The Associating Factors of Parent-Teen and Peer Relationships Among Chinese Adolescents with Type 1 Diabetes Mellitus

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Background: Positive parent-teen and peer relationships are crucial support resources for adolescents with type 1 diabetes mellitus (T1DM). There is quite a bit of research on parent-teen relationships in Western countries, less so with peer relationships. Additionally, information on these relationships and their influencing factors among adolescents from other regions with different family culture and peer cohesion is limited, which impedes the development of targeted interventions.

Methods: This study analyzed baseline data from a randomized controlled trial in China involving 122 adolescents with T1DM aged 12–18 years. Data were collected using established questionnaires on social-demographic and clinical characteristics, perceived stress, general self-efficacy, coping styles, diabetes self-management, and parent-teen and peer relationships. Multivariate linear regression analysis was conducted to determine the associating factors of parent-teen relationships and peer relationships respectively.

Results: The total score of the parent-teen relationships subscale was 11.02 ± 2.77, within a theoretical range of 4–16. The total score of the peer relationships subscale was 16.51 ± 2.42, within a theoretical range of 5–20. Positive coping styles, less negative coping styles, and more collaboration with parents in diabetes self-management were associated with better parent-teen relationships. Younger age, positive coping styles, less negative coping styles, and higher goals for diabetes self-management were associated with better peer relationships.

Conclusion: There is room to improve parent-teen relationships, maybe via encouraging more collaboration between parents and adolescents for diabetes management. The coping styles training is indicated to improve both relationships.

Keywords: type 1 diabetes, adolescents, parent-teen relationships, peer relationships, associating factors

Introduction

Type 1 diabetes mellitus (T1DM) is one of the most common chronic illnesses in children and adolescents.[1] According to the International Diabetes Federation,[2] there were 1,211,900 people with T1DM younger than 20 years old globally in 2021. Managing T1DM requires strict adherence to a complex care regimen, including regular blood glucose monitoring, insulin administration, healthy eating, and physical activities.[3] Adolescence, defined by Erikson's eight-stage theory of psychosocial development, ranges from 12 to 18 years old.[4] It marks a time when individuals are expected to take primary responsibility for managing their T1DM while still relying on their families for guidance and support.[5] As per the social systems theory, adolescents live within various interdependent social systems, and changes in one system can significantly impact the stability of others.[6] This theory highlights the significance of interpersonal connections and social relationships in shaping health outcomes. Given the central role of the family and peer systems in the development and socialization of adolescents, incorporating family centered care practices becomes indispensable for the effective management of T1DM during this crucial stage.

The positive parent-teen relationships serve as a critical support resource for adolescents with T1DM.[7] However, it can be complex as adolescents seek more independence, both in daily life and in managing T1DM. Adolescents with

T1DM experience frequent and unpredictable blood glucose fluctuations, which can strain their relationships with parents due to emotional and behavioral changes.[8] When blood glucose levels are high or low, adolescents may experience discomfort or anger, affecting their emotional expression, while parents may experience worry and stress. This anxiety can hinder communication and create tension in parent-teen relationships.[9] There was a study reporting in 2014, American adolescents with T1DM experienced more parental criticism and less parental warmth than their healthy peers.[10] Many Asian cultures including China, India, and Nepal, emphasize values such as filial piety, group harmony, and parental authority,[11] while Western families focus on individual autonomy, open communication, and encouraging independence in their teens.[12] These cultural differences can significantly affect parent-teen relationships in Asian versus Western families. However, the quality of the parent-teen relationships among Asian adolescents with T1DM remains largely unexplored.

Peer relationships are another important social support resource for adolescents with T1DM, particularly in school settings.[13] For adolescents with T1DM, the necessary diabetes management regimens, such as regular blood glucose monitoring, insulin injections, and dietary restrictions,[2] may limit their participation in peer activities.[14] There is only one study from Spain showing that adolescents with T1DM had a poorer peer relationships compared to their healthy peers, characterized by lower peer acceptance and higher peer rejection.[15] In traditional Asian culture, peers may prioritize group harmony and avoid conflicts,[16] whereas Western peers may place greater emphasis on individuality, direct communication, and egalitarianism.[17] These cultural differences can give rise to distinct dynamics in peer relationships between Chinese individuals and their counterparts in Western countries like Spain. However, there is little data on the peer relationships of Asian adolescents with T1DM, including mainland China.

Existing studies primarily focus on the impact of parent-teen and peer relationships on diabetes management and metabolic control in adolescents with T1DM.[18,19] There is a lack of research exploring the factors associated with the parent-teen relationship among adolescents with T1DM. We did find studies conducted among adolescents with other chronic diseases which may help provide some insights while exploring associating factors of the parent-teen relationship.[20–22] Perceived stress, defined as an individual's assessment of their stress levels at a specific time or over a period,[23] has been shown to negatively impact parent-teen relationships in adolescents with psychosis in the US.[21] Self-efficacy is the belief that one can carry out specific behaviours under specified circumstances.[24] There was evidence that greater self-efficacy was associated with better parent-teen relationships in children with autism in the US.[20] Coping is defined as the process of managing demands (external or internal) that are appraised as taxing or exceeding the resources of the person.[25] More negative coping (such as rumination) was related to poorer parent-teen relationships in children with attention deficit hyperactivity disorder in Iran.[22] There are few studies reporting the influencing factors of peer relationships among adolescents with T1DM or other chronic illness. Taken together, there was limited information on the associating factors of the parent-teen relationships or peer relationships among adolescents with T1DM. Thus, it becomes a challenge to identify specific strategies for improving the important social support resource in this population.

