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MODELLING THE RISK FACTORS OF DEPRESSION AMONG STUDENTS USING BINARY LOGISTIC REGRESSION

Nur Aisyah Balqis Ahmad Azmi[1]
Nur Safwati Ibrahim [2*]
Nurul Bariyah Ibrahim[3]
Shamsunarnie Mohamed Zukri[4]
Nor Hazreeni Hamzah[5]
Noor Zafarina Mohd Fauzi[6]

[1] Universiti Teknologi MARA Cawangan Kelantan Kampus Kota Bharu, Kelantan, Malaysia
(E-mail: 2023260534@students.uitm.edu.my)
[2] Universiti Teknologi MARA Cawangan Kelantan Kampus Machang, Kelantan, Malaysia.
(E-mail: safwa541@uitm.edu.my)
[3] Universiti Teknologi MARA Cawangan Kelantan Kampus Kota Bharu, Kelantan, Malaysia
(E-mail: bariyah@uitm.edu.my)
[4] Universiti Teknologi MARA Cawangan Kelantan Kampus Kota Bharu, Kelantan, Malaysia
(E-mail: shamsunarnie077@uitm.edu.my)
[5] Universiti Teknologi MARA Cawangan Kelantan Kampus Kota Bharu, Kelantan, Malaysia
(E-mail: reeni683@uitm.edu.my)
[6] Universiti Teknologi MARA Cawangan Kelantan Kampus Machang, Kelantan, Malaysia
(E-mail: zafarina@uitm.edu.my)
*Corresponding author: safwa541@uitm.edu.my

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Abstract: *Depression is one of the most common mental health problems among university students and may negatively affect their daily activities and overall well-being. The purpose of this study was to assess the prevalence of depression and explore factors such as gender, academic performance, sleep quality, physical activity and perceived social support associated with depression among university students. A cross-sectional study was conducted among 98 undergraduate students at Universiti Teknologi MARA (UiTM) Kota Bharu. The data were collected using a structured questionnaire that comprised the Center for Epidemiologic Studies Depression Scale (CESD-10), Sleep Condition Indicator (SCI), International Physical Activity Questionnaire-Short Form (IPAQ-SF) and Multidimensional Scale of Perceived Social Support (MSPSS). Binary logistic regression analysis revealed that sleep quality and perceived social support were significant factors associated of depression. Students who had good quality of sleep and high level of perceived social support exhibited reduced odds of depression. In conclusion, sleep quality and perceived social support were significantly associated with depression among university students. This study provides an insight into the association between sleep quality and perceived social support with depression. Findings can be used to*

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inform interventions to promote healthy sleep and strengthen social support to reduce the risk of depression and improve students'mental well-being.

Keywords: *Depression, Sleep Quality, Physical Activity and Perceived Social Support.*

Introduction

Depression remains a significant global public health challenge, affecting millions of people worldwide each year. According to the World Health Organization (WHO, 2025), approximately 4% of the global population experiences depression in 2023 translating to an estimated 332 million people living with depression worldwide. In Malaysia, depression has received increasing scholarly attention due to its rising prevalence and the growing number of individuals affected by the condition. Studies have also reported an increasing trend of depression among university students, highlighting the growing mental health challenges faced by this population.

Higher education exposes students to a combination of academic pressures, financial concerns, and challenges related to social relationships. When these demands become overwhelming, students may experience depressive symptoms such as persistent sadness, difficulty concentrating, and persistent fatigue. These symptoms can negatively affect students' quality of life and make it challenging for them to cope with academic responsibilities and maintain their academic performance. If left untreated, severe depression may result in long-term health complications, negatively affect students' future career prospects, and in some cases lead to suicidal behaviour (Yap et al., 2021). Therefore, depression can have a profound impact on various aspects of students' daily lives, including their emotional well-being, academic functioning, and social relationships.

Recent research has highlighted the important roles of lifestyle factors and social support in promoting the mental health of university students. A longitudinal study by Roldan Espinola et al. (2024) found that healthy sleep habits, regular physical activity, and perceived support from friends and family were associated with a lower risk of developing depression and a reduced likelihood of persistent depressive symptoms. Similarly, Yang et al. (2023) reported that the poor sleep and insufficient physical activity were associated with depression among university students in rural China, while Girma et al. (2021) identified low levels of social support as a significant risk factor for depression. In addition, Alam et al. (2023) reported significant associations between sleep problems, inadequate physical activity, and depression among university students.

