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REVIEW ARTICLE

High prevalence of depression in parents of children with Type 1 diabetes in a meta-analysis of data from five continents

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Abstract

Aim: This meta-analysis identified the prevalence of depression in parents of children with Type 1 diabetes.

Methods: MEDLINE, PsycINFO and CINAHL databases were searched for papers published in English from 1980 to May 2022, yielding 18 studies ($N = 2044$ participants). The prevalence of parental depression was pooled across the studies.

Results: The prevalence of depression among parents of children with Type 1 diabetes was high. Random-effects meta-analyses estimated the prevalence of moderate depression and above in the total sample as 18.4% (95% CI 12.8–24.6; $k = 17$, $N = 2044$), with rates of 17.3% in mothers (95% CI 12.7–22.5; $k = 12$, $N = 1106$) and 9% in fathers (95% CI 4.3–15.1; $k = 6$, $N = 199$). The estimated prevalence of mild depression and above in the total sample was 32.7% (95% CI 20.3–46.6; $k = 8$, $N = 797$), with rates of 29.4% in mothers (95% CI 17.8–42.6; $k = 4$ $N = 330$) and 13.6% in fathers (95% CI 5.2–25.2; $k = 2$ $N = 44$). All results were characterised by high levels of heterogeneity. The risk of publication bias was low.

Conclusion: More than 1 in 6 parents of children with Type 1 diabetes had depression in the moderate plus category. The limitations and implications of these results are discussed.

KEYWORDS
depression, meta-analysis, prevalence, systematic review

1 | INTRODUCTION

Type 1 diabetes (T1D) is an autoimmune condition characterised by the body attacking beta cells in the pancreas that produce insulin. Complications include hyperglycaemia, which, if left untreated, can damage the heart, eyes, feet and kidneys. T1D is a serious and lifelong condition, being one of the most common paediatric chronic illnesses, preceded by asthma and epilepsy.[1] The number of young people under the age of 20 with T1D is estimated to be 1.2 million.[2] Caring for a child with T1D is emotionally challenging and time intensive.[3] Parents of young children and adolescents are ultimately responsible for the daily management of the condition. This can include checking blood glucose levels, monitoring diet and physical activity, and administering insulin injections.[4] This can have a

Abbreviations: BDI, Beck's Depression Inventory; CBT, Cognitive Behavioural Therapy; CES-D, Centre for Epidemiologic Studies Depression Scale; HADS, Hospital Anxiety and Depression Scale; HDRS, Hamilton Depression Rating Scale; NICE, National Institute for Health and Care Excellence; PHQ, Patient Health Questionnaire; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PTSD, Post-traumatic stress disorder; T1D, Type 1 Diabetes.

significant impact on family life, being time-consuming and requiring changes to family routines, contributing to parental stress and diminished quality of life.[5] Literature has demonstrated elevated rates of depression in parents of children with T1D, with up to 74% reporting symptoms following diagnosis.[6]

Depression in parents of children with T1D is an important focus of research. Depression is one of the most prevalent psychiatric illnesses.[7] In clinical settings, the prevalence of depression is higher than in the general population.[8] A number of factors may lead to the development of depression in parents of children with T1D. Having a child diagnosed with a chronic condition is associated with loss of perceived control, which is a main risk factor for depression.[9,10] Furthermore, the quality of sleep is likely to diminish for these parents as they struggle to balance their many responsibilities.[11] Sleep deprivation has several negative health consequences, with literature supporting a link between poor sleep and increased levels of stress, anxiety and depression.[12–14] Parents also report considerable levels of worry and preoccupation about their child's health.[15,16] With these factors in mind, it is unsurprising that parents are left with little time to engage in meaningful activity of their own, consequently increasing their risk of depressed mood.[17,18] Moreover, parents' perception of stress is likely to be elevated, further increasing their risk for depression.[5] Parents of children with T1D report stress around social disruption, emotional strain and financial strain when a child's condition is associated with unpredictable symptoms,[19] as is the case with diabetes. All of which have been associated with depression.[20–22] The presence of T1D may also affect parent-child attachment, placing additional stressors on the relationship and increasing the risk of depression within the family.[23]