Taken together, there is a significant need for research that examines the status of parent-teen and peer relationships and identifies the associating factors in adolescents with T1DM, especially in Asian countries. Building upon previous studies on adolescents with other chronic diseases, factors like perceived stress, general self-efficacy, and coping styles may influence the parent-teen relationships of adolescents with T1DM. In addition, diabetes self-management in T1DM is defined as an active, daily and flexible process where adolescents and their parents share responsibility and decision-making for achieving metabolic control and positive health outcomes.[26] A US study found that parent-teen relationships was positively associated with diabetes self-management in adolescents (aged 10–14 years) with T1DM.[27] Based on a conceptual model of childhood adaptation to T1DM,[28] individuals' and families' responses, such as diabetes self-management, influence parent-teen and peer relationships. The purpose of this study was to describe the parent-teen and peer relationships among Chinese adolescents with T1DM and to determine the association between perceived stress, general self-efficacy, coping styles, and diabetes self-management and these relationships. Understanding these factors is essential to support adolescents with T1DM as it can inform the development of appropriate interventions to strengthen parent-teen and peer relationships and may ultimately improve metabolic control.

Materials and Methods

Design

This study is a secondary cross-sectional analysis of baseline data from a randomized controlled trial designed to assess the efficacy of a coping skills training program for adolescents with T1DM in China. The trial was conducted between April and July 2017.[29]

Setting and Sample

The study was conducted at the outpatient department of a diabetes center in China. This outpatient department receives approximately 1800 visits annually and caters to a large number of patients with T1DM from various provinces across the country. For this secondary data analysis, 122 adolescents with T1DM were included. Eligibility criteria for this analysis included: 12–18 years of age, diagnosed with T1DM with insulin therapy for at least six months, and ability to speak and write Chinese. Exclusion criteria were serious health problems such as cancer, asthma, hypertension, and thyroid disease.

To ensure the reliability of the multivariate linear regression results with the actual sample size of 122, a simulation was conducted using G*power 3.1 TM to obtain a post hoc power of the multivariate linear regression. The sample size of 122 provides power (0.99, 0.94) to detect effect sizes of 0.273 and 0.206 (between small and medium) in regression analysis with the 10 predictors on parent-teen relationships and peer relationships, for a test of the null hypothesis of a zero coefficient with alpha = 0.05.[30] The provided power was larger than 0.80, which is a commonly accepted value for sufficient power.[30]

Recruitment

The study complied with the Declaration of Helsinki and was approved by the ethical review board of Xiangya School of Nursing, Central South University (No. 2015001). The participants were recruited by two trained diabetes educators who worked at the research site. They contacted eligible adolescents with T1DM and their parents by telephone after reviewing the medical records or when the adolescent attended regular clinic visits to explain the purpose, benefits, and risks of the study. After a sufficient period for consideration at least 24 hours, if adolescents were interested in learning more about the study, a trained research assistant described the study in detail and obtained written informed consent from adolescents and their parents.

Data Collection

Data were collected from April to July 2017 by two research assistants during adolescents' multi-disciplinary clinic visits. All self-administered questionnaires were completed in a quiet room under the guidance of trained research assistants.

Measures

Socio-demographic and clinical data were collected using a questionnaire developed by the research team and completed by the adolescents' parents. The socio-demographic information included adolescent age, sex, parent education and annual family income. Clinical data were obtained in clinical records: diabetes duration, insulin treatment regimen and most recent glycosylated hemoglobin [HbA1c]).

Perceived stress was measured by the Perceived Stress Scale.[31] This scale was revised and translated for Chinese youth (12–18 years of age).[32] There are 14 items, with scores ranging from 0 to 56, with higher scores indicating more stress. The scale has previously shown good internal consistency reliability, with a Cronbach's alpha coefficient of 0.78.[32] The Cronbach's alpha in this sample is 0.74.

General self-efficacy was measured with the General Self-Efficacy Scale.[33] The Chinese version of GSES has been developed and evaluated in Hong Kong among healthy adolescents (12–20 years of age).[34] There are ten items, with scores ranging from 10 to 40, with higher scores reflecting higher level of general self-efficacy. The Chinese version of

the scale has demonstrated good reliability and validity, with a test-retest reliability of 0.83 and an internal consistency coefficient of 0.87.[34] The Cronbach's alpha in this sample is 0.89.

Coping styles were measured with the Chinese version of Children's Coping Strategies Scale. The original scale was developed in English[35] and was revised for Chinese adolescents (13–20 years of age).[36] There are 44 items and five subscales in the Chinese scale: externalization, rumination, self-absorption, problem-solving, communication. The higher the subscale score, the more likely one is to use the specific coping strategy. Externalization, rumination, and self-absorption are negative coping styles; Problem solving and communication subscales are positive coping styles. Good internal consistency reliability for each subscale, with Cronbach's alpha coefficients ranging from 0.70 to 0.79, was reported in previous studies.[35] The Cronbach's alpha in this sample was 0.70, 0.72, 0.69, 0.82, 0.79 respectively.

Diabetes self-management was measured with the Chinese version of the Self-Management of Type 1 Diabetes in Adolescents Scale (SMOD-A)[37] which was adapted from the English version.[38] There are five subscales that include 52 items: Collaboration with Parents; Diabetes Care Activities; Diabetes Problem-Solving; Diabetes Communication; and Goals. The cut-off values for this scale have not been reported. The overall score of each subscale indicates the level of that subscale, with higher scores indicating better performance by the adolescent in that area. In a previous study, Cronbach's alpha coefficients of the five subscales ranged from 0.67 to 0.84.[37] The Cronbach's alpha for the five subscales ranged from 0.72 to 0.85 in this study.

Parent-teen relationships and peer relationships were measured using two subscales of the Quality of Life Scale for Children and Adolescents (QLS). QLS is a well-established measure in China for children and adolescents aged 7–18 years.[39] The parent-teen relationships subscale consists of four items, and the peer relationships subscale consists of five items. Each item score ranges from 1 to 4, with higher scores indicating a better parent-teen or peer relationships. The content validity index of the Quality of Life Scale for Children and Adolescents was 0.72, and the Cronbach's alpha in the original study was 0.89.[39] In this study, the Cronbach's alpha was 0.83.

