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Prevalence of Psychological Distress among the University Students: Logistic Regression Analysis with Machine Learning Algorithm

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ABSTRACT

The significance of mental health is paramount for the future achievements of students. The prolonged closure of educational institutions as a result of COVID-19 has notably impacted the mental health status of students. This study aims to explore the prevalence of psychological distress among university students and classify them using a machine learning algorithm. A cross-sectional study incorporating a convenience sample (n=435) was carried out among university students. The DASS-21 scale, along with a self-administered questionnaire, is utilized to quantify the intensity of psychological distress. The collected data was analyzed in four sectors: univariate, bivariate, multivariate analysis, and machine learning (ML). The prevalence of moderate to extremely severe depression, anxiety, and stress was 43.2%, 72.7%, and 32.7%, respectively. Logistics regression shows rurality, lower academic performance, fear of academic delay, not performing physical activities, having suicidal thoughts, and being in a relationship contribute to the risk of developing a higher level of psychological distress. The performance of correctly predicting the models for depression, anxiety, and stress was 75.36%, 84.18%, and 71.33%, respectively. The COVID-19 pandemic has the potential to affect students' mental well-being significantly. The findings suggest the importance of taking steps to recognize students who may be experiencing psychological distress and ensuring they receive appropriate support. The results of this study may provide valuable insights for future research and the development of psychological distress intervention programs.

1 Introduction

The COVID-19 epidemic has significantly increased public health concerns worldwide (Ahammed et al., 2021). It has had a profound effect on every sphere of life along with the mental health of all ages of people around the world, especially on all levels of students. The prevalence of sadness, anxiety, and stress in the population is seen as a critical indicator of mental health. Neglecting to identify and address these emotional issues will, regrettably, lead to heightened psychological morbidity, adversely affecting their jobs and lives (Al-Naggar& Al-Naggar, 2012). During the pandemic, a majority of university students are experiencing depression, anxiety, and stress. The COVID-19 pandemic originated in Wuhan, China, in December 2019. This unforeseen health calamity expanded worldwide to the point where the World Health Organization (WHO) was obliged to designate it as a worldwide pandemic on March 11, 2020 (WHO, 2020). As a result, several governments undertook a variety of anti-epidemic measures, such as prohibiting foreign citizens' travel (Zhai & Du, 2020), limiting public areas, and shutting down the whole transportation system (Chen & Yuan, 2020) in order to prevent the extremely infectious illnesses from spreading from person to person. Countries around are employing many strategies to reduce congestion, such as lockdowns, remote work policies, school closures, and the suspension of transport services. Numerous governments around have temporarily closed educational institutions to mitigate the transmission of the Covid-19 pandemic. This shutdown impacts over 90% of the world's student population (Singla et al., 2021). Bangladeshi schools have been closed from March 17, 2020, for 76 weeks till August 30, 2020. However, according to UNESCO, the country has experienced 61 weeks of complete school shutdown. Bangladeshi pupils have suffered larger educational losses than students in other regions of the world (Khan, 2021).

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To combat the spread of COVID-19, following a round of postponements, Bangladesh shuttered all of its educational institutions (schools, colleges, and universities) on March 17, and it stayed closed until October 3 (TBS Report, 2020, March 16; TBS Report, 2020, April 9; Ahmed, 2020, July 16; Star Online Report, 2020, August 27). Finally, in the last wave of COVID-19, On January 21, the government of Bangladesh announced a two-week closure of all schools, universities, and similar educational institutions until February 6, 2022 (Star Digital Report, 2022, February 2). In this situation, some private universities began offering online classes in April (Khan et al. 2021), while public universities and other educational institutions began offering online classes in July (Shovon, 2020, June 26). A significant number of students, especially those from impoverished rural areas, have expressed concern regarding their incapacity to participate in online classes due to insufficient equipment and internet connectivity. Some contend that online classes will intensify the "educational divide," when the most disadvantaged students, often enrolled in public institutions or universities on scholarships, lag considerably behind their peers due to limited access (Star Forum, 2020, July 17).

