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Original Research

Psychosocial Factors Associated with Glycemic Control in Pediatric Type 1 Diabetes: Focus on Anxiety, Depression and Peer Bullying

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ABSTRACT

Objective: This study aimed to evaluate the levels of depression, anxiety, and peer bullying in participants aged 11–18 years type 1 diabetes mellitus (T1DM) and to investigate the impact of these psychosocial factors on glycemic control.

Methods: A cross-sectional study was conducted with 95 participants aged 11–18 years who had been diagnosed with T1DM for at least six months. Sociodemographic and clinical data were collected alongside psychological assessments using the Revised Child Anxiety and Depression Scale (RCADS) and Peer Bullying Scale (PBS). Glycemic control was evaluated via HbA1c levels. Pearson correlation, t-tests, ANOVA, multivariate logistic regression, and K-means cluster analysis were performed to examine associations.

Results: Higher depression and anxiety scores were significantly associated with elevated HbA1c levels. Age, depression, and anxiety were identified as independent predictors of poor glycemic control. Although peer bullying was weakly correlated with HbA1c, no significant group differences were observed. Cluster analysis revealed that worsening glycemic control was accompanied by increasing psychological symptom severity.

Conclusion: Among psychosocial factors, depression, and anxiety were found to be particularly influential in the glycemic management of children and adolescents with T1DM. These findings underscore the importance of incorporating routine psychological assessments and timely mental health support into pediatric diabetes care to optimize metabolic outcomes.

Keywords: Type 1 diabetes mellitus, children, adolescents, anxiety, depression, peer bullying, glycemic control, psychosocial factors.

INTRODUCTION

Type 1 diabetes mellitus (T1DM) is one of the most common chronic diseases in childhood and adolescence. It is defined as a heterogeneous metabolic disorder characterized by chronic hyperglycemia resulting from insufficient insulin secretion and/or insulin resistance in pediatric populations [1]. The long-term management of T1DM requires daily responsibilities such as insulin administration, blood glucose monitoring, dietary management, and coping with hypoglycemia, which collectively imposes a substantial burden on physical health and psychological and social well-being [2].

Current literature indicates that children and adolescents with T1DM exhibit significantly higher rates of depression and anxiety compared to their healthy peers. These psychological symptoms impair self-management abilities, contributing to poor glycemic control and elevated HbA1c levels. Indeed, depression and anxiety have been identified as independent predictors of glycemic outcomes in several studies. In a systematic review and meta-analysis, Buchberger et al. [3] reported a depression prevalence of 30.04% and anxiety symptoms of up to 32% in this population, emphasizing their detrimental impact on glycemic outcomes.

Recent studies further highlight that psychological factors in young individuals with T1DM influence not only quality of life but also metabolic control [4]. Anxiety and depressive symptoms have been positively associated with higher HbA1c levels and poorer self-management behaviors [5–7]. Some studies have demonstrated the adverse impact of anxiety on glycemic control, while another underscored the interplay between age, diabetes duration, and psychiatric symptoms [6,7]. Additionally, depression and anxiety have been identified as independent predictors of elevated HbA1c levels [8]. Although a direct association was not observed in all studies, higher HbA1c levels have been linked to functional impairments and self-management difficulties, suggesting indirect psychosocial effects [9].

Main Points

- Depression and anxiety are significantly associated with poor glycemic control in children and adolescents with type 1 diabetes mellitus.
- Psychological symptom severity increases with age and is accompanied by higher HbA1c levels.
- Although peer bullying shows a weak correlation with glycemic control, its indirect impact through psychological burden should not be overlooked.
- Routine mental health screening and psychosocial interventions are crucial components of comprehensive diabetes care in pediatric populations.

