

The Relationship Between eHealth Literacy, Physical Activity, Sleep Patterns and Depression Among Pharmacy Students - A Cross-Sectional Study

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ABSTRACT:

Mental health problems among university students, particularly those enrolled in demanding disciplines such as pharmacy, represent a growing public health concern. Lifestyle behaviours and digital health competencies may play an important role in shaping psychological outcomes. The purpose of this study was to investigate the relationships among eHealth literacy, depression, physical activity, and sleep quality among pharmacy students. A cross sectional study was carried out on 610 students of Pharmacy. Standardized instruments were used, including the eHealth Literacy Scale (eHEALS), Patient Health Questionnaire-9 (PHQ-9), Mini Sleep Questionnaire (MSQ), and International Physical Activity Questionnaire (IPAQ). The mean eHEALS, PHQ-9, and MSQ scores were 27.29 ± 6.30 , 9.72 ± 6.47 , and 29.53 ± 12.35 , respectively. Multivariable regression analyses showed that the scores for the MSQ were significantly positively associated with the scores for the PHQ-9 ($B = 0.276$, $p < 0.001$). Overall, more sleep disturbance (measured by MSQ scores) and reduced eHealth literacy were significantly and negatively correlated with increased symptoms of depression among the pharmacy students. The results underscore the importance of multi-component interventions that address the behavioral and cognitive dimensions.

Keywords: eHealth literacy, sleep quality, mental health, depression, physical activity, pharmacy students.

1. Introduction

University students' mental health problems are a significant public health problem worldwide, especially in health-related fields like pharmacy and medicine (Auerbach et al., 2018; Rotenstein et al., 2016). Health-related students may experience academic pressures, clinical training pressures and uncertainties about career transitions that could lead to psychological distress. Mental disorders, such as depression, can negatively affect school performance, social functioning and quality of life (Son et al., 2020; Wang et al., 2020).

Behavioral factors are important in mental health of university students, particularly sleep. Emotional regulation, cognitive function and psychological resilience are all dependent on sleep (Buysse, 2014). University students have a high prevalence of sleep disturbances that are found to be related to academic stress and to other insomnia symptoms and mental health outcomes (Becker et al., 2018; Gardani et al., 2022). A low quality of sleep has been repeatedly correlated with increased anxiety and depressive symptoms, and decreased daily functioning (Milojevich & Lukowski, 2016; Scott et al., 2019). Moreover, modifications in sleep habits, especially when a person is under the influence of stress or spends more time in front of various screens, have been demonstrated to worsen mental health issues (Cellini et al., 2020; Chaput et al., 2018). Recent studies also note that the sleep related problems is closely linked to the academic performance and overall well-being of medical students (Yaghmour et al., 2023).

Another lifestyle factor that could impact mental health is physical activity. There is some evidence that physical activity is linked to reduced depression and anxiety symptoms in students and young people (Kim et al., 2012; Pearce et al., 2022; Rebar et al., 2015). Physical activity also seems to promote emotional wellbeing during stressful times, and to be associated with improved sleep quality (Yin et al., 2024; Rehman et al., 2024; Huang & Zhao, 2020;

Maier et al., 2021). The magnitude and direction of these associations can, however, differ by population and context.

In the digital era, eHealth literacy has become an important factor influencing health-related decision-making. This is the capacity to access, comprehend, assess and apply health information from digital sources (Faulkner et al., 2021; Paige et al., 2018). Health literacy can impact health behaviors, health self-management, and psychological health among university students who are often digital technology users (Jiang et al., 2024; Li et al., 2025; Shudayfat et al., 2023). Improved health literacy has been linked to improved health outcomes and better utilization of health care resources (Berkman et al., 2011). The relationship between eHealth literacy and mental health is still not clear, however, with access to online health information raising awareness it can also lead to anxiety if information is too much, too confusing or too inaccurate (Li et al., 2016; Buysse, 2014; Cai et al., 2023; Zhu et al., 2023). The results of systematic reviews also indicate that the health literacy of university students is diversified and not always associated with healthier behaviors (Kühn et al., 2022; Li et al., 2025; Zhang et al., 2016). Hence, eHealth literacy needs to be studied not only according to behavioural and psychological indicators (e.g. sleep related problems, physical activity, depressive symptoms), but also in combination with these.