This bitter experience of continuous closure and lockdown of educational institutions with the uncertainty of academic and professional careers has had a multifaceted effect on the mental health of the students (Akhtarul Islam et al., 2020). After severe acute respiratory syndrome (SARS), a Canadian study on the consequences of quarantine found that quarantine has a long-term relationship with a high prevalence of anxiety and depression (Hawryluck, 2004). Quarantine and extended social distance, as well as isolation, cause emotions of stigma and deprivation, which lead to stress, anxiety, and depressive symptoms (Rehman et al., 2021; Cava et al., 2005; Hawryluck et al., 2004; Xiang et al., 2020; Zhang et al., 2020). The ongoing COVID-19 epidemic is wreaking havoc on people's mental health, causing anxiety, depression, stress, sleep difficulties, and panic (Gritsenko et al., 2021; Ahorsu et al., 2022; Savitsky et al., 2020; Roy et al., 2020; Xiao et al., 2020), as well as suicidal conduct in some cases (Goyal et al., 2020). Suicide and suicide attempts are also a significant concern among young people who are depressed (Pataki et al., 2015; Teh et al., 2015; Villatte et al., 2017; Mojs et al., 2012). Students demonstrated an increased susceptibility to mental health disorders during the pandemic, potentially impacting their psychological well-being (Main et al., 2011).

Research indicates that university and college students are susceptible to mental health challenges (Beiter et al., 2015). The increasing prevalence of depression, anxiety, and stress among students has garnered heightened public attention in Western cultures. This issue is predominantly unfamiliar in Eastern cultures. The results underscored the necessity of prioritizing the mental health of the younger generation (Bruffaerts et al., 2018). Several studies on mental health prevalence among university students have been undertaken throughout the world and in Bangladesh during the COVID-19 epidemic while educational institutions were fully or partially shut off (Ahammed et al., 2021; Akhtarul et al., 2020; Shovo et al., 2021; Lee et al., 2021; Ochnik et al., 2021; Hajimiri et al., 2020). It is crucial to inquire about the mental health of the students after the reopening of the university in the ongoing COVID-19 epidemic after a long period of closure of educational institutions. The study aimed to assess the psychological distress among university students after reopening educational institutions in Bangladesh and predict them using a machine learning algorithm.

1.1 Objectives of the Study

1. Assess the level of psychological distress (Stress, Anxiety, and Depression) among the university students.

2. To investigate the prevalence of suicidality among these students.

3. Investigate the association between Stress, Anxiety, and Depression and socio-demographic, academic, behavioral, and psychopathological aspects.

4. Examining the effects of several factors on the mental health of the students.

5. Classifying and evaluating performance with a machine learning method.

2 Methods and Materials

2.1 Data Source

The target group comprised students enrolled in various faculties at Mawlana Bhashani Science and Technology University (MBSTU), located in Santosh, Tangail.

2.2 Study Period

A cross-sectional study was performed during the second week of September 2022.

2.3 Data Collection

Data were gathered utilizing a prestructured self-administered questionnaire, comprising closed-ended inquiries regarding demographic details, socioeconomic status, and 21 items from the DASS-21 scale. Data were collected from 435 participants enrolled in their first to fifth academic year through face-to-face interviews and structured questionnaires.

2.4 Sampling Technique

This study utilized the convenience sampling technique. Data collection occurred three days following the announcement of the semester break, focusing on MBSTU students residing in their respective areas. Participants filled out the questionnaire under the supervision of the facilitators.

2.5 Variables

Demographic, socioeconomic, and related variables are considered independent variables. Three key outcome

variables, named as depression, anxiety, and stress levels of students. The variable mental health (depression, anxiety, and stress) measured using a widely used scale, DASS-21.

The DASS-21 has three self-report scales intended to assess the emotional states of depression, anxiety, and stress (Lovibond and Lovibond1995). This study's Bangla version of the DASS-21 scale is instrumented (Mamun et al., 2019). The 21 items on the DASS were scored on a scale of 0 to 3, with three representing "applies to me very much" and zero representing "does not apply to me at all." Using the DASS manual as a guide, the students were asked to rate how much they had coped with each event over the previous week and then multiply their responses by two. The results for the subscales of depression, anxiety, and stress were categorized as mild, moderate, severe, or extremely severe (highest values).