Statistical Analyses

The data were double-entered and analyzed using the Statistical Package for Social Sciences for Windows, version 22.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to summarize the data. One-way ANOVA[40] was used to determine the associations of demographic and clinical characteristics with parent-teen and peer relationships. Bivariate correlations[41] were calculated among perceived stress, general self-efficacy, negative coping styles, positive coping styles, diabetes self-management subscales and the parent-teen relationships and peer relationships. All variables, except for sex, were entered as continuous variables. The Durbin-Watson statistic and variance inflation factor (VIF) were employed to test for multi-collinearity among these variables.[42]

Multivariate linear regression analysis[42] was conducted to determine the associated factors of parent-teen and peer relationships. The socio-demographic and clinical factors, and diabetes self-management factors included in the regression models were based on ANOVA analysis results, bivariate correlations results, and literature review. Perceived stress, general self-efficacy, negative coping styles, and positive coping styles were included in both models based on literature review. Participants with missing data were excluded from analyses.

Results
Socio-Demographic and Clinical Characteristics of the Participants

Of the 122 adolescents included in the study, 57.4% (n = 70) were girls. Their mean age was 13.8 ± 2.4 years (range 12–18 years), with 36.9% pre-teens (n = 45) and 63.1% adolescents (n = 77). In China, the compulsory education law mandates 9 years of schooling, comprising 6 years of elementary and 3 years of middle school. Most parents of adolescents with T1DM in this study were born in the 1980s and, due to economic conditions, many completed only the mandatory 9 years, without continuing to high school. Consequently, 9 years of education serves as the classification standard. Among the participants, 41.0% (n = 50) of mothers and 48.4% (n = 59) of fathers had more than 9 years of education. The mean duration of diabetes was 4.1 ± 3.1 years, with 35.2% (n = 43) of the adolescents diagnosed with T1DM for more than 5 years. Less than 25% (n = 30) of adolescents received treatment via an insulin pump, with most

adolescents receiving four to five insulin injections per day. The mean HbA1c level was 8.3% (Standard Deviation = 2.2), ranging from 4.7% to 14.5%. Table 1 shows detailed information on sociodemographic and clinical characteristics of participants.

The Score of Parent-Teen and Peer Relationships

The total score of the parent-teen relationships subscale was 11.02 ± 2.77, within a theoretical range of 4–16. The highest mean score was reported in the item "How satisfied are you with your relationship with your parents?" (3.17 ± 0.88), while the lowest mean score was reported in the item "How well do your parents understand you?" (2.55 ± 0.85). In addition, teens (13–18 years) scored lower than preteens (10−12 years) on the parent-teen relationships scale $(p = 0.028)$. Boys had poorer parent-teen relationships scores than did girls $(p = 0.048)$. Adolescents whose mothers had less than 9 years of education had lower parent-teen relationships scores $(p = 0.023)$. There were no significant differences in father's education level, family annual income, insulin treatment regimen, diabetes duration, and HbA1c values $(p > 0.05)$. The results are presented in Table 1 and Table 2.

Table 1 Differences in Parent-Teen and Peer Relationships by Socio-Demographic and Clinical Characteristics

Characteristics	n (%)	Parent-Teen Relationships		Peer Relationships	
		M (SD)	*P* value	M (SD)	*P* value
Socio-demographic variables					
Age					
Pre-teens (12–13 years)	45 (36.9%)	11.73 (2.98)	0.028	16.89 (2.21)	0.186
Teens (13–18 years)	77 (63.1%)	10.60 (2.57)		16.29 (2.53)	
Sex					
Male	52 (42.6%)	10.44 (2.71)	0.048	16.38 (2.35)	0.629
Female	70 (57.4%)	11.44 (2.76)		16.60 (2.49)	
Mother's education level					
Middle school or below	72 (59.0%)	10.54 (2.80)	0.023	16.00 (2.52)	0.005
High school or above	50 (41.0%)	11.70 (2.60)		17.24 (2.09)	
Father's education level					
Middle school or below	63 (51.6%)	10.70 (2.84)	0.192	16.08 (2.43)	0.043
High school or above	59 (48.3%)	11.36 (2.68)		16.97 (2.35)	
Family annual income					
Less than $3038 (low-income group)	20 (16.4%)	11.35 (3.03)	0.819	16.15 (2.30)	0.096
$3038-$6076 (middle-income group)	36 (29.5%)	10.86 (2.59)		15.92 (2.83)	
$6076+ (high-income group)	66 (54.1%)	11.00 (2.82)		16.94 (2.15)	
Clinical characteristics					
Insulin treatment regimen					
2x per day	8 (6.5%)	11.00 (3.42)	0.850	16.75 (2.12)	0.231
>2x per day	84 (68.9%)	10.93 (2.75)		16.26 (2.49)	
Insulin pump	30 (24.6%)	11.27 (2.73)		17.13 (2.24)	
Diabetes duration					
<5 years	79 (64.8%)	11.08 (2.77)	0.749	16.51 (2.54)	0.993
≥5 years	43 (35.2%)	10.91 (2.80)		16.51 (2.24)	
HbA1c					
<7.5%	55 (45.1%)	11.22 (2.88)	0.469	16.82 (2.37)	0.202
≥7.5%	67 (54.9%)	10.85 (2.69)		16.25 (2.45)	

Notes: China's National Bureau of Statistics points out that the low-income group refers to the group whose family annual income is less than 20000 RMB ($3038); the middle-income group refers to the group whose family annual income is 20000–40000 RMB ($3038–$6076); the high-income group refers to the group whose family annual income is more than 40000 RMB ($6076+) (China's National Bureau of Statistics, 2017).