Although the body of literature is increasing, there are still a number of gaps. To begin with, numerous analyses have been conducted on sleep, physical activity, and health literacy as independent variables with minimal combination of these variables into the same analytical framework. Second, the role of eHealth literacy in mental health outcomes is not consistent and understudied, especially in the context of behavioral intermediaries, including sleep and physical activity. Third, the research that has been done is dominated by Western studies, the evidence about Middle Eastern populations is

minimal, and the cultural and educational factors in both cases might affect mental health and health behaviors in different ways.

To address these gaps, the present study examined the relationships between eHealth literacy, physical activity, sleep quality, and depressive symptoms among pharmacy students. The study aimed to describe the levels of depressive symptoms, sleep related outcomes, physical activity, and eHealth literacy, and to identify factors independently associated with depression. Additional analyses were conducted to examine predictors of sleep quality.

2. Methodology

2.1 Study Design and Participants

This study used a cross-sectional design and was conducted among pharmacy students in Lebanon. A total of 610 participants were included in the analysis. Qualified respondents included undergraduate and PharmD students pursuing a pharmacy course at the time of the study. Data were collected using a structured, self-administered electronic questionnaire. The participation was voluntary and informed consent was provided before data collection. All of the responses were anonymized in order to protect the privacy and maintain the ethical principles.

2.2 Data Collection and Variables

The questionnaire gathered rich sociodemographic, academic and lifestyle data. These were age, sex, grade point average (GPA), residence, living status, smoking habits, alcohol use, working position, year of study and postgraduate studies. These variables were taken as independent variables and further analysis was made to investigate their relationships with mental health.

2.3 Measurement Instruments

2.3.1 eHealth Literacy (eHEALS)

The eHealth literacy was measured on the 8-item eHealth Literacy Scale (eHEALS), which is a measure of perceived capacity of the individual to find, comprehend, and appraise electronic-based health information. The items are rated using a Likert scale, with an overall higher score indicating

higher eHealth literacy. The scale showed excellent psychometric qualities in the current study with exploratory factor analysis supporting a one-factor structure and a high internal consistency.

2.3.2 Depression (PHQ-9)

The Patient Health Questionnaire-9 (PHQ-9), which assesses the frequency of depressed symptoms, was used to assess depression symptoms, with higher scores indicating more symptoms.

2.3.3 Sleep Quality (MSQ)

The MSQ was used to rate the quality of sleep and the scale measures frequent issues related to sleep. The more sleep was disturbed, the higher the MSQ score.. The exploratory factor analysis in this research indicated the use of a single factor structure, and the scale had an excellent internal consistency. The instrument had one item that had a comparatively lower loading than the rest but it was still included to preserve the conceptual purity of the instrument.

2.3.4 Physical Activity

The International Physical Activity Questionnaire (IPAQ) was used to measure physical activity. The total number of physical activities was computed in MET-min/week which indicated the intensity and duration of physical activities. According to the normative IPAQ classification, participants were classified as low, moderate, and high physical activity.

2.4 Statistical Analysis

The characteristics of the study population were summarized using descriptive statistics. Continuous variables were given as means and standard deviations (SD) with categorical variables given in form of frequencies and percentages.

The measurement scales were evaluated psychometrically through exploratory factor analysis (EFA) in order to evaluate underlying factor structures. The Kaiser Meyer Olkin (KMO) statistic of sampling adequacy and a test of sphericity by Bartlett were used to check the appropriateness of the data to the factor analysis. Cronbach alpha was used to determine internal consistency and item

total correlation was used to determine further reliability.

Bivariate linear regression analyses were performed to examine the associations between independent variables and depression scale (PHQ-9). Unstandardized regression coefficients, 95% confidence intervals (CI), and p-values were reported.

Multivariable linear regression models were subsequently conducted to identify independent predictors of these outcomes. Variables were selected based on theoretical relevance and results from the bivariate analyses. Adjusted regression coefficients, confidence intervals, and p-values were reported for each model.

In addition, further analyses were conducted with sleep quality (MSQ) treated as a dependent variable. Both bivariate and multivariable regression models were used to examine the associations between sleep quality and depression as well as other covariates.

All statistical analyses were performed using IBM SPSS Statistics version 31.0.2.0 (IBM Corp., Armonk, NY, USA). A p-value of less than 0.05 was considered statistically significant in all analyses.

3. Results

3.1 Participant Characteristics

A total of 610 pharmacy students were included in the study. The mean age of participants was 21.90 ± 2.94 years, and the average GPA was 3.15 ± 0.81 .