2.6 Analyses

Firstly, we performed a univariate analysis of the study variables using frequency distribution. For bivariate and multivariate analysis, we label the response variable into two categories (Hosmer et al., 2000), such as Depression = "Yes" and "No," Anxiety = "Yes" and "No," and Stress = "Yes" and "No." Here, the levels from mild to extreme severe = 'Yes' mean the students are suffering from mental distress, and normal = 'No' are considered mentally perfect.

2.7 Machine Learning Algorithm

A machine learning algorithm is trained on large datasets to recognize patterns, and its performance improves as it is exposed to more data. This allows systems to generalize their learning to new, unseen data, leading to applications like weather forecasting, image recognition, autonomous vehicles, and fraud detection. Different machine learning algorithms are available in literature. In this study the logistic regression is applied as a method of machine learning approach. The performances of the logistic regression are evaluated based on accuracy, precision, sensitivity, specificity and area under curve (AUC).

2.7.1 Logistic Regression Model

Logistic regression is a supervised machine learning algorithm used for classification problems. Unlike linear regression which predicts continuous values it predicts the probability that an input belongs to a specific class. It is used for binary classification where the output can be one of two possible categories such as Yes/No, True/False or 0/1. In a regression problem, the mean value of the outcome variable, given the value of the independent variable, is called the key quantity. This quantity is also called the conditional mean, and it will be mathematically expressed as $E(Y \mid X)$, where $Y= y_1,y_2,...,y_p$ denotes the outcome variable and $X= x_1,x_2,...,x_p$ denotes a value of the independent variable. To simplify notation, we will use the quantity $\pi(X)=E(Y \mid X)$, to represent the conditional mean when the logistic regression is used.

The specific form of logistic regression model. This model is given below:

$$\pi(X)=P[(Y=1|X)]$$
$$=\frac{e^{(\beta 0+\beta 1x)}}{1+e^{(\beta 0+\beta 1x)}}$$
$$\text{And, } 1-\pi(X)=P[(Y=1|X)]$$
$$=\frac{e^{(\beta 0+\beta 1x)}}{1+e^{(\beta 0+\beta 1x)}}$$

A transformation of $\pi(X)=P[(Y=1 \mid X)]$ which is central to the study of logistic regression, is the logistic transformation. That is defined in terms of

$$=\frac{e^{(\beta 0+\beta 1x)}}{1+e^{(\beta 0+\beta 1x)}}$$

as follows,

$$g(x)=\ln\left(\frac{\pi(x)}{1-\pi(x)}\right)$$
$$=\ln(e^{\beta 0+\beta 1x})$$
$$=\beta_0+\beta_{1x}$$

2.7.2 Area Under the ROC Curve (AUC)

The Area Under the Receiver Operating Characteristic Curve (AUC-ROC) is a widely used metric for evaluating the performance of classification models. The ROC curve itself is a graphical representation of a classifier's ability to discriminate between classes, obtained by plotting the true positive rate (sensitivity) against the false positive rate (1 - specificity) across different decision thresholds. The AUC summarizes this curve into a single value ranging from 0 to 1, where 0.5 indicates performance no better than random chance, and values closer to 1.0 reflect stronger discriminative ability. An AUC of 0.7–0.8 is generally considered acceptable, 0.8–0.9 excellent, and greater than 0.9 outstanding. Because it is threshold-independent, AUC is especially valuable when comparing models across different settings or when class imbalance exists (Fawcett, 2006; Bradley, 1997).

2.7.3 Performance Parameters

Confusion matrix: A confusion matrix, which displays actual against predicted classifications, is a technique for assessing the effectiveness of classification models. It aids in the computation of several metrics, including precision, specificity, sensitivity, and accuracy.

