Psychosocial adjustment of young offspring in the context of parental type 1 and type 2 diabetes: a systematic review

Psychosocial Adjustment of Young Offspring In the Context of Parental Type 1 and Type 2 Diabetes: A Systematic Review.

Giulia Landi[1], Maria Stella Andreozzi[1], Kenneth Pakenham[2], Silvana Grandi[1], and Eliana Tossani[1]

[1] Laboratory of Psychosomatics and Clinimetrics, Department of Psychology, University of Bologna, Viale Berti Pichat 5, 40126 Bologna, Italy

[2] The University of Queensland; School of Psychology, The University of Queensland, Brisbane QLD 4072, Australia

Author Note

Correspondence concerning this sample paper should be addressed to Giulia Landi, e-mail: giulia.landi7@unibo.it

Abstract word count: 250 words. Manuscript main text word count: 3.826.

Competing interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

What's new?

- Although diabetes like other serious medical conditions impacts family members, with young offspring being particularly vulnerable, this review identified only 10 studies which met inclusion criteria that examined the adjustment of youth to parental type 1 and type 2 diabetes.
- This is the first systematic review of research on the psychosocial outcomes in youth of parents with type 1 and type 2 diabetes. It identified research gaps and methodological issues to be addressed by future studies in this field.
- In view of the dearth of research in this area, it is not possible to draw robust evidenced-based conclusions about young offspring psychosocial adjustment to parental diabetes. However, there was weak evidence suggesting some youth are at risk of adjustment difficulties in the context of parental diabetes, which warrants the attention of future research.

Acknowledgements

All authors contributed to the design, interpretation of the data and drafting of this review. G.L. and MS.A. carried out study selection and data extraction. K.P. provided critical feedback on draft manuscripts.

Abstract

Aims. To identify all available research on psychosocial outcomes in youth of parents with type 1 and type 2 diabetes. *Methods.* Embase, PsychInfo, Scopus, Web of Science, PubMed and ProQuest Social Sciences databases were searched following a registered study protocol (PROSPERO CRD42019125301). Quality assessment, data extraction and synthesis were carried out. *Results*. The initial search yielded 11,599 articles, 10 of which met the criteria for this review – 6 for type 1 diabetes and 4 for type 2 diabetes. Through thematic analysis five categories emerged related to offspring psychosocial adjustment: offspring mental health, offspring physical health, offspring personal resources, parental illness characteristics and youth caregiving. Overall, there were few studies focusing solely on the effects of parental type 1 and type 2 diabetes on youth. From the limited available research, there is weak evidence suggesting both parental types of diabetes can adversely impact young offspring. Illness-related variables were only explored in parental type 1 diabetes studies, while youth caregiving was only examined in parental type 2 diabetes studies. *Conclusions*. Limited research has examined the effects of parental diabetes on youth. However, there was weak evidence to suggest some youth are at risk for adverse psychosocial impacts. Given the rise in the incidence of diabetes globally, there is a pressing public health need to conduct more rigorously designed studies to ascertain the extent to which youth are at risk for mental and physical health problems and to identify risk and protective factors associated with youth adjustment in the context of parental diabetes.

Keywords: parental type 1 and type 2 diabetes, offspring, children and adolescents, psychosocial outcomes, systematic review

Introduction

The number of people with diabetes has risen from 108 million in 1980 to 425 million in 2017 and a significant proportion of them are likely to be parents [1] given its prevalence among young and middle-aged adults (ages 18-50 years) who are likely to have children living at home [2]. Definitive figures of the number of offspring exposed to both parental type 1 and type 2 diabetes are difficult to obtain. Estimates in the literature suggest that approximately 5% to 15% of children grow up with a parent who is affected by a chronic illness [3]. Offspring with chronically ill parents, like diabetes, are at risk of adverse psychosocial outcomes and caregiving responsibilities [4–8].

Diabetes is a psychologically and behaviourally demanding chronic illness with a challenging regimen to maintain [9,10]. In the context of parental type 1 and type 2 diabetes young offspring may provide day to day assistance for their parents and support their diabetes self-management [11]. Type 1 diabetes requires a multifaceted treatment, including careful monitoring of the type, quantity, and timing of food intake and exercise, as well as frequent checking of blood parameters. Adults with type 1 diabetes, or their family members, must frequently monitor their blood glucose levels – often 6-10 times a day – and, when required, administer insulin because inadequate metabolic control could lead to severe short- and long-term complications [12]. On the other hand, some adults with type 2 diabetes can initially manage their illness by dieting, improving their nutritional habits and increasing physical activity – however, sustaining such lifestyle changes can be demanding for many people [13,14].

In view of these illness demands, a diagnosis of diabetes not only has significant impacts on the lives of people with diabetes but also on their families including offspring [15,16]. Diabetes and its treatment are related to diabetes distress in the parents themselves as well as in their family members [17,18,19]. Family members also experience lower emotional well-being and higher depression [15,20]. Their adjustment is worse for those more involved in diabetes care and who experience frustration about being ill-informed on how best to help the person with diabetes [16,21]. Fear of hypoglycaemia (low blood glucose) is frequently reported by family members, especially

given the fact that most people with diabetes are not usually aware of when they are experiencing hypoglycaemia and therefore rely on support from family members [16, 22–24].