Figure 1 shows the distribution of participants by gender, with a majority of the female students than males. Figure 2 shows the geographical distribution of participants. The sample was mainly female (79.8) with males constituting 20.2 percent of the respondents. Regarding residence, almost half of the students belonged to Beirut (48.5), then South Lebanon (20.7), Mount Lebanon (13.4), North Lebanon (11.8), and Bekaa (5.6). The majority of the participants were living with their families (79.5%), with smaller shares living in dormitories or sharing with roommates (16.4%), and alone (4.1%). In terms of lifestyle, most students were non-smokers (75.2%), with those who were occasional smokers (13.4%), daily smokers (9.8%), and former smokers (1.5%). The alcohol consumption was low with 92.6% saying no alcohol consumption, 4.9% saying current alcohol consumption and 2.5% saying previous alcohol consumption.

The majority of participants were unemployed (71.6%), with 22.6% of the participants having part-time employment and 5.7% of the participants employed full-time. Academically, fourth-year students (35.2) and third-year students (33.1) had the highest numbers with smaller percentages in the other years or PharmD programs. Lastly, over fifty-seven percent of the respondents (57.5) indicated that they had intentions to study postgraduates and 31.5% were not certain and 11.0% did not intend to study further. Table 1 shows the specific sociodemographic and academic features of the study population.

Table 1. Sociodemographic and academic characteristics (N = 610)

Variable	Category / Statistic	n (%) or Mean $\pm$ SD
Age (years)	Mean $\pm$ SD	21.90 $\pm$ 2.94
GPA	Mean $\pm$ SD	3.15 $\pm$ 0.81
Gender	Female	487 (79.8)
	Male	123 (20.2)
Residence area	Beirut	296 (48.5)
	Bekaa	34 (5.6)
	Mount Lebanon	82 (13.4)
	North Lebanon	72 (11.8)
	South Lebanon	126 (20.7)
Living arrangement	Alone at home	25 (4.1)
	Dorm / with roommates	100 (16.4)

	With family	485 (79.5)
Smoking status	Daily smoker	60 (9.8)
	Ex-smoker	9 (1.5)
	Non-smoker	459 (75.2)
Alcohol use	Occasional smoker	82 (13.4)
	No, not at all	565 (92.6)
	Previous consumer	15 (2.5)
Employment status	Yes, current consumer	30 (4.9)
	Full-time job	35 (5.7)
	Not employed	437 (71.6)
Study year	Part-time job	138 (22.6)
	First year pharmacy student	35 (5.7)
	Second year pharmacy student	18 (3.0)
Postgraduate studies	Third year pharmacy student	202 (33.1)
	Fourth year pharmacy student	215 (35.2)
	Fifth year pharmacy student	133 (21.8)
	PharmD student	7 (1.1)
	No	67 (11.0)
	Not sure yet	192 (31.5)
	Yes	351 (57.5)