Parental emotional well-being and child health are intertwined. Research has revealed a two-to-threefold increased risk of depression in children of mothers with depression.[23] Several studies have considered the transactional model of parent-child interaction for T1D, in which children affect parents and parents affect children, suggesting that it represents a 'family condition'.[24–26] Parental psychological distress has been shown to have health implications for the parent, the child with T1D and overall family functioning.[27] More specifically, parental psychological distress has shown to be associated with higher family conflict, less adaptability and having a negative effect on the child's mental health and their diabetes management.[5] The magnitude of maternal symptoms of depression has been related to both poor metabolic control and reduced quality of life in children with T1D.[28,29] Notably, depressive symptoms in children and adolescents with T1D have been associated with an increased risk of hospitalisation.[30,31]

Although several studies have explored the prevalence of depression in this population, there are limited literature reviews and meta-analyses pooling the prevalence across studies. Whittemore et al.[5] conducted a systematic review to explore the prevalence of psychological distress in parents of children with T1D. The prevalence of depression in parents of children with T1D was found to range from 10% to 74%. However, there was significant heterogeneity in the samples, making it challenging to make comparisons across studies. The authors also noted limited diversity and small sample sizes in the included studies. More recently, Bassi et al. investigated parental stress, anxiety and depression in paediatric T1D, and how they are associated with self-efficacy in disease management.[4] Although this was limited to a literature review and did not solely focus on the prevalence of depression in this population. Several meta-analyses have explored health outcomes for parents of children with chronic illness.[10,32,33] Cohn et al.[34] revealed that 35% of parents of chronically ill children met cut-offs for clinical depression, compared to 19% in the control group. However, there are limited meta-analyses solely focusing on the psychological impact of having a child with T1D, and none focusing on the prevalence of depression in this group.

A greater understanding of parental psychological distress in response to their child having T1D is needed to guide future research and clinical practice. This knowledge is of significant clinical importance, considering the impact of parental psychological distress on the child's diabetes management, and can be used for the planning of paediatric psychological services. The plan for this meta-analysis was to synthesise the research on depression rates among parents of children with T1D. The paper aimed to describe the prevalence of depression in this population and present the clinical and research implications.

Key Notes

- Depression in parents of children with Type 1 diabetes warrants consideration.
- Meta-analysis suggests the rates of depression in this group are relatively high.
- Depression should be routinely assessed; more data are needed on fathers.

2 | METHOD

2.1 | Selection of studies

Papers from peer-reviewed, English-language journals that were published between 1980 and May 2022 were considered for inclusion. This timeframe was chosen due to the publication of the Third Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) in 1980, which first introduced depression as a unitary category.[35] It was hoped that this would reduce heterogeneity in measures used within depression studies following this diagnostic criterion. Relevant studies were identified through systemic searches in three electronic databases: MEDLINE, PsycINFO and CINAHL. Animal studies were excluded from the searches. The search was conducted on 16th May 2022. The Cochrane database and PROSPERO register were searched to ensure no similar reviews were either in progress or had been published. This review was registered on PROSPERO (ID Number CRD42022317995).

The following search terms and combinations were used: (Parent* OR carer* OR caregiver* OR 'care giver' OR mother* OR father* OR Maternal* OR Paternal*) AND (Depress* OR 'mood disorder*' OR 'low mood' OR 'dysthymic disorder') AND Diabet*. The following MeSH terms were also applied to the searches: (MeSH Diabetes Mellitus, Type 1+) AND (MeSH Depression).

2.2 | Inclusion and exclusion criteria

Screening and selection of studies were conducted by the first author (HR). To ensure relevant papers were included in the meta-analysis, strict inclusion and exclusion criteria were applied. Studies were included if they reported prevalence rates of depression in parents of children aged between 0 and 18 years with T1D. The term 'parents' is used for the child's primary caregiver and the terms 'mother', 'father', or 'other parent descriptor' are used to describe gender differences. Studies were excluded if: they did not use a validated or reliable measure of depressive symptoms; prevalence rates of depression were not reported; if the children died before parental depression was assessed; if the aim of the study was to investigate the efficacy of treatment; or if the sample used were biased (e.g., only recruiting parents or children with depression). Studies were included if they were: cross-sectional design studies; case-controlled studies; and longitudinal studies. Studies were excluded if they were: randomised controlled trials; treatment or intervention studies; review articles; systematic reviews; meta-analyses; theses and dissertations; book chapters; purely qualitative research; single case reviews; or case studies.