Table 2 The Scores of Parent-Teen and Peer Relationships

Variables	Mean (SD)	t value(p)	Range	
			Theoretical	Actual
Parent-teen relationships				
How satisfied are you with your relationship with your parents?	3.17 (0.88)		1–4	1–4
Do you often like to stay with your parents?	2.70 (0.82)		1–4	1–4
How well do you think parents understand you?	2.55 (0.85)		1–4	1–4
Would you like to tell your parents when you encounter difficulties?	2.60 (0.84)		1–4	1–4
Total score	11.02 (2.77)	3.202 (0.002)	4–16	4–16
Peer relationships				
Do you think peers in your class are friendly to you?	3.43 (0.56)		1–4	2–4
How well do you think peers care about you?	3.28 (0.71)		1–4	1–4
How many good peers do you have?	3.44 (0.87)		1–4	1–4
How satisfied are you with your relationship with your peers?	3.39 (0.62)		1–4	2–4
Could you find reliable peers when you need help?	2.98 (0.72)		1–4	2–4
Total score	16.51 (2.42)	3.502 (0.001)	5–20	9–20

Abbreviation: SD, standard deviation.

The total score of the peer relationships subscale was 16.51 ± 2.42, within a theoretical range of 5–20. The highest mean score was reported in the item "How many good friends do you have?" (3.44 ± 0.87), while the lowest mean score was reported in the item "Could you find reliable peers when you need help?" (2.98 ± 0.72). Scores of peer relationships were lower in adolescents with mothers ($p = 0.005$) or fathers ($p = 0.043$) who had less than 9 years of education. However, there were no significant differences in age, sex, family income, insulin treatment plan, duration of diabetes, and HbA1c level ($p > 0.05$). The results are presented in Table 1 and Table 2.

Descriptive Outcomes of Perceived Stress, General Self-Efficacy, Coping Style, and Diabetes Self-Management

The total score of perceived stress among adolescents with T1DM was 25.19 ± 6.77 (ranging from 11 to 45). The general self-efficacy score of all participants was 2.49 ± 0.50 (ranging from 1 to 4). The scores for positive coping and negative coping were 2.75 ± 0.68 (ranging from 1 to 5) and 2.06 ± 0.63 (ranging from 1 to 4), respectively. The mean scores for C-SMOD-A score of the five subscales: Collaboration with parents, Diabetes Care Activities, Diabetes Problem Solving, Diabetes Communication and Goals, were 19.80 ± 6.28 (ranging from 1 to 38), 24.11 ± 6.10 (ranging from 8 to 38), 7.52 ± 5.04 (ranging from 0 to 21), 12.48 ± 5.29 (ranging from 1 to 28) and 12.68 ± 3.76 (ranging from 4 to 21), respectively. The results are presented in Table 3.

Correlation Matrix Between Parent-Teen Relationships and Potential Influencing Factors

Better peer relationships, higher general self-efficacy, positive coping styles, more DSM collaboration with parents and better diabetes care activities and communication were associated with a better parent-teen relationships ($r = 0.284 \sim 0.378$, $p < 0.05$). Higher perceived stress was associated with worse parent-teen relationships ($r = -0.309$, $p < 0.05$). The Durbin-Watson coefficient was 1.911, and the VIF varied from 1.188 to 2.416, indicating no significant multi-collinearity among these variables. The results of these correlations analyses are shown in Table 4.

Correlation Matrix Between Peer Relationships and Potential Influencing Factors

Better parent-teen relationships, higher general self-efficacy, positive coping styles, and more DSM goals were associated with better peer relationships ($r = 0.247 \sim 0.285$, $p < 0.05$). Higher perceived stress and negative coping styles were associated with worse peer relationships ($r = -0.368 \sim -0.206$, $p < 0.05$). The Durbin-Watson coefficient was 2.143, and

Table 3 Descriptive Data of Perceived Stress, General Self-Efficacy, Coping Styles, and Diabetes Self-Management

Variables	Mean (SD)	Range	
		Theoretical	**Actual**
Perceived stress	25.19 (6.77)	0–56	11–45
General self-efficacy	2.49 (0.50)	1–4	1–4
Coping styles			
Positive coping styles	2.75 (0.68)	1–5	1–5
Negative coping styles	2.06 (0.53)	1–5	1–4
Diabetes self-management			
DSM-Collaboration with Parents	19.80 (6.28)	0–39	1–38
DSM-Diabetes Care Activities	24.11 (6.10)	0–45	8–38
DSM-Diabetes Problem-Solving	7.52 (5.04)	0–21	0–21
DSM-Diabetes Communication	12.48 (5.29)	0–21	1–28
DSM-Goals	12.68 (3.76)	0–30	4–21

Abbreviation: SD, standard deviation.

Table 4 Correlation Matrix of Parent-Teen and Peer Relationships

	Parent-Teen Relationships	**Peer Relationships**
Parent-teen relationships	1	0.284**
Peer relationships	0.284**	1
Perceived stress	−0.309**	−0.368**
General self-efficacy	0.298**	0.285**
Coping styles		
Negative coping styles	−0.115	−0.206*
Positive coping styles	0.354**	0.247**
Diabetes self-management		
DSM-Collaboration with Parents	0.378**	0.092
DSM-Diabetes Care Activities	0.324**	0.152
DSM-Diabetes Problem-Solving	0.144	0.073
DSM-Diabetes Communication	0.362**	0.037
DSM-Goals	0.172	0.260**

Note: *$P < 0.05$; **$P < 0.01$.
Abbreviation: DSM, Diabetes Self-Management.

the VIF varied from 1.192–2.399, indicating no significant multi-collinearity among these variables. The results of these correlations analyses are shown in Table 4.