Notably, in adolescents, increasing anxiety levels have been linked to less frequent blood glucose monitoring and higher HbA1c levels [2,10]. Beyond psychological burden, social interactions significantly influence disease management in children with T1DM. Factors such as being perceived differently by peers, social exclusion, and visible diabetes-related activities (e.g., insulin injections and device usage) may increase the risk of peer bullying [11,12]. Studies have shown that diabetes-related bullying experiences exacerbate depression, social anxiety, and loneliness, further undermining self-management behaviors and indirectly affecting glycemic control [13]. However, the direct impact of bullying on glycemic outcomes remains inconclusive. It is hypothesized that such effects may be mediated through self-management challenges and increased psychological burden [14].

International guidelines, particularly the ISPAD 2022 Clinical Practice Consensus Guidelines, emphasize that diabetes care should comprehensively address not only biomedical aspects but also psychosocial dimensions. Regular screening for mental health symptoms such as anxiety and depression, consideration of social stressors, and integration of psychosocial support services into routine diabetes management are strongly recommended [15].

In line with these recommendations, the present study aims to assess the levels of anxiety, depression, and peer bullying in children and adolescents with T1DM and to examine their associations with glycemic control. By elucidating the role of psychosocial factors in diabetes management, our study seeks to contribute to developing holistic care approaches for this vulnerable population. Although previous studies have examined individual psychological factors in youth with T1DM, our study uniquely investigates their combined impact—including peer bullying—by applying both correlational and clustering analyses within the same model.

MATERIAL AND METHODS

Study Design and Participants

This study was designed as a cross-sectional descriptive study. It was conducted at the pediatric endocrinology outpatient clinic of Mardin State Hospital, a tertiary care government hospital located in southeastern Türkiye. Children and adolescents aged 11–18 years, diagnosed with type 1 diabetes mellitus (T1DM) for at least six months, who voluntarily agreed to participate during their routine outpatient visits were included. Individuals with a diagnosis of neurodevelopmental disorders (e.g., autism spectrum disorder, intellectual disability) or with coexisting chronic illnesses (e.g., epilepsy, malignancy) were excluded. Written informed consent was obtained from all participants and their legal guardians after providing detailed information about the study.

Clinical Assessments

During outpatient visits, all patients underwent anthropometric and clinical assessments, including height, weight, and blood pressure measurements. Body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters. Standard deviation scores (SDS) for height, weight, BMI, and blood pressure were calculated based on age- and sex-specific reference values. SDS values were calculated using national reference data derived from Turkish growth percentile curves [16]. Information on diabetes duration, daily total insulin dose, and the most recent HbA1c values (within the last three months) was retrieved retrospectively from medical records.

Data Collection Tools

Sociodemographic Data Form

A structured questionnaire developed by the researchers was used to collect demographic and clinical data, including age, sex, number of siblings, age at diabetes diagnosis, disease duration, and history of psychiatric consultation. Parental characteristics such as education level, employment status, household income, and marital status (married/divorced) were also recorded.

Revised Child Anxiety and Depression Scale (RCADS)

The RCADS is a self-report questionnaire developed to assess anxiety and depression symptoms in children and adolescents based on DSM-IV diagnostic criteria [16]. The Turkish adaptation and validation study was conducted by Görmez et al. [17]. The scale comprises 47 items grouped into six subscales: separation anxiety (7 items), social phobia (9 items), generalized anxiety disorder (6 items), panic disorder (9 items), obsessive-compulsive disorder (6 items), and major depressive disorder (10 items). Each item is rated on a 4-point Likert scale from 0 (Never) to 3 (Always).

Peer Bullying Scale (PBS)

Mynard and Joseph initially developed the Peer Bullying Scale to assess the frequency of victimization and bullying behaviors among students aged 11–16 years [18]. The Turkish version was adapted by Gültekin and Sayıl [19]. The scale includes 27 items with two sub-questions (a and b). Items 1a to 27a assess the frequency of being subjected to peer bullying, while items 1b to 27b evaluate the frequency of exhibiting bullying behaviors. Responses are scored on a 3-point Likert scale: 0 (Never), 1 (Once), and 2 (More than once). The total score ranges from 0 to 54. This study focused exclusively on the victimization subscale. The Cronbach's alpha coefficient for this subscale was reported as 0.93 (pre-test) and 0.90 (post-test).