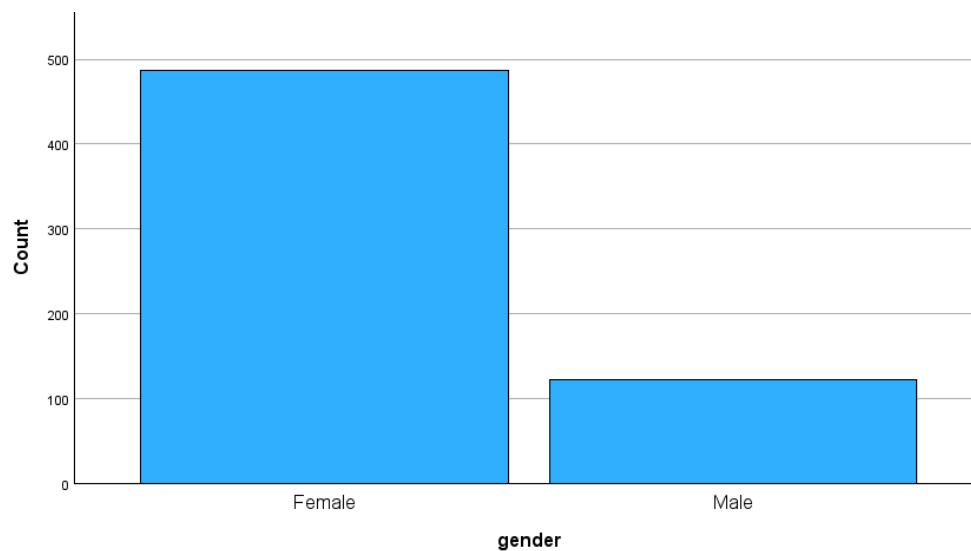


Figure 1. Distribution of participants by gender

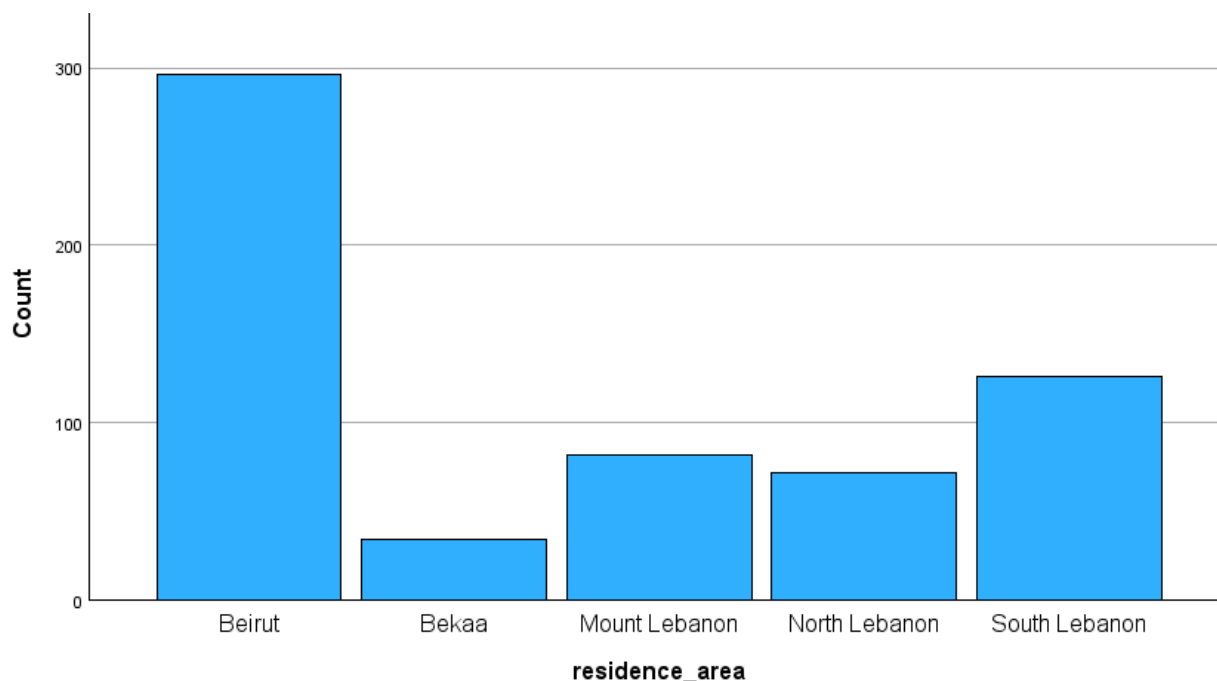


Figure 2. Distribution of participants by residence area

3.2 Descriptive Statistics of Main Variables

Table 2 summarizes the descriptive statistics of the key variables in the study. The average eHEALS score was 27.29 with a SD of 6.30 which shows that the participants had a moderate perceived digital health competence level. The average PHQ-9 score was 9.72 ± 6.47 indicating that the level of depressive symptoms was mild-moderate. The average MSQ score was 29.53 ± 12.35 , indicating moderate sleep disturbances. The mean physical activity score was 1955.64 ± 2748.05 MET-min/week, suggesting that there was a wide range of physical activity levels within the sample. Table 2 presents the minimum and maximum values of each variable which gives additional information about the distribution of these measures.

Table 2. Mental health and related scales

Variable	Mean	SD	Min	Max
eHEALS score	27.29	6.30	8.00	40.00
PHQ-9 score	9.72	6.47	0.00	27.00
MSQ total score	29.53	12.35	10.00	70.00
Physical activity (MET-min/week)	1955.64	2748.05	0.00	19278.00

3.3 Psychometric Properties of Measurement Scales

3.3.1 eHealth Literacy Scale (eHEALS)

EFA was used to assess the psychometric properties of the eHealth Literacy Scale (eHEALS). The outcome of the test favored a one-factor structure

which means that all items were loaded on the same underlying scale of the eHealth literacy.

The factor loadings were high and varied between 0.819 to 0.890 showing high contribution of each of the items to the overall construct. The sufficiency of the data to factor analysis was also verified with the KaiserMeyerOlkin (KMO) value of 0.938, and a

considerably significant Bartlett's test of sphericity ($\chi^2 = 4292.634$, $p = 0.001$), which shows excellent sampling adequacy and factor analysis.

