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Original Article

Psychosocial and Behavioral Pathways Linking Family Support and Quality of Life in Adolescents with Type 1 Diabetes Mellitus: A Systematic Review

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ABSTRACT

Background: Adolescents with T1DM face an increased risk of diminished health-related quality of life (HRQOL) due to the daily demands of disease management during a developmentally sensitive period. Family social support has been proposed as a key protective factor, yet its relationship with HRQOL varies across studies, suggesting the involvement of intervening psychosocial and behavioral mechanisms. This systematic review aimed to synthesize evidence on the psychosocial and behavioral that link family social support to HRQOL among adolescents with T1DM. The review also distinguished formally tested mediation from correlational evidence.

Method: A systematic search of Scopus and PubMed was conducted following PRISMA 2020 guidelines. Studies were included if they involved adolescents with T1DM, measured family social support and HRQOL, and reported at least one psychosocial or behavioral variable (mediator, moderator, or related factor). Study quality was assessed using the Joanna Briggs Institute critical appraisal tools. Due to heterogeneity in study designs and mediators examined, findings were synthesized narratively. Evidence strength was classified using predefined criteria.

Results: Fifteen studies involving approximately 1,759 adolescents were included, conducted across eight countries between 2006 and 2026. Seven thematic pathways were identified, and only two studies formally tested mediation. Self-efficacy and self-management showed the most consistent evidence, and emotional and psychological adjustment and family functioning as a proximal correlate were mostly consistent. Metabolic control, examined in eight studies, showed a positive but mixed pattern. Autonomy, resilience, and peer support were supported by convergent qualitative evidence from two countries. Illness representation was examined in only one study. Methodological quality was good in nine studies, moderate in four, and low in two.

Conclusion: Family social support may be linked to HRQOL among adolescents with T1DM largely through indirect pathways that include self-efficacy, self-management, and emotional adjustment, consistent with an ecological systems perspective at the individual and family levels. Given the predominance of cross-sectional designs and the limited use of formal mediation testing, these findings should be interpreted as indicative rather than confirmatory. Further longitudinal and mediation-based research, particularly from underrepresented regions, is needed.

Keywords: *Type 1 diabetes mellitus; Adolescents; Family support; Quality of life; Systematic review*

INTRODUCTION

Type 1 diabetes mellitus (T1DM) affects approximately 1.52 million children and adolescents under the age of 20 worldwide, representing 17% of the global T1DM population.[1,2] In Indonesia, this upward trajectory has been similarly pronounced. The Indonesian Pediatric Society recorded 1,249 children with T1DM between 2017 and 2019, and the Ministry of Health reported by January 2023 a prevalence of 2 per 100,000 children, a 70-fold increase since 2010, and 1,645 registered children with diabetes mellitus in 13 cities.[1] No Indonesia-specific epidemiological update has been published since this 2023 registry report. Given the persistently rising global incidence of pediatric T1DM, this trend is presumed to have continued, although the scarcity of subsequent national data reflects a broader limitation in Indonesian T1DM research, particularly concerning its psychosocial dimensions.

Within this expanding population, the psychosocial burden associated with T1DM management is considerable. This burden often manifests well before cases are formally

captured in national statistics. A clinical study conducted among pediatric patients in Jakarta found that nearly half of T1DM patients (45.8%) exhibited clinically significant psychological problems, most commonly internalizing symptoms, and that this burden was more pronounced among those with longer disease duration and a history of complications.[3] Family social support, which encompasses emotional responsiveness, open communication, and shared problem-solving, has consistently emerged as a proximal buffer against this burden.[4] It is particularly relevant during adolescence, when the daily demands of insulin administration, glycemic monitoring, and dietary regulation intersect with a heightened need for autonomy and peer acceptance.

Family support was selected as the primary exposure for three reasons. First, the family is the proximal context of daily T1DM management and has consistently emerged as a buffer against psychosocial burden.[4] Second, the family is often the main source of support for adolescents, particularly where structured peer, school, and community programs are limited. Third, a single exposure keeps the review question specific enough to map pathways, and broader social systems are interpreted as context. Peer, school, and healthcare support were therefore not excluded as influences. They are treated as complementary mechanisms within the ecological framework and are examined where the included studies reported them.

Despite this recognized importance, evidence linking social support directly to HRQOL among adolescents with T1DM remains inconsistent. Some studies report significant associations between family support and HRQOL.[5] Others find absent or context-dependent effects, with the direct influence of support disappearing once mediating mechanisms such as coping are accounted for.[6,7] This inconsistency suggests that family support does not influence HRQOL through a simple, direct pathway.

This inconsistency can be explained through Bronfenbrenner's Ecological Systems Theory.[8] The theory conceptualizes adolescent development as nested within several interacting systems, ranging from the individual level, which involves personal cognitive and behavioral characteristics, to the family or microsystem level. These systems extend further to the broader social environment, including peers, schools, and healthcare communities, and ultimately to the national level, which encompasses health policy, insurance systems, and cultural norms. Family support therefore cannot influence HRQOL alone. It must operate through individual-level mechanisms shaped by these broader social and national systems. At this individual level, family support has been theorized to strengthen adolescents' diabetes management self-efficacy, improve treatment adherence, and support glycemic control, outcomes hypothesized to shape their overall quality of life.[9]

Beyond behavioral mechanisms, a parallel body of theory points to psychosocial and cognitive-emotional pathways through which family support may influence HRQOL. Illness representations, or how adolescents perceive and interpret their disease, have been proposed as one such pathway.[10] Family affection, communication, and psychological control have been shown to jointly predict adolescents' self-esteem, perceived illness threat, and levels of anxiety and depression.[11] Similar patterns have been observed specifically among adolescents with T1DM, where family support was associated with lower psychopathology and more favorable illness perception,[12] and where family cohesion was linked to reduced anxiety and depressive symptoms.[13] Beyond the family, peer support has also been found to strengthen adolescents' emotional adjustment and buffer the isolation associated with parental overprotection.[14]

Over the past two decades, a growing body of primary research has examined one or more of these candidate mediating pathways among adolescents with T1DM. These studies span cross-sectional, longitudinal, randomized, and qualitative designs. They have been conducted across a wide range of cultural contexts, including the United States, Europe, the Caribbean, and Asia. Some have focused on behavioral mediators such as self-efficacy and adherence, while others have examined psychosocial pathways such as depression, illness perception, and family conflict. Despite this growing volume of evidence, findings remain scattered across disconnected strands of literature.

No systematic review, however, has comprehensively synthesized this fragmented evidence base through an ecologically informed lens. Existing reviews have generally examined single pathways in isolation, such as adherence or depression, rather than mapping how multiple psychosocial and behavioral mediators operate together. To our knowledge, this is the first systematic review to integrate evidence on behavioral and psychosocial mediators of the relationship between family support and HRQOL specifically among adolescents with T1DM. This gap leaves clinicians and researchers without a clear picture of which mediating pathways carry the strongest and most consistent evidentiary support.

Addressing this gap, the present systematic review aims to synthesize evidence on the psychosocial and behavioral pathways that link family social support to HRQOL among adolescents with T1DM. Findings from this review are intended to inform more targeted, mechanism-based family-centered interventions. Specifically, pathways with consistent evidence can identify modifiable targets for family-centered interventions, such as self-efficacy training and emotional support. They can also indicate which psychosocial domains clinics should screen routinely during diabetes care, and they can show where the evidence is too limited to support clinical recommendations. This is particularly relevant to Indonesia and other developing-country contexts, where family and community systems play a central role in adolescent chronic disease management.