In recent years, the prevalence of depression among university students has increased, particularly after the COVID-19 pandemic (Wong et al., 2023). University life, which was previously characterised by face-to-face learning, social interactions, and independent living experiences, underwent significant changes during the pandemic. The implementation of movement restrictions and online learning resulted in reduced social interaction, prolonged isolation, and disruptions to students' daily routines. These changes may have contributed to increased feelings of loneliness, academic uncertainty, stress and emotional difficulties among university students. Furthermore, changes in lifestyle patterns, such as reduced physical activity, irregular sleep schedules, and limited social support, may have further affected students' psychological well-being and increased their vulnerability to depression.

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Despite national mental health initiatives, such as *Let's TALK Minda Sihat* campaign conducted by the Ministry of Health Malaysia, depression remains a significant public health concern in Malaysia. According to the World Health Organization (WHO, 2024), findings from the National Health and Morbidity Survey indicate that approximately one in four young Malaysians experiences depressive symptoms, while one in ten has reported a suicide attempt. These findings suggest that young people including university students are at a higher risk of experiencing depression. Students experiencing depression may have difficulty concentrating on their studies, more tendency of developing suicidal thoughts, loss of appetite and feelings of anger, and frustration (Abdullah et al., 2022). These consequences are concerning not only for their parents but also for the nation, as young people play an important role in Malaysia's future development.

The prevalence and contributing factors of depression may vary across geographical, cultural, and educational contexts and further research is needed to develop a clearer understanding of depression among Malaysian university students. Therefore, this study was conducted to determine the prevalence of depression among students and to identify the significant factors including gender, academic performance, sleep quality, physical activity and perceived social support that associated with depression among students at Universiti Teknologi MARA (UiTM) Kota Bharu. The findings of this research could provide valuable insights into the extent of depression and the factors associated with it, thereby supporting the development of more targeted and contextually appropriate mental health interventions.

Literature Review

Previous research has identified several risk factors associated with depression among higher education students, including gender, academic performance, sleep quality, physical activity and perceived social support. The high prevalence of depression among university students is a growing concern. Mwita et al. (2025) evaluated 768 undergraduate students at the University of Gondar, Ethiopia using the Beck Depression Inventory-II (BDI-II) and reported a prevalence of 35.7%. The study also identified demographic characteristics, parental relationships, and family economic status as key determinants of depression among undergraduate students.

Zulkafli et al. (2022) investigated depression among 260 university students in Borneo, Malaysia, with a focus on physical activity and the year of study. Depression was measured using the Patient Health Questionnaire-9 (PHQ-9) tool and physical activity via the International Physical Activity Questionnaire (IPAQ-M). The result showed the prevalence rate of depression in the participants of the study is very high and reaches 82%, whereas the prevalence rate observed previously in other studies conducted in Peninsular Malaysia among university students only reached 23.43%. Moreover, binary logistic regression revealed a significant association between the year of study and depression: students of the first and second years were found to suffer from depression two to three times more often.

Alasqah et al. (2023) examined sociodemographic determinants of depression, anxiety and stress among 453 students at Qassim University, Saudi Arabia using the Depression Anxiety Stress Scale-21 (DASS-21). The findings reveal that gender was associated with depression, with a higher level of depression in female students compared to male students' meanings that women are more likely to suffer from mental health issues because of early responsibilities, exposure to sexual assault, and domestic violence.

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Moreover, Hassan et al. (2023) have conducted a study involving 355 Malaysian university students using the DASS-21 to examine the level of depression, anxiety and stress among male and female students. Using an independent sample T-test, it reported that there was significant difference between genders in depression. The overall percentage score for female students is higher compared to male students. Thus, the authors concluded that female students may experience greater emotional burden due to social expectations and academic workload, while male students might underreport emotional distress.

The role of academic performance in depression among university students has already been recognized. In a study on 100 students, Zainab and Zafar (2019) found that poor academic performance was a predictor of depression. Likewise, in their study involving 450 medical students and examining factors contributing to anxiety and depression, Mengesha et al. (2025) found that there was a strong relationship between academic performance and depression. Those students who had honors had the least prevalence of depressive symptoms while those who either failed a module or repeated the year had the highest chances of developing depression.

In high pressure settings such as Malaysian universities, all students want to achieve a good academic performance. Perceived academic failure can also lead to hopelessness and emotional burnout. According to a study by Akhtari-Zavare et al. (2023) there is a significant association between CGPA and depression, since students with the lowest CGPA (2.00–2.24) showed higher rates of depression than those with a CGPA of 2.25 or above.

