime dysfunction, sleep efficiency, sleep latency, sleep disturbances, subjective SQ, and use of sleeping medications. These dimensions are crucial for a comprehensive understanding of how different aspects of sleep impact depression. The studies generally address broader sleep characteristics without delving deeply into these nuanced elements, which could provide additional insights into the complex relationship between sleep and depression. Evidence from research in the U.S. and Romania (Luis Torres et al., 2023) (Manuela C. Caciula1, Luis Torres, 2024) reveals a significant relationship between PA, BC, and mental health. An examination conducted in the U.S. (Luis Torres et al., 2023) analyzed correlations between mental health, PA, and BC in American college students following the COVID-19 lockdown. It found significant links between decreased PA and worsening mental health alongside changes in BC. Additionally, an investigation compared mental health, BC, and PA between American and Romanian college students post-lockdown. It highlighted similar patterns in both populations, with lower PA and altered BC correlating with poorer mental health (Manuela C et al., 2024). A notable gap in these studies is that the first study's focus on American college students limits its applicability to other cultural and regional contexts (Luis Torres et al., 2023). While the second study offers a comparative perspective between American and Romanian students, it must thoroughly address SQ. This omission is significant because SQ can interact with BC and PA to influence mental health (Manuela C. Caciula1, Luis Torres, 2024). Previous studies came from American, German, Romanian, Indian, Chinese, and Saudi Arabia contexts. However, none have been conducted in the Iraqi framework. Owing to the research location, chosen research approach, applied sampling techniques and the population sample, the earlier findings may not apply in the Iraqi context. However, only one of the previous studies was conducted in the Middle East (Yousef D Alqurashi, Ali H. Al Qattan, 2022). None of the previous studies have explored the model of the relationship between BC, SQ, PA, and Depression among female college students. Additionally, this limitation highlights the issue of restricted generalizability and underscores the need for research specifically targeting female college students within the Iraqi context.

Methods and Material

Participants

The study was conducted at the University of Sulaimani (UOS) in the Kurdistan region of Iraq during the second semester, from March 26 to April 20, 2023. The participants comprised 132 full-time female undergraduate students from the 1st to the 4th year, with ages ranging from 18 up to 24 years inclusively , with a mean age of 20.22 (SD = 1.51). All participants were of Kurdish ethnicity. To ensure the validity of the assessment instruments and the cognitive capacity of the participants, measurements of PA, SQ, and depression were administered to all students. Additionally, body composition metrics, including BMI and BF, were assessed for all participants. Data were included only from students who provided complete responses. Incomplete

responses or those lacking essential data were excluded from the analysis. Participants were randomly selected from various faculties, excluding those from the Departmen this separation was due to the unique physical exercise classes undertaken by students in the college of Sport Science and Physical Education, which could cause differences in physical fitness compared to students in other faculties.

Procedure

The Ethics Committee of the Faculty of Sport Science and Physical Education/University of Sulaimani approved this study, and each student could decide on whether or not they wanted to take part based on their own interests without any promise of personal or school advantages. Moreover, participants received written instructions concerning the study process as well as their rights before entering into it; hence, they were free to drop out whenever they wanted to. Owing to the anonymity adopted during data collection exercises and the retrospective characteristic of the same, there was no need to apply informed consent for the data collection procedure, as the researcher is a lecturer at the same university. Thus, the researcher was allowed to perform data collection without procuring informed consent from the University of Sulaimani. This work plan was guided by Helsinki's declaration made in 1964 and last reviewed in Fortaleza, Brazil, in 2013 (Association, 2013).

Instruments

Body composition

To determine body fat and BMI, the researcher measured body fat (%) and body mass index (BMI). A body composition analyzer with height-weight capabilities consisting of an electronic body fat scale (EW-700A) was used to determine body fat percentage (%), BMI, weight (kg) and height (cm). This instrument can precisely measure these parameters. Throughout the process of measurement, participants were told to wear light clothes, take off any metal objects that touched them, keep their backs straight, and avoid talking or changing their positions. The BMI and body fat percentage are variables of interest in this study. The average BMI for participants was 23.15 (SD = 3.72), and the average body fat percentage was 20.32% (SD = 5.22).