Actual	**Predicted**	
	Positive	Negative
Positive	True Positive (TP)	False Negative (FN)
Negative	False Positive (FP)	True Negative (TN)

Accuracy: determines the percentage of cases that are correctly classified.

$$\text{Accuracy}=\frac{(TP+TN)}{(TP+TN+FP+FN)}$$

Confidence Interval: offers a range that, with 95% certainty, represents the model's actual accuracy.

$$CI=Accuracy\pm1.96\times\sqrt{\frac{(Accuracy\times(1-Accuracy)}{n}}$$

Where, n = Total sample size

Sensitivity (Recall or True Positive Rate, TPR): Evaluates the model's accuracy in identifying real positive cases.

$$Sensitivity=\frac{TP}{TP+FN}$$

Specificity (True Negative Rate, TNR): Evaluates the model's accuracy in identifying real negative situations.

$$Specificity=\frac{TN}{TP+FN}$$

Precision (Positive Predictive Value, PPV): Calculates the percentage of accurately predicted positive instances out of all predicted positive cases.

$$Precision=\frac{TP}{TP+FP}$$

Levels	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely Severe	28+	20+	34+

2.8 Software and Technical Support

SPSS version 25, R version 4.2.3 and MS Excel 2019.

3 Result and Discussion

The mean score of the depression level according to the DASS-21 scale was found to be 12.54 with a standard deviation of 8.29, and its minimum and maximum scores were 0 and 40, respectively. The minimum and maximum values for anxiety and stress were found to be similar, i.e., the minimum value was 0, and the maximum value was 42 in both cases. However, their mean scores and standard deviations slightly differed from each other.

Table2: Descriptive statistics of the levels of Depression, Anxiety and Stress.

Levels	Depression (n=435)	Anxiety (n=435)	Stress (n=435)
	Frequency (%)	Frequency (%)	Frequency (%)
Normal	155 (35.6)	98 (22.5)	242 (56.6)
Mild	92 (21.1)	21 (4.8)	51 (1.7)
Moderate	119 (27.4)	109 (25.1)	62 (14.3)
Severe	45 (10.3)	58 (13.3)	44 (10.1)
Extremely severe	24 (5.5)	149 (34.3)	36 (8.3)
Mean ± SD	12.54 ± 8.29	15.63 ±10.57	14.87 ±10.74
Maximum	40	42	42
Minimum	0	0	0

As can be seen in Table 2, Out of the total respondents (n=435), 64.3% of the students exhibit signs of depression in varying degrees, whereas 35.6% are normal. About 15.8% of students are suffering from severe and extremely severe levels of depression, while 21.1% and 27.45% are from mild and moderate levels of depression. In the case of anxiety, about 72.7% of students are suffering from anxiety out of 435 students, whereas the normal and mild level of anxiety is 27.3%. It is seen that a mass amount (about 34.3%) of students' anxiety level was extremely severe level. On the other hand, most students' stress levels (56.6%) were normal. Among the total number of respondents (n=435), about 32.7% of students suffer from stress, whereas 8.3% suffer from extreme stress. The same results observed in other studies (Kamboj et al., 2021; Wahed & Hassan, 2016; Nadeem et al., 2017; Hamaideh et al., 2021; Alim et al., 2017).

Figure 1: Correlation matrix among Depression, Anxiety and Stress, and claustration by Sex. *** refers p-value < 0.001

The correlation matrix shown in Figure 1 explains that the overall scores of Depression, Anxiety, and Stress are positively correlated with each other, and the correlation among them is highly significant. Positive and significant correlations of Depression, Anxiety, and Stress by sex category are seen, and the box plot depicted several levels of mental distress by sex.

It is seen from the Table 3 that depression has significant relationship with the permanent place of residence, academic performance, engaged with internet for entertainment, academic delay, study hours daily in pandemic. On the other hand, the faculty of students,

age of students, academic results, permanent place of residence, current living place, family status, using internet for study, using internet for other purposes have significant association with anxiety of the students in pandemic. Moreover, the stressed were significantly related with relationship status, study hours per day, teachers' patronage, practicing physical exercise.