Multivariate Linear Regression Analysis of Correlates of Parent-Teen Relationships

Positive coping styles, less negative coping styles and more collaboration with parents were associated with better parent-teen relationships ($\beta = -0.257 \sim 0.237$, $p < 0.05$). Age, sex, mother's education level, perceived stress, general self-efficacy, diabetes care activities or diabetes communication were not associated with parent-teen relationships ($p > 0.05$). The F-test statistics for the regressions' overall fit was 5.540 and was statistically significant at the 5% level. The results of these multivariate linear regression analyses are displayed in Table 5.

Table 5 Multivariate Linear Regression Analysis of Correlates of Parent-Teen Relationships

Outcome	Predictor(s)	Adjusted R^2	B	Sb	β	F/t	p
Parent-teen relationships	Overall	0.273				5.540	<0.001
	Constant		8.534	2.564		3.328	0.001
	Age		−0.732	0.509	−0.128	−1.437	0.732
	Sex		0.421	0.472	0.075	0.893	0.374
	Mother's education level		0.334	0.482	0.059	0.692	0.490
	Perceived stress		−0.023	0.049	−0.057	−0.475	0.635
	General self-efficacy		−0.100	0.630	−0.018	−0.159	0.874
	Coping styles						
	Negative coping styles		−1.377	0.562	−0.257	−2.450	0.016
	Positive coping styles		1.118	0.460	0.273	2.432	0.017
	Diabetes self-management						
	Diabetes care activities		0.017	0.044	0.036	0.376	0.708
	Collaboration with parents		0.083	0.042	0.188	1.999	0.048
	Diabetes communication		0.087	0.056	0.167	1.570	0.119

Table 6 Multivariate Linear Regression Analysis of Correlates of Peer Relationships

Outcome	Predictor(s)	Adjusted R^2	B	Sb	β	F/t	p
Peer relationships	Overall	0.206				4.146	<0.001
	Constant		19.133	2.477		7.819	<0.001
	Age		−0.252	0.094	−0.252	−2.670	0.009
	Sex		−0.101	0.431	−0.021	−0.235	0.814
	Mother's education level		0.794	0.528	0.162	1.504	0.135
	Father's education level		0.039	0.503	0.008	0.078	0.938
	Perceived stress		−0.037	0.045	−0.104	−0.828	0.409
	General self-efficacy		−0.184	0.588	−0.038	−0.313	0.755
	Coping styles						
	Negative coping styles		−1.117	0.511	−0.239	−2.185	0.031
	Positive coping styles		0.841	0.415	0.235	2.027	0.045
	Diabetes self-management						
	Goals		0.158	0.075	0.245	2.092	0.039
	Diabetes care activities		−0.033	0.039	−0.083	−0.838	0.404

Multivariate Linear Regression Analysis of Correlates of Peer Relationships

Younger age, positive coping styles, less negative coping styles, and higher level of DSM-goals were associated with better peer relationships (β=−0.42 ~ 0.22, $p < 0.05$). Sex, mother's education level, father's education level, perceived stress, general self-efficacy or diabetes care activities were not associated with peer relationships ($p > 0.05$). The F-test statistics for the regressions' overall fit was 4.146 and was statistically significant at the 5% level. The results of these multivariate linear regression analyses are displayed in Table 6.

Discussion

This study is the first to report the parent-teen and peer relationships of adolescents with T1DM in China prior to the COVID-19 pandemic, along with factors that influence these relationships. Our findings reveal that adolescents with T1DM tend to have less favorable parent-teen relationships compared to their healthy adolescents. However, as the scores were remarkably close, indicating that even though there was a statistical difference, it may not translate into a significant clinical distinction. Furthermore, it's noteworthy that the peer relationships of adolescents with T1DM appear to be more positive than those of healthy adolescents. Those who report less negative coping, more positive

coping, and more frequent collaboration with parents on diabetes management tend to have better parent-teen relationships. Concurrently, we observed that older age, less negative coping, more positive coping, and higher level of commitment to the self-management goals were associated with better peer relationships. Sex, mother's education level, HbA1c levels, perceived stress, general self-efficacy, and diabetes care activities of self-management had no significant correlations with either parent-teen or peer relationships.

In this study, the item with the lowest score observed in the parent-teen relationships subscale was "How well do you think parents understand you?" This indicates that the majority of adolescents with T1DM feel their parents do not fully understand their experiences living with the condition. This perception may stem from the struggle they face in balancing diabetes management with their desire for independence and autonomy.[43] Moreover, parental controlling behavior may hinder communication and reduce adolescent autonomy in managing their diabetes, thereby exacerbating these issues.[44]

Regarding peer relationships, the item "How many good peers do you have?" received the highest score, while the item "Could you find reliable peers when you need help?" received the lowest score. This suggests that most adolescents believe they have many good friends but relatively few individuals they can rely on for assistance when needed. This phenomenon may be linked to distinctive features of traditional Chinese culture, such as collectivism and the emphasis on interpersonal relationships. These cultural factors may foster greater acceptance and support among classmates for peers with diabetes, contributing to improved peer relationships among Chinese adolescents with T1DM.[45] However, due to the lack of diabetes management knowledge among their peers, little professional help can be provided in emergency situations.[15]

More positive coping and less negative coping were linked to improved parent-teen relationships, as seen in previous research on children with attention deficit hyperactivity disorder in Iran.[22] Negative coping strategies, such as denial and avoidance, may contribute to increased stress and tension in the parent-teen relationships.[22] Conversely, positive coping strategies, such as problem-solving and family support seeking, may promote open communication and collaboration, fostering a stronger parent-teen bond.[22] Furthermore, frequent collaboration between adolescents and their parents on diabetes management also enhances parent-teen relationships. Collaborative problem-solving and decision-making can promote understanding and respect between adolescents and their parents, which strengthens the parent-teen relationships.[46,47]

