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Research article

Depressive symptoms associated with loneliness and physical activities among graduate university students in Bangladesh: findings from a cross-sectional pilot study

Satyajit Kundu [a,*,1], Jhantu Bakchi [b,1], Md. Hasan Al Banna [c], Abu Sayeed [d], M. Tasdik Hasan [e,f], Mohammad Tazrian Abid [g], Subarna Ghosh [h], Nobonita Sarker [i], Md Shafiqul Islam Khan [c]

[a] Department of Biochemistry and Food Analysis, Patuakhali Science and Technology University, Patuakhali, 8602, Bangladesh
[b] Department of Public Health, North South University, Dhaka, Bangladesh
[c] Department of Food Microbiology, Patuakhali Science and Technology University, Patuakhali, 8602, Bangladesh
[d] Department of Post-Harvest Technology and Marketing, Patuakhali Science and Technology University, Patuakhali, 8602, Bangladesh
[e] Department of Primary Care & Mental Health, University of Liverpool, Liverpool, UK
[f] Public Health Foundation, Bangladesh (PHF,BD), Dhaka, Bangladesh
[g] Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali, 8602, Bangladesh
[h] Department of Public Health Nutrition, Primeasia University, Dhaka, 1216, Bangladesh
[i] Department of Geography and Environmental Studies, University of Chittagong, Chittagong, Bangladesh

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ABSTRACT

In low-resource settings like Bangladesh, there is a dearth of research on the mental health of university students. This pilot study aimed to identify the prevalence of depressive symptoms, loneliness, and physical activities as well as the associated factors of depressive symptoms among graduate students in a public university of Bangladesh.

This cross-sectional study was carried out among 323 graduate students between February 2019 and May 2019. By the convenience sampling technique, data were collected by a pretested, structured questionnaire. Depressive symptoms were assessed by the validated Patient Health Questionnaire-9 (PHQ-9) tool with a cut-off score of ≥10 vs. less; University of California, Los Angeles (UCLA) loneliness scale was applied to assess loneliness, International Physical Activity Questionnaire (IPAQ) scale was used to measure physical activity level.

The overall prevalence of depressive symptoms was 52% and about 43% of participants felt most lonely. About 32.8% of students were involved in low physical activity. Being female, from lower income families, having poor academic performance, experiencing shorter sleep time, lower physical activity, and being lonely were potential risk factors for depressive symptoms among graduate university students. A positive correlation was found between loneliness and depressive symptoms of students ($r = 0.367$, $p < 0.001$).

The higher prevalence of depressive symptoms among Bangladeshi graduate university students suggests the need for situation analysis, confirmatory clinical diagnosis, in-depth qualitative explorations, and large-scale surveys to explore the burden of such disorders and design appropriate low-intensity interventions like implementing student counselling service, offering mental assistance or other mental health support program in the country.

1. Introduction

Depression is one of the most common mental health problems for students [1, 2, 3]. It is widely recognized that university students are one of the groups particularly prone to depression [4]. University students adjust a critical transitory period whilst migrating from late adolescence to adulthood and making many major life decisions that might trigger several stressors [5, 6]. These pressures make them vulnerable to depression & similar issues [4, 5, 6]. The prevalence of depression in university students is rising [1, 2, 3]. Among university students,

* Corresponding author.
E-mail address: satyajitnfs@gmail.com (S. Kundu).
[1] Satyajit Kundu and Jhantu Bakchi contributed equally to this study.

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depression is extremely prevalent and comprehensive problem across the countries [7, 8, 9]. The prevalence of depression among university students is comparatively high, estimated between 10.2% [10] and as high as 71.2% [11].

Previous studies revealed that many factors that might increase students' vulnerability to depression [12], for example, are stressful socio-demographic factors [3, 6]; loneliness [13]; physical inactivity [14, 15, 16]; sleeping problems [15, 17]. Depression and loneliness are distinct but closely related, mutually reinforcing phenomena [4]. Both feelings of loneliness [18, 19] and depressive symptoms [20] are related to a number of negative consequences. For university students, depression [21, 22] is strongly linked to poor academic achievements and drop-out. Besides, several studies also revealed that praying has an important role on reducing the depressive symptoms [23]. Previous literature suggests that those who are involved in regular prayer are less depressed than those who are not involved in daily praying [24, 25]. Dion and Giordano conducted a study among university students and found a significant sex differences in the self-reported depressive symptoms, where women were more depressed than men [26].

In low-resource settings like Bangladesh, there is a dearth of research on the mental health of university students. Previous studies in Bangladesh have shown that the prevalence of depression was 69.5% and 39% respectively among university and medical students, with unsatisfactory sleep quality, suicidal ideation and lack of physical activity being the major risk factors for depression [15, 27]. But no study described the relationship between depression and loneliness in the country. Also, mental health of graduate students never received adequate attention before though a high unemployment rate, an uncertain future has a contributory role in the development of depressive symptoms among graduate students in Bangladesh [28]. Several previous Bangladeshi studies also found that low socio-economic status was also a significant risk factor for depression among university students [15, 16].

We hypothesized that (i) loneliness, lower physical activities, and short sleep duration, and (ii) socio-demographic and academic performances are significantly associated with depressive symptoms of graduate university students in Bangladesh. Thus, this pilot study was conducted to add to the existing limited evidence by reporting the prevalence of depressive symptoms, loneliness, physical activities, and associated factors of depressive symptoms among graduate students in a public university in Bangladesh. We anticipate these novel findings will provide new insights on the issue, initiate research discussion, further exploration & design of appropriate interventions to support them.

2. Materials and methods

2.1. Participants, procedure and sampling

This cross-sectional study was carried out among 323 graduate students from Patuakhali Science & Technology University, Patuakhali, Bangladesh between February 2019 and May 2019. All the participants were face-to-face interviewed by the trained research staffs to collect data using a pre-tested, structured questionnaire. The questionnaire had five parts-a) demographic information includes academic performance and health & personal behavioral measures; b) Nine-item Patient Health Questionnaire (PHQ-9) depression scale to assess the depressive symptoms; c) University of California, Los Angeles (UCLA) loneliness scale to measure the status of loneliness; d) Dutch short version of the International Physical Activity Questionnaire (IPAQ) for assessing physical activity practices of the participants & e) Questions on total sleep time. The pre-study questionnaire was written in English, and two bilingual researchers translated it into the local language (Bengali). Another independent bilingual expert back-translated the questionnaire to check for consistencies and to prevent any bias.

