

Prevalence and Associated Risk Factors of Depression Among Secondary School Students in Multan District, South Punjab, Pakistan: A Cross-Sectional Study

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ABSTRACT

Background: Depressive symptoms among adolescents may affect educational, interpersonal, and psychological functioning, but evidence from secondary-school students in South Punjab is limited. **Objective:** To estimate the prevalence of elevated depressive symptoms and examine associated sociodemographic, behavioural, family, social, digital-media, and school-related factors among secondary-school students in Multan District. **Methods:** This analytical cross-sectional study included 450 students from 40 public and private schools selected through multistage probability sampling. Depressive symptoms were assessed using the Revised Children's Anxiety and Depression Scale, with a depression T-score ≥ 65 defining the elevated-symptom outcome. Descriptive, univariable, logistic-regression, and multiple-linear-regression analyses were performed. **Results:** Elevated depressive symptoms were identified in 26 students, corresponding to a prevalence of 5.8% (95% CI 4.0%–8.3%). Prevalence did not differ significantly between public and private schools (7.6% versus 4.0%; OR 1.96, 95% CI 0.86–4.50). In the exploratory adjusted analysis, bullying (AOR 8.14), social-media-related stress (AOR 5.88), school-related stress (AOR 5.19), lower maternal education (AOR 4.02), parents not living together (AOR 3.58), and limited social support (AOR 3.44) were associated with elevated symptoms. Bullying, prolonged social-media use, poor sleep quality, and school stress were associated with higher continuous depression scores, whereas physical activity was associated with lower scores. **Conclusion:** Elevated depressive symptoms were associated with interconnected family, social, digital, and school-related factors rather than school sector alone. The adjusted findings should be interpreted cautiously because relatively few students met the screening threshold. **Keywords:** adolescent wellbeing; bullying victimization; depressive symptoms; psychosocial determinants; Revised Children's Anxiety and Depression Scale; school stress; social-media stress.

INTRODUCTION

Adolescence is a period of rapid physical, cognitive, emotional, and social development during which young people encounter changing academic expectations, peer relationships, family roles, and identity-related challenges. These transitions can increase vulnerability to psychological distress when appropriate coping resources and supportive environments are unavailable. Depressive symptoms during adolescence are particularly important because they may interfere with educational performance, interpersonal relationships, emotional development, and subsequent psychosocial functioning. More severe or persistent symptoms are also associated with self-harm, suicidal ideation, and other adverse health outcomes (1–3).

Depressive disorders and related symptoms represent a substantial component of the global disease burden among adolescents and young adults. International evidence indicates that adolescent mental-health problems have increased during recent years, while many affected young people remain unidentified or untreated, particularly in low- and middle-income countries where access to specialized services is limited (4–7). Schools therefore represent an important setting for identifying psychological distress because they provide regular access to adolescents during a developmentally sensitive period. However, estimates of depression prevalence among school-going adolescents vary considerably according to the population studied, sampling strategy, screening instrument, symptom threshold, and sociocultural context.

Studies conducted in different Asian and African settings have reported substantial levels of depressive symptoms among secondary-school students. Research from Bangladesh, Nepal, Ethiopia, and China has identified varying levels of depression and related psychological distress among adolescents attending school (8–12). Direct comparison between these estimates is difficult because the studies used different measurement instruments, cut-off values, age ranges, and definitions of clinically relevant symptoms. Nevertheless, the findings consistently indicate that depressive symptoms among school-going adolescents are associated with educational, behavioural, family, interpersonal, and environmental circumstances rather than with a single demographic characteristic.

Previous research has identified several correlates of adolescent depressive symptoms, including female sex, socioeconomic disadvantage, lower parental education, limited family support, academic stress, bullying victimization, sleep disturbance, physical inactivity, and weak peer relationships (13–18). Digital behaviours have also received increasing attention. Prolonged smartphone or social-media use may be associated with psychological distress, although the emotional quality of digital engagement—including social comparison, interpersonal conflict, online pressure, and social-media-related stress—may be more relevant than time spent online alone (19–21). These findings support a multidimensional approach in which adolescent mental health is examined in relation to individual characteristics, family circumstances, school experiences, lifestyle behaviours, social support, and digital stress.