Table 3: Association between Psychological by Several Factors

Variable	Depression			Anxiety			Stress		
	No (%)	Yes (%)	p	No (%)	Yes (%)	P	No (%)	Yes (%)	p
Faculty									
Science	71(52.2)	65(47.8)		51(37.5)	85(62.5)		98(72.1)	38(27.9)	
Engineering	43(58.9)	30(41.1)		17(23.2)	56(76.7)		51(49.2)	22(30.1)	
Social Science	33(61.1)	21(38.9)	0.607	7(13)	47(87)	0.004	34(63)	20(37)	0.398
Life Science	100(58.1)	72(41.9)		44(25.6)	128(74.4)		110(64)	62(36)	
Gender									
Male	113(54.3)	95(45.7)		62(29.8)	146(70.2)		144(69.2)	64(30.8)	
Female	134(59)	93(41)	0.323	57(25.1)	170(74.9)	0.272	149(65.6)	78(34.4)	0.425
Age									
18-21	52(52.5)	47(47.5)		17(17.2)	82(82.8)		67(67.7)	32(32.3)	
22-23	66(54.5)	55(45.5)	0.390	31(25.6)	90(74.4)	0.012	79(65.3)	42(34.7)	0.843
24-28	129(60)	86(40)		71(33)	144(67)		147(68.4)	68(31.6)	
Relationship Status									
Married	40(54.8)	33(45.2)		20(27.4)	53(72.6)		48(65.8)	25(34.2)	
Single	186(59.2)	128(40.8)		92(29.3)	222(70.7)		223(71)	91(29)	
In a Relationship	21(43.8)	27(56.3)	0.122	7(14.6)	41(85.4)	0.103	22(45.8)	26(54.2)	0.002
Academic Performance									
Resultnotpublish	24(48)	26(52)		7(14)	43(86)		32(64)	18(36)	
<3.00	27(56.3)	21(43.8)		8(13.1)	40(83.3)		31(64.6)	17(35.4)	
3.00-3.49	113(52.8)	101(47.2)		58(27.1)	156(72.9)		136(63.6)	78(36.4)	
>3.49	83(67.5)	40(32.5)	0.034	46(37.4)	77(62.6)	0.004	94(76.4)	29(23.6)	0.092
Permanent place of Residence									
Urban	121(63.7)	69(36.3)		61(32.1)	129(67.9)		132969.5)	58(30.5)	
Rural	126(51.4)	119(48.6)	0.010	58(23.7)	187(76.3)	0.05	161(65.7)	142(34.3)	0.407
Living Place of Residence									
Residential	145(59.4)	99(40.6)		81(33.2)	163(66.8)		170(69.7)	7430.3)	
Non-residential	102(53.4)	89(46.6)	0.208	38(19.9)	153(80.1)	0.002	123(64.4)	68(35.6)	0.258
Family Status									
Lower class	29(50.9)	28(49.1)		7(12.3)	50(87.7)		33(57.9)	24(42.1)	
Middle class	200(57.8)	146(42.2)	0.619	108(31.2)	238(68.8)	0.002	240(69.4)	106(30.6)	0.192
Upper class	18(56.3)	14(43.8)		4(12.5)	28(87.5)		20(62.5)	12(37.5)	
Spending Time in Pandemic									
Study	80(58)	58(42)		32(23.2)	106(76.8)		98(71)	40(29)	
Earning	17(53.1)	15(46.9)		9(28.1)	23(71.9)		24(75)	8(25)	
Internet	62(54.9)	51(46.9)	0.919	25(22.1)	88(77.9)	0.069	64(56.6)	49(43.4)	0.041
Others	88(57.9)	64(42.1)		53(34.9)	99(65.1)		107(70.4)	45(29.5)	
Studying Time in Pandemic									
Study	80(58)	58(42)		32(23.2)	106(76.8)		98(71)	40(29)	
Earning	17(53.1)	15(46.9)	0.919	9(28.1)	23(71.9)	0.069	24(75)	8(25)	0.041
Internet	62(54.9)	51(46.9)		25(22.1)	88(77.9)		64(56.6)	49(43.4)	
Others	88(57.9)	64(42.1)		53(34.9)	99(65.1)		107(70.4)	45(29.5)	
Studying Time in Pandemic									