Sleep quality refers to how satisfied the person is with their sleep experience. Based on Ong et al. (2023), longer sleep duration does not necessarily mean better sleep quality, but it depends on how well the body and mind can rest. It is hard to get a good sleep quality for university students since they struggle with late night study sessions, excessive caffeine uses and blue light exposure from phones right before bed. A good night's sleep is important for optimal cognitive function, memory and decision making for students to succeed in their learning (Jie et al., 2024). According to Ou et al. (2025), a stable emotional state can often be affected by poor sleep quality and might result in problems like inattention and memory loss which can cause depression, anxiety and trigger feelings of frustration.

A body of literature demonstrates that there is a relationship between poor sleep quality and depressive symptoms in university students. Ghrouz et al. (2019) examined the effect of poor sleep quality on the occurrence of depressive symptoms in a sample of 617 Indian college students. It was found that the odds of having depressive symptoms in university students with poor sleep quality were 1.52 times more than the odds for good sleepers. Wang et al. (2023) revealed a positive association between poor sleep quality and depressive symptoms in Chinese university students.

Poor sleep quality has similarly been shown to be a key risk factor of depression among Malaysian university students. In a study that used multivariate logistic regression and the Patient Health Questionnaire-9 (PHQ-9) as tools for identifying the factors contributing to depression among Malaysian university students, Akhtari-Zavare et al. (2023) have identified the relationship between poor sleep quality and depression. Poor sleep quality is also common among Malaysian university students. According to Said et al. (2020), 59.6% of 500 Malaysian medical students suffered from poor sleep quality. The high prevalence may result from the fact

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that university students tend to sacrifice their sleep to fulfil academic commitments such as writing assignments and preparing for examinations.

Regular physical activity is recognized as crucial for maintaining good mental health. According to Wanjau et al. (2023), since mental health problems such as depression and anxiety are widespread, even a small increase in physical activity could have a large positive impact on overall mental health. However, based on Wong et al. (2021), researchers are still discussing how well physical activity really helps to reduce the risk of depression among college students. Some studies said that physical activity can lower depression risk through neurobiological boosts and improved brain function, while other studies found no clear relation or even a positive correlation between physical activity and depressive symptoms.

Physical activity is also associated to depression among university students, but the results obtained have been inconsistent from one study to another. Herbert et al. (2020) conducted a study aimed at establishing the correlation between regular physical activity and mental health status among 185 university students and established that higher amounts of regular physical activity correlated negatively with depression using the BDI-II and Pearson's correlation coefficient. Shimamoto et al. (2021), on the other hand, used PHQ-9 and Mann-Whitney U test and established a positive correlation between depression and physical activity levels variables.

One way to define perceived social support is believing you have a network of friends or family who care for you and will help you when you need it. Perceived social support are significant variable that provides an understanding of how various people handle stressful circumstances in life and avoid falling into depression (Talwar et al., 2013). Based on previous studies, low perceived social support is strongly correlated with depression. Students are more likely to have mental health breakdowns when they feel alone or have no one to share their problems with.

There is consistent evidence showing that perceived social support is a protective factor for depression among university students. Bukhari & Afzal (2017) assessed the correlation between perceived social support and psychological distress in terms of depression, anxiety and stress among 200 university students using Depression, Anxiety and Stress Scale-21 (DASS-21) and Multidimensional Scale of Perceived Social Support (MSPSS). Regression analysis showed that there is a high negative correlation between perceived social support and depression. In another study conducted by Robles-Rivera et al. (2025), using DASS-21 and MSPSS instruments, the study found that higher perceived social support was found to be significantly associated with depression.

In Malaysia, perceived social support has become important since many students move away from their homes to continue their studies. Thus, believing someone cares for you and will help you when you are in trouble, helps you survive university life in a way. A study by Amin et al. (2024), highlights the importance of support systems in taking care of mental health in their results. Family support showed moderately negative correlations, followed by support from friends and teachers. Thus, the study can confirm that emotional connections with family, friends and teachers can prevent depression and create a sense of belonging that strengthens resilience.

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Material and Methods

This research employed a quantitative, cross-sectional research design to investigate the risk factors associated with depression among university students. This approach enables the use of structured questionnaires and numerical data, thereby allowing objective measurement and statistical analysis within a single time frame. Data were collected using a structured self-administered questionnaire designed to assess students' sociodemographic characteristics, potential risk factors, and prevalence of depressive symptoms.