The sample size was estimated based on a single population proportion formula with the assumption of 95% confidence interval (1.96), 5% margin of error (0.05), and taking 30% proportion of university students with depressive symptom [29]. The final sample size was 323. The convenience sampling method was used to select the respondents and finally, each participant took approximately 20–25 min to complete the questionnaire. All the participants were adequately informed and aware of the date and time of the interview with a clear indication of the implication and purpose of the study. The university was completely residential with 5 halls. The target population of this study was graduate students residing in university dormitories ('halls'). Male research staffs were assigned to male dormitories, and female research staffs were assigned to female dormitories to collect data considering gander sensitivities. As the final sample size was 323, the research staffs tried to collect data until they got a total of 323 complete responses. Finally, they got 323 complete responses from 347 participants and then they stopped data collection. Thus, the final response rate was 93.08% in the present study.

2.2. Measures

2.2.1. Demographic information

Demographic information including age, sex (male or female), occupation of parents, educational qualification of parents, family monthly income ($\leq$20000 BDT or $>$20000 BDT), academic performance (poor or good), having partner/close friend (yes or no), habit of daily prayer (yes or no), having chronic disease (yes or no) of participants were collected.

2.2.2. Depressive symptoms

To describe depressive symptoms, PHQ-9 scale was used which contains 9 individual questions. For the PHQ-9 Scale, the result of each question was coded by "Not at all" (0) to "Nearly every day" (3) like; "Not at all" as 0; "Several days' as 1; "More than half the days' as 2 and 'Nearly every day" as 3. The PHQ-9 is a validated tool used to screen for depressive symptoms [30]. Besides the PHQ-9 scale assesses not only major depression but also the onset of depressive disorder in general population epidemiological studies [31]. The 9-item scale of the Bangla Patient Health Questionnaire [32] was used to assess the level of depression which was also used in another study in Bangladesh among university students [15]. The summed score was categorized into two categories. Those who made a score of less than 10 were described as having no depressive symptoms and those who made a score of 10 or above were categorized as having depressive symptoms (the cut-off point was $\geq$10 vs. less) [33]. The internal consistency of the scale was high (Cronbach's $\alpha = 0.76$).

2.2.3. Loneliness

Loneliness was assessed with the UCLA Loneliness Scale Version 3 [34,35], containing 20 questions in which 11 negatively worded (lonely) and 9 positively worded (non-lonely) items. Respondents were asked to rate each item on a scale ranging from 1 (never) to 4 (often). The scale has a possible total score of 20–80 points, with no identified cut-off score that defines loneliness [35, 36]. Even so, we categorized the level of loneliness as less lonely with o to 47 points and most lonely with 48–77 points which was also followed by a study [36]. After reverse coding of several items, a higher score on the scale reflects more feelings of loneliness. The instrument has been demonstrated to have good construct validity [34]. The reliability of the scale in this sample was very high (Cronbach's $\alpha = 0.91$).

2.2.4. Physical activity

Physical activity was measured using the Dutch short version of the International Physical Activity Questionnaire (IPAQ) [37]. This self--report questionnaire consisting of 27 items was used to assess physical activity levels [38, 39, 40]. According to the Metabolic Equivalent of Task (MET) minutes [38], participants were categorized into 1 of 3 categories [40]; High: at least 3000 MET-minutes/week, Moderate: at least

600 MET-minutes/week, Low: those who do not meet criteria for the categories High or Moderate.

2.2.5. Total sleep time

Total sleep time was measured using the question: "How many hours a night on average did you sleep during the past 4 weeks? In order to investigate the effect of short or long sleep time versus "normal" sleep time, we divided sleep duration into long (9 h or more), normal (7 and 8 h), and short (6 h or less). The categories were also followed by several studies conducted among university students [15, 16, 41, 42].

2.3. Statistical analyses

Data were analyzed using SPSS Version 23.0. Descriptive statistics, such as frequency counts, percentages, mean, and standard deviation, were used to identify the demographic and other characteristics of the respondents. Chi-square test was employed to identify the association between depressive symptoms and other variables. Binary logistic regression (enter model method) was employed to identify the factors associated with the depressive symptom of the participants. Multicollinearity was checked with the variance inflation factor (VIF). The final model selection was done by using the Hosmer and Lemeshow goodness of fit test (chi-square = 12.082; df = 8; p = 0.148) and the significance of variables was assessed with the Wald test. Variables were included in the binary logistic regression when the bivariate distribution indicated the statistical significance with a p value of less than 0.2. Pearson bivariate correlation and scatter plot were used to explore the relationship between the severity of depressive symptoms and the severity of loneliness. All significance level quoted was two-sided and *p*-values < 0.05 were considered to be statistically significant.

2.4. Ethics

The research was carried out in accordance with the guidelines of the Helsinki declaration. The study protocol was approved by the ethical review board of the Patuakhali Science and Technology University. It was mentioned that anonymity and confidentiality would be maintained and that the participation of students was voluntary. The participants were also informed that data would be used only for research purposes and the matter that the study had no personal implications. Written informed consent was obtained from all participants. The participants only who were willing to participate and filled written consent were given copies of the questionnaire. The research protocol was reviewed and approved by the Research Ethical Committee (REC) of the Department of Food Microbiology, Patuakhali Science and Technology University, Bangladesh (Approval No: FMB:29/11/2018:01).

3. Results

The mean (SD) age of the respondents was 22.66 years (0.927). Out of study participants, 65.6% were males. Almost half (44.3%) of the respondents' fathers were involved in a job whereas most of the mothers (81.7%) were housewives. Respondents' monthly family income was almost equally distributed in which almost half (49.8%) of their families earned above 20000 BDT. More than half of the participants' fathers' (74.6%) and mothers' (55.7%) educational level was higher secondary or above. Over 60% of the students' academic performance was good (CGPA $\geq$3.00) and 76.2% of students with poor academic performance had depressive symptoms (Table 1).

In the present study, the mean score of the PHQ-9 scale was 9.72 (SD = 4.95) with a range between 0 and 27. The overall prevalence of depressive symptoms was 52% (95% Confidence Interval: 46.7–57.3). The mean score of the UCLA loneliness scale was 44.08 (SD = 12.67). Almost half (43.3%) of the participants were most lonely. About 32.8% of students were involved in low physical activity, whereas 27.6% and almost 40% of students were involved in moderate and high physical activity, respectively. In the present study, about 39.3% and 8.4% of participants' total sleep time a day was short and long, respectively (Figure 1). Bolded values indicate statistical significance ($p < 0.05$).