All questionnaires were completed by the participants themselves in a quiet room during outpatient visits. A research assistant was present to provide clarification if needed. No parental assistance was involved during completion.

Ethical Approval

The study was approved by the Clinical Research Ethics Committee of Diyarbakır Training and Research Hospital (Date: June 14, 2019; Approval No: 287). Since Mardin State Hospital did not have an ethics committee at the time, approval was obtained from the nearest authorized board. Written informed consent was collected from all participants and their legal guardians. The study was conducted following the Declaration of Helsinki.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed, and normally distributed variables were presented as mean ± standard deviation (SD). Categorical variables were reported as frequencies (n) and percentages (%).

Differences in HbA1c levels between binary categorical variables were analyzed using independent samples t-tests, while comparisons across multi-category variables were conducted using one-way analysis of variance (ANOVA). Pearson correlation analysis was used to examine the relationships between HbA1c levels and continuous variables, including anxiety, depression, and peer bullying scores.

Multivariate logistic regression analysis was used to identify independent predictors of elevated HbA1c levels, categorizing HbA1c as < 7.5% and ≥ 7.5%. The effects of psychological scale scores on HbA1c were reported as odds ratios (OR) with 95% confidence intervals (CI).

Additionally, a K-means cluster analysis was conducted to classify participants into subgroups based on HbA1c levels and anxiety profiles. The elbow method was employed to determine the optimal number of clusters, and the clustering quality was evaluated using the silhouette coefficient.

A p-value of <0.05 was considered statistically significant in all analyses.

RESULTS

Ninety-five children and adolescents (mean age 14.02 ± 2.22 years; 60% female) were included in the study. The mean duration of diabetes was 9.34 ± 3.48 years, and the mean HbA1c level was 7.7 ± 1.25%. 60% of the participants used continuous glucose monitoring (CGM) systems, and 29.5% had a history of previous or ongoing psychiatric consultations. The sociodemographic and clinical characteristics of the participants are summarized in Table 1.

According to the psychological assessment scales, the mean total anxiety score was 26.02 ± 14.80, the mean major depression score was 6.54 ± 4.27, and the combined total anxiety and depression score was 32.56 ± 17.83. Among the subscales, the highest mean score was observed for social phobia (7.84 ± 5.58). The mean peer bullying score was calculated as 6.12 ± 9.74 (Table 2).

Correlation analyses revealed significant positive associations between HbA1c levels and the following variables: age (r = 0.286; p = 0.005), bullying score (r = 0.222; p = 0.032), depression score (r = 0.247; p = 0.016), total anxiety score (r = 0.219; p = 0.034), and combined anxiety and depression score (r = 0.264; p = 0.009). No significant correlation was found between BMI and HbA1c levels (p = 0.137) (Table 3).

Table 1. Socio-Demographic and Familial Characteristics of Participants (n=95)

Variables	**Number (%) or Mean ± SD**
Age (mean – years ± SD)	14.02 ± 2.22
Age at diabetes onset (mean – years ± SD)	4.67 ± 3.48
Height (mean – cm ± SD)	152.92 ± 13.94
Weight (mean-kg ± SD)	47.96 ± 16.03
BMI (mean-kg/m^2±SD)	19.49 ± 4.29
HbA1c (mean-%±SD)	7.7 ± 1.25
Gender	
Male	38 (40.0%)
Female	57 (60.0%)
Area of residence	
City	63 (66.3%)
Town	22 (23.2%)
Village	10 (10.5%)
School attendance	
Primary school	18 (18.9%)
Secondary school	26 (27.4%)
High school	27 (28.4%)
Not attending	24 (25.3%)
Use of sensor	57 (60.0%)
Coeliac disease	8 (8.4%)
The presence of any past or present psychiatric disorder in the participants	28 (%29.5)
Age of mother (mean – years ± SD)	41.18 ± 5.80
Level of education of the mother	
Primary school	19 (20.0%)
Secondary school	17 (17.9%)
High school	35 (37.6%)
University	22 (23.2%)
The presence of any past or present psychiatric disorder in the mothers	12 (12.6%)
Age of father (mean – years ± SD)	44.59 ± 6.16
Level of education of the father	
Primary school	20 (21.5%)
Secondary school	15 (16.1%)
High school	35 (37.6%)
University	23 (24.7%)
The presence of any past or present psychiatric disorder in the fathers	5 (5.4%)
Family status	
Living with both parents	75 (78.9%)
Single-parent	20 (21.5%)