A strong underlying structure was evident in the extracted factor that explained 73.51% of the total variance. Moreover, the scale had excellent internal

consistency with a Cronbach alpha of 0.948. The detailed factor loadings and communalities are given in Table 3, the item-total correlations, all of which were strong and statistically significant, are given in Table 4, and it further supports the reliability and validity of the scale.

Table 3. Exploratory factor analysis of the eHEALS scale

Item	Factor loading	Communality
eHeals2	0.890	0.791
eHeals3	0.882	0.778
eHeals5	0.881	0.776
eHeals4	0.872	0.760
eHeals1	0.845	0.715
eHeals6	0.843	0.710
eHeals7	0.824	0.680
eHeals8	0.819	0.670

Table 4. Pearson correlation matrix of eHEALS items with total scale score

Item	Correlation with total eHEALS score (r)	p-value
eHeals1	0.845	<0.001
eHeals2	0.886	<0.001
eHeals3	0.879	<0.001
eHeals4	0.870	<0.001
eHeals5	0.878	<0.001
eHeals6	0.846	<0.001
eHeals7	0.829	<0.001
eHeals8	0.822	<0.001

3.3.2 Sleep Quality Scale (MSQ)

EFA was used to evaluate the psychometric properties of the Mini Sleep Questionnaire (MSQ). The findings revealed a one-factor model implying that all the items were used to measure a similar underlying construct of sleep quality.

The MSQ items had a high factor loading with an average of 0.736 to 0.854 which means that the majority of the items had a significant contribution to the overall factor. The factor derived had a strong variance of 57.14, which supports the suitability of the scale structure.

The scale also experienced good reliability as the Cronbach's alpha of 0.912 was high indicating high

internal consistency of the MSQ. Nevertheless, a single item (msq_7) had a relatively smaller factor loading (0.337) and communality (0.114), which indicates that it did not contribute to the overall construct as much as the rest of the items did. This notwithstanding, the item was included in the analysis to maintain the conceptual wholeness of the scale.

The results of the factor analysis detailing factor loadings and communalities are provided in Table 5 and inter-item and item-total correlations that indicate internal consistency of the scale are provided in Table 6. Figure 3 shows the inter-item correlations of the Mini Sleep Questionnaire (MSQ).

Table 5. Exploratory Factor Analysis of the Mini Sleep Questionnaire (MSQ)

Item	Factor 1 Loading	Communality
msq_10	0.854	0.729
msq_9	0.832	0.693
msq_2	0.817	0.668
msq_4	0.793	0.629
msq_1	0.792	0.628
msq_6	0.771	0.594
msq_3	0.751	0.564
msq_8	0.745	0.555
msq_5	0.736	0.542
msq_7	0.337	0.114

Table 6: Pearson Correlation Matrix of MSQ Items and Total Score (N = 610)

Variable	msq_1	msq_2	msq_3	msq_4	msq_5	msq_6	msq_7	msq_8	msq_9	msq_10	msq_total
msq_1	1	.686	.597	.612	.521	.532	.221	.514	.574	.599	.786
msq_2	.686	1	.655	.597	.491	.527	.180	.615	.596	.657	.805
msq_3	.597	.655	1	.513	.422	.524	.267	.526	.517	.583	.748
msq_4	.612	.597	.513	1	.718	.603	.152	.430	.605	.601	.793
msq_5	.521	.491	.422	.718	1	.629	.216	.385	.538	.559	.745
msq_6	.532	.527	.524	.603	.629	1	.178	.521	.595	.590	.768
msq_7	.221	.180	.267	.152	.216	.178	1	.316	.276	.216	.392
msq_8	.514	.615	.526	.430	.385	.521	.316	1	.629	.645	.742
msq_9	.574	.596	.517	.605	.538	.595	.276	.629	1	.815	.825
msq_10	.599	.657	.583	.601	.559	.590	.216	.645	.815	1	.842
msq_total	.786	.805	.748	.793	.745	.768	.392	.742	.825	.842	1