Both type 1 and type 2 diabetes can also adversely impact parental mental health and, in turn, potentially that of their offspring [25,26]. Parents with diabetes may struggle with balancing their diabetes management tasks along with their parenting responsibilities [9,27]. In addition, the possibility of long-term complications related to poor levels of control over the illness – such as blindness, kidney failure, retinopathy, heart attacks, stroke and lower limb amputation – can evoke worry and fear in the parents with diabetes and their young offspring [28,29].

Most of the prior research into the impacts of diabetes on the family has focused on all household members including spouses/partners, offspring, parents of the person with diabetes and other adult relatives [15,16,22]. In addition, most of the research on the effects of parental diabetes on offspring has been undertaken in the context of mixed parental disease samples, making it hard to draw any firm conclusions on impacts specific to parental diabetes [7,30,31].

Despite the potential risk for children and adolescents living with a parent with diabetes to develop psychosocial problems [7,16,31], there is no published review of the research on this likely important public health issue. Both parental type 1 and type 2 diabetes were examined in this review as evidence suggests that they differ in terms of biomedical processes, treatment and self-management demands and the psychosocial impacts on the adults with diabetes and their family members (e.g. mental health, distress, stigma and family functioning) [10–16,18–24,26,27,32]. Hence, it is possible that the two types of parental diabetes have differential consequences for offspring. The present review, therefore, systematically assessed the current state of knowledge of the psychosocial impacts of parental type 1 and type 2 diabetes on young offspring.

Method

Search Strategy

A systematic search was undertaken following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [33]. The review protocol was published in the

International prospective register of systematic reviews (PROSPERO; registration number CRD42019125301). The identification, selection and analysis of representative literature were completed by two authors. The first stage involved identifying peer-reviewed literature published in English. Reviews were searched in six databases (Embase, PsychInfo, Scopus, Web of Science, PubMed and ProQuest Social Sciences) from their respective inception dates through to January 10, 2020. Search terms were parent (OR parental OR mother OR father OR family) combined with chronic illness (or chronic disease OR diabet* OR physical illness) and adolescent (OR child OR offspring OR youth) and problem (OR adjustment OR well-being OR resilience OR psychosocial OR distress OR caregiving OR impact). Targeted searches were additionally carried out examining reference lists and forward citations of articles included in the review to identify additional relevant studies. The flowchart in Figure 1 illustrates the inclusion procedure.

Eligibility Criteria

Eligible studies had to be peer-reviewed original research focusing on the psychosocial impact of parental diabetes on young offspring and could include quantitative or qualitative methods. Only published articles written in English were included. Research examining offspring up to 18 years of age were eligible. Studies had to consider parental type 1 or type 2 diabetes and include measures of offspring psychosocial outcomes. Studies with mixed parental chronic illness samples and those focused on parental diabetes where data were not presented separately for type 1 and type 2 parental diabetes were excluded. Studies with adult offspring were excluded. Non-empirical studies (i.e. poster, case studies, reviews, dissertation, comment, books) and poor quality studies were excluded.

Data Extraction and Quality Assessment

Search results were exported to Endnote X8 and duplicates removed. Two authors screened titles and abstracts for adherence to inclusion criteria. Potentially eligible articles were screened full-text to create the final list of included studies. Any disagreement in inclusion decision were discussed among the reviewers.

Quality analysis was conducted by two authors using the Mixed Methods Appraisal Tool (MMAT) designed for reviews including qualitative and quantitative studies [34]. For each type of study, five MMAT criteria were evaluated. Each criterion was worth 20% with a maximum score of 100%. Data from studies rated as poor during quality assessment (i.e. with an MMAT score lower than 50%) were excluded from this review. Quality evaluation of the included studies revealed an acceptable interrater agreement of 81%. Any disagreements were solved by additional readings of the article and discussion between authors.

Data Analysis

A thematic synthesis was carried out to explore data extracted from the included literature. Both quantitative and qualitative studies that met inclusion criteria were coded to reveal the various constructs assessed in each study. All analogue constructs were subsequently grouped into a category examining different aspects related to offspring psychosocial adjustment.

Results

After removal of duplicates, the initial search strategy yielded 11,476 records. Hand-searches located one hundred and twenty-three additional studies. Title and abstract screening produced 278 full-text articles, 10 of which met final inclusion criteria after full-text examination and quality assessment (see Figure 1).

The authors, year and country of origin, aims, sample, key findings, and methodological quality of retrieved articles differentiated by type of parental diabetes are summarized in Table 1. Of all included records, six considered parental type 1 diabetes [35–40] and four included parental type 2 diabetes [41–44]. All the parental type 1 diabetes studies were quantitative [35–40], while among the parental type 2 diabetes studies, two were quantitative [41,42] and two were qualitative [43,44].

Sample

The age of offspring with parental type 1 diabetes in the included studies varied considerably, ranging from 1 to 18 years. One study examined infants [38] and another pre-school

children [36], while all the other studies investigated school age children and adolescents [35,37,39,40]. The parental type 2 diabetes studies consisted of samples of school age children and adolescents, with an age range of 6 to 17 [41–44]. The specific type of parental diabetes, type of study, diabetic parent's gender, offspring age range and number included in each study are reported in Table 2.