Older adolescents in our study reported poorer peer relationships compared to pre-teens. This may be due to the challenges older adolescents face during transitions to new educational or residential environments, like entering high school, which can temporarily hinder stable peer relationships.[48] Positive coping strategies and less negative coping were linked to better peer relationships, aligning with a previous study on healthy adolescents in Sweden.[49] Negative coping strategies can lead to social difficulties and less support, while positive coping strategies promote better social skills, higher self-esteem, and positive peer relationships.[50] Moreover, when adolescents are highly committed to self-management goals, it enhances their acceptance of self-management.[38] This increased understanding motivates them to share information about their illness, thereby strengthening peer relationships.[51]

Our study found no significant associations between perceived stress, general self-efficacy, or diabetes care activities and parent-teen or peer relationships among adolescents with T1DM. This differed from previous research on healthy adolescents or adolescents with other chronic illness.[51–54] Cultural differences may explain these discrepancies, as Chinese culture values family harmony and collectivism, which may mitigate the impact of stress on parent-teen and peer relationships.[55,56] Similarly, the influence of general self-efficacy on relationships may be less significant compared to diabetes-specific self-efficacy in the context of T1DM. Regarding diabetes care activities, since these tasks primarily fall under the individual responsibilities of adolescents with T1DM, they may not necessarily negatively relate to the quality of parent-teen or peer relationships.

Limitations

This study has several limitations that should be considered when interpreting the results. First, our study relied on data collected from April to July 2017 before COVID-19 pandemic. Research indicates that the COVID-19 lockdown may have worsened parent-child relationships and increased family conflicts, but these relationships can return to pre-lockdown level after the lockdown was lifted.[57] Thus, this study may still reflect the current post-pandemic situation.

Second, the adolescents with T1DM who participated in the study, although all from the largest diabetes center in China, were limited to this one, which might restrict the generalizability of the findings. Third, we were unable to measure diabetes-related perceived stress and diabetes-specific self-efficacy which may limit the interpretation of findings. Fourth, the parent-teen and peer relationships subscales consisted of only 4–5 items, which may have limited the scope of what was assessed regarding these relationships. Lastly, important factors such as parental controlling behavior, warmth and caring behaviors, and authoritarian behavior were not included in the study, necessitating further investigation to explore additional variables and their impact on the parent-teen relationships across different cultural contexts.

Implications

Our study has several important implications for adolescents with T1DM. Firstly, our findings emphasize the significance of improving the parent-teen and peer relationships, with a priority of enhancing the parent-teen relationships among older adolescents. As such, family nurses should routinely evaluate the parent-teen and peer relationships in adolescents with T1DM and provide tailored interventions. Secondly, our study highlights the importance of implementing coping skills interventions that promote positive coping strategies while reducing negative coping patterns in adolescents with T1DM. Techniques such as cognitive restructuring, problem-solving, and conflict resolution can be utilized to enhance coping skills, which can positively impact both the parent-teen and peer relationships. Thirdly, family nurses can play a pivotal role in facilitating peer mentoring programs dedicated to providing role models and guidance for adolescents with T1DM. Creating a supportive environment through online networks or mobile applications allows experienced peers to share their valuable experiences in diabetes management, fostering peer support and collaboration. Lastly, future research should explore additional factors (eg, parental controlling behavior, family conflict) related to parent-teen and peer relationships among adolescents with T1DM. This exploration would help guide the development of targeted interventions aimed at fostering better parent-teen and peer relationships.

Conclusions

There is much room to improve parent-teen relationships for adolescents with T1DM in China. For family nurses, it is suggested conducting interventions aimed at fostering positive coping and reducing negative coping to improve both parent-teen and peer relationships in this population. Moreover, more frequent collaboration with parents on diabetes management has proven particularly effective in enhancing the parent-teen relationships, while a greater commitment to self-management goals may aid in improving peer relationships.

Abbreviations

T1DM, Type 1 diabetes mellitus; IDF, International Diabetes Federation; HbA1c, glycosylated hemoglobin; GSES, General Self-Efficacy Scale; SMOD-A, The Self-Management of Type 1 Diabetes in Adolescents Scale; QLS, Quality of Life Scale; VIF, Variance inflation factor.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Informed Consent

The study complied with the Declaration of Helsinki and was approved by the ethical review board of Xiangya School of Nursing, Central South University (No. 2015001). Permission to conduct this study was obtained from the hospitals. Adolescents and their parents received information about the purpose, process, benefits, and risks of the study, including predetermined analyses of psychological factors. They signed an informed consent form indicating their willingness to participate in the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare they have non-financial competing interests.