Evidence concerning adolescent mental health in Pakistan remains limited and geographically uneven. Available Pakistani studies have primarily examined broad emotional and behavioural problems, general psychological wellbeing, or selected groups of adolescents rather than depression-specific outcomes among probability-based samples of secondary-school students (22–24). School mental-health initiatives in Pakistan have also highlighted the need for locally generated evidence to guide early identification and contextually appropriate support in resource-constrained educational settings (25,26). Evidence from South Punjab is particularly limited despite regional differences in socioeconomic conditions, educational resources, family structure, and access to mental-health services.

Multan District contains a large and diverse population of adolescents attending both public and private secondary schools. Students in these settings may experience different combinations of academic pressure, family circumstances, digital exposure, peer relationships, and access to supportive resources. However, the prevalence of elevated depressive symptoms and their associated sociodemographic, behavioural, family, social, and school-related factors have not been adequately characterized in this population. The present study therefore aimed to estimate the prevalence of elevated depressive symptoms among grade 9 and 10 students attending public and private secondary schools in Multan District, South Punjab, Pakistan, and to examine their associations with school sector, sociodemographic characteristics, digital-media use and stress, sleep and physical activity, family circumstances, social support, school-related stress, and bullying.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted among students enrolled in grades 9 and 10 at public and private secondary schools in Multan District, South Punjab, Pakistan. The target population

comprised school-going adolescents. Students were eligible when they were enrolled in one of the participating schools, fell within the specified age and grade ranges, provided written assent, and had written parental consent to participate. Students who did not provide assent or whose parents did not provide consent were not enrolled.

A multistage probability sampling approach was used to recruit participants from public and private secondary schools. The sampling process was organized according to school sector, participating school, and eligible students within the selected schools. A total of 40 schools were included, comprising 20 public and 20 private schools. The final sample consisted of 450 students, with equal allocation between public schools (n=225) and private schools (n=225). This stratified allocation allowed comparison of depressive-symptom outcomes between the two school sectors.

Data were collected using a structured questionnaire covering sociodemographic, family, behavioural, lifestyle, digital-media, social-support, and school-related characteristics. The variables included school sector, sex, maternal education, maternal employment, parental living arrangement, perceived friend and community support, daily mobile-phone use, daily social-media use, social-media-related stress, sleep duration, sleep quality, school-related stress, bullying victimization, and physical activity. Daily mobile-phone and social-media use were categorized using a threshold of more than four hours per day. Short sleep duration was defined as fewer than six hours per night, while sleep quality was assessed separately. Regular physical activity was defined as participation on four or more days per week. Bullying exposure was categorized according to whether students reported being bullied sometimes or often. Social-media stress, school-related stress, social support, maternal education, and the remaining categorical variables were analysed according to the classifications specified in the study questionnaire.

Depressive symptoms were assessed using the depression subscale of the 47-item Revised Children's Anxiety and Depression Scale. Depression-subscale responses were scored according to the applicable RCADS scoring procedure, and the resulting scores were converted to standardized T-scores. The primary categorical outcome was an elevated depressive-symptom score, defined as an RCADS depression T-score of at least 65. Continuous depression-subscale scores were also retained to examine variation in symptom severity across participant characteristics. The term "elevated depressive symptoms" was used to describe students meeting the screening threshold because the instrument was used for symptom screening rather than clinical diagnosis.

Before the main survey, the questionnaire was piloted to assess its feasibility, comprehensibility, and suitability for the target population. The internal consistency of the standardized measures was evaluated in the study sample. Data collection proceeded after written parental consent and student assent had been obtained, and participation was voluntary.

Data were entered and analysed using IBM SPSS Statistics version 26.0. Participant characteristics and depressive-symptom outcomes were summarized using frequencies and percentages for categorical variables and means with standard deviations for continuous variables. The mean depression score was compared between public- and private-school students using an independent-samples t-test. Associations between categorical participant characteristics and elevated depressive symptoms were initially examined using the chi-square test, with sparse distributions requiring an appropriate exact procedure.

Univariable binary logistic regression was used to estimate crude odds ratios with 95% confidence intervals for associations between the selected characteristics and elevated depressive symptoms. Variables considered clinically or epidemiologically relevant and those demonstrating evidence of an unadjusted association were evaluated in multivariable binary logistic regression. Adjusted odds ratios with 95% confidence intervals were reported to describe independent statistical associations after accounting for the other variables included in the model. Because the study was cross-sectional, odds ratios were interpreted as measures of association rather than evidence of causation or temporal risk.