METHODS

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.[15] The completed PRISMA 2020 checklist is provided as Supplementary File 1. The review question was formulated using the Population-Exposure-Outcome (PEO) framework, which is methodologically appropriate for systematic reviews addressing associative and mechanistic relationships between a non-interventional exposure and a health outcome. Within this framework, the population (P) was defined as adolescents diagnosed with T1DM, the exposure (E) was family social support, and the outcome (O) was HRQOL. Given the review's explicit mechanistic focus, an additional requirement was incorporated specifying that eligible studies must report at least one psychosocial or behavioral variable functioning as a mediator, moderator, or related factor within the family support and HRQOL relationship. Because eligible studies could report mediators, moderators, or related factors, the terms 'pathway' and 'candidate mediator' are used throughout, and 'mediation' is reserved for effects that were formally tested.

2.1 Eligibility Criteria

Eligibility criteria were established based on the PEO-M framework described above. Studies were eligible for inclusion if they were original empirical investigations involving an adolescent population, operationally defined as 10 to 19 years of age, in line with the World Health Organization definition; studies encompassing a broader developmental range, such as children or young and emerging adults, were retained when adolescent-specific data could be extracted or when at least 50% of participants fell within the 10 to 19 year range, judged from the reported age range, mean, and standard deviation. When age-specific data were unavailable, eligibility was based on the reported mean age and the authors' description of the sample as adolescents. Four studies (Liu et al.[13], Temmen et al.[19], Hilliard et al.[24], and Weissberg-Benchell et al.[25]) included some participants younger than 10 years and were retained because at least half of the participants were 10 years or older (median age of 11 years in Liu et al.; mean ages of 12.0 to 12.4 years in the other three studies). Eligible studies were required to report a diagnosis of T1DM among participants, to measure family social support under any of its commonly used conceptual labels, and to measure HRQOL as an outcome, whether assessed generically or through a diabetes-specific instrument. Because the review question concerned broader quality of life, studies that assessed related well-being constructs, such as emotional wellbeing or psychosocial functioning, or that explored quality of life qualitatively were also eligible and were treated as proxy indicators of HRQOL. This criterion was broadened during study selection and departs from a strict requirement for a validated HRQOL instrument, and the deviation is acknowledged in the Limitations. Critically, studies were required to examine or report at least one psychosocial or behavioral variable operating as a mediator, moderator, or related factor within the family support and HRQOL pathway. No restriction was placed on study design, and quantitative, qualitative, and mixed-methods studies were all considered eligible provided that empirical data, rather than a protocol alone, were reported.

Studies were excluded if they constituted secondary or synthesis-type publications, including systematic reviews, systematic literature reviews, scoping reviews, integrative reviews, narrative reviews, umbrella reviews, meta-analyses, meta-syntheses, or bibliometric analyses. Non-empirical or non-peer-reviewed publication types, including editorials, letters to the editor, commentaries, opinion papers, perspectives, protocols, conference abstracts, conference proceedings, book chapters, dissertations or theses, corrections, errata, and publication notes, were likewise excluded.

2.2 Information Sources and Search Strategy

A systematic literature search was performed across two electronic bibliographic databases, Scopus and PubMed, selected for their comprehensive indexing of biomedical and psychosocial literature relevant to pediatric chronic disease research, and because they were the databases accessible through the authors' institutional subscription. The search strategy combined four conceptual blocks corresponding to the population, the clinical condition, the exposure, and the outcome, connected using Boolean operators and truncation symbols to capture lexical variants. This is detailed in Table 1. The Scopus search was run in the TITLE-ABS-KEY fields. The Scopus search was restricted to final-stage, open access publications and the PubMed search to records with free full text, so eligible records without open access or free full text may have been missed. The filters were applied because the authors could not access subscription-only full texts. The strings contained no terms for family functioning, conflict, cohesion, or parental involvement, so studies that measured these constructs were retrieved only when they also used support-related terms. The search was conducted from 2006 up to June 2026. The last search was conducted on July 19, 2026. No language restriction was applied.

Table 1. Search strategy and applied filters by database

Database	Search string	Applied filters
Scopus	(adolescen* OR teenager* OR youth) AND ("type 1 diabetes" OR T1DM OR "juvenile diabetes") AND ("social support" OR "family support" OR "peer support" OR	Publication stage: Final; Open Access: All

Database	Search string	Applied filters
	"community support") AND ("quality of life" OR QoL OR HRQOL) NOT ("systematic review" OR "systematic literature review" OR "bibliometric" OR "meta-analysis")	
PubMed	("Diabetes Mellitus, Type 1"[Mesh] OR "type 1 diabetes"[tiab] OR T1DM[tiab] OR "juvenile diabetes"[tiab] OR "insulin-dependent diabetes"[tiab]) AND ("Adolescent"[Mesh] OR adolescen*[tiab] OR teenager*[tiab] OR youth[tiab] OR "young people"[tiab]) AND ("Social Support"[Mesh] OR "social support"[tiab] OR "family support"[tiab] OR "peer support"[tiab] OR "community support"[tiab] OR "school support"[tiab] OR "social network*"[tiab]) AND ("Quality of Life"[Mesh] OR "quality of life"[tiab] OR QoL[tiab] OR HRQOL[tiab] OR "health-related quality of life"[tiab] OR well-being[tiab] OR wellbeing[tiab]) NOT ("systematic review" OR "systematic literature review" OR "bibliometric" OR "meta-analysis")	Full text free

2.3 Study Selection Process

Following the removal of duplicate records, all retrieved citations were screened in two sequential stages. In the first stage, titles and abstracts were independently evaluated against the eligibility criteria by two independent reviewers (NS and MDP). In the second stage, the full texts of records judged potentially eligible were retrieved and independently assessed against the same criteria to confirm final inclusion. At both stages, disagreements between reviewers were resolved through discussion, and where consensus could not be reached, a third reviewer (DS) was consulted to adjudicate the final decision. The entire selection process, including the number of records identified, screened, excluded, and finally included, was documented and is reported as a PRISMA flow diagram in the Results section (Figure 1).

2.4 Data Extraction

A standardized, piloted data extraction form was developed to ensure consistent and reproducible capture of study characteristics and findings relevant to the review question. Data were extracted independently by NS and MDP, and any discrepancies were cross-checked and resolved through discussion through referral to a third reviewer. The extraction form captured ten components spanning bibliographic identification, methodological characteristics, exposure and outcome measurement, mediating variables, and substantive findings.

2.5 Quality Assessment

The methodological quality of included studies was appraised using the Joanna Briggs Institute (JBI) critical appraisal checklists,[16] with the specific checklist selected according to each study's design. Studies that reported only baseline data from a trial were appraised with the cross-sectional checklist. Only items rated yes were counted as met, and items that did not apply to a study design were excluded from the denominator. Quality appraisal was performed independently by NS and MDP, with each checklist item rated as yes, no, unclear, or not applicable. Discrepancies in appraisal scores were resolved through discussion through consultation with a third reviewer (DS). An overall quality rating was derived for each study based on the proportion of criteria satisfactorily met (good, 70% or more; moderate, 50 to 69%; low, below 50%), and results are reported descriptively. The JBI manual leaves the scoring system and the cut-off to the review team and asks reviewers to justify their decision rules, so these thresholds were defined by the review team.[16] Quality ratings were used to describe the evidence base and were not used to exclude studies or to modify consistency ratings.