Data were given as mean ± standard deviation or number (percent%).
Abbreviations: SD: Standard Deviation.

Table 2. Bullying, Anxiety and Depression Scale Scores of the participants (n=95)

Variables	Mean ± SD
Bullying Level	6.12 ± 9.74
Separation Anxiety	3.53 ± 3.14
Generalized Anxiety	6.08 ± 3.61
Panic	4.01 ± 4.61
Social Phobia	7.84 ± 5.58
Obsession Compulsion	4.56 ± 3.12
Depression	6.54 ± 4.27
Total Anxiety	26.02 ± 14.80
Total Anxiety and Depression	32.56 ± 17.83

Data were given as mean ± standard deviation
Abbreviations: SD: Standard Deviation.

Table 3. Correlations between HbA1c and continuous variables

Parameters	HbA1c	
	r*	p*
Age	0.286	**0.005***
Bullying score	0.222	**0.032***
Separation anxiety score	0.164	0.113
Generalized anxiety score	0.197	0.054
Panic score	0.189	0.065
Social phobia score	0.179	0.079
Obsession compulsion score	0.139	0.180
Depression score	0.247	**0.016***
Total anxiety score	0.219	**0.034***
Total anxiety and depression score	0.264	**0.009***
Body mass index	0.155	0.137

Pearson Correlation Analysis.
Bold font indicates statistical significance: $p < 0.05$

When participants were categorized based on HbA1c levels (<7.5% [n = 48] and ≥7.5% [n = 47]), those in the higher HbA1c group exhibited significantly higher scores for generalized anxiety (p = 0.006), social phobia (p = 0.033), obsessive-compulsive symptoms (p = 0.048), depression (p < 0.001), total anxiety (p < 0.001), and combined anxiety and depression (p < 0.001). Although the bullying score was higher in the elevated HbA1c group, the difference did not reach statistical significance (p = 0.083) (Table 4, Figure 1).

In the multivariate logistic regression analysis, age (OR: 1.334; p = 0.007), depression score (OR: 1.193; p = 0.031), and total anxiety score (OR: 1.114; p = 0.036) emerged as independent predictors of elevated HbA1c levels. Higher levels of depression and general anxiety were associated with poorer glycemic control, highlighting the critical role of mental health in diabetes management. The influence of age suggests that age-related physiological or lifestyle factors may also contribute to glycemic outcomes (Table 5).

As a supportive analysis, K-means cluster analysis was conducted to classify participants based on both HbA1c levels and anxiety profiles. The analysis identified three distinct clusters. A clear pattern was observed: from the first to the third cluster, there was a progressive increase in mean HbA1c levels (7.03; 7.78; 8.39) and anxiety scores (Figure 2). This finding supports the notion that worsening glycemic control is associated with higher levels of anxiety and depression symptoms. The silhouette scores, used to assess cluster validity, indicated moderate separation between clusters (0.45; 0.40; 0.39), suggesting that while the clusters were reasonably distinct, some participants exhibited characteristics overlapping with other groups.