2.3 | Data extracted from each study

The first author (HR) screened all studies and extracted information using a database. Several study variables were examined: author; year of publication; country; setting; inclusion and exclusion criteria; data collection method; recruitment method; and sample size. The following participant data was extracted: age, gender and ethnicity of parents; assessment methods and measures; and the number of parents meeting the cut-off for depression. The majority of studies only collected data at one timepoint ($k=15$). However, for the remaining studies ($k=3$) that reported depression prevalence at multiple time points, only baseline prevalence was extracted. Data extracted from each study is displayed in Table 1. The extracted data for all studies were reviewed by an independent researcher (AH) to reduce the likelihood of error.[36] Any queries were discussed until consensus was reached. If consensus could not be reached by the two authors (HR and AH), a final decision was made by the senior researcher (RM-S).

The majority of studies reported levels of depression according to published cut-offs for each measure. For example, no depression, and mild, moderate and severe depression. In the current study, severity of depression was then divided into two categories: parents who scored in the mild range of depression and above (mild plus); and parents who scored in the moderate range of depression and above (moderate plus) on the measures. Two studies only categorised parents as either below or above the clinical cut-off for depression and placed them in 'moderate plus' category. One study used a category defined as 'doubtful cases', and these were placed into the 'mild plus' category in the current study.

The studies included in this meta-analysis collected data at various timepoints following a diagnosis of T1D, ranging from the acute period to 5 years post-diagnosis (see Table 1).

2.4 | Risk of bias

The quality of each study was analysed by two researchers (HR and AH). An adapted version of a risk-of-bias tool used in a recent meta-analysis of post-traumatic stress disorder (PTSD) prevalence was used,[37] using common quality assessment questions developed by Munn et al.[38] The risk-of-bias tool included six questions that assessed quality according to the description of sample characteristics, non-response rates and reasons provided, representativeness, recruitment procedures and reporting of inclusion and exclusion criteria. As prevalence was the only outcome extracted from each study, the type of analyses used were not assessed for quality. A qualitative descriptor of risk-of-bias was applied to each study (Low, Medium and High) and the scoring was adapted to reflect the number of questions assessing quality (9–12 = low risk, 5–8 = medium risk, 0–4 = high risk). All studies were inter-rated by the two researchers (HR and AH). Analysis was then conducted to assess inter-rater reliability using MAVIS (version 1.1.3).

2.5 | Statistical analysis

The meta-analyses were conducted using R (version 4.1.3), using the metafor package (version 3.8-1).[39] The prevalence of parents with depression was extracted from each paper. Parents were classed as having depression if they met cut-off on a validated depression measure. To account for likely between-study heterogeneity, a random effects model was used, as it provides a more conservative 95% CI around the estimate of prevalence.

The estimates of prevalence underwent an arcsine square-root (angular) transformation to ensure that CIs did not fall below zero for samples where the prevalence estimate was low.[40] The results were then back transformed to enable ease of interpretation.

The heterogeneity of studies was assessed by visual inspection of forest plots, in addition to conducting a Cochran's Q test.[41] The Cochran's Q test indicates whether heterogeneity is significant between the studies. The I^2 statistic was used to determine the percentage of total variation in sample estimates that is due to between-study heterogeneity.[42] I^2 between 30% and 60% indicates moderate heterogeneity, 50%–90% represents substantial heterogeneity and 75% and above indicates considerable heterogeneity.[43]

TABLE 1 Characteristics of the 18 studies included in the meta-analysis.