The target population of this study comprised 1,197 undergraduate students at Universiti Teknologi MARA (UiTM) Kota Bharu. The minimum required sample size was determined using the Raosoft sample size calculator, with a 10% margin of error and a 95% confidence level. According to Fowler (2013), the precision of survey results is primarily determined by the sample size and margin of error, while the total population size has little effect. A larger margin of error allows researchers to obtain a smaller sample size while maintaining an acceptable level of precision, particularly when time, resources, or access to respondents is limited. Therefore, a margin of error of 10% was considered appropriate for determining the sample size in this study, as it balanced the need for accuracy with practical constraints. After accounting for an additional 10% to accommodate potential non-response, the required sample size was 98 students. Proportionate stratified random sampling was employed to select the study participants, whereby the target population was divided into two strata based on gender. Subsequently, students were randomly selected from each stratum using simple random sampling.

Research Instrument

This research considers five risk factors that significantly influence the depression among students. Those factors are gender, academic performance measured by CGPA, sleep quality, physical activity and perceived social support. The questionnaire was adopted from several previous studies. The students' sleep quality was measured based on Sleep Condition Indicator (SCI). The instrument consists of 8 items which is self-rating questionnaire rated on ranging from 0 to 4. The total SCI score is calculated by summing all 8 items, producing a possible score range of 0 to 32. Sleep quality was classified based on established cutoff criteria, where scores of 16 or below indicated poor sleep quality, while scores above 16 indicated good sleep quality (Catling et al., 2025).

Students' physical activity used a questionnaire from the International Physical Activity Questionnaire (IPAQ) Short Form. The IPAQ-SF is a standardized and widely used self-report instrument designed to measure habitual physical activity across multiple intensity levels in adult populations. It required participants to report the frequency (days per week) and duration (minutes per day) of walking, moderate and vigorous activities in the past 7 days. Physical activity over the past seven days was calculated by determining the time spent at each activity intensity level, applying the corresponding Metabolic Equivalent of Task (MET) values, and converting these into an overall energy expenditure score. First, for each activity category, MET-minutes per week (MET-min/week) were calculated by multiplying the assigned MET value (walking = 3.3 METs, moderate activity = 4.0 METs, vigorous activity = 8.0 METs) by the reported duration in minutes per day and the number of days performed per week. Next, the MET-minutes/week of walking, moderate and vigorous activities were summed to obtain the total physical activity score, representing overall weekly physical activity. Finally, participants were classified into low (< 600 MET-min/week), moderate (600-2999 METmin/week) or high (≥ 3000 MET-min/week) physical activity levels. Sitting time was recorded separately as an

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indicator of sedentary behaviour but it was not included in the total MET score (Ghrouz et al., 2019).

The Multidimensional Scale of Perceived Social Support (MSPSS) questionnaire was used to measure perceived social support. The MSPSS consisted of 12 items representing three dimensions of perceived social support which were family, friends, and significant others. Each item was rated on a 7-point Likert Scale, ranging from 1 (very strongly disagree) to 7 (very strongly agree). The overall perceived social support was calculated by summing all 12 item scores which range from 12 to 84 and divided by 12 to get the total mean perceived social support score. Then, the respondents were classified into three levels of perceived social support based on their mean MSPSS scores and the scale response descriptors. Mean scores ranging from 1.0 to 2.9 were categorized as low perceived social support, scores from 3.0 to 5.0 as moderate perceived social support, and scores from 5.1 to 7.0 as high perceived social support (Bukhari & Afzal, 2017).

Epidemiologic Studies Depression Scale (CESD-10) was used as the instrument to measure students' depression level. This instrument was selected since all 10 items in CESD-10 are provide a more focus measurement directly toward depressive symptomatology. A study conducted by Umegaki and Todo (2017) found that CESD-10 is the useful choice to study about depression among students. This instrument considers the frequency of depressive symptoms experienced by respondents during the past week, capturing affective, cognitive, and somatic aspects of depression. The scale consisted of 10 items, and each rated on a 4-point Likert scale ranging from 0 (rarely or none of the time), 1 (some of the time), 2 (occasionally), to 3 (all the time). All 10 items were summed to obtain a total score, with possible scores ranging from 0 to 30. Higher total scores indicate higher levels of depressive symptom severity. The depression levels were classified based on a cutoff score of 10 or higher was used to indicate the presence of significant depressive symptoms, while scores below 10 were classified as indicating no depressive symptoms. This cut-off was applied for screening and analytical purposes and does not represent a clinical diagnosis of depression (Islam et al., 2018).