DISCUSSION

In this study, depression, anxiety, and peer bullying levels were evaluated in children and adolescents diagnosed with type 1 diabetes mellitus (T1DM), and the impact of these psychosocial factors on glycemic control (HbA1c) was investigated. Our findings revealed a significant association between depressive and anxiety symptoms and HbA1c levels. This study demonstrated that depression and anxiety symptoms are independent and significant predictors of poor glycemic control in children and adolescents with type 1 diabetes. Additionally, it was observed that both psychological symptoms and HbA1c values increased with advancing age.

Previous studies have demonstrated that children and adolescents with T1DM exhibit higher rates of depression and anxiety compared to their healthy peers [4,5,8,20]. However, some studies reported a weak association between these psychological symptoms and glycemic control. In contrast, the present study identified both depression and anxiety symptoms as significant correlates of HbA1c levels, and they were found to be independent predictors in multivariate analyses. These findings suggest that psychological burden adversely affects diabetes self-management, thereby exerting a direct impact on glycemic control.

Table 4. Comparison of scale scores by HbA1c Group

Variable	HbA1c ≤ 7.5 Mean ± SD n = 48	HbA1c > 7,5 Mean ± SD n = 47	t-statistic	df	p-value
Bullying score	4.68 ± 7.97	7.97 ± 11.02	-1.748	93	0.083
Separation anxiety score	3.11 ± 2.99	3.99 ± 3.27	-1.414	93	0.161
Generalized anxiety score	5.14 ± 3.37	7.14 ± 3.65	-2.834	93	**0.006***
Panic score	3.28 ± 4.14	4.83 ± 4.97	-1.674	93	0.098
Social phobia score	6.68 ± 5.09	9.16 ± 5.86	-2.158	93	**0.033***
Obsession compulsion score	3.94 ± 2.87	5.25 ± 3.32	-2.004	93	**0.048***
Depression score	5.08 ± 3.73	8.16 ± 4.39	-4.014	93	**<0.001***
Total anxiety score	21.35 ± 13.06	31.25 ± 15.63	-3.908	93	**<0.001***
Total anxiety and depression score	26.43 ± 15.19	39.41 ± 18.91	-4.542	93	**<0.001***

Independent-sample t-test was used to test group differences.

Data were given as mean ± standard deviation.