Sample	Location	Parent age		*n*	Proportion female (%)	Gender data reporting	Depression measure	Depression categorisation	Child age (mean)	Diabetes duration (years)	Risk of bias (/12)
		Range	Mean (SD)								
Butwicka 2013	Poland	NR	39.6 (5.1)	166	100	Mothers	HDRS	Mild and moderate	13.4	4.1	Medium (7)
Capistrant 2017	India	NR	40.6 (6.8)	178	50	Total	PHQ-9	Mild and moderate	12.3	4.7	Medium (8)
Capistrant 2019	India	NR	i. 41.56 (6.78), ii. 41.30 (6.47)[a]	165	i. 68.8, ii. 48.3[a]	Mothers, fathers and total	PHQ-9	Moderate	NR	NR	Medium (8)
Hansen 2012	USA	NR	Mo: 41.4 (5.5), Fa: 44.1 (5.6)[b]	125	66	Mothers, fathers and total	HADS	Moderate	10.8	4.4	Medium (7)
Hood 2009	USA	NR	NR	187	84	Mothers	CES-D	Moderate	14.4	6.5	Low (9)
Horsch 2007	UK	NR	40.2 (5.9)	60	100	Mothers	HADS	Mild and moderate	10.3	2.9	Medium (6)
Jaser 2010	USA	30–57	43.5 (6.7)	30	100	Mothers	CES-D	Moderate	12.6	5.8	Medium (8)
Jaser 2014	USA	28–58	44.2 (5.8)	118	100	Mothers	CES-D	Moderate	12.8	4.9	Medium (8)
Khemakhem 2020	Tunisia	NR	NR	41	85	Mothers, fathers and total	HADS	Mild and moderate	NR	3.8	Medium (7)
Kovacs 1985	USA	NR	Mo: 37.5 (6.2), Fa: 40.8 (6.9)[b]	107	64.5	Mothers, fathers & total	BDI	Mild & moderate	11.0	0.0	Medium (8)
McConville 2020	USA	NR	36.6 (6.4)	125	87.5	Mothers, fathers and total	CES-D	Moderate	7.5	0.4	Medium (8)
Moreira 2013	Portugal	25–65	42 (6)	104	94	Total	HADS	Mild and moderate	12.4	5.6	Medium (5)
Nguyen 2022	Netherlands	34–59	46 (4.6)	137	89	Total	PHQ-9	Moderate	15.0	7.2	Medium (6)
Noser 2019	USA	NR	36.6 (6.4)	126	88	Mothers, fathers and total	CES-D	Moderate	7.5	0.4	Low (9)
Patton 2011	USA	NR	35.1 (6.4)	39	NR	Total	BDI-II	Mild	5.1	NR	Low (9)
Streisand 2008	USA	20–61	40.2 (7.2)	102	61	Total	CES-D	NR	9.7	NR	Medium (7)
Williams 2009	USA	NR	NR	187	82	NR	CES-D	Moderate	14.4	6.5	Low (9)
von Borries 2020	Chile	NR	Dep: 42.5 (7.53), No dep: 44.5 (9.52)[c]	86	100	Mothers	BDI	Moderate	14.0	Dep: 5.0, No dep: 6.3	Medium (7)

Abbreviation: NR, Not reported.

[a]i. = moderate/severe depression, ii. = no/mild depression.

[b]Mo = mothers, Fa = fathers.

[c]Dep = with depression, No dep = no depression.