Data Screening

The Standardized Residuals (SDR) was used for detecting outlier. According to Sangra and Codina (2015), observations with absolute standardized residual values greater than three (3) were indicate as potential outliers (|SDR|>3). Furthermore, a data point is considered to have high leverage if its value is significantly larger than the twice average leverage determined by the formula in Dhakal (2017) and it is shown in Equation 1.

$$\text{Average levarage} = \frac{2(k+1)}{n} \quad (1)$$

Based on allocation formula, k is the number of independent variables and n is the number of observations. The influential data point was detected using Cook's Distance, which integrates both residuals and leverage to evaluate an individual observation's impact on the overall model. A Cook's Distance value greater than 1 was considered a potentially influential observation, as this cut-off has been suggested as a practical rule of thumb for identifying influential cases (Ghosh, 2022). The summary of cut-off points for outliers and influential points for this research was shown in Table 1.

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Table 1: The Summary of Outlier and Influential Point

Measure	Cut-off Point
Standardized Residual	± 3
Average Leverage	0.1224
Cook's Distance	1

Statistical Analysis

The analyses were carried out using the Statistical Package for the Social Sciences (SPSS). The reliability test using Cronbach's alpha was used to assess the internal consistency and stability of the questionnaire for perceived social support and depression since the questionnaire is represented in Likert scale. Cronbach's alpha values above 0.8 indicate good reliability, values between 0.6 and 0.8 are considered acceptable, and values below 0.6 are regarded as unacceptable, particularly in exploratory research (Sigudla & Maritz, 2023).

Binary Logistic Regression

Binary logistic regression was applied to determine the factors of gender, academic performance, sleep quality, physical activity and perceived social support that are significantly affect the depression among higher education students.

Depression was classified into two classes. A score of 10 or higher was interpreted as "Depressed", while scores below 10 indicated "Not Depressed". Table 2 showed the code that were used to define the depression.

Table 2: Classification of Depression

Depression	Internal Value	Total Score
Depressed	1	Score ≥10
Not Depressed	0	Score <10

General assumptions for binary logistic regression must be satisfied. The observations must be independent of each other. This means that each participant or case should be unique and not related to another participant in the dataset. Independence ensures that each observation contributes equally and separately to the analysis. Box-Tidwell test (Petrovic et al., 2023) was used for checking the assumption of linear relationship between the continuous independent variables and the log of the odds of the independent variable. This does not mean that the independent variable itself must be linearly related to the dependent variable, but it must be linearly related to the log odds of the outcome. The linearity assumption is met if the interaction term's p-value is not significant where p-value is more than alpha (0.05).

No multicollinearity among the independent variables should be considered. This means that independent variables should not be too highly correlated with each other. When two or more predictors are strongly related, it becomes difficult to separate their individual effects on the dependent variable. In other words, the model cannot clearly tell which variable is influencing the outcome. Multicollinearity can be checked by looking at the Variance Inflation Factor (VIF) or Tolerance values. When examining tolerance, make sure that no numbers are less than 0.1 and VIF values are less than 10.

The estimated "logit" model of Binary Logistic Regression for this study is in Equation 2.

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$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon \qquad (2)$$

Based on the allocation formula, p is the probability of depression, $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ and β_5 is the parameter estimates, X_1 is gender, X_2 is Academic Performance, X_3 is sleep quality, X_4 is physical activity, X_5 is perceived social support and ε is an error term.

The probability of depression as shown in Equation 3.

$$P(Y=1) = \frac{1}{1+e^{-z}} \qquad (3)$$

where $z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$

The selection method that has been selected was the backward (Wald) method. This method is helpful in finding the predictors which contribute to the model. A backward elimination process was carried out using a pre-set level of significance. At each stage of the process, the predictor with the largest Wald p-value was considered for deletion from the model. The variables were removed one after another in accordance with the removal rule specified, and the procedure went on until no additional variables satisfied the criterion for removal. A predictor variable was regarded as statistically significant if its p-value was below the pre-determined significance level ($\alpha = 0.05$), which showed that there was a statistically significant association between it and the dependent variable after considering the other predictors in the final model.

Test of Model Fit

The test of model fit is used to assess how well the model describes the observed data. It determines whether the independent variables included in the model significantly improve the prediction of the dependent variable compared to a model with no predictors. A good model fit means that the predicted probabilities are close to the actual outcomes in the dataset. Several statistical tests and indicators are used together to evaluate model fit.