With the exception of one cohort study [37] and two low-income sample studies [43,44], most of the families had middle or high socio-economic status. Half of the studies were conducted in the United States (n = 5), the remainder was carried out in the UK (n = 2), France and Canada (n = 1), Denmark (n = 1), and Poland (n = 1).

Study Design and Quality

Among the parental type 1 diabetes quantitative studies, the most common study design was case-comparison (n = 4) [35,36,38,39], followed by cross-sectional survey (n = 1) [40] and one registry-based study (n = 1) [37]. The two parental type 2 diabetes quantitative studies were case-comparisons [41,42]. Most case-comparison studies compared offspring of a parent with either type 1 or type 2 diabetes with offspring of 'healthy' parents [36–40,42]. Some of these studies included an additional comparison group of parents with cancer or chronic pain. The remaining case-comparisons studies used other parental chronic illnesses as the comparison group [35,41]. Parental diabetes was the primary focus of research in only two of these case-comparison studies and parents in both studies had type 1 diabetes [36,38]. There was only one longitudinal study which had follow-up assessments every six months for two years and focused on parental type 1 diabetes [38]. All qualitative studies on parental type 2 diabetes [43,44] used a narrative approach and collected data via individual interviews.

Information about offspring outcomes in most of the studies was obtained directly from the offspring or indirectly from the parent with diabetes or from both the offspring and the parent with diabetes [35,36,39–45]. A few studies also included information about offspring outcomes from the

'healthy' parent [42], teachers [36,39], paediatrician, other medical professionals or nurses [36,38,40,41], or national register [37].

The overall quality of the included studies was rated as good. The majority met four or five [35–38,40–44] out of the five quality criteria according to the MMAT (see Table 1 for MMAT ratings). One study with a type 1 diabetes sample [39] was rated as fair, while two studies – one with type 1 and one with type 2 diabetes samples – were rated as poor and were, therefore, omitted from the review [45,46]. Quality of the included quantitative studies was reduced by limitations in recruitment methods, inadequate description of participants' demographics, small sample size and no examination of potential confounding variables in statistical analyses. Quality of the included qualitative studies was reduced by inadequate information concerning methods of analysis and lack of attention to factors that were likely to affect data interpretation.

Parental Type 1 Diabetes

Four main categories emerged from thematic analysis of all the type 1 diabetes studies: offspring mental health (i.e., emotional and behavioural problems and other psychopathology), offspring physical health (i.e., minor or major health problems), offspring personal resources (i.e., psychomotor development, intelligence, school performance and illness behaviour), parental illness characteristics (i.e., illness duration and type 1 diabetes metabolic control). The categories and instruments used for the assessment of young offspring psychosocial outcomes in the studies with a type 1 diabetes samples are presented in Table 3.

Offspring mental health. Three studies reported findings regarding offspring mental health in the context of parental type 1 diabetes [35,36,39]. Two studies did not find differences in emotional and behavioural problems between pre-school and school-age children of parents with type 1 diabetes and children of 'healthy' parents [36,39]. Case-comparison studies of parental type 1 diabetes with other parental chronic illnesses indicated that youth (ages 8-18 years) of parents with type 1 diabetes did not differ in behavioural problems and psychological adjustment compared to youth of parents with chronic low back pain and chronic respiratory insufficiency [35,39];

however, they displayed better psychological adjustment than youth of mothers with metastatic cancer [35].

Offspring physical health. Only one study explored offspring physical health in the context of parental type 1 diabetes and reported no differences in physical health between children and adolescents of mothers with type 1 diabetes and those with 'healthy' mothers [36].

Offspring personal resources. Five studies with a parental type 1 diabetes sample described youth personal resources [36–40]. A longitudinal study, examining psychomotor development in infants (ages 1-3 years) of mothers with type 1 diabetes indicated that they showed significantly more delay in movement coordination, speech and social reactions, but not in motor development when compared to infants of mothers with gestational diabetes and infants of 'healthy' mothers [38]. Another study evaluating intelligence in children (ages 6-12 years) revealed poorer working memory in those of mothers with type 1 diabetes compared to normative data, even if their total IQ did not significantly differ [40]. Offspring of parents with type 1 diabetes did not differ from children and adolescents of 'healthy' mothers in academic performance despite a nonsignificant trend for youth of mothers with type 1 diabetes to miss school more often and have lower academic achievement than youth of 'healthy' mothers [36,37]. Finally, one study of children (ages 9-12 years) of parents with type 1 diabetes indicated they did not differ from children of 'healthy' parents in health locus of control and illness behaviour [39]. However, they displayed lower external health locus of control and illness behaviour than children of parents with chronic pain [39].

Parental illness characteristics. Three studies reported findings regarding illness characteristics associated with offspring psychosocial adjustment [37,38,40]. One quantitative study examined relations between parental illness duration and offspring outcomes and found that performance in working memory scores in children (ages 6-12 years) of mothers with type 1 diabetes were not related to maternal illness duration [40]. Diabetes metabolic control was also examined in three quantitative studies [37,38,40]. Inadequate metabolic control in mothers with

type 1 diabetes during pregnancy was significantly associated with a delay in the psychomotor development of infants (ages 1-3 years) [38] and with lower average school grades in adolescents (ages 15-16 years) [37]. Conversely, another study found that level of HbA1c in mothers with type 1 diabetes during pregnancy was unrelated to working memory scores in their children (ages 6-12 years) [40].