References

1. Association AD. 13. Children and adolescents: standards of medical care in diabetes-2019. *Diabetes Care*. 2019;42(Suppl 1):S148–S164. doi:10.2337/dc19-S013
2. IDF Diabetes Atlas 10th Edition Scientific Committee. IDF DIABETES ATLAS. (10th ed.). International Diabetes Federation; 2021. Available from: https://diabetesatlas.org/atlas/tenth-edition. Accessed December 6, 2021.
3. DiMeglio LA, Acerini CL, Codner E, et al. ISPAD clinical practice consensus guidelines 2018: glycemic control targets and glucose monitoring for children, adolescents, and young adults with diabetes. *Pediatr Diabetes*. 2018;19(Suppl 27):105–114. doi:10.1111/pedi.12737
4. Orenstein GA, Lewis L. Eriksons stages of psychosocial development. *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing. Available from: https://www.ncbi.nlm.nih.gov/books/NBK556096/. Accessed November 7, 2022.
5. Markowitz JT, Garvey KC, Laffel LM. Developmental changes in the roles of patients and families in type 1 diabetes management. *Curr Diabetes Rev*. 2015;11(4):231–238. doi:10.2174/1573399811666150421114146
6. Hartup WW. The social worlds of childhood. *Am Psychol*. 1979;34(10):944–950. doi:10.1037/0003-066X.34.10.944
7. Smetana J. Goals and goal pursuit in the context of adolescent-parent relationships. In: Oettingen G, Gollwitzer P, editors. *Self-Regulation in Adolescence (The Jacobs Foundation Series on Adolescence)*. Cambridge: Cambridge University Press; 2015:243–265.
8. Ellis M, Jayarajah C. Adolescents' view and experiences of living with type 1 diabetes. *Nurs Child Young People*. 2016;28(6):28–34. doi:10.7748/ncyp.2016.e727
9. Anderson BJ, Holmbeck G, Iannotti RJ, et al. Dyadic measures of the parent-child relationship during the transition to adolescence and glycemic control in children with type 1 diabetes. *Fam Syst Health*. 2009;27(2):141–152. doi:10.1037/a0015759
10. Helgeson VS, Palladino DK, Reynolds KA, et al. Early adolescent relationship predictors of emerging adult outcomes: youth with and without type 1 diabetes. *Ann Behav Med*. 2014;47(3):270–279. doi:10.1007/s12160-013-9552-0
11. Wang Q, Hsueh Y. Parent-child interdependence in Chinese families: change and continuity. In: Violato C, Oddone-Paolucci E, editors. *The Changing Family and Child Development*. Ashgate Publishing Ltd; 2000:60–69.
12. Pomerantz EM, Qin L, Wang Q, et al. Changes in early adolescents' sense of responsibility to their parents in the United States and China: implications for academic functioning. *Child Dev*. 2011;82(4):1136–1151. doi:10.1111/j.1467-8624.2011.01588.x
13. Wiebe DJ, Helgeson V, Berg CA. The social context of managing diabetes across the life span. *Am Psychol*. 2016;71(7):526–538. doi:10.1037/a0040355
14. Momani AM, Callery P, Lin YL, et al. "I like people to treat me normally": barriers to type 1 diabetes self-management among adolescents. *Clin Diabetes*. 2022;40(2):196–203. doi:10.2337/cd20-0116
15. Núñez-Baila M, Gómez-Aragón A, González-López JR. Social support and peer group integration of adolescents with diabetes. *Int J Environ Res Public Health*. 2021;18(4):2064. doi:10.3390/ijerph18042064
16. Shao Y, Kang S. The association between peer relationship and learning engagement among adolescents: the chain mediating roles of self-efficacy and academic resilience. *Front Psychol*. 2022;13:938756. doi:10.3389/fpsyg.2022.938756
17. Grilo SA, Santelli JS, Nathanson C, et al. Psychosocial outcomes and peer influences among multiracial adolescents in the United States. *Front Public Health*. 2023;11:852268. doi:10.3389/fpubh.2023.852268
18. Trojanowski PJ, Niehaus CE, Fischer S, et al. Parenting and psychological health in youth with type 1 diabetes: systematic review. *J Pediatr Psychol*. 2021;46(10):1213–1237. doi:10.1093/jpepsy/jsab064
19. Doe E. An analysis of the relationships between peer support and diabetes outcomes in adolescents with type 1 diabetes. *J Health Psychol*. 2018;23(10):1356–1366. doi:10.1177/1359105316656228
20. Román-Oyola R, Reynolds S, Soto-Feliciano I, et al. Child's sensory profile and adult playfulness as predictors of parental self-efficacy. *Am J Occup Ther*. 2017;71(2):1487714581p–1487714582p. doi:10.5014/ajot.2017.021097
21. Bentley E, Millman ZB, Thompson E, et al. High-risk diagnosis, social stress, and parent-child relationships: a moderation model. *Schizophr Res*. 2016;174(1–3):65–70. doi:10.1016/j.schres.2016.04.014
22. Taghizade S, Mahmoodi Z, Zandifar A, et al. The relationship model among parent-child relationship, coping responses and behavioral problems in children with attention deficit hyperactivity disorder. *BMC Psychiatry*. 2022;22(1):596. doi:10.1186/s12888-022-04224-3

23. Cohen S, Williamson G. Perceived stress in a probability sample of the United States. In: Spacapan S, Oskamp S, editors. *The Social Psychology of Health: Claremont Symposium on Applied Social Psychology*. Newbury, CA: Sage; 1988:31–67.

24. Bandura A. Self-efficacy: the exercise of control. *J Cogn Psychother*. 1997;13:158–166. doi:10.1891/0889-8391.13.2.158

25. Lazarus RS, Folkman S. *Stress, Appraisal, and Coping*. New York: Springer; 1984.

26. Schilling LS, Grey M, Knafl KA. The concept of self-management of type 1 diabetes in children and adolescents: an evolutionary concept analysis. *J Adv Nurs*. 2002;37,87–99. doi:10.1046/j.1365-2648.2002.02061.x

27. Berg CA, King PS, Butler JM, et al. Parental involvement and adolescents' diabetes management: the mediating role of self-efficacy and externalizing and internalizing behaviors. *J Pediatr Psychol*. 2011;36(3):329–339. doi:10.1093/jpepsy/jsq088

28. Whittemore R, Jaser S, Guo J, et al. A conceptual model of childhood adaptation to type 1 diabetes. *Nurs Outlook*. 2010;58(5):242–251. doi:10.1016/j.outlook.2010.05.001

29. Guo J, Luo J, Yang J, et al. School-aged children with type 1 diabetes benefit more from a coping skills training program than adolescents in China: 12-month outcomes of a randomized clinical trial. *Pediatr Diabetes*. 2020;21(3):524–532. doi:10.1111/pedi.12975

30. Faul F, Erdfelder E, Buchner A, et al. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods*. 2009;41(4):1149–1160. doi:10.3758/BRM.41.4.1149

31. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24(4):385–396. doi:10.2307/2136404

32. Yang TZ, Huang HT. An epidemiological study on stress among urban residents in social transition period. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2003;24(9):760–764. doi:10.3760/j.issn:0254-6450.2003.09.004

33. Schwarzer R, Jerusalem M. Generalized self-efficacy scale. In: Weinman J, Wright S, Johnson M, editors. *Measures in Health Psychology: A User's Portfolio, Causal and Control Beliefs*. 1995:35–37.