2.6 Data Synthesis

Given the substantial heterogeneity anticipated across included studies with respect to design, mediating variables examined, and analytic approach, a quantitative meta-analysis was not undertaken. Instead, findings were synthesized narratively, informed by the Synthesis Without Meta-analysis (SWiM) reporting guideline, through a five-step procedure structured around the review's central research question.[17]

The first step involved grouping all included studies according to the type of psychosocial or behavioral pathway variable examined, generating thematic categories such as self-efficacy, adherence and self-management, metabolic control, illness representation, family functioning and conflict, and coping. A single study could be assigned to more than one thematic category where multiple mediators were tested concurrently. The second step involved appraising the methodological strength of mediation evidence within each thematic category by cross-referencing study design and analytic method. Evidence was ranked from strongest to

weakest as follows: formal mediation testing (structural equation modeling or path analysis); longitudinal or experimental designs; cross-sectional correlational or regression analyses; and qualitative thematic evidence. Each theme was then assigned a review-defined strength rating. The rating was moderate when at least two studies applied formal mediation testing with a consistent direction, limited when one study applied formal mediation testing or when several consistent studies relied on correlational designs, and very limited when the evidence came from a single study or from qualitative data alone. Themes that describe an exposure dimension or a contextual moderator were not rated for mediation strength. A formal certainty-of-evidence framework such as GRADE or GRADE-CERQual was not applied. The third step synthesized the direction and consistency of findings within each thematic category, classifying the overall pattern of evidence as consistent, mixed, or conflicting. The fourth step contextualized the patterns identified in the third step against potential moderating factors, including country or cultural context, sample characteristics, and the specific instruments used to measure family support and HRQOL. The final step involved presenting the synthesized findings in a synthesis matrix and a narrative synthesis. Themes were grouped as individual-level candidate mediators, a clinical outcome, an exposure dimension, and contextual moderators.

RESULTS

a. Study Selection

The systematic search of Scopus and PubMed identified a combined total of 84 records (Scopus, n = 49; PubMed, n = 35). After the removal of 22 duplicate records, 62 unique records remained for title and abstract screening. Of these, 43 records were excluded for not meeting the eligibility criteria, leaving 19 reports sought for full-text retrieval. Four reports could not be retrieved, resulting in 15 reports assessed for full-text eligibility. No further reports were excluded at this stage, yielding a final set of 15 studies included in the qualitative synthesis. The complete study selection process is illustrated in the PRISMA 2020 flow diagram (Figure 1). The four reports could not be retrieved in full text through the databases or the authors' institutional access, and their authors were not contacted. Eligibility could not be assessed without the full text, so these reports were not included. No report was excluded at the full-text stage. The excluded records and the reasons for exclusion are listed in Supplementary Table S1. Four studies cited as background in the Introduction were not included. Graue et al.[6] was published before the 2006 start of the search window and was not identified by the search. Luo et al.[7] was not identified by the search and did not measure family support. Tzavela et al.,[4] was identified but excluded at screening because it did not measure HRQOL. Alzawareh & Ozturk[18] were not identified by the search and did not measure family support.

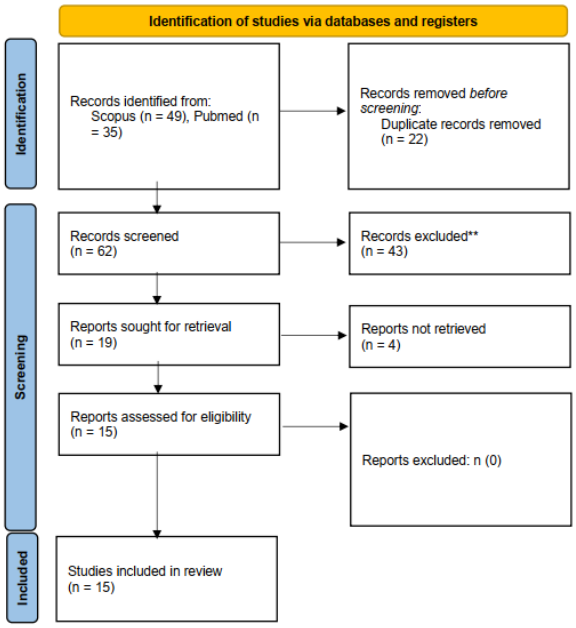


Figure 1. PRISMA 2020 flow diagram

b. Study Characteristics

The 15 included studies were published between 2006 and 2026, with a marked concentration of recent publications, including four studies published in 2025 alone. Geographically, the evidence base was internationally diverse, encompassing the United States (six studies), Spain and Turkey (two studies each), and single studies from Portugal, Barbados, Australia, China, and the Netherlands. Collectively, the studies involved approximately 1,759 adolescents with T1DM at baseline, excluding the 75 healthy comparison participants in the case-control study by Liu et al.,[13] with reported ages spanning approximately 8 to 18 years, though the majority of samples were concentrated in early-to-middle adolescence (11 to 17 years).

Regarding study design, cross-sectional designs predominated (six studies), followed by cross-sectional analyses of baseline data from trials (three studies), a secondary analysis of trial data with a 12-month follow-up (one study), longitudinal or cohort designs (two studies), qualitative designs employing phenomenological or descriptive-interpretive approaches (two studies), and a pilot randomized waiting-list trial (one study). Instruments used to operationalize family social support varied considerably, ranging from generic parenting-style measures to diabetes-specific conflict scales and standardized family environment measures. Similarly, HRQOL was assessed using a mixture of generic instruments, diabetes-specific instruments, and, in four studies, qualitative or proxy conceptualizations of well-being in the absence of a validated HRQOL instrument. The complete characteristics of the included studies are summarized in Table 2.