Parental Type 2 Diabetes

Three main categories emerged from thematic analysis of all the included type 2 diabetes studies: offspring mental health (i.e., emotional and behavioural problems, depression and anxiety), offspring personal resources (i.e., self-esteem, coping and illness behaviour) and youth caregiving (i.e., caregiving tasks and conflict between parental type 2 diabetes management and offspring needs). The categories and instruments used for the assessment of young offspring psychosocial outcomes in the studies with type 2 diabetes samples are presented in Table 4.

Offspring mental health. Two studies reported findings regarding offspring mental health in the context of parental type 2 diabetes [41,42]. One study did not find differences in mental health (depressive symptomatology, anxiety and emotional and behavioural problems) between children (ages 10-13 years) of mothers with type 2 diabetes and children of 'healthy' mothers [42]. Only one case-comparison study indicated more emotional and behavioural problems in children (ages 6-12 years) of mothers with type 2 diabetes relative to a comparison group (children of mothers with non-metastatic breast cancer) [41]. The other case-comparison studies did not find differences in emotional and behavioural problems between children (ages 6-13 years) of parents with type 2 diabetes and children of parents with other chronic illnesses [41,42].

Offspring personal resources. Two studies with a parental type 2 diabetes sample investigated offspring personal resources [41,42]. One study found that levels of self-esteem did not differ between children (ages 6-12 years) of mothers with type 2 diabetes and children of mothers with breast cancer. However, levels of self-esteem were significantly lower in children of mothers with type 2 diabetes compared to children of mothers with fibrocystic breast disease [41]. Children

(ages 6-12 years) of mothers with type 2 diabetes reported similar coping skills to children of mothers with fibrocystic breast disease, which were significantly less adaptive than those in children of mothers with breast cancer [41]. Finally, children of mothers with type 2 diabetes (ages 6-13 years) did not differ in illness behaviour from children of 'healthy' mothers or from children of mothers with chronic pain [42].

Youth caregiving. Two qualitative studies investigated youth caregiving in the context of parental type 2 diabetes [43,44]. One study examined the role of children and adolescents (ages 10-17 years) in their parent's diabetes day-to-day care, highlighting that caregiving activities consisted of monitoring blood glucose readings, reminding their parent to have their insulin injections, assisting with meal planning or preparation, controlling parents' dietary intake, promoting healthy habits (i.e., dieting and exercising), and providing advice and emotional support [44]. The second study analysed different patterns of family disputes about the intersection of adults' meal strategies and youth reactions to household dietary changes due to parental diabetes [43]. In some families, all members followed the same diabetes related dietary changes and prepared one meal for everyone, whereas in other families children resisted such dietary changes. A conflict between youth needs and diabetes self-management was also reported as youth would occasionally tempt their parents to stray from their diet in order to fulfil their own needs [44].

Discussion

Overall, the literature evaluating the impact of parental type 1 and type 2 diabetes on young offspring was scarce and heterogeneous. Only 10 studies focusing on the effects of parental type 1 and type 2 diabetes on their young offspring met inclusion criteria. Illness-related variables were only explored in parental type 1 diabetes studies, while youth caregiving was only examined in parental type 2 diabetes studies. We found no published study that examined the potential differential impacts of parental type 1 and type 2 diabetes on youth.

From the limited available research evaluating psychosocial adjustment in youth of parents with either type 1 or type 2 diabetes, there is weak evidence suggesting that young offspring are at

risk of adverse psychosocial adjustment. It is not possible to make firm conclusions about the effects of either parental type 1 or type 2 diabetes on youth psychosocial adjustment because of the limited numbers of studies and their methodological weaknesses. In relation to the latter, only two studies had a sample size higher than 100. In addition, although guidelines for the assessment of youth mental health suggest using multiple informant evaluations [47], most of the studies in this review assessed offspring outcomes with self-report from parents, teachers or other medical professionals, and neglected youth self-report. Furthermore, three of the included studies were conducted in the 1980's and may not reflect the current status of psychosocial adjustment of offspring living with parental type 1 and type 2 diabetes, especially in view of the recent rapid developments in diabetes management [48]. Nonetheless, this review highlights an overall trend for young offspring of parents with type 1 and type 2 diabetes to be susceptible to negative psychosocial outcomes which is in line with the broader literature on youth of parents with chronic illnesses [4–8] and research on family members of adults with diabetes [15,16].

Findings from this review have exposed many gaps in the research on the effects of parental type 1 and type 2 diabetes on young offspring. First, although in the broader literature youth caregiving in the context of parental illness is associated with poorer mental health outcomes in young offspring [4–8], little is known about the caregiving experiences and tasks in children and adolescents of parents with diabetes, especially in the context of parental type 1 diabetes. Second, few studies have identified which, if any, diabetes variables (e.g., illness duration, type 1 vs. type 2, level of HbA1c and diabetes metabolic control, treatment types and adherence, and diabetes distress) negatively impact youth adjustment. The broader literature on parental chronic illness indicates that longer illness duration and higher levels of illness unpredictability are related to poorer youth psychosocial adjustment [6,7]. Third, the effects of youth characteristics (e.g., age and gender), parental factors (e.g., gender, age and mental health) and family variables (SES, family functioning, family size and single vs. dual parent household) on youth adjustment to parental diabetes have not been adequately examined. A meta-analysis on the impacts of parental chronic

illness on children highlighted that youth and parent's younger age, lower SES and single parent household are significant risk factors for adverse youth outcomes [7]. Finally, the potential positive effects of parental diabetes on young offspring have not been examined. For example, it has already been established that taking care of a parent with a chronic illness could positively influence youth in terms of benefit finding [49]. A related issue is the absence of research in this field that has assessed youth mental health as both absence of psychopathology and presence of wellbeing. Future studies should address these research gaps. The identification of risk and protective factors for youth of parents with diabetes will inform service needs and interventions for the people with diabetes, their offspring and the whole family.