Multiple linear regression was used to examine associations between the selected predictors and continuous depression scores. Unstandardized regression coefficients, standard errors, standardized coefficients, test statistics, and p-values were used to describe the direction and magnitude of these associations. Multicollinearity was assessed using tolerance and variance inflation factor values, with low tolerance and elevated variance inflation factors considered evidence of potentially problematic correlation among predictors.

Hierarchical logistic regression was performed to examine the incremental contribution of conceptually related groups of variables. Sociodemographic characteristics were entered in the first block, followed by digital-media variables in the second block, sleep and lifestyle variables in the third block, and family circumstances, social support, school-related stress, and bullying in the final block. Model performance was evaluated using the model chi-square statistic, Nagelkerke R^2 , classification measures, the Hosmer–Lemeshow goodness-of-fit test, and the area under the receiver operating characteristic curve. All statistical tests were two-sided, and a p-value below 0.05 was considered statistically significant.

RESULTS

A total of 450 secondary-school students were included, with equal representation from public and private schools. The mean depression score was 14.56 ± 9.29 . Public-school students had a mean score of 14.99 ± 9.71 compared with 14.13 ± 8.84 among private-school students, corresponding to a mean difference of 0.86 points (95% CI -0.86 to 2.58 ; $p=0.326$). Overall, 26 students screened above the RCADS threshold for elevated depressive symptoms, giving a prevalence of 5.8% (95% CI 4.0%–8.3%). The prevalence was 7.6% in public schools and 4.0% in private schools, but the difference was not statistically significant (OR 1.96, 95% CI 0.86–4.50; $p=0.156$).

Table 1. Depression Scores and Prevalence of Elevated Depressive Symptoms by School Sector

Outcome	Total (N=450)	Public schools (n=225)	Private schools (n=225)	Effect estimate (95% CI)	Test statistic	p-value
Depression score, mean $\pm$ SD	14.56 ± 9.29	14.99 ± 9.71	14.13 ± 8.84	Mean difference: 0.86 (-0.86 to 2.58)	$t=0.98$	0.326
Elevated depressive symptoms, n (%)	26 (5.8)	17 (7.6)	9 (4.0)	OR: 1.96 (0.86–4.50)	$\chi^2=2.00$	0.157

Footnotes: CI, confidence interval; OR, odds ratio; SD, standard deviation. Elevated depressive symptoms were defined as an RCADS depression T-score ≥ 65 . The confidence intervals for prevalence were 4.0%–8.3% overall, 4.8%–11.8% in public schools, and 2.1%–7.4% in private schools. The mean difference was calculated as public minus private school. The p-value for elevated depressive symptoms was based on the continuity-corrected chi-square test.

Table 2. Univariable Associations With Elevated Depressive Symptoms

Predictor	Elevated symptoms, n/N (%)	Reference category, n/N (%)	Crude OR (95% CI)	p-value
Public school	17/225 (7.6)	Private school: 9/225 (4.0)	1.96 (0.86–4.50)	0.156
Female sex	20/271 (7.4)	Male sex: 6/179 (3.4)	2.30 (0.90–5.84)	0.098
Mobile-phone use >4 h/day	16/169 (9.5)	≤ 4 h/day: 10/281 (3.6)	2.83 (1.25–6.40)	0.012
Social-media use >4 h/day	12/96 (12.5)	≤ 4 h/day: 14/354 (4.0)	3.47 (1.55–7.78)	0.005
Poor sleep quality	11/100 (11.0)	Good sleep quality: 15/350 (4.3)	2.76 (1.23–6.22)	0.025
High school-related stress	14/140 (10.0)	Lower school-related stress: 12/310 (3.9)	2.76 (1.24–6.13)	0.015
Bullied sometimes or often	13/110 (11.8)	Never or rarely bullied: 13/340 (3.8)	3.37 (1.51–7.51)	0.004
Physical activity ≥ 4 days/week	4/182 (2.2)	<4 days/week: 22/268 (8.2)	0.25 (0.09–0.74)	0.007

Footnotes: CI, confidence interval; OR, odds ratio. Odds ratios and 95% confidence intervals were recalculated directly from the reported 2 $\times$ 2 cell counts. Two-sided Fisher exact p-values are reported because only 26 participants met the elevated-symptom threshold.