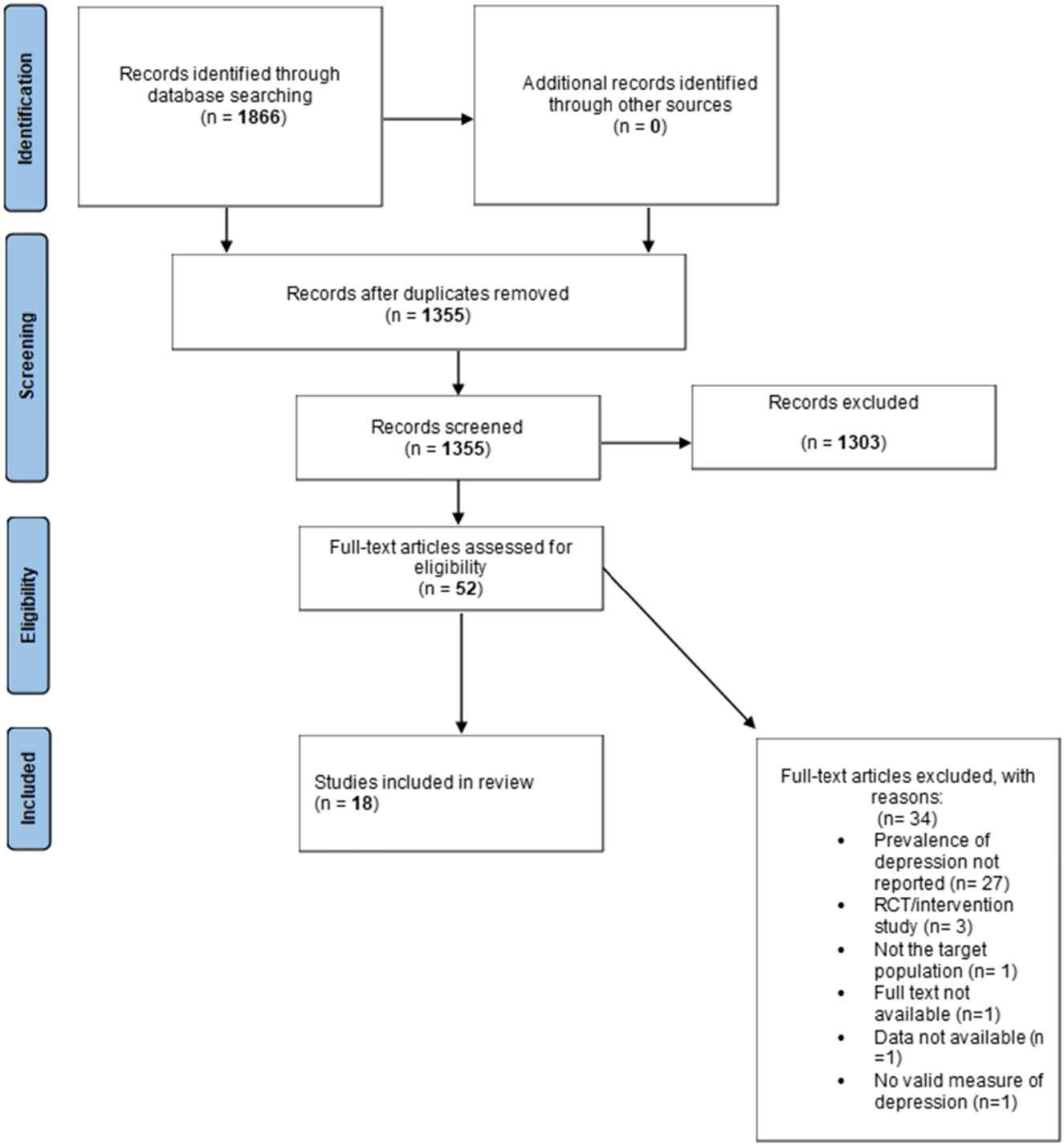

FIGURE 1 PRISMA flowchart of studies identified, screened and included in the final meta-analysis.

Prediction intervals (PI) were also reported, enabling clinical interpretation of the heterogeneity.[44] A 95% PI estimates where the true effects are to be expected for 95% of similar studies conducted in the future.[45]

Publication bias was assessed using funnel plots.[46] However, due to the lack of assessment of clinical significance in prevalence studies, the risk-of-bias in levels of acceptance to journals is reduced.[47] Funnel plot asymmetry was tested using Egger's test.[48]

Sensitivity analyses were conducted to assess the impact of risk-of-bias on the pooled prevalence. This was achieved by repeating the meta-analysis, excluding samples where there was a high risk of bias. A meta-analytic regression was used to test for any clinically significant differences in the sensitivity analysis.

Moderator analysis was not conducted for certain variables due to the homogeneity of the variables, for example the type of depression measure used (all used self-report measures) and the income status of the country (majority recruited from high income

countries). Moderator analysis was conducted to explore differences in prevalence rates between mothers and fathers.

In clinical research, researchers may choose not to write up and publish studies with uninteresting findings, for example those with smaller or nonstatistically significant effect sizes.[49] However, this can lead to publication bias. With prevalence research, it is unclear whether researchers would be more likely to publish studies reporting either low or high prevalence rates, and therefore less is known about the risk of publication bias within this research. Nevertheless, publication bias was assessed in the current review for robustness.

3 | RESULTS

We identified 1355 papers after duplicates had been removed. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) diagram shows that 52 papers met the eligibility criteria following the initial screen of titles and abstracts (see Figure 1). Full text reviews were then conducted on these 52 papers. Following further exclusions, the total number of samples included in this review was 18. All 18 studies reported prevalence rates of depression in parents of children diagnosed with T1D. Five studies included only female participants. One study did not report the percentage of female participants. Of the remaining 12 studies, the average percentage of female participants was 74.6%. The average child age was 11.45 across the 17 studies that reported child age. Studies mostly originated in high-income countries ($k = 15$).

3.1 | Characteristics of the studies

The characteristics of the included studies can be found in Table 1. Participants ranged in age from 20 to 61. The estimated mean age of parents across all studies was 40.4. Seven studies were not included in this overall mean age calculation as they either did not report mean age or they reported it according to gender or severity of depression rather than the total sample. A range of inclusion and exclusion criteria were applied across the studies. Participants were frequently excluded if their child had another serious mental or physical comorbidity and if the diagnosis of T1D was less than 6 months. To assess depression prevalence in their samples, six studies used the Centre for Epidemiologic Studies Depression Scale (CES-D)[50]; three studies used the Beck's Depression Inventory (BDI)[51]; three studies used the Patient Health Questionnaire (PHQ-9)[52]; four studies used the Hospital Anxiety and Depression Scale (HADS)[53]; and two studies used the Hamilton Depression Rating Scale (HDRS).[54]

3.2 | Risk-of bias assessment

Fourteen studies were deemed to be at medium risk-of-bias and four were deemed to be at low risk-of-bias. No studies were deemed to be at high risk-of-bias. Inter-rater reliability was assessed for all ratings on all studies ($n = 18$) by the two raters (HR, AH). They achieved an intra-class correlation of 0.68 for risk-of-bias, indicating a good correlation on all items [interclass correlation = 0.68, 95% confidence intervals (CI) 33.5–86.6].[55] This suggests that the quality assessment tool was robust, with good inter-rater reliability.