Most of the studies reviewed suffered methodological weaknesses. Future quantitative research should address these by using larger sample sizes, longitudinal study designs, multiple informants for assessing youth adjustment, and comparison groups of youth from 'healthy' parents and parents with other chronic illnesses. Only two qualitative studies met inclusion criteria. More qualitative research is required to provide insights into how youth experience daily living in the context of parental diabetes. Future research should address the lack of data regarding the potential differential impacts of parental type 1 and type 2 diabetes on youth adjustment, given that the two types of diabetes are characterized by distinctive biomedical processes and psychosocial impacts on both the adults with diabetes and their family members [10–16,18–26, 32].

Conclusions

Few studies have focused solely on the effects of parental type 1 and type 2 diabetes on youth. Given that this review is based on only 10 studies, some of which were methodologically weak, no robust conclusions can be made as to the effects of parental diabetes on youth. However, on balance there was weak evidence suggesting some young offspring are at risk for adverse psychosocial impacts. This finding is consistent with the broader literature on the effects of parental illness on children [4–8]. This review has identified the research gaps and methodological deficiencies of published studies in this field. Given the rise in the incidence of diabetes globally

[1,2], there is a pressing public health need to conduct more rigorously designed studies to ascertain the extent to which youth are at risk for mental and physical health problems and to identify key risk and protective factors associated with youth adjustment in the context of parental type 1 and type 2 diabetes. Such data are critical for informing the development of tailored individual and whole-family focused support services and psychosocial interventions.

Funding sources

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. World Health Organization. Global Report on Diabetes. Available at http://apps.who.int/iris/bitstream/handle/10665/204871/9789241565257_eng.pdf;jsessionid=E97422048FB4B73E1A9E038498D61475?sequence=1. Last accessed 2 October 2018.
2. Center for Disease Control and Prevention. National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States. Available at www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf. Last accessed 6 November 2018.
3. Worsham NL, Compas BE, Ey S. Children's Coping With Parental Illness. In Wolchik SA, Sandler IN (eds.). *Handbook of children's coping: Linking theory and intervention.* New York: Plenum Press, 1997; 195–213.
4. Chikhradze N, Knecht C, Metzing S. Young carers: Growing up with chronic illness in the family - A systematic review 2007-2017. *J Compas Health Care* 2017; **4**(1): 1–12.
5. Ireland MJ, Pakenham KI. The nature of youth care tasks in families experiencing chronic illness/disability: Development of the Youth Activities of Caregiving Scale (YACS). *Psychol Health* 2009; **25**(6): 713–731.
6. Pakenham KI, Bursnall S, Chiu J, Cannon T, Okochi M. The psychosocial impact of caregiving on young people who have a parent with an illness or disability: Comparisons between young caregivers and noncaregivers. *Rehabil Psychol* 2006; **51**(2): 113–126.
7. Sieh DS, Meijer AM, Oort FJ, Visser-Meily JMA, Van der Leij DAV. Problem behavior in children of chronically ill parents: A meta-analysis. *Clin Child Fam Psychol Rev* 2010; **13**(4): 384–397.
8. Walczak A, McDonald F, Patterson P, Dobinson K, Allison K. How does parental cancer affect adolescent and young adult offspring? A systematic review. *Int J Nurs Stud* 2018; **77**: 54–80.
9. Cox DJ, Gonder-Frederick L. Major developments in behavioral diabetes research. *J Consult Clin Psychol* 1992; **60**(4): 628–638.

10. Fisher L, Chesla, CA, Skaff MM, Gilliss C, Mullan JT, Bartz RJ *et al.* The family and disease management in Hispanic and European-American patients with type 2 diabetes. *Diabetes Care* 2000; **23**(3): 267–272.

11. Jacobson S, Wood FG. Contributions of children to the care of adults with diabetes. *Diabetes Educ* 2004; **30**(5): 820–826.

12. Hunter CM. Understanding diabetes and the role of psychology in its prevention and treatment. *Am Psychol* 2016; **71**(7): 515.

13. American Diabetes Association. Foundations of care: Education, nutrition, physical activity, smoking cessation, psychosocial care, and immunization. *Diabetes Care* 2015; **38**, S20–S30.

14. Vongmany J, Luckett T, Lam L, Phillips JL. Family behaviours that have an impact on the self-management activities of adults living with Type 2 diabetes: A systematic review and meta-synthesis. *Diabet Med* 2018; **35**(2): 184–194.

15. Kovacs Burns K, Nicolucci A, Holt, RIG, Willaing I, Hermanns N, Kalra S *et al*. Diabetes Attitudes, Wishes and Needs second study (DAWN2™): Cross-national benchmarking indicators for family members living with people with diabetes. *Diabet Med* 2013; **30**(7): 778–788.