Table 2. Characteristics of studies included in the systematic review

No.	Author, Year, & Setting	Study Design	Sample Characteristics	Mediator/Intervening Variable(s)	Main Findings (Family Support-Mediator-HRQOL)
1	Rodríguez-Rubio et al. (2025) Spain (Valencia); pediatric endocrinology outpatient clinic, Hospital General Universitario de Valencia	Two-part pilot study: (a) RCT (experimental vs. waiting-list control, pre-post); (b) within-subject longitudinal, 3 time points	n=19 T1DM adolescents (study 1: experimental n=10, control n=9; study 2 within-subject n=13); age 11-17 years (M=13.31; SD=1.66; inclusion criterion of 12 to 16 years); 57.9% male	Self-esteem (RSE); illness perception (B-IPQ); emotional competencies (ESCQ-21); anxiety-depression (HADS); psychopathology (SDQ); psychological well-being (BIEPS-J, proxy indicator of HRQOL)	Autonomy promotion within the family was positively correlated with psychological well-being (rho=0.740) and negatively correlated with psychopathology (rho=-0.706); a less favorable illness perception was correlated with lower autonomy promotion (rho=-0.486) and more psychopathology (rho=0.530). Results of the caregiver-involving 10VIDA pilot intervention are preliminary, and the sample (n=19) is too small to support causal conclusions.
2	Whittemore et al. (2014) United States (multi-site: Pennsylvania, Arizona, Florida, and Connecticut); pediatric clinics	Cross-sectional with Structural Equation Modeling (SEM) for mediation testing	n=320 T1DM adolescents aged 11 to 14 years; 55% female, 58% early adolescent, 63% White	Self-management (primary mediator)	Self-management mediated the relationships of family conflict and depressive symptoms with quality of life, and of family conflict, warmth-caring, parent guidance-control, and depressive symptoms with HbA1c (indirect effects), although total effects on HbA1c were not significant. Warmth-caring was not a significant indirect predictor of quality of life (p=0.06), direct effects of family functioning were not significant, and the role of guidance-control was inconsistent.
3	Hilliard et al. (2009) United States; Children's National Medical Center, Washington DC	Prospective longitudinal cohort (4 time points: before and 1, 6, and 12 months after pump initiation); hierarchical linear modeling	n=53 parent-child T1DM dyads transitioning to insulin pump therapy; age 8-17 years (M=12.0; SD=2.4); 28 dyads completed all four assessments	Depressive (CDI) and anxiety (MASC) symptoms; family conflict and cohesion (FES); pre-pump regimen, child and parent age, illness duration	Before the transition, QoL (DQOL-Y) was poorer among youth with more depressive or anxiety symptoms, those on conventional regimens, and older children and parents. QoL (satisfaction and impact scales) improved after the transition to the pump, most strongly among youth with more symptoms, longer illness duration, and older age. Family conflict and cohesion were not associated with QoL or with change in QoL.
4	Temmen et al. (2022) United States; 4 pediatric endocrinology centers (baseline data from the "Family Management of Diabetes" RCT)	Cross-sectional analysis of baseline data from a randomized clinical trial (latent profile analysis)	n=390 youth with T1DM aged 9 to 14.9 years (M=12.43; SD=1.72; 50.8% female; 75% White) and primary caregivers	HbA1c, regimen adherence, depressive symptoms; parental involvement class as predictor	Three parental involvement classes were identified: "Harmonious" (high task & collaborative involvement, low conflict) was associated with the best adherence, glycemic control, and psychosocial QoL; "Inharmonious" (high conflict) was associated with the worst psychosocial well-being.

No.	Author, Year, & Setting	Study Design	Sample Characteristics	Mediator/Intervening Variable(s)	Main Findings (Family Support-Mediator-HRQOL)
5	Villaécija et al. (2023) Spain; Reina Sofía University Hospital, Córdoba	Longitudinal (2 time points, T1 & T2, 3 to 6 months apart depending on age); path analysis & mediation analysis	T1: n=151 (M age=14.50; SD=2.67; 41.1% female); T2: n=97 (M age=14.93; SD=2.56; 39.2% female)	Self-efficacy (primary mediator); self-care skills	Family social support was significantly positively associated with subjective emotional wellbeing and self-care; self-efficacy fully mediated the relationship between family social support and subjective emotional wellbeing (excellent model fit).
6	Pereira et al. (2008) Portugal; pediatric diabetes unit of one hospital in Oporto (convenience sample)	Cross-sectional	n=157 Portuguese T1DM adolescents aged 10 to 18 years (M=15; SD=2.2; 51% girls); age, gender, illness duration, and social class controlled as covariates	Adherence, metabolic control (tested as direct outcomes, not as a formal multilevel mediation model)	Family social support predicted better quality of life overall ($p<0.001$), among males, females, and lower-class participants, and predicted better adherence overall and among females and lower-class participants. Family conflict predicted lower quality of life overall ($p<0.05$) and in the upper class, where it also predicted metabolic control. Cohesion and organization were largely unrelated to outcomes, and no family variable predicted metabolic control overall. Family social support moderated the adherence-metabolic control association ($p=0.027$).
7	Weissberg-Benchell et al. (2009) United States (four pediatric diabetes centers in Boston, Chicago, Houston, and Jacksonville; baseline data of a pilot intervention study, Family Management of Diabetes Study)	Cross-sectional with an observed family interaction task	n=121 youth with T1DM aged 9 to 14.5 years (M=12.1; SD=1.6; 49.6% female) and primary caregivers (92% mothers)	Diabetes-specific family conflict; negative diabetes-specific family communication; collaborative parent involvement	Diabetes-specific family conflict was associated with lower generic and diabetes-specific HRQOL on both child and parent reports, and observed negative communication was associated with lower child-reported diabetes-specific HRQOL. Collaborative parent involvement was associated with higher child-reported HRQOL, whereas sharing of diabetes responsibilities was not. Diabetes-specific parent-child behaviors explained 13% to 31% of the variance in HRQOL beyond demographic and generic parenting variables.
8	Benskin & Lashley (2025) Barbados; Diabetes Specialty Outpatient Clinic, Queen Elizabeth Hospital	Qualitative descriptive-interpretive study (semi-structured online interviews, thematic analysis with constant comparison)	n=12 T1DM adolescents aged 13-17 years, >1 year since diagnosis, at least 6 months of clinic follow-up	Autonomy; internal resilience (themes functioning as pathways toward diabetic health literacy)	Family support, together with clinical & peer support, was a key factor influencing adolescents' autonomy and resilience, which contributed to diabetic health literacy and self-management confidence (in this review, a qualitative proxy for QoL).

No.	Author, Year, & Setting	Study Design	Sample Characteristics	Mediator/Intervening Variable(s)	Main Findings (Family Support-Mediator-HRQOL)
9	Savin et al. (2018) United States; Vanderbilt University Medical Center	Cross-sectional (dyadic, multi-informant)	n=120 adolescent-parent dyads; adolescents aged 13 to 17 years (M=14.84; SD=1.46); 52.5% female	Parental factors (education, marital status, household income); glycemic control	Adolescents reported higher conflict than parents on both direct and indirect management tasks. Parental education, marital status, and household income were associated with reported conflict. Higher diabetes-specific QoL was associated with a discrepancy of low parent-reported and high adolescent-reported conflict on indirect tasks, and poorer glycemic control with a discrepancy of high parent-reported and low adolescent-reported conflict on direct tasks.
10	Moore et al. (2013) Australia; Royal Children's Hospital Melbourne, diabetes clinic	Cross-sectional	n=76 parent-adolescent dyads (59 mothers, 17 fathers; 44 female adolescents, 32 male); M adolescent age=14.57 years (SD=1.67), range 12-18 years	Adolescent behavior/adjustment (BE, GBE), mental health (MH), self-esteem (SE) as related factors	Parent-reported family conflict, parental emotional and time impact, and disruption of family activities were high. In bivariate correlations, higher HbA1c and lower adolescent self-care were associated with poorer parent-reported behavior, mental health, self-esteem, and family functioning, whereas family cohesion was unrelated to HbA1c (r=-0.01). No multivariable models were tested.
11	Kerimoğlu Yıldız et al. (2026) Turkey; public hospital diabetes education & management unit	Qualitative phenomenological study (semi-structured interviews, Braun & Clarke inductive thematic analysis)	n=14 newly diagnosed T1DM adolescents (<1 year); age 12-18 years (M=14.78; SD=1.97); 8 female, 6 male	Fear of future limitations; parent-imposed isolation; fear of stigma/social judgment; peer support	Family support (especially parental) played a crucial role in adolescents' emotional adjustment & self-management following diagnosis; however, parental overprotection also produced social isolation; peer support was a complementary resource for psychosocial adaptation (psychosocial adjustment, rather than QoL, was the outcome explored and was treated as a proxy indicator).
12	Liu et al. (2025) China (Dongguan); Dongguan Eighth People's Hospital (Dongguan Children's Hospital)	Retrospective cross-sectional (case-control: T1DM vs. healthy controls)	n=75 T1DM adolescents + 75 healthy controls; age 8-16 years in the T1DM group (median 11 years) and 7-16 years in controls (median 10 years); 57.33% male (T1DM group)	Anxiety (SCARED); depression (DSRSC); mental state (SCL-90); HbA1c as an additional outcome	Family cohesion was negatively correlated with mental state, anxiety, depression, and HbA1c (r=-0.403 with HbA1c); emotional expression was positively correlated with school functioning/QoL (r=0.699); family cohesion was positively correlated with emotional functioning/QoL (r=0.681); family control was positively correlated with depression.