In univariable analyses, students reporting mobile-phone use exceeding four hours per day had higher odds of elevated depressive symptoms than those reporting lower use (OR 2.83, 95% CI 1.25–6.40; $p=0.012$). Social-media use exceeding four hours per day was associated with more than threefold higher odds (OR 3.47, 95% CI 1.55–7.78; $p=0.005$). Elevated symptoms were also associated with poor sleep

quality (OR 2.76, 95% CI 1.23–6.22; $p=0.025$), high school-related stress (OR 2.76, 95% CI 1.24–6.13; $p=0.015$), and being bullied sometimes or often (OR 3.37, 95% CI 1.51–7.51; $p=0.004$). Physical activity on at least four days per week was inversely associated with elevated symptoms (OR 0.25, 95% CI 0.09–0.74; $p=0.007$). The association with female sex did not reach statistical significance when the reported cell counts were analysed using Fisher's exact test (OR 2.30, 95% CI 0.90–5.84; $p=0.098$).

Table 3. Multivariable Logistic Regression Analysis of Elevated Depressive Symptoms

Predictor	Adjusted OR	95% CI	p-value
Public school	2.56	0.83–7.94	0.103
Female sex	1.07	0.38–3.03	0.897
Lower maternal education	4.02	1.46–11.09	0.007
Mother employed	0.38	0.13–1.07	0.067
Parents not living together	3.58	1.06–12.17	0.041
Low community/friend support	3.44	1.20–9.88	0.022
Social-media use >4 h/day	1.28	0.35–4.67	0.706
High social-media-related stress	5.88	1.73–19.99	0.005
Sleep duration <6 h/night	2.04	0.65–6.39	0.220
High school-related stress	5.19	1.80–14.96	0.002
Bullied sometimes or often	8.14	2.89–22.95	<0.001

Footnotes: CI, confidence interval; OR, odds ratio. Adjusted estimates are presented as reported in the source analysis. Reference categories were private school, male sex, higher maternal education, mother not employed, parents living together, adequate social support, social-media use ≤ 4 hours/day, lower social-media-related stress, sleep duration ≥ 6 hours/night, lower school-related stress, and never or rarely bullied.

Table 4. Multiple Linear Regression Analysis of Continuous Depression Scores

Predictor	B	SE	95% CI for B	Standardized β	t	p-value
Public school	0.58	0.71	–0.81 to 1.97	0.03	0.82	0.413
Female sex	1.24	0.68	–0.09 to 2.57	0.08	1.82	0.069
Mobile-phone use >4 h/day	0.93	0.74	–0.52 to 2.38	0.05	1.26	0.208
Social-media use >4 h/day	3.48	0.81	1.89 to 5.07	0.21	4.29	<0.001
Poor sleep quality	2.87	0.76	1.38 to 4.36	0.17	3.78	<0.001
High school-related stress	2.46	0.69	1.11 to 3.81	0.15	3.57	<0.001
Bullied sometimes or often	4.12	0.73	2.69 to 5.55	0.25	5.64	<0.001
Physical activity ≥ 4 days/week	–1.31	0.62	–2.53 to –0.09	–0.09	–2.11	0.035

Footnotes: B, unstandardized regression coefficient; CI, confidence interval; SE, standard error. Reference categories were private school, male sex, mobile-phone and social-media use ≤ 4 hours/day, good sleep quality, lower school-related stress, never or rarely bullied, and physical activity on fewer than four days per week. Model summary: $N=450$; $R^2=0.324$; adjusted $R^2=0.312$; $F(8,441)=26.42$; $p<0.001$. Confidence intervals and the overall F statistic were derived from the reported coefficients, standard errors, sample size, number of predictors, and R^2 .

Table 5. Apparent Performance of the Logistic Regression Model

Hosmer–Lemeshow p-value	Nagelkerke R^2	Overall accuracy, %	AUC
0.554	0.318	94.4	0.842

Footnotes: AUC, area under the receiver operating characteristic curve. Values represent apparent model performance in the same sample used to develop the model. Sensitivity, specificity, positive predictive value, negative predictive value, classification threshold, and internal validation estimates were not available in the reported analysis.