16. Kovacs Burns K, Holt RIG, Nicolucci A, Lucisano G, Skovlund SE, Comaschi M *et al.* Correlates of psychological outcomes among family members of people with diabetes in the second Diabetes Attitudes, Wishes and Needs (DAWN 2™) study. *Diabet Med* 2016; **33**(9): 1184–1193.

17. Skinner TC, Joensen L, Parkin T. Twenty-five years of diabetes distress research. *Diabet Med* 2019; **0**(0): 1–8.

18. Lawton J, Rankin D, Elliott J, Heller SR, Rogers HA, De Zoysa N *et al*. Experiences, views, and support needs of family members of people with hypoglycemia unawareness: Interview study. *Diabetes Care* 2014; **37**(1): 109–115.

19. Katz ML, Volkening LK, Dougher CE, Laffel LMB. Validation of the Diabetes Family Impact

Scale: A new measure of diabetes-specific family impact. *Diabet Med* 2015; **32**(9): 1227–1231.

20. Jia Z, Li X, Yuan X, Zhang B, Liu Y, Zhao J *et al*. Depression is associated with diabetes status of family members: NHANES (1999–2016). *J Affect Disord* 2019; **249**: 121–126.
21. Stuckey HL, Mullan-Jensen C, Kalra S, Reading J, Wens J, Vallis M *et al*. Living with an adult who has diabetes: Qualitative insights from the second Diabetes Attitudes, Wishes and Needs (DAWN2) study. *Diabetes Res Clin Pract* 2016; **116**: 270–278.
22. Rintala TM, Jaatinen P, Paavilainen E, Åstedt-Kurki P. Interrelation between adult persons with diabetes and their family: A systematic review of the literature. *J Fam Nurs* 2013; **19**(1): 3–28.
23. Grammes J, Stock W, Mann CG, Flynn EM, Kubiak T. Focus group study to identify the central facets of fear of hypoglycaemia in people with type 2 diabetes mellitus. *Diabet Med* 2017; **34**(12): 1765–1772.
24. Whittemore R, Delvy R, McCarthy MM. The experience of partners of adults with type 1 diabetes: An integrative review. *Curr Diab Rep* 2018; **18**(4): 19.
25. Collins MM, Corcoran P, Perry IJ. Anxiety and depression symptoms in patients with diabetes. *Diabet Med* 2009; **26**(2): 153–161.
26. Fisher L, Gonzalez JS, Polonsky WH. The confusing tale of depression and distress in patients with diabetes: A call for greater clarity and precision. *Diabet Med* 2014; **31**(7): 764–772.
27. Lynch L, Davey M. Parental Diabetes. In Davey M, Kissil K, Lynch L (eds.). *Helping children and families cope with parental illness: A clinician's guide.* New York: Routledge, 2016; 113–125.
28. Bennich BB, Røder ME, Overgaard D, Egerod I, Munch L, Knop FK *et al*. Supportive and non-supportive interactions in families with a type 2 diabetes patient: An integrative review. *Diabetol Metab* Syndr 2017; **9**(1): 57.
29. Isakov E, Sussak Z, Eldar R. Minor injury resulting in lower-limb loss in diabetic patients. *Clin Rehabil* 1992; **6**(2): 97–101.
30. Sieh DS, Dikkers ALC, Visser-Meily JMA, Meijer AM. Stress in adolescents with a chronically

ill parent: Inspiration from Rolland's family systems-illness model. *J Dev Phys Disabil* 2012; **24**(6): 591–606.

31. Pakenham KI, Cox S. The effects of parental illness and other ill family members on youth caregiving experiences. *Psychol Health* 2015; **30**(7): 857–878.
32. Schabert J, Browne JL, Mosely K, Speight J. Social stigma in diabetes. *Patient* 2013;**6**: 1-10.
33. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Ann Intern Med* 2009: **151**(4): 264–269.
34. Hong QN, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P *et al*. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Educ Inform* 2018; **34**(4): 285–291.
35. Flahault C, Sultan S. On being a child of an ill parent: A Rorschach investigation of adaptation to parental cancer compared to other illnesses. *Rorschachiana* 2010; **31**(1): 43–69.
36. Hadden DR, Byrne E, Trotter I, Harley JMG, McClure G, McAuley RR. Physical and psychological health of children of Type 1 (insulin-dependent) diabetic mothers. *Diabetologia* 1984; **26**(4): 250–254.
37. Knorr S, Clausen TD, Vlachová Z, Bytoft B, Damm P, Beck-Nielsen H *et al*. Academic achievement in primary school in offspring born to mothers with type 1 diabetes (the EPICOM study): A register-based prospective cohort study. *Diabetes Care* 2015; **38**(7): 1238–1244.
38. Kowalczyk, M, Ircha G, Zawodniak-Szalapska M, Cypryk K, Wilczynski J. Psychomotor development in the children of mothers with type 1 diabetes mellitus or gestational diabetes mellitus. *J Pediatr Endocrinol Metab* 2002; **15**(3): 277–282.
39. Rickard K. The occurrence of maladaptive health-related behaviors and teacher-rated conduct problems in children of chronic low back pain patients. *J Behav Med* 1988; **11**(2): 107–116.
40. Temple RC, Hardiman M, Pellegrini M, Horrocks L, Martinez-Cengotitabengoa MT. Cognitive function in 6-to 12-year-old offspring of women with Type 1 diabetes. *Diabet Med* 2011; **28**(7): 845–848.