Physical activity

The IPAQ-S7S was used to assess PA levels. The Cronbach's alpha coefficient was 0.70. The validity and reliability of IPAQ-S7S have been tested among university students (Dinger, Behrens, & Han, 2006) (Craig et al., 2003). Thus, the IPAQ-S7S measures the amount of time spent engaging in physical activity during the preceding week by gauging the frequency and duration of staying active through walking, moderate-intensity as well as vigorous-intensity exercises lasting at least ten minutes each. Using the IPAQ data processing guidelines, we estimate individual average levels of PA, which are provided in detail in another place (Craig et al., 2003). Only cases that were invalid in all three PA domains were removed using the case removal approach. Compute total weekly time spent walking and in activity with moderate- and/or high-intensity levels as follows: Multiply days per week per category by time spent daily on days when the activity took place. The amount of time each day devoted to an area is multiplied by the metabolic equivalents of tasks specific to the area, such as walking (3.3 METs), moderate (4 METs) and vigorous (8 METs) exercise and quantified into metabolic equivalents (METs) thus obtaining the physical activity Economic Commission for Africa (ECA) countries per week. A

survey of the population showed that there were three levels of PA: low (meaning an individual does not do much exercise), moderate and high. These categories entail what the established scoring criteria are; they are obtained from the http: //www.ipaq.ki.se website, and normally for adult (18-65 years) populations involve moderately intense activity for 30 minutes or more for at least 5 days a week or vigorous activity for 20 minutes or more at least three days a week. Categorization: low: does not meet minimum criteria for either moderate or high. Moderate: covers any of the following three concepts: (a) 3 days of at least 20 minutes of vigorous physical activity per day; (b) walking moderately for more than 30 minutes each day on 5 days each week or for each time; or (c) any combination of walking, moderate or vigorous physical activity for 5 days each week with an accumulation of >600 MET-minutes/week. High: meets either of the following two conditions: (a) engaging in high-intensity weekly for >3 days and accumulating ≥1500 MET-minutes/week; or (b) 5 days of any combination of walking, moderate-intensity or vigorous-intensity physical activities achieving at least 3000 MET-minutes/week.

Sleep Quality

The most commonly used scale in medical and non-medical populations is the PSQI to assess SQ. It has a Cronbach's alpha value of around 0.83, signaling high reliability. The PSQI has been found to be reliable and valid across various populations (Mollayeva et al., 2016) (Wolf and Rosenstock, 2017). Furthermore, it has been shown that even with small sample sizes, the PSQI is valid (Mollayeva et al., 2016). The PSQI is a self-rated questionnaire comprised of nineteen items aimed at assessing SQ for the month preceding it (Buysse et al., 1989). The PSQI includes various aspects of SQ, which are subjective SQ, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. These domains range from 0 to 3. After summing up personal scores to obtain a global score, this ranges from 0 to 21, with higher global scores indicating worse SQ.

Depression

In this study, the Zung Self-Rating Depression Scale (SDS) was used as a norm-referenced measure for screening adults for depressive disorders (William, 1965). It has a Cronbach's alpha value of around 0.79, which is acceptable. That Lee and colleagues utilized it in the study of several populations has been demonstrated clearly by available data for such use in research done previously by Chinese scholars (Lee et al., 1994) (Chen et al., 2020), also suitable for undergraduates (Nie, Zhang and Liu, 2017)' (Shao et al., 2020). The SDS is a standard instrument intended for self-administration that is meant to gauge the severity of someone's depressive symptoms. The first scale has 20 questions that measure depressive symptoms around these four main factors: anxiety, cognitive-affective (emotional), somatic-vegetative (biological or physiological), and core-depressive symptoms (Dunstan and Scott, 2019) (Kirkby, Al Saif and el-din Mohamed, 2005). The study adjusted the SDS culturally to conform to the context of Iraqi society. One item about sexual pleasure was omitted because it was considered sensitive and likely to conflict with Iraqi culture. Thus, this modification aimed to enhance cultural understanding and boost both acceptance and precision of depression assessment among the Iraqis. The SDS has been altered to include nineteen items. Ten of them assess negative experiences, e.g., "I feel down-hearted and blue," while the remaining nine determine positive experiences and are scored differently; for example, "I eat as much as I used to eat." Every Item was rated by respondents according to their experiences throughout the previous week on the Likert scale. Response options for the negative posers will

range from 1 (some of the time) through 4 (most of the time). In the positive items, the frequency of responses varies, going from 4 (some of the time) to 1 (most of the time). The total score is constituted by all 19 items, thereby showing a person's level of depression. Each participant's score is between 25 and 100, where high scores indicate more symptoms. Those with 25 – 49 have average results where else; anything at 70 upwards is generally an indication that one has a terrible case of depression.