No.	Author, Year, & Setting	Study Design	Sample Characteristics	Mediator/Intervening Variable(s)	Main Findings (Family Support-Mediator-HRQOL)
13	de Wit et al. (2007) Netherlands; 4 pediatric diabetes outpatient clinics (including 1 academic center, VUmc)	Cross-sectional (part of an RCT baseline)	n=91 T1DM adolescents & parents; age 13-17 years (M=14.9; SD=1.1); diabetes duration M=6.6 years (SD=4.1)	Depressive symptoms (CES-D)	More diabetes-specific family conflict (DFCS) was associated with lower psychosocial well-being (CHQ) on both adolescent and parent reports, and with more depressive symptoms on adolescent report only (parent-reported conflict was unrelated to adolescent depression). Adolescents with good glycemic control reported less conflict (p=0.046), but the correlation between conflict and HbA1c was not significant. Single-parent family structure and other ethnicity were associated with higher HbA1c.
14	Özgüven Öztornacı et al. (2025) Turkey (İzmir); pediatric endocrinology outpatient clinic of one university hospital (single center)	Descriptive cross-sectional	n=79 T1DM adolescents aged 11 to 18 years (M=14.29; SD=2.86); 55.7% female	Diabetes Management Self-efficacy Scale for Adolescents with T1D; HbA1c	Parental collaboration was not associated with HbA1c (a single self-reported value; rho=-0.09), was weakly and positively associated with QoL (rho=0.228, p=0.043), and was strongly and positively associated with diabetes management self-efficacy (rho=0.614, p<0.001). QoL was higher among adolescents who self-managed with support from both parents, were not school absentees, and measured glucose regularly.
15	Botello-Harbaum et al. (2008) United States; two pediatric endocrinology clinics in Baltimore (secondary analysis of data from an adherence intervention trial)	Secondary analysis of trial data: cross-sectional at baseline and prospective at 12 months (multiple linear regression)	n=81 youth with T1DM aged 11 to 16 years (M=13.3; SD=1.7; 56% female; 85% White; mean diabetes duration 7.7 years); 69 retained at 12 months	Parent responsiveness and demandingness (Authoritative Parenting Index, child-reported) as predictors; diabetes-specific parent-child conflict, responsibility sharing, age, gender, and diabetes duration as covariates; baseline QoL and treatment group in the 12-month model	Child-reported parental responsiveness was associated with better diabetes-related QoL (DQOL) at baseline (β=0.23, p=0.04) and at 12 months after adjustment for baseline QoL and treatment group (β=0.22, p=0.04). Demandingness, parent-child conflict, and responsibility sharing were not significant predictors. Parenting was child-reported only, and the design cannot establish causality.

c. Quality Assessment

Methodological quality, appraised using the JBI critical appraisal checklists corresponding to each study design, ~~i~~ndicated that methodological quality ranged from low to good. Nine studies were rated good, most commonly on the basis of multi-site recruitment, validated instruments, control of confounders, or robust analytic techniques such as structural equation modeling. Four studies were rated moderate, with recurring limitations such as bivariate analyses without adjustment for confounders, unclear measurement of outcomes, and incomplete reporting of the researchers' influence in the qualitative study. Two studies were rated low. One study[12] was a pilot trial with 19 participants, and another study[19] lost 36% of participants between the two assessments without explanation and did not control for confounders. Of the two qualitative studies, Benskin and Lashley[20] was rated good and Kerimoğlu Yıldız et al.[14] moderate, and both followed the COREQ reporting checklist. A summary of the quality appraisal is presented in Table 3.

Table 3. Summary of quality assessment using the JBI critical appraisal tools

Author (Year)	JBI Checklist Applied	Overall Quality Rating	Key Methodological Note
Rodríguez-Rubio et al. (2025)	JBI Checklist for RCT	Low (5/13)	Very small sample; no a priori power calculation; 6-month follow-up; randomization safeguards and blinding not met or not reported
Whittemore et al. (2014)	JBI Cross-Sectional Checklist	~~Good~~Good (8/8)	Robust SEM; large multi-site sample; cross-sectional design limits causal inference
Hilliard et al. (2009)	JBI Cohort Checklist	Good (7/8)	Repeated longitudinal follow-up; small sample; 28 of 53 dyads completed all four assessments, and attrition was analyzed and handled with multilevel modeling
Temmen et al. (2022)	JBI Cross-Sectional Checklist (baseline data of an RCT)	Good (8/8)	~~Clear randomization; large multi-site sample~~Large multi-site sample; LPA analysis cross-sectional at baseline
Villaécija et al. (2023)	JBI Cohort Checklist	Low (3/8)	Valid measures and bootstrapped mediation analysis; 36% attrition from T1 (n=151) to T2 (n=97) not explained; no control of confounders; follow-up interval of 3 or 6 months depending on age
Pereira et al. (2008)	JBI Cross-Sectional Checklist	Good (7/8)	Adequate sample; multiple subgroup analyses reduce statistical power per subgroup; adherence measured with a questionnaire validated within the same sample
Weissberg-Benchell et al. (2009)	JBI Cross-Sectional Checklist	Good (8/8)	Multi-site; combined self-report and observed interaction strengthens validity; participants were mostly mothers and higher-income families
Benskin & Lashley (2025)	JBI Checklist for Qualitative Research	Good (9/10)	Methodological coherence; systematic coding; data saturation reported; no member checking
Savin et al. (2018)	JBI Cross-Sectional Checklist	Good (7/8)	Dyadic multi-informant design strengthens validity; cross-sectional; 34% of approached families declined, and adjustment for covariates was unclear

Author (Year)	JBI Checklist Applied	Overall Quality Rating	Key Methodological Note
Moore et al. (2013)	JBI Cross-Sectional Checklist	Moderate (4/8)	84% parent response among families with a completed adolescent questionnaire; dual parent-child HbA1c verification (r=0.97); bivariate analyses only, without adjustment for confounders; inclusion criteria not clearly defined
Kerimoğlu Yıldız et al. (2026)	JBI Checklist for Qualitative Research	Moderate (6/10)	Researcher triangulation; audit trail; COREQ followed; data saturation achieved; researcher position and influence on the data only partly addressed
Liu et al. (2025)	JBI Cross-Sectional Checklist	Moderate (5/8)	Healthy comparison group; sample size above the calculated target (150 vs. 128); unadjusted analyses; SCL-90 is an adult instrument and FES scoring was unclear; sampling method not described; retrospective design
de Wit et al. (2007)	JBI Cross-Sectional Checklist	Good (8/8; response-rate caveat)	Multi-site; validated instruments; ~53% participation raises selection-bias concern
Özgüven Öztornacı et al. (2025)	JBI Cross-Sectional Checklist	Moderate (5/8)	T1D-specific instruments; single self-reported HbA1c value; single center; no adjustment for confounders; descriptive design limits causal inference
Botello-Harbaum et al. (2008)	JBI Cross-Sectional Checklist (secondary analysis of trial data)	Good (7/8)	Validated instruments and adjustment for age, gender, diabetes duration, conflict, and responsibility sharing; child-reported parenting only; small single-trial sample; 15% attrition at 12 months without a stated missing-data method