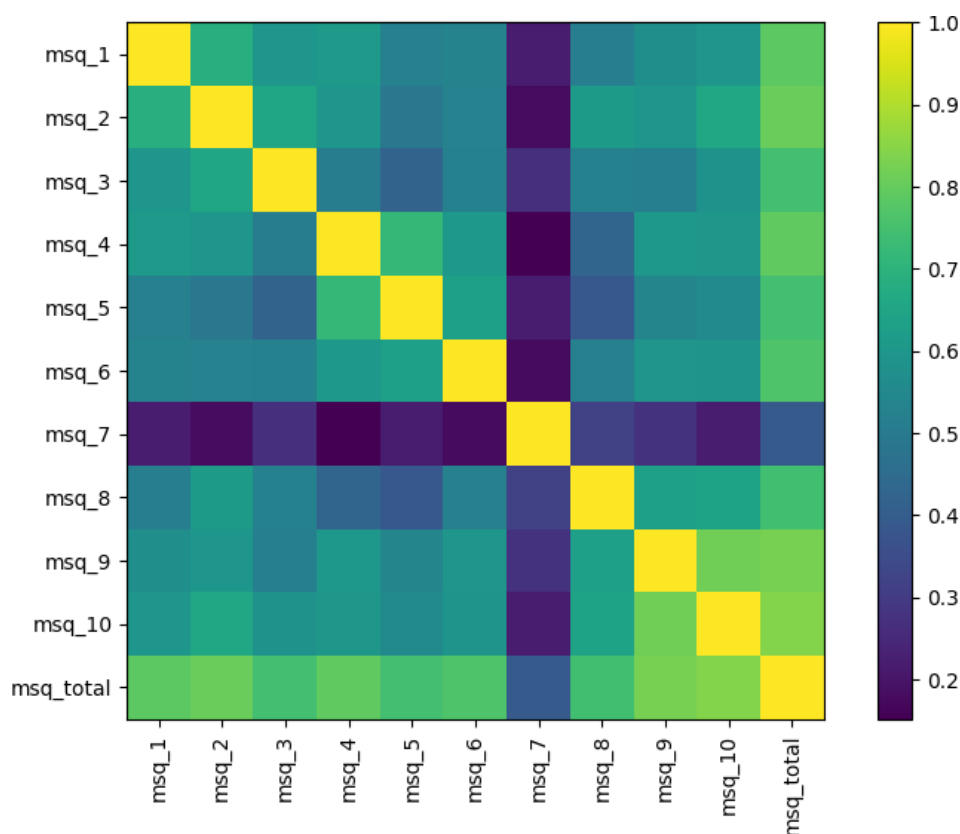


Figure 3. Correlation matrix of Mini Sleep Questionnaire (MSQ) items and total score

3.4 Physical Activity Distribution

Table 7 presents the distribution of the physical activity levels among the participants. The average total physical activity was 1955.64 ± 2748.05 MET-min/week which means that the level of activity among the sample was quite varied. The reported values were quite diverse (0 to 19,278 MET-min/week) which revealed the existence of extremely sedentary and extremely active people.

The IPAQ classification showed that the distribution of the participants was relatively even at the activity levels. In particular, low physical activity, moderate, and high physical activity accounted 38.0, 38.9 and 23.1 percent, respectively. With this distribution, the percentage of the students in the low activity group implies that a sizeable number of the population might not be getting enough physical activity. Table 7 shows detailed information about the levels of physical activity and its distribution.

Table 7. Physical Activity Score and Distribution (N = 610)

Variable	Category	Value
Total physical activity (MET-min/week)	Mean $\pm$ SD	1955.64 $\pm$ 2748.05
	Min – Max	0.00 – 19278.00
IPAQ physical activity level	Low	232 (38.0%)
	Moderate	237 (38.9%)
	High	141 (23.1%)

3.5 Bivariate Analysis

The bivariate analyses examining factors associated with depressive symptoms measured by PHQ-9 are presented in Table 8. MSQ scores were most strongly related with depressive symptoms. Higher MSQ scores, indicating poorer sleep quality, were significantly associated with higher PHQ-9 scores ($p < 0.001$). eHealth literacy showed a borderline negative association with depressive symptoms ($p = 0.053$).

Gender was also significantly associated with depressive symptoms, with female students reporting higher PHQ-9 scores than male students ($p = 0.049$). Living arrangement was significantly associated with depressive symptoms ($p = 0.027$). However, age, GPA, residence, smoking status, alcohol use, and total physical activity were not significantly associated with PHQ-9 scores. The results are detailed in Table 8.