Data collection

The standard back-translation method was used during language translation (Maneesriwongul and Dixon, 2004). At least two independent translators are necessary for this stage. The first translator translated the original scale into the target language, while the second translator retranslated the same scale back into its original language in the target language (Carlson, 2000). An educational psychologist expert in English and an independent English language specialist translated the scale into Kurdish independently. A Kurdish version was developed temporarily after two education psychology specialists retranslated the version back to English under the guidance of the official translation firm. As (Sousa, 2011) noted, the translation assistant ought to be well acquainted with both languages and understand the area covered. Following this procedure, the Kurdish translation was considered acceptable and sufficient for the scales, giving it its final form in Kurdish.

Statistical Analysis

The primary step in the process of data analysis was writing the variables and questions in the code. Next, the data cleaning and preparation involved checking for outliers, suspicious response patterns, missing data, and normalcy using the Statistical Package for the Social Sciences (SPSS) software version 29. Once the data was cleaned, the sample's central tendencies (mean and standard deviations for continuous variables) and the frequency analysis (for categorical variables) were calculated. Using SmartPLS Software version 4.1, the researchers used the SEM approach to measure the premises and model variables. The measurement validity may be evaluated using 0.6 for the model as well as the path model as long as it is in line with the research objectives of explaining and predicting the difference between constructs. SmartPLS is a powerful tool for assessing model prediction hypotheses and models due to its advanced PLS-SEM functionality. Among the features it includes an intuitive user interface, ample model assessment tools, PLSpredict to assess predictive performance, and efficient data processing. The essence of these traits is to ensure that it is ideal for accurate predictions and complex models since they are both important in disciplines as diverse as computer science and digital marketing (Cheah, Magno and Cassia, 2024).

Results

Age and body composition

The data analytics on the female undergraduates indicated that the ages of the students ranged between 18 and 24 years at an average of 20.22 years old (Standard Deviation = 1.51). The Body Mass Index (BMI) ranges from 14.10 to 32.10, with an average of (M=23.15, SD=3.72). The range of body fat percentage (BF) is from 10.30 to 36.50, with an average of (M=20.32, SD= 5.22).

Table 1 Descriptive analysis for age and body composition

	Minimum	Maximum	Mean	Std. Deviation
AGE	18	24.00	20.22	1.51
BMI	14.10	32.10	23.15	3.72
BF	10.30	36.50	20.32	5.22

The results for students' PA showed that 32.6% of students had low PA, 47.7% of students participated in moderate PA, and only 19.7% had high PA (Figure 1).