Table 6. Hierarchical Logistic Regression Models for Elevated Depressive Symptoms

Model	Variables entered	Nagelkerke R^2	Change in R^2	Cumulative model χ^2	Overall model p-value
Model 1	Sociodemographic variables	0.127	0.127	20.96	<0.001
Model 2	Model 1 + digital-media variables	0.307	0.180	52.27	<0.001
Model 3	Model 2 + sleep and lifestyle variables	0.334	0.027	57.05	<0.001
Model 4	Model 3 + family, social-support, school-stress, and bullying variables	0.494	0.160	87.23	<0.001

Footnotes: The change in Nagelkerke R^2 represents the numerical difference from the preceding model. The chi-square values and p-values describe the overall fit of each cumulative model rather than the statistical significance of the change between consecutive blocks.

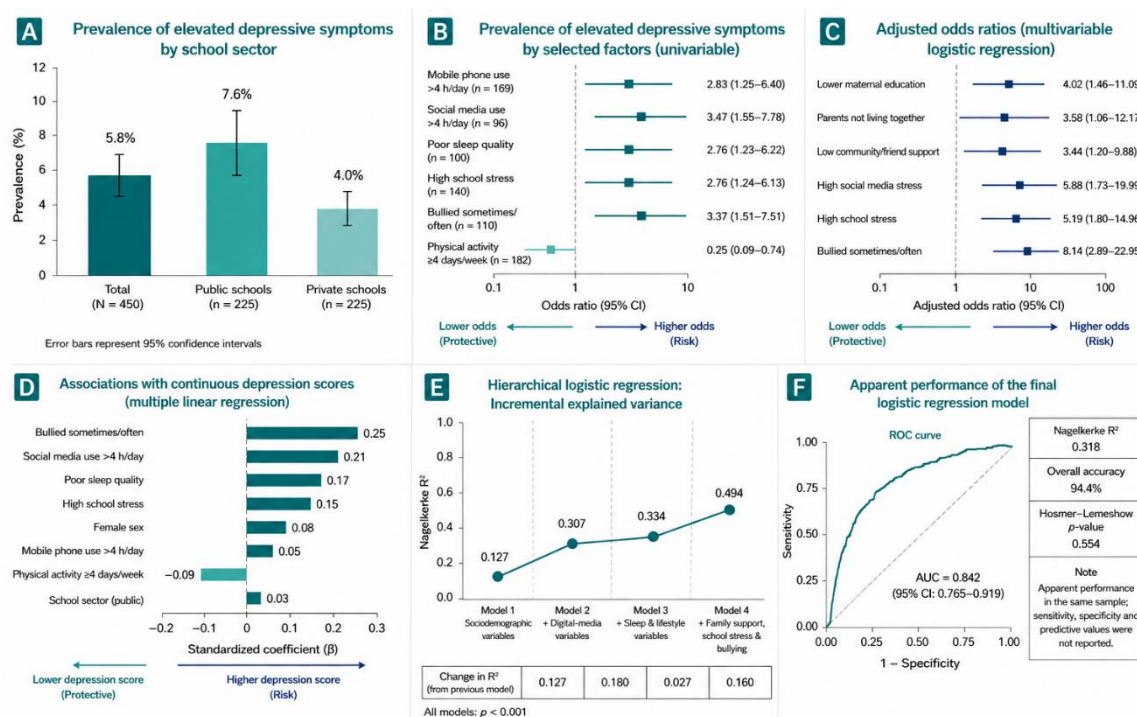
In the reported multivariable logistic regression model, school sector, sex, daily social-media duration, and short sleep duration were not independently associated with the elevated-symptom outcome. Lower maternal education was associated with higher adjusted odds of elevated depressive symptoms (AOR 4.02, 95% CI 1.46–11.09; $p=0.007$), as were parents not living together (AOR 3.58, 95% CI 1.06–12.17;

$p=0.041$) and low community or friend support (AOR 3.44, 95% CI 1.20–9.88; $p=0.022$). High social-media-related stress was associated with an AOR of 5.88 (95% CI 1.73–19.99; $p=0.005$), while high school-related stress was associated with an AOR of 5.19 (95% CI 1.80–14.96; $p=0.002$). The largest adjusted estimate was observed for students who reported being bullied sometimes or often (AOR 8.14, 95% CI 2.89–22.95; $p<0.001$).