Bold font indicates statistical significance: $p < 0.05$

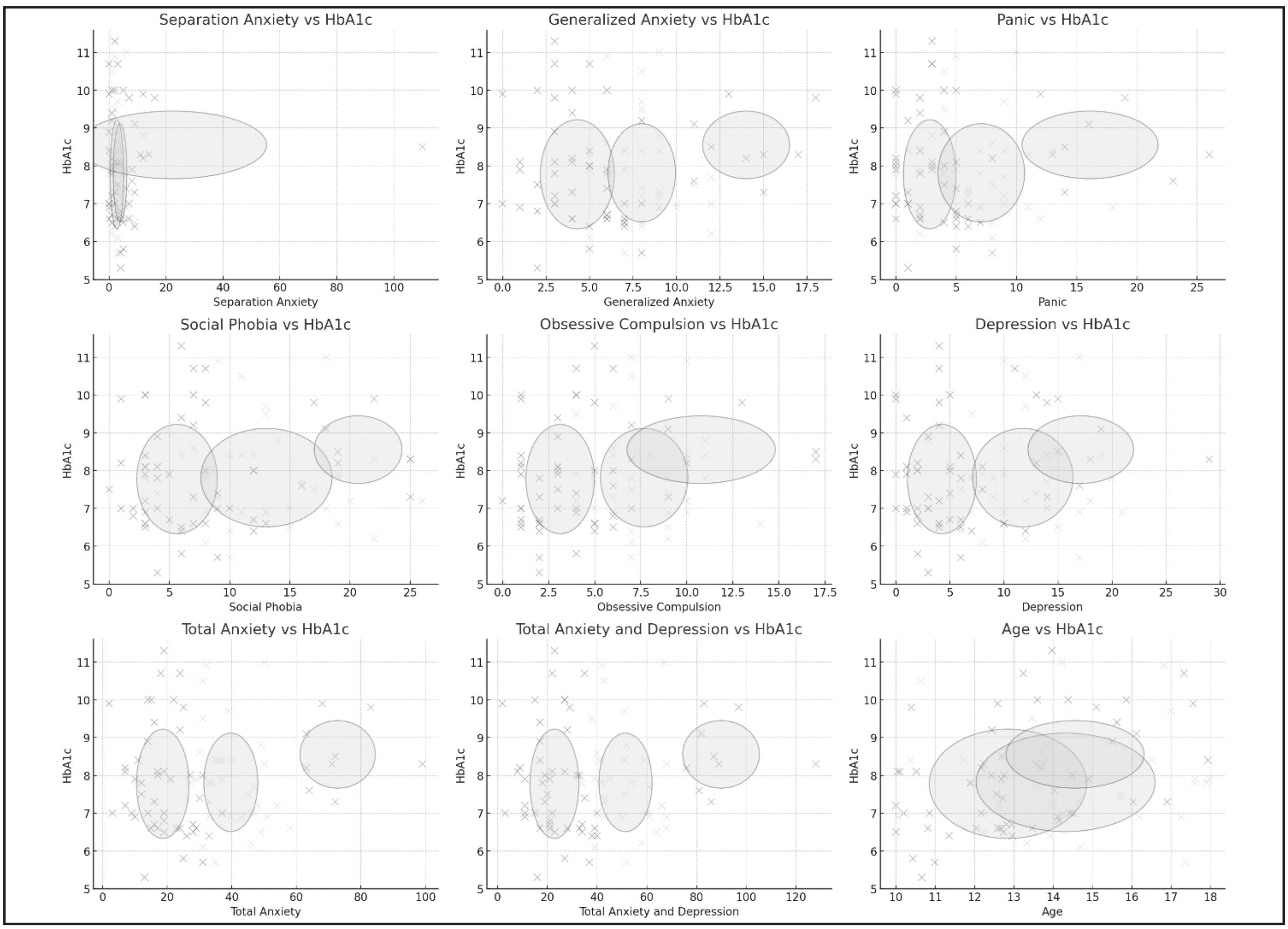

Figure 1. Comparison of Psychological Symptom Scores Between Low and High HbA1c Groups

Boxplots display the distribution of psychological symptom scores across two groups categorized by HbA1c levels (< 7.5% and ≥ 7.5%). Subscales include bullying, separation anxiety, generalized anxiety, panic, social phobia, obsessive-compulsive symptoms, depression, total anxiety, and total anxiety and depression. Statistically significant differences demonstrate higher psychological symptom scores in the high HbA1c group.

Table 5. Logistic regression analysis for the HbA1c Status

Variable	Odds Ratio	95% Confidence Interval	p-value
Age	1.334	[1.082, 1.644]	**0.007***
Depression	1.193	[1.016, 1.403]	**0.031***
Total anxiety	1.114	[1.007, 1.232]	**0.036***
Total anxiety and depression	1.103	[1.003, 1.213]	**0.043***