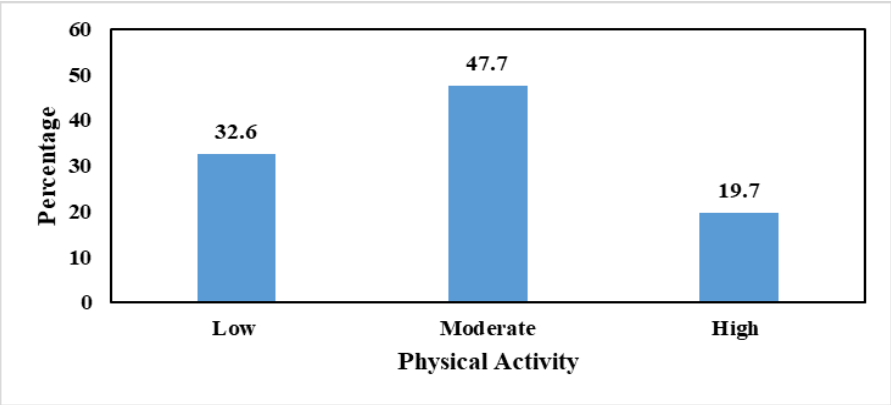

Figure 1. Distribution of PA among students

Sleep Quality

SQ contains seven domains (sleep latency, sleep efficiency, sleep duration, SQ, sleep disturbance, daytime duration and use of medicine). The first four domains were assessed using different scales, while the last three domains were assessed using similar scales. The results showed that for the sleep latency domain, the highest percentage belonged to 16-30 minutes (36.4%), while 31.8% of students experienced a sleep latency of over 60 minutes. Results for the second domain, sleep efficiency, indicated that it was distributed predominantly in the range of 75-84% (47%) and only 18.9%, reaching over 85% efficiency. Findings for sleep duration showed that most of the students had a sleep duration between 5-6 hours (29.5%), while 20.5% slept over 7 hours. For SQ, results revealed that 30.3% of students responded to it as fairly good and 25% as very good; however, 28% rated their SQ as very bad.

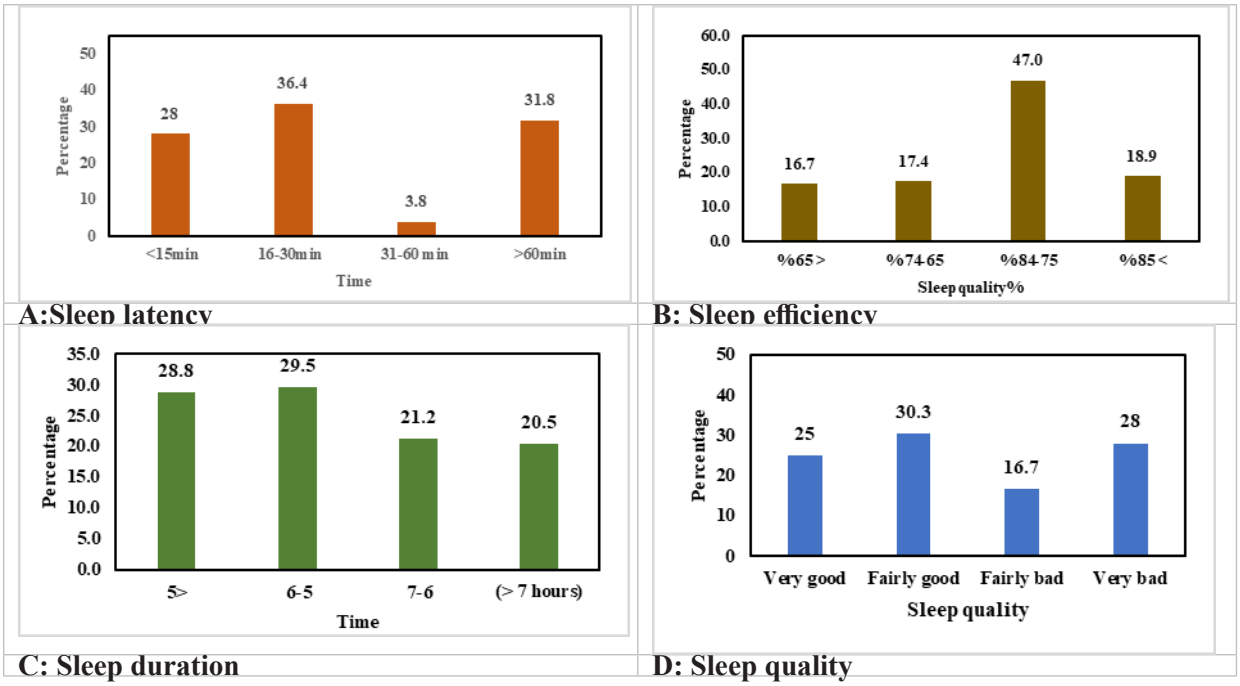

Figure 2. Distribution of students' response to sleep latency, sleep efficiency, sleep duration and sleep quality

The findings for sleep disturbances (table 2), which includes 9 indicators, show that a considerable portion of students experienced sleep disturbances regularly. For instance, 31.1% of the students wake up between three or more times every week in the middle of the night or early in the morning. Results revealed that 32.6% of students had bad dreams. Using a lower perplexity and higher burstiness, it was also a common problem to get up for the bathroom for 55.3% of students. This was something that happened less than once per week, according to the survey results. Other sleep disturbances, such as feeling too cold or coughing/snoring loudly, are less frequent, with 13.6% and 37.1% respectively.