Table 7. Multicollinearity Diagnostics for Selected Predictors in the Linear Regression Model

Predictor	Tolerance	VIF
School sector	0.88	1.14
Sex	0.91	1.10
Daily mobile-phone use	0.69	1.45
Daily social-media use	0.64	1.56
Sleep quality	0.77	1.30
School-related stress	0.71	1.41
Bullying	0.74	1.35
Physical activity	0.82	1.22

Footnotes: VIF, variance inflation factor. Tolerance values ranged from 0.64 to 0.91 and VIF values ranged from 1.10 to 1.56, indicating no substantial multicollinearity among the eight predictors included in the reported linear regression model.



Elevated depressive symptoms were defined as RCADS depression T-score ≥65 (screening outcome, not a clinical diagnosis). OR, odds ratio; AOR, adjusted odds ratio; CI, confidence interval; AUC, area under the ROC curve; ROC, receiver operating characteristic.

Figure 1 The multipanel figure summarizes the prevalence and correlates of elevated depressive symptoms among secondary-school students. Overall prevalence was 5.8%, with a higher but non-significant proportion in public schools than private schools (7.6% vs 4.0%). Univariable analyses showed higher odds with prolonged mobile-phone and social-media use, poor sleep quality, school stress, and bullying, while regular physical activity was associated with lower odds. In the adjusted model, bullying, social-media-related stress, school stress, lower maternal education, parents not living together, and limited social support showed the strongest associations. Bullying also had the largest standardized association with continuous depression scores. The hierarchical models showed increasing explained variance as psychosocial variables were added, while the final logistic model demonstrated an AUC of 0.842, Nagelkerke R² of 0.318, and overall accuracy of 94.4%.

The multiple linear regression model accounted for 32.4% of the variance in continuous depression scores ($R^2=0.324$; adjusted $R^2=0.312$; $F[8,441]=26.42$; $p<0.001$). Bullying showed the largest standardized association with depression scores: students reporting bullying sometimes or often had scores 4.12 points higher than the reference group (95% CI 2.69–5.55; standardized $\beta=0.25$; $p<0.001$). Social-media use exceeding four hours per day was associated with a 3.48-point higher score (95% CI 1.89–5.07; standardized $\beta=0.21$; $p<0.001$), while poor sleep quality was associated with a 2.87-point higher score (95% CI 1.38–4.36; standardized $\beta=0.17$; $p<0.001$). High school-related stress was associated with a 2.46-point

higher score (95% CI 1.11–3.81; standardized $\beta=0.15$; $p<0.001$). In contrast, physical activity on at least four days per week was associated with a 1.31-point lower depression score (95% CI -2.53 to -0.09 ; standardized $\beta=-0.09$; $p=0.035$).

The logistic regression model had an apparent AUC of 0.842 and a Nagelkerke R^2 of 0.318. Although its reported overall classification accuracy was 94.4%, 94.2% of the sample did not meet the elevated-symptom threshold; therefore, overall accuracy alone provided limited information about classification performance. Sensitivity, specificity, predictive values, and internally validated performance were not available.

In hierarchical analysis, the sociodemographic block accounted for a Nagelkerke R^2 of 0.127. Adding digital-media variables increased the cumulative value to 0.307, while the addition of sleep and lifestyle variables produced a smaller increase to 0.334. The final model, which also included family circumstances, social support, school-related stress, and bullying, had the highest reported Nagelkerke R^2 of 0.494. All cumulative models were statistically significant overall; however, block-specific likelihood-ratio tests were not reported, and the overall model p -values did not independently establish the statistical contribution of each newly entered block. Tolerance values of 0.64–0.91 and VIF values of 1.10–1.56 indicated no substantial multicollinearity among the eight predictors included in the linear regression model.

DISCUSSION

This study estimated the prevalence of elevated depressive symptoms and examined their associated factors among secondary-school students in Multan District, South Punjab. Overall, 5.8% of students had an RCADS depression T-score ≥ 65 , while the mean depression score was 14.56 ± 9.29 . The prevalence was numerically higher among public-school students than private-school students, but neither the prevalence nor the mean depression score differed significantly by school sector. The findings therefore suggest that elevated depressive symptoms were present in both educational settings and were more closely associated with family, social, behavioural, and school-related circumstances than with school sector alone.