Table 1. Distribution of depressive symptoms according to sociodemographic characteristics of the participants (n = 323).

Variables	Total; n (%)	Depressive symptoms		Chi-square test	
		No; n (%)	Yes; n (%)	χ^2 (df)	*p* value
Age (Mean ± SD)	22.66 ± 0.93	22.79 ± 0.93	22.53 ± 0.91		
Sex					
Male	212 (65.6)	114 (53.8)	98 (46.2)	**8.274 (1)**	**0.004**
Female	111 (34.4)	41 (36.9)	70 (63.1)		
Fathers' occupation					
Job	143 (44.3)	75 (52.4)	68 (47.6)	2.045 (1)	0.153
Non-Job	180 (55.7)	80 (44.4)	100 (56.6)		
Mothers' occupation					
Housewife	264 (81.7)	122 (46.2)	142 (53.8)	1.825 (1)	0.177
Job	59 (18.3)	33 (55.9)	26 (44.1)		
Fathers' education level					
< Higher Secondary	82 (25.4)	33 (40.2)	49 (59.8)	2.640 (1)	0.104
≥ Higher Secondary	241 (74.6)	122 (50.6)	119 (49.4)		
Mothers' education level					
< Higher Secondary	143 (44.3)	63 (44.1)	80 (55.9)	1.589 (1)	0.207
≥ Higher Secondary	180 (55.7)	92 (51.1)	88 (48.9)		
Family's monthly income					
≤20000 BDT	162 (50.2)	66 (40.7)	96 (59.3)	**6.838 (1)**	**0.009**
>20000 BDT	161 (49.8)	89 (55.3)	72 (44.7)		
Academic performance					
Poor (CGPA <3.00)	126 (39.0)	30 (23.8)	96 (76.2)	**48.385 (1)**	**<0.001**
Good (CGPA ≥3.00)	197 (61.0)	125 (63.5)	72 (36.5)		

χ^2 = Chi-square value. Bolded values indicate statistical significance ($p < 0.05$)

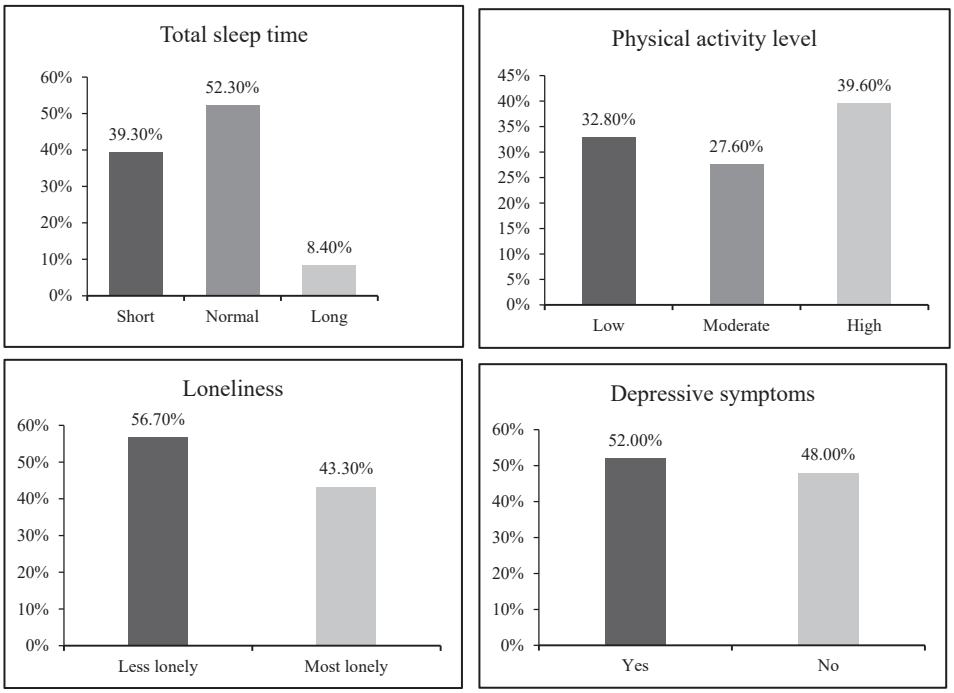

Figure 1. Prevalence of depression, and status of loneliness, physical activity and total sleep time of graduate university students.

Most of the participants (72.1%) had their partner or close friend and the vast percentage (92.6%) of the participants had no chronic diseases. Almost half (47.4% %) of the participants did not have a habit of daily prayer, of them, 61.4% had depressive symptoms, compared to 43.5% of participants who prayed daily. About 63.8% of students with short sleep time and 61.3% of students involved in lower physical activity had depressive symptoms. Of total, 67.9% of students with the most loneliness had depressive symptoms (Table 2).

The participants with depressive symptoms were significantly more likely than non-depressed participants to be female ($\chi^2 = 8.274$, $p = 0.004$), from lower income family ($\chi^2 = 6.838$, $p = 0.009$), have poor academic performance ($\chi^2 = 48.385$, $p < 0.001$), have no habit of daily prayer ($\chi^2 = 10.347$, $p = 0.001$), have short or long total sleep time ($\chi^2 = 11.835$, $p = 0.002$), engage in lower physical activity ($\chi^2 = 10.041$, $p = 0.006$), and to be lonely ($\chi^2 = 24.855$, $p < 0.001$)

Table 2. Distribution of depressive symptoms according to health and behavioral characteristics of the participants (n = 323).