According to these results (table 2), it was found that for daytime dysfunction, 58.3% of students reported in no time at all, they found it easy to keep awake while driving, meal taking or socializing. However, keeping enthusiasm is a challenge for 29.5% of students, which indicates they struggle with these three or more times per week. Even though these challenges, a considerable portion of students (25%) experienced over a one-week period, less than once did 46.3% face problems staying focused, while 28.8% found it hard to stay excited and energized. For using sleeping medication, results showed that it was relatively low among the students. For the majority of students (63.6%), it was reported that no sleeping medication was used in the past month.

Table 2 Sleep disturbances and daytime dysfunction were frequently responded to by students, in addition to medication use.

Domain	Item	Not during the past month	Less than once per week	Once or twice per week	Three or more times per week
Sleep disturbances	Cannot get to sleep within 30 minutes	14.4	32.6	31.1	22
	Wake up in the middle of the night or early morning	17.4	29.5	22	31.1
	Have to get up to use the bathroom	22.7	55.3	18.2	3.8
	Cannot breathe comfortably	34.1	34.1	17.4	14.4
	Cough or snore loudly	37.1	43.9	15.2	3.8
	Feel too cold	13.6	35.6	24.2	26.5
	Feel too hot	26.5	19.7	25.8	28
	Have bad dreams	5.3	43.2	18.9	32.6
	Have pain	18.2	28	34.8	17.4
Daytime dysfunction	During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	58.3	25	15.2	1.5
	During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?	12.9	28.8	28.8	29.5
Sleeping medication	Use of sleeping medication	63.6	15.9	16.7	3.8

Depression

The results of descriptive statistics for depression domains (anxiety, cognitive, somatic, and core depressive symptoms) are presented in Table 3. According to these results, the highest mean score belonged to core depressive with a median score of M= 2.766, SD=0.449, followed by cognitive domain shows a median score of M=2.485, SD=0.478 plus somatic symptoms with a mean score of M=2.432, SD=0.576. It was found that the lowest mean score was observed for anxiety, with a median score of M=2.177, SD=0.653.

Table 3 Results of descriptive analysis for depression scale

Sub-domain	Minimum	Maximum	Mean	SD
Anxiety	1.000	3.670	2.177	0.653
Cognitive	1.250	3.750	2.485	0.478
Somatic	1.330	3.670	2.432	0.576
Core depressive	1.570	3.710	2.766	0.449

Measurement model assessment

First-Order Model

All variables in this research were considered as single items, including (BMI body fat, PA and seven domains of SQ). Only depression was a second-order construct with four sub-domains. Therefore, the measurement model was used to assess this construct. The results (Table 4) indicated that all subscales of depression (Anxiety, Cognitive, Core Depressive and somatic) have a high level of convergent validity. Results showed that all items had an acceptable loading factor (above the threshold of 0.5). The research indicates that both the composite reliability (CR) and alpha Cronbach were above 0.7, and the average variance extracted (AVE) surpassed the acceptable threshold (0.5). The HTMT criterion, established by (Henseler, Ringle and Sarstedt, 2015)is crucial in evaluating discriminant validity.

Table 4 Convergent validity and reliability assessment of measurements

Construct	No items	Loading	Cronbach's Alpha	CR	AVE
Anxiety	3	0.791- 0.867	0.772	0.782	0.687
Cognitive	4	0.688-0.772	0.717	0.733	0.537
Core Depressive	7	0.589-0.776	0.802	0.812	0.459
Somatic	3	0.583-0.870	0.638	0.732	0.57

Second order assessment

Since depression was a second-order construct, Therefore bootstrapping was used to evaluate the second-order model for this construct. Results (Table 5) show that the four sub-dimensions of depression, including anxiety ($l = 0.637$; $p < 0.001$), cognitive ($l = 0.612$; $p < 0.001$), core depressive ($l = 0.853$; $p < 0.001$) and somatic ($l = 0.520$; $p < 0.001$) significantly boosted depression, working under a second-order hidden parameter.

Table 5 Second-order assessment of measurements using Bootstrap

First order	Loading	SE	T value	P Values
Anxiety	0.637	0.055	11.537	<0.001
Cognitive	0.612	0.077	7.989	<0.001
Core Depressive	0.853	0.03	28.573	<0.001
Somatic	0.52	0.079	6.54	<0.001

Discriminant validity was evaluated using the HTMT method, and results (Table 6) indicated that HTMT values were below 0.85, ranging from 0.011- 0.635. Therefore, the variables exhibit significant discriminant validity.