The prevalence identified in this study was lower than estimates reported among school-going adolescents in Bangladesh, Nepal, Ethiopia, and China (8–12). For example, previous studies have reported depressive-symptom prevalence ranging from approximately one-quarter to more than two-fifths of secondary-school students in some settings (8–10). These estimates should not be compared directly, however, because the studies differed in participant age, sampling methods, cultural context, screening instruments, recall periods, scoring procedures, and symptom thresholds. The present study used an RCADS depression T-score ≥ 65 , which identifies students with comparatively elevated symptom levels rather than all students experiencing mild or moderate symptoms. Differences in thresholds and measurement approaches may therefore partly explain the lower prevalence observed in Multan.

School sector was not significantly associated with either elevated depressive symptoms or continuous depression scores. Although public-school students had a numerically higher prevalence, the confidence interval for the school-sector odds ratio included the null value. Public- and private-school students may experience different types of pressure, including socioeconomic constraints, academic competition, parental expectations, or differences in educational resources, but the present findings do not establish that either sector independently increases the likelihood of elevated symptoms. School sector may instead function as a broad contextual characteristic whose relationship with mental health is influenced by more proximal family, peer, behavioural, and academic factors.

Female students initially appeared to have higher odds of elevated symptoms based on the observed proportions, but this association did not reach statistical significance when the reported cell counts were analysed using an exact procedure and was attenuated further in the adjusted analysis. Previous studies

have frequently reported higher levels of depressive symptoms among adolescent girls (9–12). The current findings indicate that sex alone did not independently account for elevated symptoms after other characteristics were considered. Family circumstances, interpersonal support, school stress, bullying, and digital stress may partly explain differences that initially appear to be related to sex.

Lower maternal education was associated with higher adjusted odds of elevated depressive symptoms. Similar relationships between parental educational disadvantage and adolescent mental-health problems have been observed in other low- and middle-income settings (18,27). Maternal education may represent several overlapping circumstances, including health literacy, household socioeconomic resources, communication patterns, recognition of emotional difficulties, and access to appropriate support. The cross-sectional design does not identify which of these mechanisms, if any, explains the observed association, and residual socioeconomic confounding remains possible.

Parental living arrangements and perceived social support were also associated with the screening outcome. Students whose parents were not living together had higher adjusted odds of elevated symptoms, while limited friend or community support was associated with a similar increase. Family disruption, parental psychological difficulties, interpersonal conflict, reduced supervision, and limited emotional availability have previously been associated with poorer mental-health outcomes among children and adolescents (16,28). Supportive relationships may help adolescents manage academic demands and interpersonal difficulties, whereas social isolation or unstable family circumstances may reduce access to practical and emotional coping resources. Nevertheless, the present data cannot determine the temporal direction of these relationships, and elevated depressive symptoms may themselves influence adolescents' perceptions of available support.

Digital-media variables showed different patterns depending on how exposure was defined. Spending more than four hours per day on social media was associated with elevated symptoms in univariable analysis and with higher continuous depression scores, but it was not independently associated with the binary screening outcome in the reported multivariable model. In contrast, high social-media-related stress retained a comparatively strong adjusted association. This distinction suggests that the psychological context of digital engagement may be more relevant than duration alone. Social comparison, fear of exclusion, online conflict, pressure to remain continuously available, and exposure to distressing content may contribute to psychological strain, although reverse causation is also possible because students experiencing depressive symptoms may engage with digital media differently or perceive online interactions as more stressful (19–21).

School-related stress was consistently associated with depressive symptoms. Students reporting high school stress had higher depression scores and higher adjusted odds of meeting the elevated-symptom threshold. Academic demands may contribute to distress when students perceive that examination pressure, workload, competition, or expectations exceed their available coping and support resources. Previous research has linked academic stress with depressive symptoms through pathways involving anxiety and hopelessness (29). Because both school stress and depressive symptoms were measured at the same time, however, the present study cannot determine whether stress preceded depressive symptoms or whether students with greater symptoms perceived school demands more negatively.

Bullying showed the largest standardized association with continuous depression scores and the largest adjusted odds ratio in the reported logistic model. This finding is consistent with evidence linking bullying victimization to depression, anxiety, social withdrawal, diminished self-esteem, and other adverse psychological outcomes among adolescents (17,30). Repeated bullying may undermine students' sense of safety, belonging, and social acceptance. Conversely, students experiencing emotional or behavioural difficulties may also be more vulnerable to victimization or more likely to report adverse peer interactions. The large estimate and wide confidence interval indicate a potentially important association but also substantial statistical uncertainty.