3.3 | Depression prevalence

The pooled prevalence of depression estimates and heterogeneity statistics for all studies can be seen in Table 2. A total of 18 studies reported prevalence rates, which resulted in a pooled prevalence of parental depression following their child's diagnosis of T1D. However, not all 18 studies categorised depression into mild and moderate or reported depression prevalence in mothers and fathers separately. Therefore, the number of studies included in each meta-analysis varies. Please refer to Table 2 for a breakdown of the studies included in each meta-analysis.

Six meta-analyses were conducted: total participants scoring in the moderate depression and above range (moderate plus); total number of mothers scoring in the moderate depression and above range; total number of fathers scoring in the moderate depression and above range; total participants scoring in the mild depression and above range (mild plus); total number of mothers scoring in the mild depression and above range; total number of fathers scoring in the mild depression and above range.

TABLE 2 Pooled point prevalence of depression for all samples.

Meta-analysis subgroup	*k*	*n*	Pooled prevalence (%)	95% CI	*Q*	I^2 (%)	95% PI
Moderate plus							
Total	17	2044	18.4	12.8, 24.6	191.15***	91.7	1.8, 46.6
Mothers	12	1106	17.3	12.7, 22.5	59.27***	78.0	5.0, 35.0
Fathers	6	199	9.0	4.3, 15.1	8.05	35.4	1.9, 20.4
Mild plus							
Total	8	797	32.7	20.3, 46.6	100.78***	93.7	3.9, 72.6
Mothers	4	330	29.4	17.8, 42.6	14.3	82.1	8.2, 57.0
Fathers	2	44	13.6	5.2, 25.2	0.05	0	5.2, 25.2

Abbreviations: CI, confidence interval; *k*, number of studies; *n*, number of participants; PI, prediction interval.
***$p < 0.0001$.

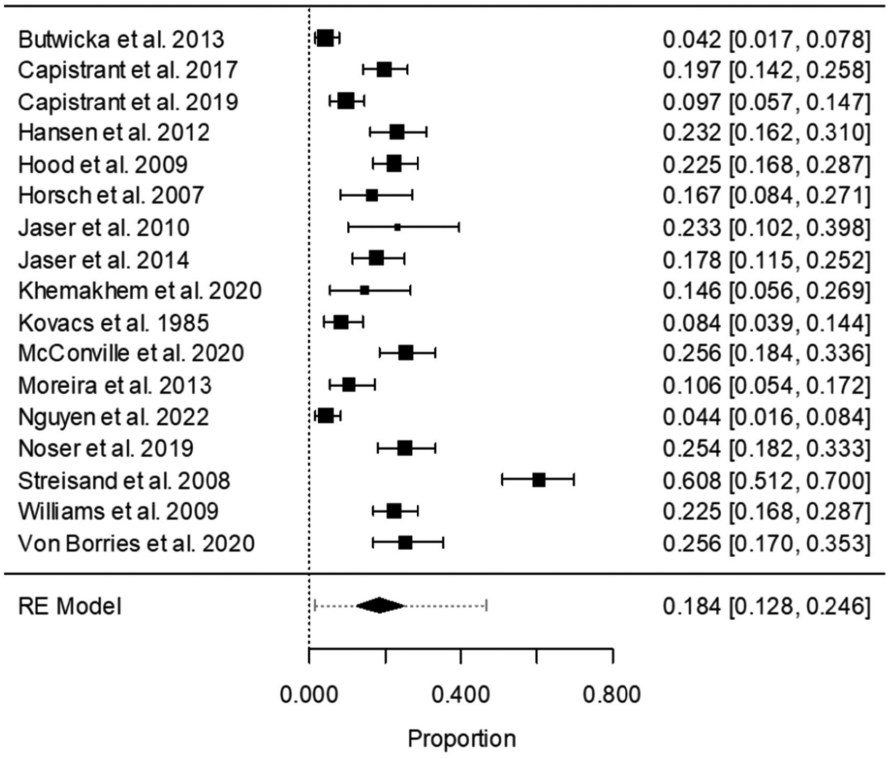

FIGURE 2 Forest plot for prevalence of moderate depression and above (moderate plus) in the total sample.