Table 8. Bivariate analysis of factors associated with depressive symptoms measured by PHQ-9

Independent variable	PHQ-9: B (95% CI), p
eHEALS	-0.081 (-0.162, 0.001), 0.053
Age (years)	0.012 (-0.163, 0.188), 0.890
Gender (female vs male)	1.282 (0.003, 2.561), 0.049
GPA	0.324 (-0.312, 0.961), 0.317
Residence (new residence)	-0.197 (-0.510, 0.116), 0.218
Living arrangement (new living)	-1.119 (-2.111, -0.128), 0.027
Smoking (NEWSMOKE)	0.263 (-0.440, 0.965), 0.463
Alcohol use (new drink)	-0.002 (-1.136, 1.132), 0.998
Physical activity (MET-min/week)	0.00004 (0.000, 0.000), 0.639
MSQ score	0.273 (0.237, 0.308), <0.001

3.6 Multivariable Regression Analysis

The results of the multivariable linear regression analyses examining factors associated with depression outcomes are presented in Table 9.

3.6.1 Predictors of PHQ-9 scores

The eHealth literacy was significantly and negatively related PHQ-9 scores ($B = -0.124$, $p < 0.001$), which means that an increase in the level of eHealth literacy was correlated with the decrease in

depressive symptoms. Conversely, MSQ score was highly positive with respect to PHQ-9 scores ($B = 0.276$, $p < 0.001$): Higher depressive symptom scores were associated with poorer sleep quality. In the multivariate model, physical activity and GPA were not found to be significantly related to depression. Overall, the multivariable model indicated that poorer sleep quality and lower eHealth literacy were independently associated with higher depressive symptoms. Table 9 contains detailed regression results.

Table 9. Multivariable Linear Regression Models

Variable	PHQ-9 (B, 95% CI, p)
eHEALS	-0.124 (-0.194, -0.054), $p < 0.001$
MSQ score	0.276 (0.241, 0.312), $p < 0.001$
Physical activity	0.000, $p = 0.186$
GPA	0.317, $p = 0.259$

3.7 Additional Analysis: Predictors of MSQ scores

3.7.1 Bivariate Analysis with MSQ as the Dependent Variable)

The results of the bivariate analysis examining factors associated with MSQ scores are presented in

Table 10. The severity of depressive symptoms (as measured by PHQ-9 scores) was highly correlated with sleep disturbance (as measured by MSQ scores; $B = 0.993$, $p < 0.001$). Conversely, physical activity, age, gender and living arrangement were not significantly related to sleep quality (all $p > 0.05$).

TABLE 10: Bivariate Analysis (DV = MSQ score)

Independent Variable	B (Unstandardized)	95% CI	p-value
PHQ-9 score	0.993	(0.864 – 1.123)	<0.001
Physical Activity (MET-min/week)	0.000	(0.000 – 0.000)	0.479
Age (age_years)	-0.134	(-0.469 – 0.201)	0.432
Gender (gendernum)	1.859	(-0.587 – 4.304)	0.136
Living status (newliving)	-0.540	(-2.440 – 1.360)	0.577

3.7.2 Multivariable Models for MSQ

The results of the multivariable linear regression models predicting MSQ scores are shown in Table 11. The overall models were adjusted for other factors to control for the influence of these potential confounding factors. In the adjusted models, PHQ-9 score was a robust and statistically significant positive predictor of sleep disturbances

($p < 0.001$), suggesting that higher levels of psychological distress are independently associated with poorer sleep quality. The age, gender, living arrangement, residence, physical activity and GPA levels were not significantly correlated with MSQ scores after adjustment. In general, depressive symptoms were thought to be the most important factors involved in increased sleep disturbance. The detailed results are given in Table 11.

TABLE 11: Multivariable Linear Regression Models Predicting MSQ Score

Variable	Model 1 B (95% CI)	p-value	Model 2 B (95% CI)	p-value	Model 3 B (95% CI)	p-value
PHQ-9 score	0.993 (0.864–1.123)	<0.001	—	—	0.993 (0.864–1.123)	<0.001
Age (years)	Not significant	>0.05	Not significant	>0.05	—	—
Gender	1.859 (–0.587 to 4.304)	0.136	—	—	—	—
Living arrangement	–0.540 (–2.440 to 1.360)	0.577	—	—	—	—
Area of residence	0.122 (–0.477 to 0.720)	0.690	—	—	—	—
IPAQ score	Not significant	>0.05	Not significant	>0.05	—	—
GPA	Not significant	>0.05	Not significant	>0.05	—	—

4. Discussion

The purpose of this study was to explore eHealth literacy and its relationships with physical activity, MSQ scores and depression symptoms in pharmacy students. Results indicated that sleep disturbance was significantly related to increased depressive symptoms. Depression was inversely associated with eHealth literacy, but not significantly with physical activity in the adjusted model.