41. Armsden GC, Lewis FM. Behavioral adjustment and self-esteem of school-age children of women with breast cancer. *Oncol Nurs Forum* 1994; **21**(1): 39–45.

42. Dura JR, Beck SJ. A comparison of family functioning when mothers have chronic pain. *Pain* 1988; **35**(1): 79–89.

43. Laroche HH, Davis MM, Forman J, Palmisano G, Heisler M. What about the children? The experience of families involved in an adult-focused diabetes intervention. *Public Health Nutr* 2007; **11**(04): 427–436.

44. Laroche HH, Davis MM, Forman J, Palmisano G, Reisinger HS, Tannas C. Children's roles in parents' diabetes self-management. *Am J Prev Med* 2009; **37**(6): 251–261.

45. Anderson BJ, Kornblum H. The family environment of children with a diabetic parent: Issues for research. *Fam Syst Med* 1984; **2**(1): 17–27.

46. Marjorie PL, Chanu B. Child sadness perceived by self, diabetic and non-diabetic parents in a selected community setting. *J Nurs Health Sci* 2016; **5**(2): 1–6.

47. De Los Reyes A, Augenstein TM, Wang M, Thomas SA, Drabick DA, Burgers DE *et al*. The validity of the multi-informant approach to assessing child and adolescent mental health. *Psychol Bull* 2015; **141**(4): 858–900.

48. Murphy, HR, Holt RIG. Technology: An increasingly important component in the management of diabetes. *Diabet Med* 2018; **35**(4): 407–408.

49. Pakenham KI, Cox S. Effects of benefit finding, social support and caregiving on youth adjustment in a parental illness context. *J Child Fam Stud* 2018; **27**(8): 2491–2506.

Table 1. *Key Information of the Included Studies Differentiated by Parental Type of Diabetes.*

	Authors, Year & Country	Aims	Sample	Results/Key Findings	Study Quality
Type 1 Diabetes	Flahault & Sultan 2010 [35] France & Canada	To assess children psychological functioning	102 children (8-18 yrs, M_{age} = 12.3 yrs, 45% male): - 28 children of parents with type 1 diabetes - 52 children of parents with metastatic cancer - 22 children of parents with chronic respiratory insufficiency	Youth of parents with diabetes and youth of parents with chronic respiratory insufficiency scored lower than youth of parents with cancer in depression, anxiety, isolation, distress, perceived pressure, amount of personal resources, self-disgust, shame and feeling of guilt	60%
	Hadden *et al.* 1984 [36] UK	To assess the health and intellectual ability of children of mothers with type 1 diabetes	247 pre-school and school age children: - 123 children of mothers with type 1 diabetes - 124 children of mothers without diabetes	There were no difference in physical health, emotional and behavioural problems and academic achievement between children of mothers with type 1 diabetes and children of 'healthy' mothers	80%
	Knorr *et al.* 2015 [37] Denmark	To examine school grades in youth of mothers with type 1 diabetes	61,048 adolescents (15-16 yrs): - 707 adolescents of mothers with type 1 diabetes - 60,341 adolescents of 'healthy' mothers	Offspring of mothers with type 1 diabetes obtained school grades comparable to offspring with 'healthy' mothers. However, inadequate metabolic control during pregnancy, was related to lower school grades in the offspring	100%
	Kowalczyk *et al.* 2002 [38] Poland	To examine infant psychomotor development	59 children (1-3 yrs): - 19 children of mothers with type 1 diabetes - 20 children of mothers with gestational diabetes - 19 children with 'healthy' mothers	Infants of mothers with type 1 diabetes displayed significantly more delay in psychomotor development compared to infants of mothers with gestational diabetes and infants of 'healthy' mothers – in movement coordination, speech and social reactions but not in motor development	80%
	Rickard 1988 [39] USA	To investigate child modelling of parental abnormal illness behaviour	63 children: - 21 children (9-12 yrs) of a parent with type 1 diabetes - 21 children of parents with chronic low back pain - 21 children of 'healthy' parents	Children of parents with diabetes showed lower external health locus of control, conduct problems and illness behaviours than children of chronic pain parents	60%
	Temple *et al.* 2011 [40] UK	To assess the impact of maternal type 1 diabetes on cognitive function in offspring	40 children (6-12 yrs, 45% male) with 40 mothers with type 1 diabetes	There was no significant difference in total IQ between children of mothers with type 1 diabetes and normative data; however, children of mother with type 1 diabetes presented poorer working memory scores	100%
Type 2 Diabetes	Armsden & Lewis 1994 [41] USA	To assess psychosocial adjustment of children of mothers with chronic illnesses	48 children (6-12 yrs, 60.4% male): - 18 children of mothers with type 2 diabetes - 13 children of mothers with non-metastatic breast cancer - 17 children of mothers with fibrocystic breast disease	Children of mothers with diabetes and those whose mothers had fibrocystic breast disease displayed more behaviour problems than children of mothers with breast cancer. Children of women with diabetes or fibrocystic breast disease coped less effectively than those of mother with breast cancer	80%
	Dura & Beck 1988 [42] USA	To investigate family functioning among mothers with type 2 diabetes, chronic pain or healthy mothers	21 children: - 7 children (10-13yrs, M_{age} = 10.7 yrs) of mothers with type 2 diabetes - 7 children of mothers with chronic pain - 7 children of 'healthy' mothers	Children of mothers with diabetes did not differ from children of mothers with chronic pain or children of 'healthy' mothers in depressive symptomatology, anxiety, total problem behaviours, social functioning, and illness behaviour	80%
	Laroche *et al.* 2007 [43] USA	To explore household dietary changes related to parental type 2 diabetes	15 children (10-17 yrs, 53.3% male) of parents with type 2 diabetes enrolled in a diabetes self-management program	Different patterns of family disputes emerged about the intersection of adults' meal strategies and youth reactions to household dietary changes: same food/no or little resistance, same food/resistance, different food/resistance, different food/no resistance	100%
	Laroche *et al.* 2009 [44] USA	To examine the role of children in their parents' type 2 diabetes self-management	24 children (10-17 yrs, 50% male) and their 24 parents with type 2 diabetes	Children had many roles in parental type 2 diabetes self-management: monitoring parents' dietary intake, reminding them what they should not be eating, helping in shopping and meal preparation, reminding to exercises, to take medications and to check blood sugar	100%