*Bold font indicates statistical significance: $p < 0.05$

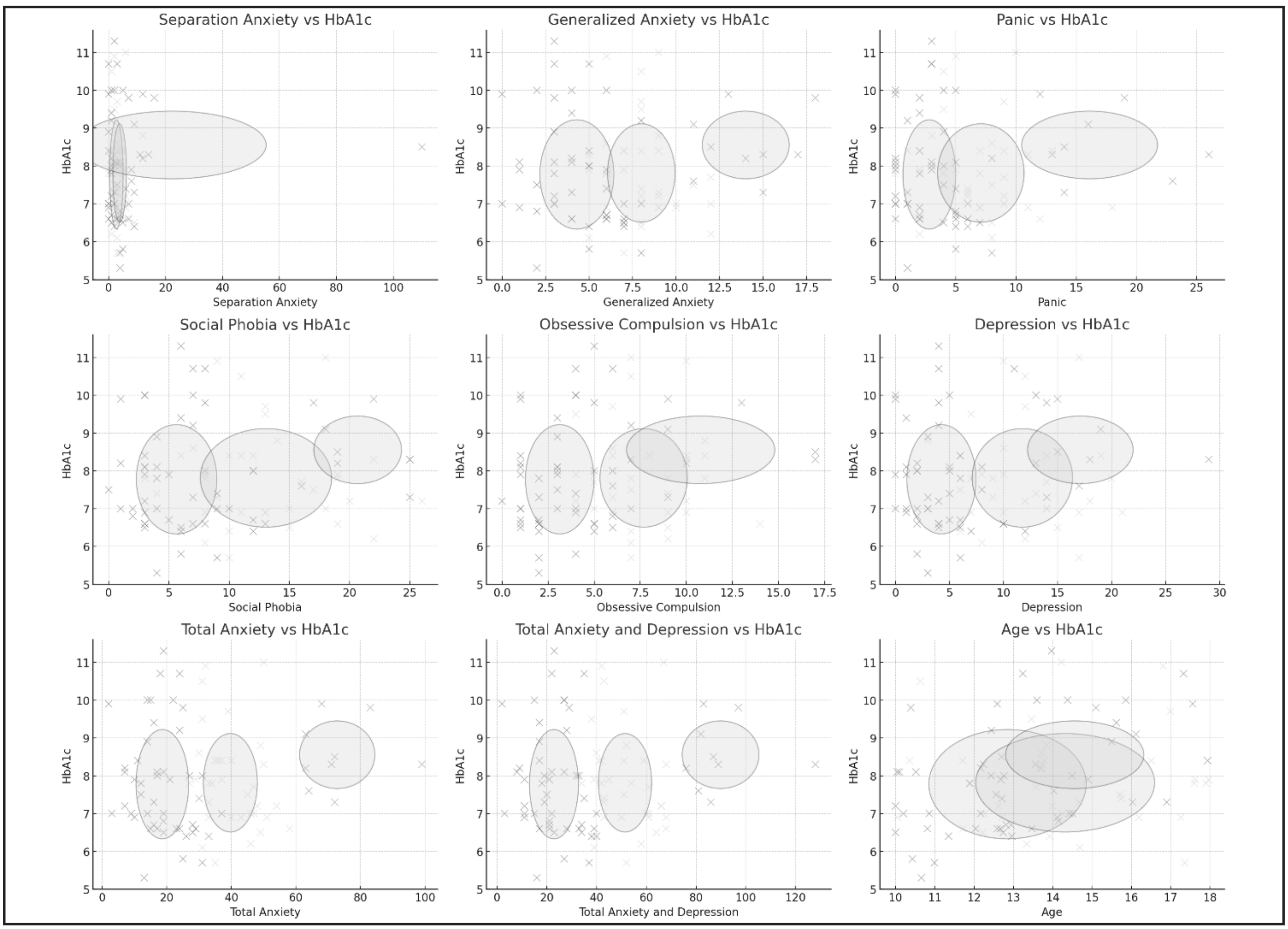

Figure 2. Scatter Plots of HbA1c Levels in Relation to Psychological Symptom Scores and Age with K-means Clustering

Scatter plots illustrate the relationships between HbA1c levels and various psychological symptom scores, including separation anxiety, generalized anxiety, panic, social phobia, obsessive-compulsive symptoms, depression, total anxiety, total anxiety and depression, and age. K-means clustering analysis identified three distinct subgroups. Ellipses represent cluster boundaries, indicating that higher HbA1c levels are associated with increased psychological symptom severity.