Poor sleep quality was associated with higher continuous depression scores, while short sleep duration was not independently associated with the elevated-symptom outcome in the reported adjusted logistic model. Sleep quality and sleep duration are related but distinct constructs and should not be interpreted interchangeably. Emotional distress may interfere with sleep initiation, continuity, and perceived restfulness, while inadequate or disrupted sleep may reduce concentration and emotional regulation. The cross-sectional findings cannot determine the direction of this relationship. Physical activity on at least four days per week was associated with lower odds of elevated symptoms in univariable analysis and with a modestly lower continuous depression score. Physical activity may support psychological wellbeing through behavioural, social, and physiological pathways, but reduced activity may also be a consequence of depressive symptoms rather than a preceding protective exposure.

The linear regression model accounted for approximately one-third of the variation in continuous depression scores, with bullying, prolonged social-media use, poor sleep quality, and school-related stress showing the largest standardized associations. The hierarchical analysis suggested that adding family, social-support, school-stress, and bullying variables increased the model's apparent explanatory value beyond sociodemographic characteristics alone. These results support a multidimensional understanding of adolescent depressive symptoms. However, changes in Nagelkerke R^2 do not independently establish that every newly entered block significantly improved prediction because block-specific likelihood-ratio tests were not reported.

The reported logistic model had an apparent AUC of 0.842, but this performance estimate was obtained from the same sample used to develop the model. Its overall accuracy of 94.4% should also be interpreted cautiously because 94.2% of participants did not meet the elevated-symptom threshold. A model classifying every student as screening negative would therefore have achieved almost the same overall accuracy. Sensitivity, specificity, predictive values, calibration plots, and internally validated performance were unavailable. Consequently, the model should be regarded as exploratory rather than as a validated tool for individual risk prediction.

The study has several strengths. It included students from both public and private schools, used a multistage sampling approach, examined factors across several domains, and employed a recognized adolescent symptom-screening instrument. Analysing depressive symptoms both categorically and continuously also provided complementary information about students above the screening threshold and variation across the full symptom range.

Several limitations should be considered. First, the cross-sectional design prevents determination of temporal sequence or causality. Second, depressive symptoms and associated factors were self-reported and may have been affected by recall error, social-desirability bias, and differences in symptom recognition. The RCADS threshold identifies elevated symptoms but does not establish a clinical diagnosis. Third, only 26 students met the elevated-symptom threshold. The number of predictors included in the multivariable and hierarchical logistic models was therefore high relative to the number of outcome events, increasing the risk of overfitting, unstable coefficients, wide confidence intervals, and optimistic model-performance estimates. The adjusted associations should consequently be interpreted as exploratory and require confirmation in larger samples using parsimonious or penalized models.

Fourth, students were sampled within schools, but the reported analyses did not account for potential correlation among students attending the same institution. Ignoring school-level clustering may have produced confidence intervals that were narrower than those obtained from cluster-aware analyses. Fifth, equal numbers of public- and private-school students were recruited. Unless these sectors contain approximately equal proportions of the district's secondary-school population or sampling weights are applied, the overall estimate may not precisely represent district-wide prevalence. Sixth, incomplete information about nonparticipation and missing responses limits evaluation of selection bias. Finally,

the findings are specific to grade 9 and 10 students in Multan District and may not be generalizable to younger adolescents, students outside formal schooling, or adolescents in other regions of Pakistan.

Taken together, the findings indicate that elevated depressive symptoms among secondary-school students in Multan were associated with interconnected family, social, behavioural, digital, and school-related circumstances. Bullying and school-related stress showed particularly prominent associations, while social-media-related stress, lower maternal education, parental living arrangements, and limited social support were also relevant in the exploratory adjusted analysis. These patterns emphasize the importance of interpreting adolescent psychological wellbeing within the broader environments in which students live, interact, study, and use digital media.

CONCLUSION

Elevated depressive symptoms were identified in 5.8% of secondary-school students in Multan District, with no statistically significant difference between public- and private-school students. Lower maternal education, parents not living together, limited social support, social-media-related stress, school-related stress, and bullying were associated with higher odds of elevated symptoms in the exploratory adjusted analysis, while prolonged social-media use, poor sleep quality, school stress, and bullying were associated with higher continuous depression scores. Physical activity was associated with lower symptom scores. These findings describe cross-sectional associations rather than causal relationships and should be interpreted cautiously because of the small number of students meeting the elevated-symptom threshold.

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