Table 2. *Type of Parental Diabetes, Type of Study, Parent with Diabetes' Gender, Offspring Age Range and Number in the Included Studies.*

	Authors and Year	Type of Study	Parent with Diabetes' Gender	Offspring Age Range	Offspring Number
Type 1 Diabetes	Flahault & Sultan 2010 [35]	Quantitative	Either	8-18 yrs	*n* = 28
	Hadden *et al.* 1984 [36]	Quantitative	Mothers	Pre-school and school age children	*n* = 123
	Knorr *et al.* 2015 [37]	Quantitative	Mothers	15-16 yrs	*n* = 707
	Kowalczyk *et al.* 2002 [38]	Quantitative	Mothers	1-3 yrs	*n* = 19
	Rickard 1988 [39]	Quantitative	Either	9-12 yrs	*n* = 21
	Temple *et al.* 2011 [40]	Quantitative	Mothers	6-12 yrs	*n* = 40
Type 2 Diabetes	Armsden & Lewis 1994 [41]	Quantitative	Mothers	6-12 yrs	*n* = 18
	Dura & Beck 1988 [42]	Quantitative	Mothers	10-13 yrs	*n* = 7
	Laroche *et al.* 2007 [43]	Qualitative	Either	10-17 yrs	*n* = 15
	Laroche *et al.* 2009 [44]	Qualitative	Either	10-17 yrs	*n* = 24

Notes. Offspring age range is not specified when the original study did not report it.

Table 3. *Categories and Instruments Used for the Assessment of Young Offspring of Parents with Type 1 Diabetes' Outcomes.*

Categories		Instruments
• **Offspring Mental Health**		
> Emotional and Behavioural Problems	(+)	Conners Teacher Rating Scale [39]
	(-)	Emotional and behavioural problems [36]
> Other Psychopathology	(+)	Rorschach Comprehensive System [35]
• **Offspring Physical Health**		
> Minor or major health problems	(-)	Paediatric visit and questionnaires assessing physical health [36]
• **Offspring Personal Resources**		
> Psychomotor Development	(+)	Brunet-Lezine Psychomotor Development Scale [38]
> Intelligence	(+)	Wechsler Intelligence Scale for Children (WISC-IV) [40]
> School Performance	(+)	Information about child's academic performance and school behaviour [36]
	(+)	School grades [37]
> Illness Behaviour	(-)	Children Illness Behaviour [39]
• **Parental Illness Characteristics**		
> Illness Duration	(-)	Parental medical information [40]
> Type 1 Diabetes Metabolic Control	(-)	Parental medical information [37,38,40]

Notes. (-) = Unstructured measures in quantitative studies; (+) = Validated measures in quantitative studies.

Table 4. *Categories and Instruments Used for the Assessment of Young Offspring of Parents with Type 2 Diabetes' Outcomes.*

Categories	Instruments
• **Offspring Mental Health**	
> Emotional and Behavioural Problems	(+) Child Behaviour Checklist (CBCL) - Teacher form [42]
	(+) Louisville Behaviour Checklist (LBCL) [41]
> Depression	(+) Children's Depression Inventory (CDI) [42]
> Anxiety	(+) State-Trait Anxiety Inventory for Children (STAIC) [42]
• **Offspring Personal Resources**	
> Self-Esteem	(+) Personal Attribute Inventory for children (PAIC) [41]
> Coping	(+) Zeitiling Coping Inventory (ZCI) [41]
> Illness Behaviour	(-) Children illness behaviour [42]
• **Youth Caregiving**	
> Caregiving Tasks	(•) Caregiving tasks [44]
> Type 2 Diabetes Management vs. Offspring Needs	(•) Conflict between household dietary changes and offspring needs [43]

Notes. (-) = Unstructured measures in quantitative studies; (+) = Validated measures in quantitative studies; (•) = Theme derived from qualitative studies.

Figure 1. PRISMA flow diagram of identification and screening process for systematic review.