Variables	Total; n (%)	Depressive symptoms		Chi-square test	
		No, n (%)	Yes, n (%)	χ^2 (df)	*p* value
Having partner/close friend					
Yes	233 (72.1)	112 (48.1)	121 (51.9)	0.002 (1)	0.963
No	90 (27.9)	43 (47.8)	47 (52.2)		
Everyday Prayer					
Yes	170 (52.6)	96 (56.5)	74 (43.5)	**10.347 (1)**	**0.001**
No	153 (47.4)	59 (38.6)	94 (61.4)		
Having chronic disease					
Yes	24 (7.4)	10 (41.7)	14 (58.3)	0.415 (1)	0.519
No	299 (92.6)	145 (48.5)	154 (51.5)		
Total sleep time					
Short	127 (39.3)	46 (36.2)	81 (63.8)	**11.835 (2)**	**0.002***
Normal	169 (52.3)	95 (56.2)	74 (43.8)		
Long	27 (8.4)	14 (51.9)	13 (48.1)		
Physical activity					
High	128 (39.6)	75 (58.6)	53 (41.4)	**10.041 (2)**	**0.006***
Moderate	89 (27.6)	39 (43.8)	50 (56.2)		
Low	106 (32.8)	41 (38.7)	65 (61.3)		
Loneliness (UCLA scores)	44.08 ± 12.67				
Less lonely (0–47 points)	183 (56.7)	110 (60.1)	73 (39.9)	**24.855 (1)**	**<0.001**
Most lonely (48–77 points)	140 (43.3)	45 (32.1)	95 (67.9)		
Depressive symptoms					
Yes	168 (52.0)	-	-	-	-
No	155 (48.0)	-	-		

*Fisher's Exact Test; χ^2 = Chi-square value. Bolded values indicate statistical significance ($p < 0.05$)

(Tables 1 and 2). Bolded values indicate statistical significance ($p < 0.05$).

When Pearson correlation was done to see the relationship between the severity of depressive symptoms and severity of loneliness, a significant positive correlation was found between the scores ($r = 0.367$, $p < 0.01$). A Pearson correlation coefficient of 0.367 indicates a moderate effect size (Figure 2).

A binary logistic regression model was performed to examine the influencing factors that affect the depressive symptoms of the students. A Hosmer and Lemeshow test statistic of regression analysis ($\chi^2 = 12.082$, $p = 0.148$) indicated a good model fit with the observed values.

The adjusted model of regression analysis demonstrated the risk factors which were significant risk factors of depressive symptoms of university students. Being female (Adjusted Odds Ratio [AOR] = 2.224, 95% Confidence Interval [CI]: 1.215–4.072) and being from a lower income family (AOR = 1.921, 95% CI: 1.050–3.513) had higher odds of depressive symptoms compared to males and participants belong to higher income families, respectively. Participants having poor academic performance were five times more likely to have depressive symptoms compared to those with good academic performance (AOR = 5.138, 95% CI: 2.871–9.193). Participants who didn't pray daily had higher odds of depressive symptoms compared to those who did regularly (AOR = 2.762, 95% CI: 1.574–4.849). Participants having short or long total sleep duration were 2.79 times more likely to have depressive symptoms compared to those with normal sleeping duration (AOR = 2.793, 95% CI: 1.556–5.014). Engaging in lower physical activity had higher odds of depressive symptoms compared to those who were involved in higher or moderate physical activity (AOR = 1.912, 95% CI: 1.005–3.638). Most lonely participants were 4.7 times more likely to have depressive symptoms compared to those who were less lonely (AOR = 4.656, 95% CI: 2.610–8.305) (Table 3).

4. Discussion

Few studies are reporting mental health difficulties among university students in Bangladesh. This pilot study explored the prevalence of depressive symptoms, loneliness, physical activities, and unearthed some important associated factors related to depressive symptoms among graduate students in a public university in Bangladesh. . The reported findings presented here support the hypothesis of the study.

The prevalence of depressive symptoms was found to be consistent with the previous studies in Bangladesh among university students [16], job-seeking graduate students [43] and medical students [27, 44]. But the prevalence of depression in this study is lower than the finding from a study among Bangladeshi first-year university students that used the PHQ-9 scale to assess the level of depression [15]. In the global context, the prevalence of depressive symptoms in the present study was almost similar to the other studies on university students in Thailand (47.01%) [45] and Cambodia (50.6%) [46]; relatively higher than the studies in Oman (27.70%) [47], China (23.8%) [6], Ethiopia (21.60%) [48], India (32%) [49], Malaysia (37.2%) [50], Jordan (28.5%) [51], and USA (23%) [52], but less than the study done in Egypt (62.4%) [53]. These fluctuations might be due to differences in the types of scales used in the screening, geographical locations, sociocultural settings, graduation status and demographic structure of the participants.

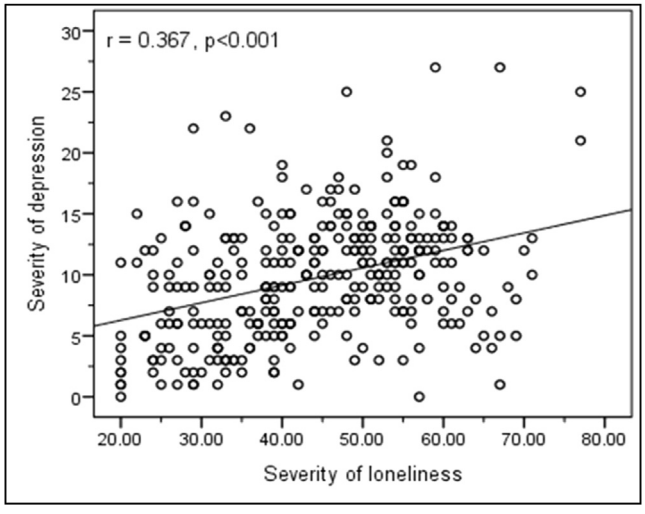

Figure 2. The relationship between loneliness and depressive symptoms of participants (n = 323).

In the present study, significant differences in depressive symptoms between two sexes were found, where the females were more depressed than the males and this is supported by other studies [26, 54]. Nevertheless, there are also several studies in Bangladesh [44], India [55], Pakistan [56], Malaysia [50], Turkey [57], Egypt [58], Australia [59], and USA [52], which contradict this finding or conclude no discrepancies between the two sexes. The findings of these studies from different countries may differ due to the differences in life expectancy, as well as differences in environmental factors [60]. Generally, a higher prevalence of depressive symptoms amongst females has been attributed to socio-cultural factors, including factors related to biological and psychological explanations [61, 62]. Females are generally more likely to accept and report such symptoms [63, 64]. Besides, females may have more difficulties with science and technology studies in this setting, as the finding of this study shows that 48.6% of female graduates had poor academic performance, compared to 34% of male graduates indicating further in-depth research.