Note. Ratings are based on the proportion of applicable JBI items rated yes: good, 70% or more; moderate, 50 to 69%; low, below 50%. Items rated unclear or no were not counted as met, and items that did not apply to a design were excluded from the denominator. 'Response-rate caveat' indicates a good rating with the limitation stated in the last column.

d. Synthesis of Psychosocial and Behavioral Pathways

Following the narrative synthesis procedure outlined in the Methods section, included studies were grouped into thematic categories of psychosocial and behavioral pathways, with the methodological strength of evidence evaluated separately within each theme. Seven overarching thematic categories emerged from the 15 included studies: self-efficacy and self-management/adherence, metabolic control, emotional and psychological adjustment, illness representation, family functioning/conflict as a proximal correlate, autonomy/resilience/peer support, and sociodemographic/parental moderators. These were organized into four groups: individual-level candidate mediators (self-efficacy and self-management/adherence, emotional and psychological adjustment, illness representation, and autonomy/resilience/peer support); a clinical outcome (metabolic control); an exposure dimension (family functioning/conflict as a proximal correlate); and contextual moderators (sociodemographic and parental factors). Only two studies,[19,21] formally tested mediation, and all other evidence is correlational, longitudinal, experimental, or qualitative, as stated within each subsection. A single study could contribute evidence to more than one thematic category where multiple mediating variables were examined concurrently.

Group 1: Individual-Level Candidate Mediators

d.1. Self-Efficacy and Self-Management/Adherence

Five of the 15 studies examined self-efficacy or self-management/adherence as a pathway linking family social support to HRQOL-related outcomes. Villaécija et al.[19] found that family social support was positively associated with self-care and subjective emotional wellbeing, with self-efficacy fully mediating this relationship in a well-fitting path model. This study was rated low quality because of unexplained attrition and the absence of confounder control. Similarly, Whittemore et al.[21] demonstrated that self-management mediated the relationship of family conflict, but not family warmth, with QoL, and the relationships of family functioning

variables with HbA1c, although the total effects on HbA1c were not significant. In contrast, Pereira et al.,[5] Temmen et al.[22], and Özgüven Öztornacı et al.[23] provided correlational or subgroup-based evidence, showing that higher family support and collaborative parental involvement were associated with better adherence, more favorable parental-involvement profiles, and higher adolescent self-efficacy, respectively. Overall, evidence for this pathway was directionally consistent across all five studies, although only two studies[19,21] formally tested mediation, and the other three provided correlational or subgroup evidence.

d.2. Emotional and Psychological Adjustment

Six studies examined depressive symptoms, anxiety, self-esteem, or general psychopathology as pathways linking family support to HRQOL-related outcomes. Rodríguez-Rubio et al.[12] reported strong correlations, in a pilot sample of 19 adolescents, between family autonomy promotion and both psychological well-being (rho=0.740) and lower psychopathology (rho=-0.706). Consistent with this, Moore et al.,[24] Liu et al.,[13] and de Wit et al.[25] reported, respectively, that poorer parent-rated mental health and lower family functioning were each associated with higher HbA1c and poorer self-care (the link between them was not tested directly), that higher family cohesion was associated with lower anxiety and depression, and that more adolescent-reported conflict, but not parent-reported conflict, was associated with more depressive symptoms. Hilliard et al.[26] found that depressive and anxiety symptoms, but not family conflict or cohesion, were associated with diabetes-related QoL before and after the transition to insulin pump therapy, while Whittemore et al.[21] situated depressive symptoms as an antecedent condition within a broader SEM-tested pathway. Overall, findings across this thematic category were mostly consistent in direction, with exceptions (Hilliard et al.[26] and parent-reported conflict in de Wit et al)[25]. One study (Whittemore et al.[23]) formally tested mediation, and the remaining studies offered correlational, longitudinal, or pilot trial evidence. This evidence supports emotional and psychological adjustment as a candidate mediating pathway.

d.3. Illness Representation and Cognitive-Emotional Appraisal

Only one study, Rodríguez-Rubio et al.,[12] explicitly examined illness perception as a candidate mediating variable within the family support and HRQOL relationship. In a pilot sample of 19 adolescents, a less favorable illness perception was correlated with lower family autonomy promotion (rho=-0.49) and more psychopathology (rho=0.53), but not significantly with psychological well-being. Given the paucity of evidence, illness representation represents a distinctly underexamined pathway relative to the other thematic categories identified in this review, warranting dedicated investigation in future research.

d.4. Autonomy, Resilience, and Peer Support

The two qualitative studies included in this review, Benskin and Lashley[20] and Kerimoğlu Yıldız et al.,[14] converged in identifying autonomy and psychological resilience as pathways through which family support shapes adolescents' diabetes-related adjustment. Benskin and Lashley[20] found that family support, alongside clinical and peer support, was a key factor fostering autonomy and resilience, which in turn contributed to diabetic health literacy and self-management confidence. Kerimoğlu Yıldız et al.[14] reported that while parental support facilitated emotional adjustment and self-management following diagnosis, parental overprotection could paradoxically produce social isolation, and that peer support was a complementary resource for psychosocial adaptation. Although this evidence cannot establish statistical mediation, the thematic convergence across two independent qualitative studies in different cultural contexts lends credibility to autonomy, resilience, and peer support as complementary explanatory mechanisms. Neither study measured quality of life directly, so their findings were treated as proxy indicators.

Group 2: Clinical Outcome

d.5. Metabolic Control (HbA1c)

Eight studies examined metabolic control as an outcome associated with family social support, either directly or through an intervening psychosocial process. Findings were largely, though not uniformly, consistent with a protective effect of family support on glycemic control. Temmen et al.[22] found the most harmonious parental-involvement profile associated with the best glycemic control. Moore et al.,[24] Liu et al.,[13] and de Wit et al.[25] reported correlations between better family functioning and lower HbA1c, which were significant in some studies (r=-0.403 for cohesion in Liu et al.[13]). In Moore et al.,[24] parent-rated time impact and disruption of family activities, but not family cohesion (r=-0.01), were associated with higher HbA1c, and in de Wit et al.[25] adolescents with good glycemic control reported less conflict (p=0.046), although the correlation between conflict and HbA1c was not significant. Whittemore et al.[21] situated this relationship within a formal SEM pathway mediated by self-management, although the total effects on HbA1c were not significant. However, two studies qualified this general pattern. Pereira et al. found that no family variable predicted metabolic control overall and family conflict predicted it only among upper social-class participants, and Özgüven Öztornacı et al.[23] reported no significant association between parental collaboration and HbA1c despite significant associations with QoL and self-efficacy. Overall, the evidence for this pathway was directionally consistent but showed mixed statistical significance across contexts, with only one study providing formally tested mediation evidence.