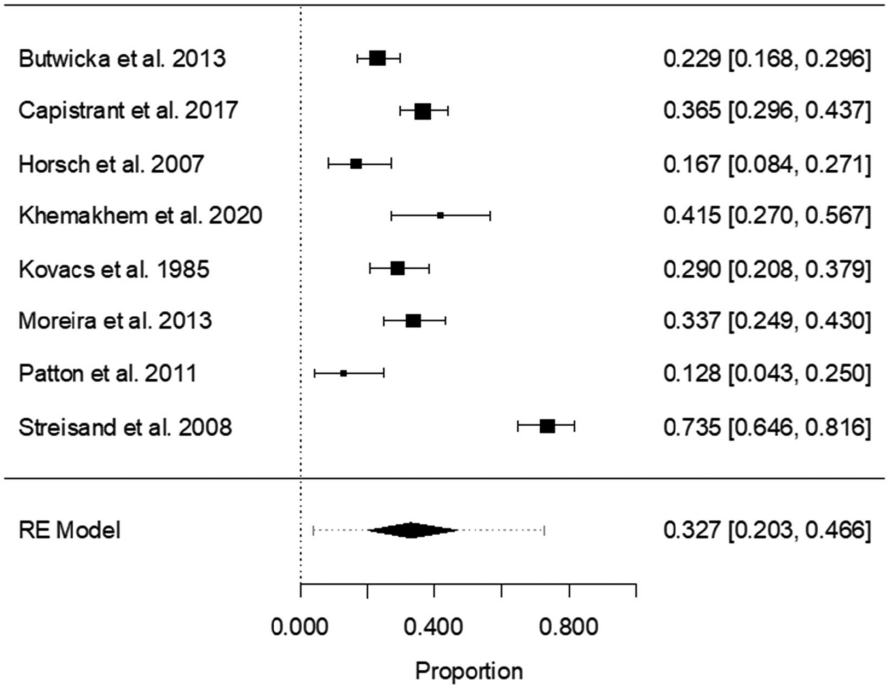

FIGURE 3 Forest plot for prevalence of mild depression and above (mild plus) in the total sample.

3.3.1 | Moderate plus depression

The overall pooled prevalence was 18.4% of the parents from the studies ($k=17$) who had a child diagnosed with T1D developed depression in the moderate and above range (see Figure 2). For mothers, the pooled prevalence was 17.3% ($k=12$). The degree of heterogeneity for these two meta-analyses was considerably high. For fathers, the pooled prevalence was 9% ($k=6$), with a low degree of heterogeneity.

3.3.2 | Mild plus depression

This overall pooled prevalence was 32.7% of the parents from the studies ($k=8$) who had a child diagnosed with T1D developed depression in the mild and above range (see Figure 3). For mothers, the pooled prevalence was 29.4% ($k=4$). The degree of heterogeneity for these two meta-analyses was considerably high. For fathers, the pooled prevalence was 13.6% ($k=2$), with a low degree of heterogeneity.

3.4 | Sensitivity analysis

On visual inspection of the forest plot, the study of Streisand et al. appeared to be an outlier.[5] The two meta-analyses estimating the prevalence of mild (mild plus) and moderate (moderate plus) depression and above in the total sample were run again, excluding this study, to analyse the impact of this study on the overall pooled prevalence of depression. Streisand et al.[6] did not report depression prevalence for mothers and fathers separately. Therefore, sensitivity analysis was only conducted for the total sample. For moderate plus, the prevalence of depression reduced to 16.2%; for mild plus, the prevalence of depression reduced to 27.4%. This sensitivity analysis showed that the inclusion of the Streisand et al. study resulted in little change in the pooled prevalence of depression, and it was therefore deemed appropriate to include it in the analysis.

Sensitivity analysis was also conducted, excluding studies that recruited parents during the acute stage of their child receiving a T1D diagnosis and one study that did not report this information ($k=6$; see Table S1). The acute stage refers to studies that included data from the time of diagnosis to 1-year post-diagnosis. The remaining studies that recruited parents at least 6 months post-diagnosis or who had a mean diabetes duration of at least 4.5 years were pooled, and a meta-analysis was conducted ($k=12$). For moderate plus, the prevalence of depression reduced only slightly to 16.1%; for mild plus, the prevalence of depression reduced slightly to 27%. This sensitivity analysis showed that the inclusion of studies that recruited parents around the time of receiving a diagnosis of T1D resulted in little change in the pooled prevalence of depression.