Unsurprisingly, the relationship between socio-economic status and depressive symptoms was significant in the current study. Students from families with low economic condition had higher depressive symptoms scores than those from well-off families which is consistent with two recent studies in Bangladeshi university students [15, 16]. There is a linkage between household income and depressive symptoms and several studies also revealed that university students with low socioeconomic background were predisposed to higher depressive symptoms [53, 57, 65, 66]. This might be because economic conditions affect people's self-esteem and self-confidence and low levels of self-esteem and self-confidence would lead to depressive symptoms [6]. Besides, this finding supports the social causation theory of the association between income and mental health. In a longitudinal study, Sareen et al. also found that a decrease in household income was associated with the increased mental health problems [67]. This might be due to some mechanisms including overcrowding, hunger, violence, social networks and a decreased capacity to health care for physical health problems that might increase the risk of students from lower income families to develop depressive symptoms [68].

The research results depict that students with poor academic performance tended to report higher depressive symptoms which is supported by other studies [46, 54] where it was argued that depressive symptoms increase with poor academic performance. This finding also conforms to the findings from a systematic review of 24 studies [3] and another study in China [2]. These findings may lead to two hypotheses that could explain the association between academic performance and depressive symptoms. First, if the students are depressed at the time of their examination, this could affect their ultimate academic performance regardless of how well they had learned the material during the course [69]. Second, poor academic performance may also lead to a decrease in self-esteem and consequently, to the occurrence of depressive symptoms in university students [65].

This study identified that students who prayed daily were less likely to be depressed as compared to those not involving their daily prayer. Another study among college students [70] reported the significant negative correlation between prayers and the prevalence of depressive symptoms. Previous studies also revealed that prayers had a positive effect on depressive symptoms and lower the level of depressive

Table 3. Regression analysis of factors associated with the participants having depressive symptoms.

Variables	B	SE	Wald	AOR (95% CI)	*p* value
Sex					
Male				Reference	
Female	0.799	0.309	6.712	**2.224** (1.215–4.072)	**0.010***
Fathers' occupation					
Job				Reference	
Non-Job	0.253	0.313	0.653	1.288 (0.697–2.382)	0.419
Mothers' occupation					
Housewife	0.121	0.356	0.116	1.129 (0.562–2.267)	0.733
Job				Reference	
Fathers' education level					
< Higher Secondary	0.234	0.388	0.364	1.264 (0.591–2.702)	0.546
≥ Higher Secondary				Reference	
Family income (monthly)					
≤20000 BDT	0.653	0.308	4.490	**1.921** (1.050–3.513)	**0.034***
>20000 BDT				Reference	
Academic performance					
Poor (CGPA <3.00)	1.637	0.297	30.394	**5.138** (2.871–9.193)	**<0.001****
Good (CGPA ≥3.00)				Reference	
Everyday prayer					
Yes				Reference	
No	1.016	0.287	12.524	**2.762** (1.574–4.849)	**<0.001****
Total sleep time					
Short	1.027	0.299	11.839	**2.793** (1.556–5.014)	**0.001***
Normal				Reference	
Long	-0.638	0.504	1.605	0.528 (0.197–1.418)	0.205
Physical activity					
High				Reference	
Moderate	0.363	0.339	1.151	1.438 (0.741–2.793)	0.283
Low	0.648	0.328	3.903	**1.912** (1.005–3.638)	**0.048***
Loneliness					
Less lonely (0–47 points)				Reference	
Most lonely (48–77 points)	1.538	0.295	27.134	**4.656** (2.610–8.305)	**<0.001****
Constant	-3.167	0.495	40.999	**0.042**	**<0.001****

*p < 0.05, **p < 0.001. Bolded values indicate statistical significance (p < 0.05).
Hosmer and Lemeshow test: chi-square = 12.082; df = 8; p = 0.148. Bolded values indicate statistical significance (p < 0.05)
Abbreviation: B, Parameter Estimates (β); SE, Standard Error; AOR, Adjusted Odds Ratio; CI, Confidence Interval.

symptoms [23, 24, 25]. This finding calls for further research in Bangladesh on spirituality and mental health among students. The present study obtained a significant association concerning (i) short sleep time and depressive symptoms (ii) low physical activity and depressive symptoms. This compares with recent Bangladeshi studies [15, 16, 27] who reported that students engaged in lower physical activity and having poor sleeping habit were more likely to be depressed than those engaging in regular physical exercise and having normal total sleep time. . Several studies have also reported such an association between depressive symptoms and detrimental behaviors such as limited physical activity and poor sleep habit [46, 52, 71]. Sleep plays a vital role of human well-being by helping in maintaining individuals' biological rhythm. The associations between lower sleep quality and symptoms depression are well established, to the extent that sleep disturbance is listed as a risk factor for depressive symptoms [72]. Another previous study [73] also reported that lower physical activity may contributing to depressive symptoms, similarly, this study also found a significant association between low physical activities and the risk of having depressive symptoms.

In this study, loneliness was a potential risk factor for depressive symptoms in these university students. This finding was in accordance with many similar studies [4, 74, 75]. Researchers also reported a significant positive correlation between loneliness and depressive symptoms of university students (see Figure 1). This finding is consistent with previous studies among university students in Bangladesh [13], USA [76], and Canada [77]. The relationships of lonely persons with other persons are not at the desired levels and lonely individuals are not content with the situation [78]. Thus, individuals with deep feelings of loneliness seek various ways to avoid these situations and to recoup for their loneliness. These solutions can sometimes lead individuals into difficult situations such as the adoption of undesired habits like severe internet addiction [75], and that internet addiction is a crucial factor in explaining depression particularly among university students [41, 42]. These might be the possible reasons for being depressed due to the experience of loneliness. Besides, depressed individuals may have low energy and anhedonia, which results in decreased engagement in social activities leading to feelings of loneliness. In addition, along with the loneliness, several other factors like social support, anxiety, number of friends, feelings of guilt might influence both loneliness and depression [60]. These possible influential factors as well as some other confounding factors were not included in the present study, and further research including these factors in this population is warranted.

This study has several limitations. Firstly, the study was cross-sectional, thus causal conclusions cannot be drawn. Further prospective studies will be needed to clarify the nature of the causal relationships between depressive symptoms and associated risk factors among graduate Bangladeshi students identified from this investigation. Secondly,

the investigation was carried out with students from one Bangladeshi public university, so the findings cannot be generalized in all the university (both private and public) students in Bangladesh. . Thirdly, as the questionnaire was self-completed, the findings are not without biases such as participants may have been biased in reporting symptoms of depression, feelings of loneliness, etc. Fourth, this study only examined subjective total sleep time, and many other sleep characteristics have been found to relate to depressive symptoms (e.g., maintenance insomnia, late chronotype). Using a structured tool for reporting sleep disturbances e.g. Insomnia Severity Index would have yielded more authentic information. Lastly, the status of daily prayer of the participants was self-reported which might be biased by the social pressure to give the information as positive.