The Omnibus Test of Model Coefficients is the first indicator of overall model fit. This test compares the model that includes only the constant with the model that contains the independent variables. A significant Omnibus test (p-value <0.05) suggests that the inclusion of the independent variables improves the model's predictive ability.

The Hosmer-Lemeshow test divides the sample into groups based on predicted probabilities and compares the observed and expected frequencies of the outcome within each group. The p-value in Hosmer–Lemeshow test is more than alpha (0.05) indicates that the model's predictions are consistent with the actual data, meaning the model fits well.

The classification table shows how accurately the model can classify cases into the correct outcome categories based on predicted probabilities. It compares the predicted and actual values of the dependent variable and calculates the percentage of correctly classified cases. A classification accuracy ranges from 50% to 100%, with higher classification rates indicating better model performance (Weiss & Dardick, 2016).

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The area under the ROC curve (AUC) provides a single measure of the model overall ability to correctly distinguish between the two groups. An AUC value under 0.6 indicates that the model fails to distinguish between the outcome groups and values closer to 1 indicate better model performance (Corbacioglu & Aksel, 2023). Table 3 show the AUC value and its interpretation:

Table 3: AUC Value and its Interpretation

AUC Value	Interpretation Suggestion
$0.9 \leq AUC$	Excellent
$0.8 \leq AUC < 0.9$	Considerable
$0.7 \leq AUC < 0.8$	Fair
$0.6 \leq AUC < 0.7$	Poor
$0.5 \leq AUC < 0.6$	Fail

The Odds Ratio

The odds ratio is a statistical measure used in logistic regression to describe the association between an independent variable and a binary outcome. It indicates the odds of an outcome occurring in the presence of an independent variable compared with the odds of the outcome occurring in the absence of that exposure. The odd ratio in Binary Logistic Regression was shown in Equation 3.

$$e^{B} = e^{\ln\left(\frac{p}{1-p}\right)} = \frac{p}{1-p} \tag{4}$$

An odd ratio equal to 1 indicates that there is no association between the independent variable and the dependent variable. An odd ratio greater than 1 suggests that the group with the independent variable has higher odds of experiencing the dependent variable compared with the reference group, whereas an odd ratio less than 1 indicates lower odds of experiencing the dependent variable. In binary logistic regression, the odds ratio for each independent variable is presented in the Exp(B) column of the Variables in the Equation table in SPSS. The odd ratio is obtained by exponentiating the regression coefficient (B), which transforms the log-odds relationship into a more interpretable measure of association.

Result and Discussion

The descriptive and inferential analyses were conducted to identify patterns within the data and to determine whether significant associations existed between the selected risk factors and depression.

Reliability Analysis

The reliability test was performed to evaluate the internal consistency and stability of the measurement instrument. Cronbach's Alpha was used to assess the reliability for perceived social support and depression since these variables were constructed in Likert scale. The result of reliability test was shown in Table 4.

Table 4: Reliability Test

Variable	Reliability Test	No. of Item
Perceived Social Support	0.920	12
Depression	0.926	10

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Table 4 shows the instrument for both variables achieved acceptable Cronbach's Alpha coefficient since the values were greater than 0.6 as stated by Sigudla and Maritz (2023). Thus, it can be concluded that all the items are related to each other for each construct.

Outlier and Influential Data

The result of Standardized Residuals showed that there was no observation considered as outlier since all the |SDR| are less than 3. However, two observations (35 and 78) had extreme value in predictor as their leverage value exceeded the cut-off point of 0.1224. Based on the Cook's Distance value, both observations were influential data points since Cook's Distance value exceeded 1. Hence observation 35 and 78 were removed from the dataset making the new number of total datasets is 96.

Table 5: Outlier, Leverage and Influential Detection

Observation	Leverage	Cook's Distance
35	0.52633	1.97193
78	0.52633	1.97193

Descriptive Statistics

The descriptive analysis shows that there are 54.17% (52) respondents who were depressed while another 45.83% (44) respondents were not depressed. This indicates that the total students who were depressed are slightly higher than total students who were not depressed. Table 6 shows the summary of demographic profile of respondents and classification of variables based on depression status. Most of the participants are females (70.8%), out of which 55.9% are categorized under the depressed status. With respect to the quality of sleep, more people in the category of poor sleep quality have depression (83.3%) compared to those with good sleep quality (47.4%). With regards to physical activity, the category of low physical activity had 65.9% of respondents with depression while in the category of high physical activity, only 33.3% were depressed. Consider the perceived social support, there is 81.4% of respondents with depression for moderate social support while 32.1% with high social support.