Group 3: Exposure Dimension

d.6. Family Functioning and Conflict as a Proximal Correlate

Eight studies measured family functioning or conflict in more detail. For instance, looking separately at diabetes-related conflict versus everyday family conflict, or at family closeness versus family control. Rather than acting as a separate mediating factor, these measures were more specific versions of family support itself. Weissberg-Benchell et al.[27] found that diabetes-specific parent-child behaviors explained 13 to 31% of the variance in HRQOL beyond demographic and generic parent-child variables, with family conflict and negative communication associated with lower HRQOL and collaborative parental involvement with higher HRQOL. Savin et al.[28] showed that discrepancies between adolescent and parent reports of conflict were themselves significantly associated with HRQOL and glycemic control. Moore et al.,[24] Liu et al.,[13] and de Wit et al.[25] each reported that better family functioning (lower conflict, higher cohesion, or lower family impact) was associated with better psychological or glycemic outcomes, although not all associations were significant. Pereira et al.[5] found that family conflict predicted lower QoL overall, whereas cohesion and organization did not, and Hilliard et al. found no association of family conflict or cohesion with QoL. Botello-Harbaum et al.[29] found that child-reported parental responsiveness, but not demandingness, was associated with better diabetes-related QoL at baseline and at 12 months, whereas parent-child conflict and responsibility sharing were not significant predictors. Overall, this thematic category showed a mostly consistent direction of association across the eight studies, with null findings for conflict or cohesion in three of them, predominantly supported by correlational and regression-based evidence.

Group 4: Contextual Moderators

d.7. Sociodemographic and Parental Factors as Contextual Moderators

Three studies identified sociodemographic or parental characteristics that were associated with family conflict or outcomes, or that appeared to modify the family support and HRQOL relationship. Savin et al.[28] found that parental education, marital status, and household income were associated with reported levels of conflict. Pereira et al.[5] found that the association of family variables with adherence, QoL, and metabolic control differed by adolescent gender and social class, with family support most clearly related to adherence and QoL in the lower social class. De Wit et al.[25] reported that single-parent family structure and other ethnicity were independently associated with higher HbA1c. Overall, evidence in this category was context-dependent rather than uniformly directional, suggesting that the strength of family support pathways may vary systematically according to household structure and socioeconomic context.

e. Synthesis Matrix of Pathways

The seven thematic categories of pathways, along with their supporting evidence base, predominant methodological strength, direction of association, overall consistency rating, and review-defined strength of mediation evidence, are summarized in Table 4.

Table 4. Synthesis matrix of psychosocial and behavioral pathways between family social support and HRQOL

Pathway Theme	Supporting Studies (n)	Predominant Design Strength	Direction of Relationship	Consistency Rating	Strength of Mediation Evidence
Group 1: Individual-Level Candidate Mediators					
Self-efficacy and self-management/adherence	5 Whittemore 2014; Villaécija 2023; Pereira 2008; Temmen 2022; Özgüven Öztornacı 2025)	Mixed: 2 formal mediation/SEM; 3 correlational/subgroup	Positive	Consistent	Moderate
Emotional/psychological adjustment	6 (Rodríguez-Rubio 2025; Hilliard 2009; Whittemore 2014; Moore 2013; Liu 2025; de Wit 2007)	Mixed: 1 SEM, 1 pilot trial, remainder correlational/longitudinal	Positive	Mostly consistent (family findings null in Hilliard and for parent-	Limited

Pathway Theme	Supporting Studies (n)	Predominant Design Strength	Direction of Relationship	Consistency Rating	Strength of Mediation Evidence
				reported conflict in de Wit)	
Illness representation	1 (Rodríguez-Rubio 2025)	Correlational (single study)	Positive	Insufficient evidence	Very limited
Autonomy, resilience, and peer support	2 (Benskin & Lashley 2025; Kerimoğlu Yıldız 2026)	Qualitative (thematic analysis)	Positive/complementary	Consistent (qualitative convergence)	Very limited
Group 2: Clinical Outcome					
Metabolic control (HbA1c)	8 Whittemore 2014; Temmen 2022; Pereira 2008; Savin 2018; Moore 2013; Liu 2025; de Wit 2007; Özgüven Öztornacı 2025)	Predominantly correlational; 1 formal SEM	Weakly positive	Mixed (null or non-significant findings in several studies; subgroup-specific findings in Pereira)	Limited
Group 3: Exposure Dimension (Proximal Correlate)					
Family functioning/conflict as proximal correlate	8 (Weissberg-Benchell 2009; Savin 2018; Moore 2013; Liu 2025; de Wit 2007; Pereira 2008; Hilliard 2009; Botello-Harbaum 2008)	Correlational/hierarchical regression	Positive	Mostly consistent (null in Hilliard; cohesion unrelated in Pereira; conflict not significant in Botello-Harbaum)	Not applicable (exposure dimension)
Group 4: Contextual Moderators					
Sociodemographic/ parental moderators	3 (Savin 2018; Pereira 2008; de Wit 2007)	Correlational/subgroup	Context-dependent	Mixed	Not applicable (contextual moderators)

DISCUSSION

This systematic review synthesized evidence from 15 studies on how psychosocial and behavioral pathways link family social support to HRQOL among adolescents with T1DM. Seven thematic pathways emerged. Self-efficacy and self-management, emotional and psychological adjustment, and family functioning as a proximal correlate showed consistent or mostly consistent positive evidence. Metabolic control and sociodemographic moderators showed a mixed pattern. Autonomy, resilience, and peer support were supported by convergent qualitative evidence from two culturally distinct settings. Illness representation remained supported by only a single study. These findings are compatible with an indirect, mechanism-based model rather than a simple direct link between family support and HRQOL.

These findings align with prior research on family factors in adolescent chronic illness more broadly. Postigo-Zegarra et al.[11] similarly found that family affection,

communication, and psychological control jointly predicted adolescents' self-esteem and emotional distress across several chronic conditions, not limited to T1DM. This convergence suggests that the role of emotional adjustment identified in this review, which was examined in six studies including Rodríguez-Rubio et al.[12] and Hilliard et al.,[26] reflects a broader pattern in pediatric chronic disease rather than a mechanism unique to T1DM. This review adds specificity by also mapping T1DM-specific behavioral pathways, particularly self-management and glycemic control, which do not have direct counterparts in most other chronic illness populations.

The strength of evidence varied considerably across the seven themes. Only two studies, Whittemore et al.[21] and Villaécija et al.[19] applied formal mediation testing through SEM or path analysis. Most other studies relied on correlational or subgroup-comparison designs, which can indicate association but cannot establish a sequential mediating process. This imbalance was most visible in the metabolic control theme, where eight studies were identified but only Whittemore et al.[21] provided formally tested mediation evidence. The remaining seven relied on correlational designs, and two of them[5,23] reported findings that qualified or contradicted the general pattern. Mediators were also operationalized inconsistently. Family conflict, for instance, was measured through generic parenting scales in some studies and diabetes-specific conflict scales in others, which likely contributed to the mixed evidence observed for metabolic control.

The same heterogeneity applied to the other constructs. Family social support was measured through parenting-style, family-environment, and diabetes-specific conflict instruments, which capture different aspects of support, such as warmth, cohesion, control, and conflict, and are not interchangeable. HRQOL was assessed with generic and diabetes-specific instruments and, in four studies, with qualitative or proxy indicators of well-being, so results are not directly comparable. Self-efficacy, self-management, and psychological adjustment were also assessed with different scales and informants (adolescent, parent, or both). These differences in instruments and operational definitions may have inflated or attenuated associations and may partly explain why consistency differed across themes. The consistency ratings in this review reflect the direction of association rather than its magnitude, and they should be read with this limitation.