5. Conclusion

The present study reports novel information on depressive symptoms, loneliness, physical activities, and associated factors of depressive symptoms among graduate university students in Bangladesh. The higher prevalence of depressive symptoms among university students is alarming. These findings suggest the need for situation analysis, confirmatory clinical diagnosis, in-depth qualitative explorations, and large-scale surveys to explore the burden of such disorders and design appropriate low-intensity interventions like implementing student counselling service, offering mental assistance or other mental health support program in the country. These services should reach out particularly to the students with poor academic performance, from lower wealth families, and who are most lonely. In addition, these results suggest that promoting a healthy lifestyle focused on good sleep and exercise may be important for individuals with depressive symptoms.

Declarations

Author contribution statement

Satyajit Kundu: Conceptualization, methodology, writing manuscript, formal analysis, and critical review & editing; **Jhantu Bakchi:** Conceptualization, literature search, review & editing; **Md. Hasan Al Banna:** Literature search, original draft writing, review & editing junior; **Abu Sayeed**: Literature search, writing manuscript; **M Tasdik Hasan:** Review and editing, validation; **Mohammad Tazrian Abid:** Literature search, writing manuscript; **Subarna Ghosh:** Literature search, writing manuscript; **Nobonita Sarker:** Critical review, editing and writing manuscript during revision, final approval; **Md Shafiqul Islam Khan:** Analyze and interpretation of data, critical review, editing and writing manuscript during revision, final approval.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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References

[1] S. Lyubomirsky, F. Kasri, K. Zehm, Dysphoric rumination impairs concentration on academic tasks, Cognit. Ther. Res. 27 (2003) 309–330.
[2] X.-Y. Lei, L.-M. Xiao, Y.-N. Liu, Y.-M. Li, Prevalence of depression among Chinese University students: a meta-analysis, PloS One 11 (2016).
[3] A.K. Ibrahim, S.J. Kelly, C.E. Adams, C. Glazebrook, A systematic review of studies of depression prevalence in university students, J. Psychiatr. Res. 47 (2013) 391–400.
[4] P. Grygiel, P. Switaj, M. Anczewska, G. Humenny, S. Rebisz, J. Sikorska, Loneliness and depression among polish university students: preliminary findings from a longitudinal study, Bulg. Comp. Educ. Soc. (2013).
[5] J.L. Buchanan, Prevention of depression in the college student population: a review of the literature, Arch. Psychiatr. Nurs. 26 (2012) 21–42.
[6] L. Chen, L. Wang, X.H. Qiu, X.X. Yang, Z.X. Qiao, Y.J. Yang, Y. Liang, Depression among Chinese university students: prevalence and socio-demographic correlates, PloS One 8 (2013) e58379–e58379.
[7] M. Frotani, Depression in students of higher education centers, Iran, J. Nurs. Res. 18 (2005) 13–27.
[8] S. Abedini, A. Davachi, F. Sohbaee, M. Mahmoodi, O. Safa, Prevalence of depression in nursing students in hormozgan university of medical sciences, Hormozgan Med. J. 11 (2007) 42.
[9] D. Sarokhani, A. Delpisheh, Y. Veisani, M.T. Sarokhani, R.E. Manesh, K. Sayehmiri, Prevalence of depression among university students: a systematic review and meta-analysis study, Depress. Res. Treat. 2013 (2013).
[10] A. Christensson, M. Vaez, P.W. Dickman, B. Runeson, Self-reported depression in first-year nursing students in relation to socio-demographic and educational factors: a nationwide cross-sectional study in Sweden, Soc. Psychiatr. Psychiatr. Epidemiol. 46 (2011) 299–310.
[11] G.S. Kumar, A. Jain, S. Hegde, Prevalence of depression and its associated factors using Beck Depression Inventory among students of a medical college in Karnataka, Indian J. Psychiatr. 54 (2012) 223.
[12] NIMH, National Institute of Mental Health, Depression and College Students, New York, 2003.
[13] A. Rahman, A. Bairagi, B. Dey, L. Nahar, Loneliness and Depression in University Students, 2017.
[14] L.A. Taliaferro, B.A. Rienzo, R.M. Pigg, M.D. Miller, V.J. Dodd, Associations between physical activity and reduced rates of hopelessness, depression, and suicidal behavior among college students, J. Am. Coll. Health 57 (2009) 427–436.
[15] S. Islam, R. Akter, T. Sikder, M.D. Griffiths, Prevalence and factors associated with depression and anxiety among first-year university students in Bangladesh: a cross-sectional study, Int. J. Ment. Health Addiction (2020) 1–14.
[16] M.A. Mamun, M.S. Hossain, M.D. Griffiths, Mental health problems and associated predictors among Bangladeshi students, Int. J. Ment. Health Addiction (2019) 1–15.
[17] A.M. Angelone, A. Mattei, M. Sbarbati, F. Di Orio, Prevalence and correlates for self-reported sleep problems among nursing students, J. Prev. Med. Hyg. 52 (2011) 201–208.
[18] N.E. Mahon, A. Yarcheski, T.J. Yarcheski, B.L. Cannella, M.M. Hanks, A meta-analytic study of predictors for loneliness during adolescence, Nurs. Res. 55 (2006) 308–315.
[19] L.C. Hawkley, J.T. Cacioppo, Loneliness matters: a theoretical and empirical review of consequences and mechanisms, Ann. Behav. Med. 40 (2010) 218–227.
[20] K.D. Michael, T.J. Huelsman, C. Gerard, T.M. Gilligan, M.R. Gustafson, Depression among college students: trends in prevalence and treatment seeking, Counsel. Clin. Psychol. J. 3 (2006).
[21] A. Hysenbegasi, S.L. Hass, C.R. Rowland, The impact of depression on the academic productivity of university students, J. Ment. Health Pol. Econ. 8 (2005) 145.
[22] E. Heiligenstein, G. Guenther, K. Hsu, K. Herman, Depression and academic impairment in college students, J. Am. Coll. Health 45 (1996) 59–64.
[23] K.J. Denny, Instrumental variable estimation of the effect of prayer on depression, Soc. Sci. Med. 73 (2011) 1194–1199.
[24] P.A. Boelens, R.R. Reeves, W.H. Replogle, H.G. Koenig, The effect of prayer on depression and anxiety: maintenance of positive influence one year after prayer intervention, Int. J. Psychiatr. Med. 43 (2012) 85–98.
[25] P.A. Boelens, R.R. Reeves, W.H. Replogle, H.G. Koenig, A randomized trial of the effect of prayer on depression and anxiety, Int. J. Psychiatr. Med. 39 (2009) 377–392.
[26] K.L. Dion, C. Giordano, Ethnicity and sex as correlates of depression symptoms in a Canadian university sample, Int. J. Soc. Psychiatr. 36 (1990) 30–41.
[27] M.T. Hasan, S. Hossain, R. Das Gupta, V. Podder, N.A. Mowri, A. Ghosh, H.R. Mahmood, F. Ahmmed, M.S.T. Halima, Depression, sleeping pattern & suicidal ideation among medical students in Bangladesh: a cross-sectional pilot study, PsyArXiv. March. 19 (2020).
[28] M.A. Mamun, S. Akter, I. Hossain, M.T.H. Faisal, M.A. Rahman, A. Arefin, I. Khan, L. Hossain, M.A. Haque, S. Hossain, M. Hossain, M.T. Sikder, K. Kircaburun, M.D. Griffiths, Financial threat, hardship and distress predict depression, anxiety