Table 6: Demographic Profile and Classification Variables

			Depression Status	
Variable	**Categories**	**n (%)**	**Depressed**	**Not Depressed**
Gender	Male	28 (29.2%)	14 (50%)	14 (50%)
	Female	68 (70.8%)	38 (55.9%)	30 (44.1%)
Sleep Quality	Poor	18 (18.8%)	15 (83.3%)	3 (16.7%)
	Good	78 (81.3%)	37 (47.4%)	41 (52.6%)
Physical Activity	Low	41 (42.7%)	27 (65.9%)	14 (34.1%)
	Moderate	40 (41.7%)	20 (50%)	20 (50%)
	High	15 (15.6%)	5 (33.3%)	10 (66.7%)
Perceived Social Support	Low	-	-	-
	Moderate	43 (44.8%)	35 (81.4%)	8 (18.6%)
	High	53 (55.2%)	17 (32.1%)	36 (67.9%)

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Binary Logistic Regression Model

The Box–Tidwell procedure was performed to assess the assumption of linearity in the logit for the continuous independent variable (CGPA), the only continuous predictor (covariate) evaluated in the model. The interaction term between CGPA and its natural logarithm was not statistically significant (p-value = 0.869 > 0.05), indicating that the assumption of linearity in the logit was satisfied.

Based on the result in Table 7, it can be concluded that there is no multicollinearity exists between all the independent variables since all the tolerance values are above 0.1 and the Variance Inflation factor (VIF) values also are all less than 10. Thus, the independent variables are not correlated to each other.

Table 7: Multicollinearity Detection

Variable	Tolerance	VIF
Academic Performance	0.969	1.032
Gender	0.923	1.083
Sleep Quality	0.951	1.052
Physical Activity	0.867	1.154
Perceived Social Support	0.900	1.000

The Omnibus Test was conducted to assess the overall significance of the model. Based on Table 8, the overall model was statistically significant ($\chi^2 = 29.235$, $p < 0.001$), indicating that the final model with the retained predictors provided a significantly better fit to the data.

Table 8: Summary of Omnibus Test using Backward Method

Chi-square	Degree of Freedom	Significant (p-value)
29.235	2	<0.001

Hosmer-Lemeshow Tests were performed to assess the model's goodness of fit. Table 9 shows the results of Chi-square and the significant value for Hosmer-Lemeshow Test. The value for Chi-square is 1.448 (df=2) and for the p-value is 0.485 where it is greater than alpha (0.05). Hence, the Hosmer-Lemeshow goodness of fit test indicates that Binary Logistic Regression model fits the data well.

Table 9: Summary of Hosmer-Lemeshow Test using Backward Method

Chi-square	Degree of Freedom	Significant (p-value)
1.448	2	0.485

The value of Cox & Snell R^2 and Nagelkerke R^2 provide an indication of the amount of variation in the dependent variable explained by the model. Based on the result in Table 10, the Cox & Snell R^2 and Nagelkerke R^2 values are 0.263 and 0.351 respectively. It suggests that between 26.3% and 35.1% of total variation in depression is explained by the logistic regression model.

Table 10: Summary of Cox & Snell R^2 and Nagelkerke R^2 Using Backward Method

Cox & Snell R^2	Nagelkerke R^2
0.263	0.351

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The classification table in Table 11 shows the accuracy of the model was 75% which is greater than 50%. It can be concluded that the model correctly classifies 75% of the observations into the appropriate depression category. Thus, the value for the error rate of the model is 25%. Therefore, this model can be used precisely to predict depression status among university students.

Table 11: Classification Table using Backward Method

Observed		Predicted		
		Depression Status		Percentage Correct
		Not Depressed	Depressed	
Depression Status	Not Depressed	33	11	75.0
	Depressed	14	38	73.1
	Overall Percentage			74.0

The area under the ROC curve (AUC) obtained was 0.779 as shown in Table 12, indicating that the model had a fair ability to differentiate between students who were classified as depressed and those who were not depressed. The 95% confidence interval ranged from 0.686 to 0.872, indicating the estimated range of the model's distinguish ability. Hence, the final logistic regression model showed an acceptable level of predictive accuracy in identifying depression status among the university students.