The results of this research showed that MSQ scores was significantly related to depressive symptoms. The results indicated that greater sleep disturbance was significantly associated with higher PHQ-9 scores and was an independent predictor in the multivariable linear regression model. The results align with previous studies indicating that sleep is a crucial process for emotional regulation, psychological functioning and well-being in university students (Milojevich & Lukowski, 2016; Yaghmour et al., 2023). Furthermore, large-scale investigations have shown that sleep related problem is a significant factor associated with the quality of life and mental health of students (Moussa-Chamari et al., 2024). The results validate the need to consider sleep issues in student mental health interventions.

In the adjusted model, eHealth literacy was significantly negatively correlated with depressive symptoms. This implies that student access to, understanding of, and ability to evaluate digital health information may improve their health concerns management and ability to access support when needed. While earlier research has yielded mixed results about the connection between eHealth literacy and mental health (Kühn et al., 2022; Zhang et al., 2016), the results of the present study indicate a protective effect of eHealth literacy. As for negative impacts of health information online, however, there have been cases of excess, inaccurate or anxiety inducing information (Li et al., 2016; Zhu et al., 2023). Thus, eHealth literacy needs to be seen as a capability to seek, find, access, and critically assess and use reliable health information online, not just an ability to access it.

In this study, there was no significant association between physical activity and depressive symptoms.

While regular physical activity is generally thought to have a positive impact on mental health, this effect may not be seen as independent of other population factors, activity intensity and other lifestyle factors (Pearce et al., 2022; Rehman et al., 2024; Yin et al., 2024). The association between physical activity and mental health has also been partially attributed to sleep patterns and other behaviors, which may account for the current modest independent effect of physical activity (Yin et al., 2024).

Gender was a significant bivariate association and was positively correlated with depressive symptoms, with female students having higher PHQ-9 scores than male students. The result is in line with the previous study that revealed that depressive symptoms and psychological distress are prevalent among university students with females exhibiting higher psychological distress compared to males (Ibrahim et al., 2013; Duffy et al., 2019).

There are a number of practical implications of the findings. First, there is a high correlation between MSQ scores and depressive symptoms, so it is recommended to focus on sleep hygiene education and sleep-oriented interventions in university mental health programs. Second, while there was no association between physical activity and depressive symptoms in this study, physical activity is still a key factor in students' health. Third, the association between eHealth literacy and depression indicates that facilitating students' ability to find, assess, and engage with accurate digital health information could be beneficial for psychological well-being and healthier lifestyle habits (Jiang et al., 2024; Li et al., 2025; Shudayfat et al., 2023). In general, it is recommended that student mental health programs incorporate a multi-faceted strategy that incorporates sleep hygiene, digital health literacy, physical activity, and psychological support.

While the study has its merits, there are a number of limitations. First, the cross-sectional design does not enable causal statements to be made. Secondly, self-reported data may have resulted in recall or social desirability bias. Third, convenience sampling might restrict the representativeness of the sample. The study was also carried out in a particular academic

setting, and the results may not be applicable to the wider student community. Lastly, the sample consisted mainly of females and this should be taken into account when interpreting the associations found.

5. Conclusion

This study identifies the correlation between behavioral and cognitive factors with the existence of depressive symptoms among pharmacy students. The most significant factor related to depressive symptoms was higher sleep disturbances, suggesting that sleep disturbances may be important for students' mental health. The higher the eHealth literacy, the lower the depressive symptoms, which implies that students with higher eHealth literacy levels might be more capable of using digital health information, accessing it, comprehending it and assessing it, and thus better able to respond to health issues and access support as needed. However, physical activity was not a significant predictor of depressive symptoms in the adjusted

model though it is also an important factor of health and wellbeing. The results reveal that a number of factors may be interrelated in affecting depressive symptoms among pharmacy students, and sleep disturbance is among the most significant factors.. Pharmacy universities should consider developing mental health promotion programs that incorporate sleep hygiene education and stress management, as well as information on the use of digital health information. EHealth literacy may be beneficial in helping students sift through the information available on the Internet to find reliable and trustworthy sources, and in avoiding misinformation that might increase anxiety or distress. Physical activity was not independently associated in this study; however, it should be encouraged as a part of a healthy lifestyle. A multi-dimensional strategy that combines sleep support, digital health literacy, physical activity and psychological support can promote better mental health in students.

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