and stress among the unemployed youths: a Bangladeshi multi-city study, J. Affect. Disord. 276 (2020) 1149–1158.
[29] M.A. Islam, W.Y. Low, W.T. Tong, C.C.W. Yuen, A. Abdullah, Factors associated with depression among University Students in Malaysia: a cross-sectional study, KnE Life Sci. (2018) 415–427.
[30] K. Kroenke, R.L. Spitzer, J.B.W. Williams, The PHQ-9: validity of a brief depression severity measure, J. Gen. Intern. Med. 16 (2001) 606–613.
[31] A. Martin, W. Rief, A. Klaiberg, E. Braehler, Validity of the brief patient health questionnaire mood scale (PHQ-9) in the general population, Gen. Hosp. Psychiatr. 28 (2006) 71–77.
[32] A.N. Chowdhury, S. Ghosh, D. Sanyal, Bengali adaptation of brief patient health questionnaire for screening depression at primary care, J. Indian Med. Assoc. 102 (2004) 544–547.
[33] L. Manea, S. Gilbody, D. McMillan, Optimal cut-off score for diagnosing depression with the Patient Health Questionnaire (PHQ-9): a meta-analysis, Can. Med. Assoc. J. 184 (2012) E191–E196.
[34] D.W. Russell, UCLA loneliness scale (version 3): reliability, validity, and factor structure, J. Pers. Assess. 66 (1996) 20–40.
[35] D. Russell, Ucla loneliness scale version 3 (instructions), J. Pers. Assess. 66 (1996) 3–4.
[36] K.B. Adams, S. Sanders, E.A. Auth, Loneliness and depression in independent living retirement communities: risk and resilience factors, Aging Ment, Health 8 (2004) 475–485.
[37] C.L. Craig, A.L. Marshall, M. Sjöström, A.E. Bauman, M.L. Booth, B.E. Ainsworth, M. Pratt, U.L.F. Ekelund, A. Yngve, J.F. Sallis, International physical activity questionnaire: 12-country reliability and validity, Med. Sci. Sports Exerc. 35 (2003) 1381–1395.
[38] B.E. Ainsworth, W.L. Haskell, M.C. Whitt, M.L. Irwin, A.M. Swartz, S.J. Strath, W.L. O'brien, D.R. Bassett, K.H. Schmitz, P.O. Emplaincourt, Compendium of physical activities: an update of activity codes and MET intensities, Med. Sci. Sports Exerc. 32 (2000) S498–S516.
[39] S. Wassink-Vossen, R.M. Collard, R.C.O. Voshaar, H.C. Comijs, H.M. de Vocht, P. Naarding, Physical (in) activity and depression in older people, J. Affect. Disord. 161 (2014) 65–72.
[40] M.C. Bruin, H.C. Comijs, R.M. Kok, R.C. Van der Mast, J.F. Van den Berg, Lifestyle factors and the course of depression in older adults: a NESDO study, Int. J. Geriatr. Psychiatr. 33 (2018) 1000–1008.
[41] A. Sayeed, M.N. Hassan, M.H. Rahman, S. El Hayek, M.H. Al Banna, T. Mallick, A.-R. Hasan, A.E. Meem, S. Kundu, Facebook addiction associated with internet activity, depression and behavioral factors among university students of Bangladesh: a cross-sectional study, Child. Youth Serv. Rev. 118 (2020) 105424.
[42] A. Sayeed, M.H. Rahman, M.N. Hassan, E. Christopher, S. Kundu, M.H. Al Banna, A.-R. Hasan, T. Mallick, A.E. Meem, M.T. Hasan, Problematic internet use associated with depression, health, and internet-use behaviors among university students of Bangladesh: a cross-sectional study, Child. Youth Serv. Rev. 120 (2021) 105771.
[43] M.A. Mamun, M.A. Rafi, A.H.M.S. Al Mamun, M.Z. Hasan, K. Akter, K. Hsan, M.D. Griffiths, Prevalence and psychiatric risk factors of excessive internet use among northern Bangladeshi job-seeking graduate students: a pilot study, Int. J. Ment. Health Addiction (2019) 1–11.
[44] S.M.A.H.M. Alim, M.G. Rabbani, E. Karim, M.S.I. Mullick, A. Al Mamun, M.Z.R. Khan, Assessment of depression, anxiety and stress among first year MBBS students of a public medical college, Bangladesh, Bangladesh, J. Psychiatr. 29 (2015) 23–29.
[45] P. Ratanasiripong, Mental health of Muslim nursing students in Thailand, ISRN Nurs. (2012) 2012.
[46] C. Ngin, K. Pal, S. Tuot, P. Chhoun, R. Yi, S. Yi, Social and behavioural factors associated with depressive symptoms among university students in Cambodia: a cross-sectional study, BMJ Open 8 (2018), e019918.
[47] Z. Al-Busaidi, K. Bhargava, A. Al-Ismaily, H. Al-Lawati, R. Al-Kindi, M. Al-Shafaee, A. Al-Maniri, Prevalence of depressive symptoms among university students in Oman, Oman Med. J. 26 (2011) 235.
[48] Y. Dessie, J. Ebrahim, T. Awoke, Mental distress among university students in Ethiopia: a cross sectional survey, Pan Afr, Med. J. 15 (2013).
[49] S. Sachdeva, Assessment of depression, anxiety, and stress among medical students enrolled in a medical college of New Delhi, India, Indian J. Soc. Psychiatr. 34 (2018) 157–162.
[50] K. Shamsuddin, F. Fadzil, W.S.W. Ismail, S.A. Shah, K. Omar, N.A. Muhammad, A. Jaffar, A. Ismail, R. Mahadevan, Correlates of depression, anxiety and stress among Malaysian university students, Asian J. Psychiatr. 6 (2013) 318–323.
[51] S.H. Hamaideh, Alexithymia among Jordanian university students: its prevalence and correlates with depression, anxiety, stress, and demographics, Psychiatr. Care 54 (2018) 274–280.