Not at all	67(48.2)	72(51.8)	0.006	43(30.9)	96(69.1)	0.472	93(66.9)	46(33.1)	0.458
<2 hours	110(64.3)	61(35.7)		45(26.3)	126(73.7)		113(66.1)	58(33.9)	
2-5 hours	54(62.1)	33(37.9)		24(27.6)	63(72.4)		57(65.5)	30(43.5)	
>5hours	16(42.1)	22(57.9)		7(18.6)	31(81.6)		30(78.9)	8(21.1)	
Type of Study Respondents' Involved with									
Academic	85(53.8)	73(46.2)	0.834	28(17.7)	130(82.3)	0.003	101(63.9)	57(36.1)	0.775
Job	73(59.8)	49(40.2)		39(32)	83(68)		86(70.5)	36(29.5)	
Research	16(61.5)	10(38.5)		9(34.6)	17(65.4)		19(73.1)	7(26.9)	
Training	11(52.4)	10(47.6)		3(14.3)	18(85.7)		14(66.7)	7(33.3)	
Others	62(57.4)	46(42.6)		40(37)	68(63)		73(67.6)	35(32.4)	
Using Internet for Study									
Yes	99(55.3)	80(44.7)	0.604	39(21.8)	140(78.2)	0.029	123(68.7)	86(31.3)	0.613
No	148(57.8)	108(42.2)		80(31.3)	176(68.8)		170(66.4)	86(33.6)	
Using Internet or Entertainment									
Yes	191(59.7)	129(40.3)	0.041	84(26.3)	236(73.8)	0.388	269(65.3)	111(34.7)	0.129
No	56(48.7)	59(51.3)		35(30.4)	80(69.6)		84(73)	3127)	
Using Internet Most for									
Study	30(45.5)	36(54.5)	0.485	14(21.2)	52(78.8)	0.018	45(68.2)	21(31.8)	0.384
Research	17(63)	10(37)		9(33.3)	18(66.7)		23(85.2)	4(14.8)	
You tube	88(59.1)	61(40.9)		46(30.9)	103(69.1)		99(66.4)	50(33.6)	
Facebook	95(58.6)	67(41.4)		35(21.6)	127(78.4)		108(66.7)	54(33.3)	
Games	5(55.6)	4(44.4)		3(33.3)	6(66.7)		5(55.6)	4(44.4)	
others	12(54.5)	10(45.5)		12(54.5)	10(45.5)		13(59.1)	9(40.9)	
Academic Delay									
Mild	68(70.1)	29(29.9)	0.004	25(25.8)	72(74.2)	0.268	70(72.2)	27(27.8)	0.075
Moderate	120(55.8)	95(44.2)		66(30.7)	149(69.3)		150(69.8)	65(30.2)	
Severe	59(48)	64(52)		28(22.8)	95(77.2)		73(59.3)	50(40.7)	
Teacher Patronage									
Yes	126(61.5)	79(38.5)	0.063	50(24.4)	155(75.6)	0.190	148(72.2)	57(27.8)	0.042
No	121(52.6)	109(47.4)		69(30)	161(70)		145(63)	85(37)	
Physical Exercise									
Yes	107(61.8)	66(38.2)	0.083	54(31.2)	119(68.8)	0.142	130(75.1)	43(24.9)	0.005
No	140(53.4)	122(46.6)		65(24.5)	197(75.2)		163(62.2)	99(37.8)	

It is seen from the Table 3 that depression has significant relationship with the permanent place of residence, academic performance, engaged with internet for entertainment, academic delay, study hours daily in pandemic. On the other hand, the faculty of students, age of students, academic results, permanent place of residence, current living place, family status, using internet for study, using internet for other purposes have significant association with anxiety of the students in pandemic. Moreover, the stressed were significantly related with relationship status, study hours per day, teachers' patronage, practicing physical exercise.