Table 6 Results of Discriminant Validity using HTMT method

	Anxiety	BMI	Body Fat	Cognitive	Core Depressive	Daytime _dysfunction	Physical activity	Sleep _duration	Sleep _efficiency	Sleep _latency	Sleep _disturbances	Somatic	Subjective _sleep quality
Anxiety													
BMI	0.549												
Body Fat	0.46	0.635											
Cognitive	0.248	0.393	0.3										
Core Depressive	0.456	0.558	0.605	0.447									
Daytime _dysfunction	0.102	0.107	0.118	0.132	0.127								
Physical activity	0.326	0.314	0.346	0.361	0.49	0.123							
Sleep _duration	0.106	0.156	0.235	0.119	0.368	0.351	0.026						
Sleep _efficiency	0.487	0.378	0.263	0.180	0.399	0.176	0.371	0.100					
Sleep _latency	0.12	0.029	0.038	0.26	0.123	0.121	0.166	0.073	0.089				
Sleep_ disturbances	0.387	0.378	0.412	0.24	0.401	0.39	0.124	0.339	0.132	0.217			
Somatic	0.401	0.381	0.462	0.393	0.323	0.246	0.198	0.296	0.186	0.502	0.393		
Subjective _sleep quality	0.217	0.198	0.325	0.297	0.452	0.015	0.276	0.202	0.206	0.407	0.066	0.438	
Use of sleeping_ medication	0.323	0.359	0.315	0.268	0.349	0.144	0.294	0.265	0.286	0.011	0.019	0.139	0.14

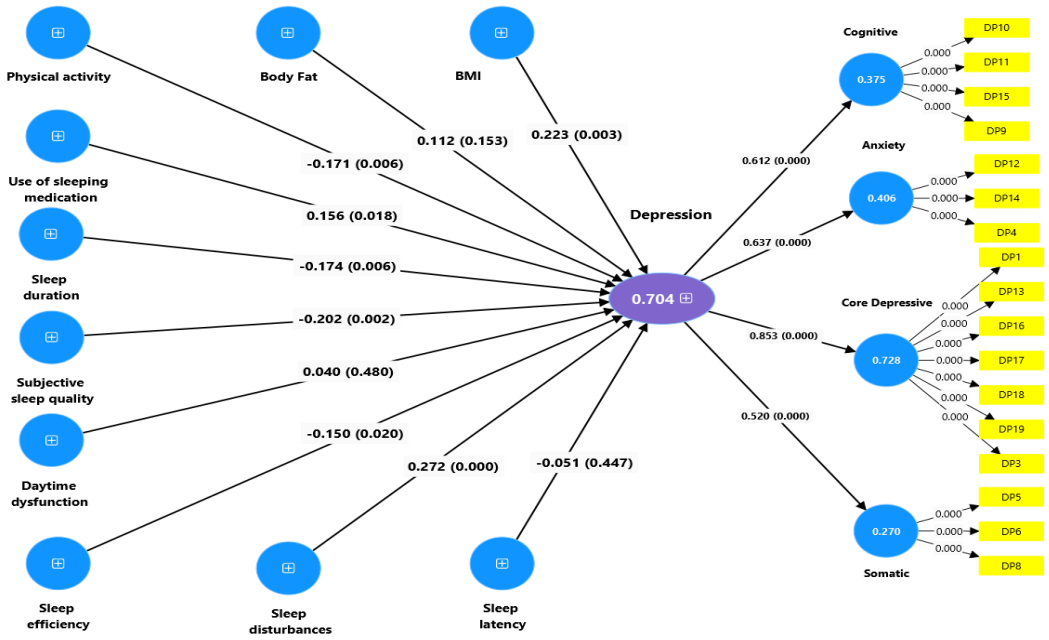

Figure 3 Structural model using bootstrapping methods

Path model:

In order to test the main research hypotheses, the path model was tested using the bootstrap approach with 5000 samples. The collinearity assumption indicates that there were no multicollinearity issues among predictors, and the highest VIF value was 2.136 (below 2.5). The results of the path model using Bootstrap (Table 7) presented that there was a positive and important association between BMI and depression (β = 0.223, P = 0.003, f2 = 0.085), indicating that higher BMI is related to advanced stages of depression. There was a negative and significant relationship between PA and depression (β = -0.171, P = 0.006, f2 = 0.073). Similarly, the result also showed that there was a negative and significant relationship between sleep period (β = -0.174, P= 0.006, f= 0.069) and sleep efficiency (β= -0.150, P= 0.019, f2= 0.055) with depression. Results indicate that there were positive and significant relationship between sleep disturbances (β = 0.272, P <0.001 0.019, f2 = 0.149) and use of sleeping medication (β = 0.156, P = 0.019, f2 = 0.058) and depression while there was a negative and significant relationship between subjective SQ (β = -0.202, P <0.001, f2 = 0.090) plus depression.

These results also showed that there was no significant relationship between Body Fat (β = 0.112, P =0.150, f2 = 0.020), Daytime impairment (β = 0.040, P =0.478, f2 = 0.004), and sleep latency (β = -0.051, P =0.441, f2 = 0.007) with depression. The adjusted R square (R2) value depression as a dependent variable was 0.679, revealing that 67.9% SQ, PA, and BMI explained such a huge amount of variance in depression. (Figure 3).

Table 7. Path model assessment using Bootstrap.

Path	β	SE	T value	P values	f^2
BMI -> Depression	0.223	0.075	2.976	0.003	0.085
Body Fat -> Depression	0.112	0.078	1.44	0.15	0.02

Daytime _dysfunction -> Depression	0.04	0.057	0.709	0.478	0.004
Physical activity -> Depression	-0.171	0.062	2.774	0.006	0.073
Sleep _duration -> Depression	-0.174	0.063	2.763	0.006	0.069
Sleep _efficiency -> Depression	-0.150	0.064	2.346	0.019	0.055
Sleep _latency -> Depression	-0.051	0.067	0.771	0.441	0.007
Sleep_ disturbances -> Depression	0.272	0.074	3.651	0	0.149
Subjective _sleep quality -> Depression	-0.202	0.062	3.248	0.001	0.090
Use of sleeping_ medication -> Depression	0.156	0.066	2.354	0.019	0.058

DDISCUSSION

The current research indicated a negative and significant relationship between PA and depression. This suggests that higher levels of physical activity among students are strongly connected to a notable decrease in depression rates. It was indicated by previous research that greater overall PA quantities were linked to lesser proportions of ill health symptoms in college students (Zhang, Cheng and Zhao, 2024 Guo et al., 2020). This is because female college students might have increased satisfaction with their body image; young women could actually end up reaping greater psychological advantages, and well-being when it comes to engaging in physical activities. This result simply shows that physical exercise helps to reduce the severity of depression, raise satisfaction with life, improve mood, strengthen strong then and strengthen the sense of purpose and meaning in life among people. Furthermore, in this present investigation study, sleep duration is negatively correlated with depression. The findings suggest that sleep duration negatively impacts the prevalence rate of depressive symptoms among students, therefore inferring that quality and quantity of sleep are negatively associated with students' mental health. Additionally, other studies also found that among college students, a high proportion are depressed where there is too little sleep (Li et al., 2020 and Zhang et al., 2023). In the same vein, depression had an inverse relationship with sleep efficiency (SE). It can be argued that lower depression cases are associated with higher sleep efficiency levels. Additionally, our results concur with other studies that assert that sleep efficiency is a key predictor of depression's severity, while marked fluctuations in daily SE predict higher levels of depression and anxiety among young adults (Lim et al., 2022and Yan et al., 2022). Therefore, it is pertinent that people maintain a high SE to prevent depression symptoms.

In this study, a positive association between sleep disturbances and depression was found. The outcome is in agreement with an earlier study that was conducted by 416 Iraqi adults, which highlighted the strong positive correlation between sleep disturbance and depression symptoms (M Salih et al., 2023). Additionally, factors such as sleep disturbances have been linked to a higher likelihood of depression among young women (Barsha and Hossain, 2020). Moreover, research indicates that women are more disposed to mental health issues like depression (Salk, Hyde and Abramson, 2017). Collectively, these findings underscore that sleep disturbances and depression among women are influenced by a range of factors, including psychological differences, hormonal fluctuations, and societal pressures. This study found that the Use of sleeping medication positively correlated with depression among members of this specific sample. Research supports a positive relationship between the use of sleeping medication and depression. Individuals experiencing depression often suffer from poor SQ and are more inclined to use sleep medications (Chery et al., 2024), findings that align with our study results. Thus, this dynamic between sleep medications, depression, and their associated symptoms illustrates the complex interplay between SQ, mental health, and the use of medication.