34. Zhang JX, Schwarzer R. Measuring optimistic self-beliefs: a Chinese adaptation of the general self-efficacy scale. *Int J Psychol*. 1995;38 (3):174–181. doi:10.1080/09515089508573160

35. Jose PE, D'Anna CA, Cafasso LL, et al. Stress and coping among Russian and American early adolescents. *Dev Psychol*. 1998;34(4):757–769. doi:10.1037/0012-1649.34.4.757

36. Hou YB, Zhang M. Revision of coping style scale for adolescents. *Zhongguo Lin Chuang Xin Li Xue Za Zhi*. 2006;14(6):566–568. doi:10.3969/j.issn.1005-3611.2006.06.005

37. Guo J, Whittemore R, Grey M, et al. Diabetes self-management, depressive symptoms, quality of life and metabolic control in youth with type 1 diabetes in China. *J Clin Nurs*. 2013;22(1–2):69–79. doi:10.1111/j.1365-2702.2012.04299.x

38. Schilling LS, Dixon JK, Knafl KA, et al. A new self-report measure of self-management of type 1 diabetes for adolescents. *Nurs Res*. 2009;58 (4):228–236. doi:10.1097/NNR.0b013e3181ac142a

39. Wu HR, Meng H, Liu PL. Norm, reliability and validity of children and adolescents' QOL scale. *Zhongguo Xue Xiao Wei Sheng*. 2006;27(1):18–21.

40. Mishra P, Singh U, Pandey CM, et al. Application of student's t-test, analysis of variance, and covariance. *Ann Card Anaesth*. 2019;22(4):407–411. doi:10.4103/aca.ACA_94_19

41. Ma Z, Hanson TE, Ho YY. Flexible bivariate correlated count data regression. *Stat Med*. 2020;39(25):3476–3490. doi:10.1002/sim.8676

42. Marill KA. Advanced statistics: linear regression, part II: multiple linear regression. *Acad Emerg Med*. 2004;11(1):94–102. doi:10.1197/j.aem.2003.09.006

43. Helgeson VS, Reynolds KA, Snyder PR, et al. Characterizing the transition from paediatric to adult care among emerging adults with type 1 diabetes. *Diabet Med*. 2013;30(5):610–615. doi:10.1111/dme.12067

44. van Rijsewijk L. *Antecedents and Consequences of Helping Among Adolescents* [Thesis fully internal (DIV), University of Groningen]. Rijksuniversiteit Groningen; 2018. Available from: https://pure.rug.nl/ws/portalfiles/portal/64164013/Chapter_1.pdf.

45. Wen M, Lin D. Child development in rural China: children left behind by their migrant parents and children of nonmigrant families. *Child Dev*. 2012;83(1):120–136. doi:10.1111/j.1467-8624.2011.01698.x

46. Iskander JM, Rohan JM, Pendley JS, et al. A 3-year prospective study of parent-child communication in early adolescents with type 1 diabetes: relationship to adherence and glycemic control. *J Pediatr Psychol*. 2015;40(1):109–120. doi:10.1093/jpepsy/jsu027

47. Martin MT, Miller-Johnson S, Kitzmann KM, et al. Parent-child relationships and insulin-dependent diabetes mellitus: observational ratings of clinically relevant dimensions. *J Fam Psychol*. 1998;12(1):102–111. doi:10.1037/0893-3200.12.1.102

48. Barzeva SA, Richards JS, Veenstra R, et al. Quality over quantity: a transactional model of social withdrawal and friendship development in late adolescence. *Soc Dev*. 2022;31(1):126–146. doi:10.1111/sode.12530

49. Blomgren AS, Svahn K, Åström E, et al. Coping strategies in late adolescence: relationships to parental attachment and time perspective. *J Genet Psychol*. 2016;177(3):85–96. doi:10.1080/00221325.2016.1178101

50. White NE, Richter JM, Fry C. Coping, social support, and adaptation to chronic illness. *West J Nurs Res*. 1992;14(2):211–224. doi:10.1177/019394599201400208

51. Raymaekers K, Prikken S, Oris L, et al. A person-centered perspective on the role of peer support and extreme peer orientation in youth with type 1 diabetes: a longitudinal study. *Ann Behav Med*. 2020;54(11):893–903. doi:10.1093/abm/kaaa025

52. Drew LM, Berg C, Wiebe DJ. The mediating role of extreme peer orientation in the relationships between adolescent-parent relationship and diabetes management. *J Fam Psychol*. 2010;24(3):299–306. doi:10.1037/a0019352

53. Auerbach RP, Bigda-Peyton JS, Eberhart NK, et al. Conceptualizing the prospective relationship between social support, stress, and depressive symptoms among adolescents. *J Abnorm Child Psychol*. 2011;39(4):475–487. doi:10.1007/s10802-010-9479-x

54. Wachs S, Görzig A, Wright MF, et al. Associations among adolescents' relationships with parents, peers, and teachers, self-efficacy, and willingness to intervene in bullying: a social cognitive approach. *Int J Environ Res Public Health*. 2020;17(2):420. doi:10.3390/ijerph17020420

55. Gao XH. The impact of cultural differences on family education in China and the United States. *Zhong Wai Jiao Liu*. 2018;46:36.

56. Pan X. The inspiration of traditional Chinese harmony thought to build a harmonious society. *Xin Si Lu*. 2022;5:9–11.

57. Tan TX, Wang JH, Wang P, Huang Y. Child-parent relationship during the Wuhan COVID-19 lockdown: role of changes in preschool children's daily routines. *Fam Relat*. 2022;72:92–104. doi:10.1111/fare.12755