The table 4 presented the multiple logistic regression for depression, anxiety and stress separately. The variable which are significant in the bivariate analysis are considered for logistic regression. The categories of the variables are statistically significant are indicated by asterisk (*) sign and their odds with reference categories are shown in the table for each dependent variable. The logistic regression model for depression was run with eight variables. The comprehensive model encompassing all predictors was statistically significant (χ^2= 69.42, P-value<.001, demonstrating its capability to differentiate between respondents classified as having moderate to extremely severe depression and those who were not reported as such. The regression model for anxiety was run with thirteen variables and model was statistically significant (χ^2=97.165 P-value<.001). The overall model for dependent variable is also statistically significant at 5% level of significance (χ^2=46.005, P-value<.001) indicating that the model was able to distinguish between respondents who were reported and who were not reported moderate to extremely severe stress.

Table 4: Logistic Regression Analysis of Psychological Distress among Students

Variables	Category	Depression		Anxiety		Stress	
		P	OR	P	OR	P	OR
Faculty	Engineering Vs Science®			0.57	1.27		
	Social Science Vs Science®			0.02*	3.24		
	Life Science Vs Science®			0.29	1.37		
CGPA	Not published Vs >3.49®	0.03*	2.35	0.56	1.42		
	<3.00 Vs >3.49®	0.22	1.62	0.02*	3.05		
	3.00-3.49 Vs >3.49®	0.01*	2.04	0.02*	1.94		
Teacher Patronage	No Vs Yes®					0.04*	1.56
Fear of Academic Delay	Moderate Vs Mild®	0.03*	1.91				
	Severe Vs Mild®	0.00*	2.78				
Relationship status	Married Vs In relation®					0.13	0.53
	Single Vs In relation®					0.01*	0.40
Permanent residence	Urban Vs Rural®	0.03*	1.59	0.04*	1.68		
Family status	Lower class Vs Upper class®			0.54	0.61		
	Middle class Vs Upper class®			0.06	0.27		
Relationship pressure	Yes Vs No®			0.04*	2.29	0.09	1.64
Present living place	Non-residential Vs Residential®			0.48	1.27		
Study time in pandemic	<2 hours Vs Not at all®	0.00*	0.47				
	2-5 hours Vs Not at all®	0.01*	0.46				
	>5 hours Vs Not at all®	0.50*	1.32				
Type of study involved during the Pandemic	Job Vs Academic®			0.01*	0.41		
	Research Vs Academic®			0.56	0.72		
	Training Vs Academic®			0.37	1.89		
	Others Vs Academic®			0.04	0.50		
Using internet for study	Yes Vs No®			0.10	1.54		
Reason for using internet most	Study Vs Others®			0.02*	4.25		
	Research Vs Others®			0.28	2.25		
	You tube Vs Others®			0.04*	3.27		
	Facebook Vs Others®			0.01*	4.20		
	Games Vs Others®			0.29	2.88		
Using internet for entertainment	No Vs Yes®	0.02*	1.80				
Physical exercise	No Vs Yes®					0.01*	0.54

Suicidal ideation	No Vs Yes®	0.03*	0.51	0.05*	0.43	0.00*	0.42
Suicidal wishes	No Vs Yes®	0.27	0.57	1.00	0.00	0.24	0.60
Suicidal attempts	No Vs Yes®	0.06	0.12				
Age of Respondents	22-23 years Vs <= 21 years®			0.90	1.06		
	>=24 years Vs <= 21 years®			0.42	0.76		
Goodness of Fit Test		χ^2= 8.61 P=0.38		χ^2=3.74 P=0.88		χ^2=1.40 P=0.97	

Table 5: Performance of several methods of Machine learning (ML) approach

Performance	Depression	Anxiety	Stress
Accuracy	0.7109	0.7969	0.6953
95% CI	(0.6242, 0.7876)	(0.7167, 0.8628)	(0.6078, 0.7735)
Sensitivity	0.8169	0.5789	0.7629
Specificity	0.5789	0.8889	0.4839
Precision (PPV)	0.7073	0.6875	0.8222
AUC	0.7536	0.8418	0.7133

Table 5 depicted the output of the logistic regression (LR) algorithm of machine learning (ML) of the dependent variables depression, anxiety and stress. The model for depression showed that the accuracy of test data set is 71.09% with sensitivity 81.69%, specificity 57.89% and precision 70.79%. The area under curve (AUC) value under the ROC curve (Figure 2) was 0.7536 indicated the model's capacity to discriminate is good. The algorithm shown 79.69% accuracy for LR model of anxiety and the AUC score 0.8418 means that the model is 84.18% ability to correctly classified the students who are suffering from anxiety and who are not. The machine learning algorithm for stress provided about 70% accuracy with sensitivity, specificity and precision 76.29%, 48.39% and 82.22% respectively. The AUC value is 0.713 meaning that the resulting score represents the model has a good performance ability to predict classes correctly.