Evidence for the behavioral pathway supports the individual-level mechanism proposed by Bronfenbrenner's Ecological Systems Theory.[8] Family support appears to strengthen adolescents' confidence in managing their own care, which in turn is associated with better adherence and glycemic outcomes. This pattern was most clearly demonstrated in the two studies using formal mediation analysis, where self-efficacy and self-management fully or partially explained the relationship between family functioning and downstream outcomes.[19,21] One of these studies was rated low quality, and in the other, mediation was significant for family conflict but not for family warmth in relation to QoL, so this pattern remains preliminary. The metabolic control theme showed a less consistent pattern. Pereira et al.[5] found that family conflict predicted metabolic control only among upper social-class participants, and Özgüven Öztornacı et al.[23] found no significant association between parental collaboration and HbA1c despite significant associations with QoL and self-efficacy. This suggests that glycemic control may be too distal an outcome to be reliably predicted by family support alone. Metabolic control is shaped by many factors beyond the family system, including insulin regimen and pubertal hormonal changes, neither of which was consistently accounted for across the included studies.

The emotional and psychological adjustment theme showed a mostly consistent direction of evidence. Lower family conflict and higher family cohesion were associated with better adolescent mental health in studies conducted in China and the Netherlands, although the findings were qualified in the Netherlands (parent-reported conflict was unrelated to depressive symptoms) and in the United States, where Hilliard et al. found that depressive and anxiety symptoms, but not family environment, were associated with QoL.[13,24,25] This consistency across otherwise heterogeneous samples supports this pathway despite the predominance of correlational designs, although the exceptions show that the association is not uniform. Illness representation, in contrast, was examined in only a single study, Rodríguez-Rubio et al.,[12] and was rated as having insufficient evidence in the synthesis matrix. This gap is notable given that illness representation is a well-established construct in the broader chronic illness literature.[10]

Consistent with the ecological framework guiding this review, evidence also pointed to influences beyond the family microsystem. The two qualitative studies included in this review, conducted in Barbados and Turkey, converged on this point despite their different cultural settings. Benskin and Lashley[20] found that family support, alongside clinical and peer support, fostered autonomy and resilience. Kerimoğlu Yıldız et al.[14] described peer support as a complementary resource for psychosocial adaptation, while parental overprotection could paradoxically increase social isolation. These findings indicate that family support does not operate as a sole determinant. Its effect appears to depend on how well it is complemented by support from peers and the broader social environment. National-level factors, such as health insurance coverage and access to specialized pediatric endocrinology care, were not directly measured in any of the included studies, despite their plausible relevance within the broader ecological model.

The generalizability of these findings to Indonesia requires caution. Most included studies were conducted in the United States and Europe, where adolescent autonomy is strongly emphasized, whereas Indonesian adolescents report that their mothers learned insulin injection, glucose

checking, and diet management with them.[30] Support that fosters autonomy in one setting may be experienced as overprotection in another, as the Turkish qualitative study suggests.[14] Pediatric endocrinologists are few, and the 39 who practice are based in only 18 of 38 provinces,[31] so families may carry more of the management burden with less clinical support. Glucose meters and strips are not covered by national health insurance,[31] and social class modified the association between family conflict and metabolic control in one included study.[5] These factors may change the size and possibly the direction of the pathways identified here, so studies of Indonesian adolescents are needed to test them.

Several limitations should be considered when interpreting these findings. Methodological quality across the 15 included studies ranged from low to good, with nine studies rated good, four moderate, and two low. However, cross-sectional designs, including baseline analyses of trial data, predominated, accounting for nine of the 15 studies, which limits causal inference regarding the direction of the proposed mediating pathways. Geographic representation was also uneven. Six studies were conducted in the United States, two each in Spain and Turkey, and the remainder as single studies from Portugal, Barbados, Australia, China, and the Netherlands. This distribution may limit generalizability to other cultural contexts, including Indonesia. Heterogeneity in family support and HRQOL instruments across studies also precluded quantitative pooling, which restricted this review to narrative synthesis.

Several limitations also relate to the review process. Only two databases were searched because of institutional access, and PsycINFO, CINAHL, Web of Science, and citation chasing were not used, so eligible studies may have been missed. The free full-text and open-access filters may have introduced selection bias. Four reports could not be retrieved in full text, and their authors were not contacted, so eligible studies may have been missed. Three of these reports came from one Portuguese research group and appeared eligible from their titles and abstracts, so the evidence on illness representation and school support may be incomplete. No language restriction was applied, but the search terms were in English, so reports without English titles or abstracts may have been missed. The review protocol was not registered in PROSPERO or another registry, so the methods were not fixed in advance, the criterion that allowed proxy indicators of HRQOL was broadened during study selection, and selective reporting and bias in study selection cannot be excluded. No formal certainty-of-evidence assessment such as GRADE or GRADE-CERQual was performed. Outcome definitions were heterogeneous, because four studies used proxy indicators of well-being instead of a validated HRQOL instrument, and four studies included participants younger than 10 years. These limitations may have affected the completeness of the evidence base and the strength of the conclusions.

Implications

These findings carry several implications for both practice and future research. For family-centered care, interventions aiming to improve HRQOL may benefit from targeting self-efficacy and emotional adjustment as proximal outcomes, given that these two themes showed the most consistent evidence in this review, although the evidence for emotional adjustment was not uniform. Healthcare providers may consider incorporating routine psychological screening alongside standard diabetes management. Because peer support was described as a complementary resource in both qualitative studies, structured peer support programs, such as diabetes camps or peer mentoring, may offer an additional avenue for improving HRQOL. In the Indonesian context specifically, family-based organizations such as IKADAR (Family Bond of Children and Adolescents with Diabetes) may serve as an existing platform through which such interventions could be integrated.

For future research, the limited use of formal mediation testing across the included studies points to a clear methodological priority. Only two studies applied structural equation modeling or path analysis, and future work should adopt these designs more routinely to confirm the mediating pathways. Longitudinal designs are also needed, given that only four included studies followed participants over time. Illness representation was examined in only a single study, despite its established relevance in the broader chronic illness literature, and warrants dedicated investigation in the T1DM population. Research conducted outside the United States and Europe remains scarce. Studies from Indonesia and other developing-country contexts would help clarify whether these mediating pathways operate similarly across different family structures, healthcare systems, and cultural norms.

CONCLUSIONS

This systematic review suggests that family social support may be linked to HRQOL among adolescents with T1DM largely through indirect pathways rather than a single direct link. Self-efficacy and self-management showed the most consistent evidence across the 15 included studies, and emotional adjustment was mostly consistent. Family functioning also showed a mostly consistent association with better outcomes. Autonomy, resilience, and peer support emerged as complementary pathways from qualitative evidence in two distinct cultural settings. Metabolic control showed a positive but less consistent pattern, and illness representation remains supported by only a single study. These pathways are consistent with Bronfenbrenner's Ecological Systems Theory at the individual and family (microsystem) levels. No included study measured national-level (macrosystem) factors, so consistency with the model at that level could not be assessed. However, given the predominance of cross-sectional designs and the limited use

of formal mediation testing, these findings should be interpreted as indicative rather than confirmatory.

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