[52] R. Beiter, R. Nash, M. McCrady, D. Rhoades, M. Linscomb, M. Clarahan, S. Sammut, The prevalence and correlates of depression, anxiety, and stress in a sample of college students, J. Affect. Disord. 173 (2015) 90–96.
[53] W.Y.A. Wahed, S.K. Hassan, Prevalence and associated factors of stress, anxiety and depression among medical Fayoum University students, Alexandria J. Med 53 (2017) 77–84.
[54] S. Sokratous, A. Merkouris, N. Middleton, M. Karanikola, The prevalence and socio-demographic correlates of depressive symptoms among Cypriot university students: a cross-sectional descriptive co-relational study, BMC Psychiatr. 14 (2014) 235.
[55] R. Kumari, B. Langer, S. Jandial, R. Gupta, S.K. Raina, P. Singh, Psycho-social health problems: prevalence and associated factors among students of professional colleges in Jammu, Indian J. Community Health 31 (2019).
[56] M.A. ul Haq, I.S. Dar, M. Aslam, Q.K. Mahmood, Psychometric study of depression, anxiety and stress among university students, J. Public Health (Bangkok). 26 (2018) 211–217.
[57] N. Bayram, N. Bilgel, The prevalence and socio-demographic correlations of depression, anxiety and stress among a group of university students, Soc. Psychiatr. Psychiatr. Epidemiol. 43 (2008) 667–672.
[58] A.R. Abdallah, H.M. Gabr, Depression, anxiety and stress among first year medical students in an Egyptian public university, Int. Res. J. Med. Med. Sci. 2 (2014) 11–19.
[59] G.P. Lovell, K. Nash, R. Sharman, B.R. Lane, A cross-sectional investigation of depressive, anxiety, and stress symptoms and health-behavior participation in Australian university students, Nurs. Health Sci. 17 (2015) 134–142.
[60] T.M. El-Mansoury, E. Taal, A.M. Abdel-Nasser, R.P. Riemsma, R. Mahfouz, J.A. Mahmoud, S.A. El-Badawy, J.J. Rasker, Loneliness among women with rheumatoid arthritis: a cross-cultural study in The Netherlands and Egypt, Clin. Rheumatol. 27 (2008) 1109–1118.
[61] R.D. Goodwin, I.H. Gotlib, Gender differences in depression: the role of personality factors, Psychiatr. Res. 126 (2004) 135–142.
[62] S. Nolen-Hoeksema, Sex differences in unipolar depression: evidence and theory, Psychol. Bull. 101 (1987) 259.
[63] N.G. Khawaja, K. Duncanson, Using the university student depression inventory to investigate the effect of demographic variables on Students' depression, J. Psychol. Couns. Sch. 18 (2008) 195–209.
[64] D.A. King, A.M. Buchwald, Sex differences in subclinical depression: administration of the Beck Depression Inventory in public and private disclosure situations, J. Pers. Soc. Psychol. 42 (1982) 963.
[65] M. Bostanci, O. Ozdel, N.K. Oguzhanoglu, L. Ozdel, A. Ergin, N. Ergin, F. Atesci, F. Karadag, Depressive symptomatology among university students in Denizli, Turkey: prevalence and sociodemographic correlates, Croat. Med. J. 46 (2005) 96–100.
[66] D. Eisenberg, S.E. Gollust, E. Golberstein, J.L. Hefner, Prevalence and correlates of depression, anxiety, and suicidality among university students, Am. J. Orthopsychiatry 77 (2007) 534–542.
[67] J. Sareen, T.O. Afifi, K.A. McMillan, G.J.G. Asmundson, Relationship between household income and mental disorders: findings from a population-based longitudinal study, Arch. Gen. Psychiatr. 68 (2011) 419–427.
[68] T.R. Insel, Assessing the Economic Costs of Serious Mental Illness, 2008.
[69] M.S.B. Yusoff, A.F.A. Rahim, A.A. Baba, S.B. Ismail, M.N.M. Pa, Prevalence and associated factors of stress, anxiety and depression among prospective medical students, Asian J. Psychiatr. 6 (2013) 128–133.
[70] M. Nadeem, A. Ali, M.A. Buzdar, The association between Muslim religiosity and young adult college students' depression, anxiety, and stress, J. Relig. Health 56 (2017) 1170–1179.
[71] J.R. Doom, G.J. Haeffel, Teasing apart the effects of cognition, stress, and depression on health, Am. J. Health Behav. 37 (2013) 610–619.
[72] American Psychiatric Association, Diagnostic and Statistical Manual of Mental Disorders (DSM-5®), American Psychiatric Pub, 2013.
[73] B. Kulsoom, N.A. Afsar, Stress, anxiety, and depression among medical students in a multiethnic setting, Neuropsychiatric Dis. Treat. 11 (2015) 1713.
[74] A. Fauziyyah, S. Ampuni, Depression tendencies, social skills, and loneliness among college students in Yogyakarta, J. Psikol. 45 (2018) 98–106.
[75] Y. Demir, M. Kutlu, The relationship between loneliness and depression: mediation role of internet addiction, Educ. Process Int. J. 5 (2016) 97–105.
[76] D.G. Weeks, J.L. Michela, L.A. Peplau, M.E. Bragg, Relation between loneliness and depression: a structural equation analysis, J. Pers. Soc. Psychol. 39 (1980) 1238.
[77] R. Ouellet, P. Joshi, Loneliness in relation to depression and self-esteem, Psychol. Rep. 58 (1986) 821–822.
[78] E. Teppers, K. Luyckx, T.A. Klimstra, L. Goossens, Loneliness and Facebook motives in adolescence: a longitudinal inquiry into directionality of effect, J. Adolesc. 37 (2014) 691–699.