Table 12: Area Under the ROC Curve (AUC)

Area	Asymptotic 95% Confidence Interval	
	Lower Bound	Upper Bound
0.779	0.686	0.872

Significant of Independent Variables

Table 13 shows the coding for categorical variables that involve in binary Logistic regression. The variables are gender, sleep quality, physical activity and perceived social support.

Table 13: Categorical Variable Coding

Variable	Categories	Frequency	Parameter Coding (1)	Parameter Coding (2)
Gender	1 (Male)**	28	0.000	
	2 (Female)	68	1.000	
Sleep Quality	0 (Poor)**	18	0.000	
	1 (Good)	78	1.000	
Physical Activity	1 (Low)**	41	0.000	0.000
	2 (Moderate)	40	1.000	0.000
	3 (High)	15	0.000	1.000
Perceived Social Support	1 (Moderate)**	43	0.000	
	2 (High)	53	1.000	0.000

** reference group

The summary of binary logistic regression using backward (Wald) method was presented in Table 14. The result shows, good sleep quality and high perceived social support were significantly associated with depression since the p-value is 0.044 and <0.001 respectively which is less than alpha (0.05).

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Table 14: Logistic Regression Predictors of Depression Status

Variable	B	S.E	Wald	df	Sig.	Exp (B)	95% CI for Exp (B)	
							Lower	Upper
Sleep Quality (1)	-1.472	0.732	4.038	1	0.044	0.23	0.55	0.964
Perceived Social Support (1)	-2.131	0.501	18.059	1	<0.001	0.119	0.044	0.317
Constant	2.664	0.76	12.275	1	<0.001	14.353		

The coefficient for good sleep quality was negative (B= -1.472) with an odd ratio of 0.230 ($e^{-1.472}$). These coefficient value indicates that good sleep quality is associated with lower odd of depression compared to those with poor sleep quality. The result also clearly indicates that good sleep quality was significantly associated with lower odds of depression compared to poor sleep quality (OR = 0.230, 95% CI: 0.100–0.530). Specifically, the students with good sleep quality had approximately 77.0% lower odds of depression, controlling for the other predictor in the model. This finding suggests that students with poor sleep quality may be more likely to experience depressive symptoms than those with good sleep quality.

High perceived social support shows a negative association with the odds of depression (B= -2.131) and the odds ratio was 0.119 ($e^{-2.131}$). Based on the odds ratio value, it can be concluded that the odds of depression for students with high perceived social support were 0.119 times the odds of those in the moderate perceived social support corresponding to 88.1% lower odds of depression while controlling good sleep quality. This result suggests that greater perceived social support is strongly associated with a lower depression, highlighting the important role of support from family, friends, and significant others in protecting students from depressive symptoms.

Therefore, the log odd ratio or "logit" as shown in Equation 5.

$$\ln\left(\frac{p}{1-p}\right) = 2.664 - 1.472X_1(1) - 2.131X_2(1) \quad (5)$$

The probability of depressed as mentioned in Equation 3 is given by:

$$P(Y = depressed) = \frac{1}{1+e^{-z}} \text{ where } z = 2.664 - 1.472X_1(1) - 2.131X_2(1)$$

Based on the equation, $X_1(1)$ is refers to good sleep quality and $X_2(1)$ is refers to high perceived social support.

Conclusion

In conclusion, depression prevalence in UiTM Kota Bharu students is 54.17% (n = 52) with 45.83% (n = 44) of students being categorized as not depressed. According to binary logistic regression analysis, sleep quality and perceived social support emerged as significant variables that affect the state of depression after controlling for all the other variables in the model. In other words, students with good sleep quality have lower odds of being categorized as depressed compared to students with poor sleep quality. Similarly, students with high perceived social support have lower odds of depression compared to students with low perceived social support. This result is supported by Ghrouz et al. (2019) which indicated a significant relationship

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between poor sleep quality and depression among university students. In addition, Bukhari & Afzal (2017) also showed a very strong negative correlation between perceived social support and depression.

The results can be very helpful to universities in terms of designing mental health initiatives. Initiatives based on good sleep, counselling opportunities, and social support networks can be suggested for implementation. It is necessary to keep in mind that the study was done in one location, thus, the results need to be generalized carefully. Also, due to the design of the study, it would be incorrect to talk about any causal connections, since the study is purely observational. The future research involving more institutions and longitudinal data collection can prove the connection between sleep quality, social support, and depression among university students.

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