The participants who participated in this study reported a low subjective SQ that coincided with an increased case of depression, according to the evidence gathered depressive symptoms are more severe when the quality of sleep is low. Previous research findings (Huang et al., 2016; Gerri Satvik Emmanuel and Lokesh, 2024ANDNakajima et al. (2023) noted that across numerous psychiatric disorders, there is an association between subjective insomnia and depressive symptoms, and this suggests those were two transdiagnostic features in different modalities. Also, this study established what women often find challenging in terms of juggling between work, taking care of kids or family members, including house chores; hence, it increases their likelihood of experiencing anxiety attacks coupled with depression, hence disrupting their sleeping patterns. Increased interventions for better sleep and less depressive symptoms are really needed among diverse ages and social categories to understand the healing process. The current study found no significant association between body fatness (BF %) and depression. The outcome agreement from another study found that body fat distribution was not significantly associated with depression in children and adolescents in the age brackets (Yuan et al., 2023). Together, these findings suggested that the association between depression and body fat may be multifaceted. Despite the suggestion that certain aspects of body fat distribution can affect one's chances of developing depression, its general correlation is hard to define because it differs across different ages or between males and females. There were also no significant associations between daytime dysfunction and sleep latency with depression. Hence, it may be possible that the reason for not finding a relationship between daytime dysfunction and sleep latency with depression in our study was the inadequate sample size. A bigger sample size could uncover linkages that were too small for our research to show. Furthermore, results might be affected by characteristics like age, sex, or certain population features in the sample, which makes them not applicable to other people. For instance, if the sample had a low prevalence of severe daytime dysfunction or depression, this might have affected the results. As for this study, it presents some advantages and disadvantages. The strengths of this study have made significant contributions to understanding the interplay between physical activity, body composition, SQ, and mental health and has introduced a novel exploratory model. While previous research has highlighted these factors individually, this study is unique in that it addresses the specific issues faced by female university students in Iraq, an area that has not been extensively explored. By investigating these challenges, the study provides new longitudinal evidence and explores a conceptual model that maps out the relationships among PA, BC, SQ, and depression in this demographic. In doing so, it addresses a serious gap in the existing literature and advances our awareness in this field. While there are limitations to the research in terms of these issues, a more in-depth survey with 132 participants would enhance its accuracy. This would lead to more reliable results for wider use, considering it would be replicated and improved on in future studies. In addition, it should be noted that respondents came only from one higher education institution situated locally within Iraqi Kurdistan, which makes it difficult for others to accept these findings worldwide. Future research should focus on a variety of demographics over time to understand the connection between these success factors.

The implications of the results of this study have essential indications for academic proceedings and public wellness. By clearing up the association between body composition, sleep quality, physical activity, and depression among female college students, this study highlights the significance of comprehensive health strategies in the educational environment. Educational foundations can take advantage of these viewings to improve aimed interference that develops better sleep quality, motivates engaging physical activity, and stimulates psychological well-being. Besides, the research's findings could contribute to upcoming studies by determining essential domains for additional inquiry, including the role of sleep treatment in promoting mental wellness results. Decision-makers can also utilize these results to recommend integrated wellness

strategies that respond to the multiple issues faced by undergraduate students, eventually helping to develop health and educational achievement.

8. Conclusion

The relationship between Body composition, Physical activity, Sleep quality and Depression among female college students is very complex, according to the research. Higher depression levels were associated with elevated BMI and poor sleep-related factors, as opposed to lower depression being linked with increased PA and better sleep quality. This study, therefore, suggests that there might be a need for intervention programs that focus on improving physical activity levels in order to reduce depression symptoms among female students in their tertiary levels of study. It is important to note that sleep should be considered during treatment for depression, particularly when there is an outbreak of a public health crisis. It is recommended that in order to fully comprehend how daytime dysfunction relates to depression, different variables should be investigated in larger and more varied samples using longitudinal designs.

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