Furthermore, our study revealed that HbA1c levels and psychological symptoms increased with age. Similar results have been reported in multicenter studies, which highlighted that age and diabetes duration significantly influence psychological symptom severity. At the same time, social support is a protective factor in this context [21]. These observations suggest that the increasing self-management responsibilities with age, compounded by adolescent psychosocial challenges, may contribute to deteriorating glycemic control.

Regarding peer bullying, our study found a weak correlation between bullying scores and HbA1c levels, with no statistically significant group differences. Previous multicenter studies have demonstrated that adolescents with chronic illnesses experience higher rates of peer bullying, which is associated with increased psychological symptoms [14,22]. Our findings imply that the impact of peer bullying on glycemic control may be mediated through increased psychological distress rather than exerting a direct effect.

In line with existing literature, our study observed that higher HbA1c levels were associated with elevated scores in social phobia, obsessive-compulsive symptoms, and generalized anxiety. Similar studies have highlighted that children with T1DM are at greater risk of developing psychological symptoms compared to their healthy peers [23]. Furthermore, recent evidence indicates that social isolation and diabetes-related visibility factors (e.g., insulin injections and device usage) exacerbate emotional distress and hinder social adaptation in this population [24]. These findings suggest that psychosocial stressors may intensify psychological symptoms, thereby negatively affecting self-management and glycemic control.

Glycemic control in diabetes is influenced not only by biomedical factors but also by psychological and social variables. Several studies have shown that anxiety and adjustment difficulties impair self-management behaviors, leading to worsened glycemic control [25]. Additionally, an inverse relationship between psychological resilience and HbA1c levels has been documented, suggesting that individuals with greater resilience achieve better diabetes management outcomes [9]. These findings underscore the critical role of psychosocial factors in effectively managing T1DM among children and adolescents.

The impact of psychological symptoms, particularly depression and anxiety, on metabolic control in pediatric T1DM populations has been emphasized in numerous studies [26]. National data have similarly demonstrated a significant association between psychiatric burden and HbA1c levels [27]. Furthermore, psychosocial intervention models have been proposed as effective strategies to disrupt the depression-anhedonia cycle and enhance coping skills in diabetes management [8].

Limitations

This study has several limitations. Its cross-sectional design precludes establishing causal relationships. Psychiatric symptoms were assessed solely through screening questionnaires, without clinical diagnostic interviews. The relatively small sample size and single-center setting limit the generalizability of the findings. Additionally, the peer bullying assessment focused exclusively on the “victim” dimension, restricting a comprehensive understanding of bullying dynamics.

CONCLUSIONS

This study demonstrated that depression and anxiety symptoms are significantly associated with glycemic control in children and adolescents with T1DM, serving as independent predictors of HbA1c levels. Both psychological symptom severity and HbA1c levels were found to increase with advancing age. Although the direct impact of peer bullying on glycemic control was not evident, its potential influence through indirect psychosocial mechanisms was suggested.

These findings emphasize the necessity of addressing psychosocial factors alongside biomedical management in the comprehensive care of pediatric diabetes. Routine screening for depression and anxiety should be implemented using validated tools, such as RCADS, during outpatient visits. In addition, diabetes care teams should include or collaborate with mental health professionals to provide timely psychological counseling. Structured psychosocial support programs—such as peer support groups, psychoeducation sessions, and school-based awareness activities—may further enhance self-management skills and improve metabolic outcomes.

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Informed Consent: Written informed consent was obtained from all participants and their legal guardians.

Ethical Approval: Ethical approval was obtained from the Clinical Research Ethics Committee of Diyarbakır Training and Research Hospital (Date: June 14, 2019; Approval No: 287). The study was conducted in accordance with the Declaration of Helsinki.

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Statement on Artificial Intelligence Use: Artificial intelligence tools (e.g., ChatGPT by OpenAI) were used solely for language editing and improving expression. The authors reviewed and approved all content, and they take full responsibility for the integrity and accuracy of the manuscript.

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