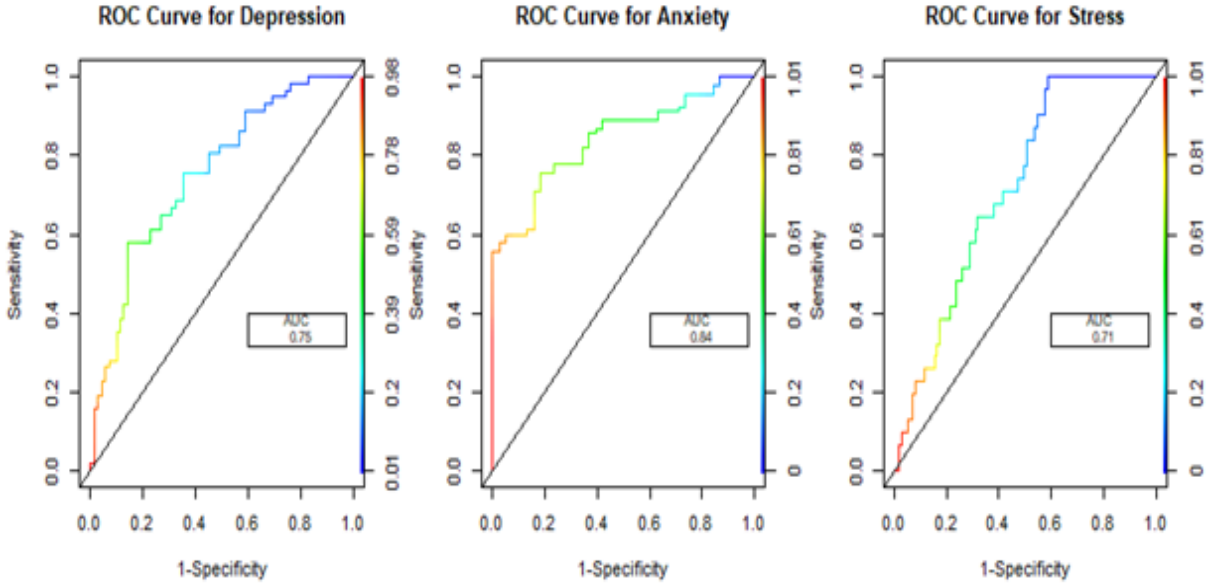

Figure 2: Receiver Operating Characteristics (ROC) Curve.

4 Conclusion

Significant anxiety and mental health problems have been brought on by the quick spread of COVID-19 and the deaths that followed. The dread of contracting the virus or sickness when a disease is pandemic harms people's mental health and causes despair, anxiety, and stress. Governments and healthcare providers were making greater efforts to raise public knowledge of COVID-19 prevention, but widespread mental diseases, including fear, depression, anxiety, and stress, were still plaguing people everywhere. Although this study has limitations, it has given the first empirical evidence of the moderate prevalence of mental health problems and high prevalence of suicidal behavior after the re-opening of universities. Anxiety is found to be highly prevalent among students. Academic performance, fear of academic delay, relationship status, rurality, and suicidal thoughts

are contributing to experiencing mental health problems. This study's findings may help to improve mental health-related activities and influence ideas for running further longitudinal studies to find causal relationships between psychological distress and a considerable amount of academic, socio-economic, demographic, and habitual variables. Preventive initiatives should be taken to alleviate this high prevalence of psychological disorders among students. There should be an established psychological counseling unit at the university where students can connect to psychiatrists personally or via any online platform. These services should be provided with minimal cost and efficiency—the gradual recovery of the damage caused during the COVID-19 pandemic to the student's studies.

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