3.5 | Moderator analysis

To consider whether parent sex moderated the prevalence of moderate plus depression, where possible, single-sex samples were identified and included in a moderator analysis. This analysis comprised of 18 samples drawn from 12 studies (12 mother samples [$n=1106$] and 6 father samples [$n=199$]). This analysis showed no statistically significant difference in prevalence as a function of gender ($Q(\text{df}=1)=3.73$, $p=0.054$; mothers pooled estimate = 17.3%, fathers pooled estimate = 9.0%).

3.6 | Publication bias

Publication bias was only reported for categories with 10 studies or more[56]: moderate plus – total sample; and moderate plus – mothers only.

For the moderate plus threshold, including all studies, a visual inspection of the funnel plot suggested that the distribution of studies was symmetrical ($k=17$). This was confirmed by Egger's test, which was non-significant ($p=0.67$). The trim-and-fill analysis did not highlight null or weaker studies as missing, indicating little to no publication bias.

For the moderate plus threshold including only data for mothers, visual inspection of the funnel plot suggested that the distribution of studies was symmetrical ($k=14$). This was confirmed by Egger's test, which was non-significant ($p=0.41$). The trim-and-fill analysis highlighted a lack of studies on the left side of the funnel plot, indicating a small degree of potential publication bias; including two additional estimated studies, which reduced the pooled prevalence to 15.5% However, this should be interpreted with caution due to the small number of studies.[56]

4 | DISCUSSION

This meta-analysis investigated the prevalence of depression in parents of children with T1D. The prevalence was 18.4% for moderate depression and above, and 32.7% for mild depression and above across a total sample of 2044 parents from 18 studies. This suggests that a significant minority of parents of children with T1D will experience depression, with more than 1 in 6 experiencing moderate depression and above. However, there was significant heterogeneity across studies ($I^2=91.7\%$ in the moderate plus category and 93.7% in the mild plus category). Sensitivity analysis showed little change in the prevalence of depression when an outlier was removed from the meta-analysis.

4.1 | Comparison to prevalence of depression in the general population

The World Health Organisation (WHO) estimates that approximately 5% of adults are affected by depression worldwide.[57] The prevalence of depression is higher in women compared to men, with a global prevalence of 5.5% and 3.2%, respectively, in 2010, among those aged 3 years and above.[58] Between 6% and 17% of women experience depression in their lifetime, with elevated rates in mothers.[59] Using the PHQ-9, the National Health and Nutrition Examination Survey (NHANES) found that 8.1% of American adults aged 20 and over had depression in a given 2-week period.[60] Women (10.4%) were almost twice as likely as men (5.5%) to score above the cut-off for depression. The prevalence of depression in parents of children with T1D in the current study was higher than in the general population; however, the finding that the prevalence is higher in women relative to men is comparable.

4.2 | Comparison to prevalence of depression in parents of healthy children

One study analysed depressive symptoms in adults across numerous parent-child relationships, revealing that parents with children currently residing within the home may have lower

psychological well-being when compared with those without children.[61] Furthermore, it is important to consider the prevalence of depression among parents of healthy children in order to make comparisons to the results of the current study. Cohn et al. compared rates of depression in parents of children with and without chronic illness, defined as those suffering from a physical, developmental, behavioural or emotional condition lasting at least 3 months. Data were collected from nine countries. The paper looked only at rates of parents scoring above the clinical cut-off for depression and, in contrast with the current paper, did not categorise into 'mild plus' and 'moderate plus' depression. The paper looked only at rates of parents scoring above the clinical cut-off for depression and, in contrast with the current paper, did not categorise into 'mild plus' and 'moderate plus' depression. Parents of affected children had higher rates of depression (35%) compared to parents of healthy children (19%).[34] Similarly to the current study, this study also had a paucity of data on fathers compared with mothers. This highlights that the prevalence rate of mild and above depression found in the current study is considerably higher than rates in parents of healthy children. However, limited studies in recent years have reported on the prevalence of depression in parents of healthy children and adolescents, and further research is needed to support this claim. Moreover, it appears little is known about the relationship between parenting and depression. Despite these gaps in the literature, our findings support previous studies demonstrating that parents of children with T1D have elevated rates of depression.[5,6,24]

4.3 | Clinical implications and suggestions for future research

This meta-analysis suggests that depression is common in a significant minority of parents of children with T1D, and therefore should be routinely assessed in clinical settings. It is recommended that this screening is conducted as early as possible following a child's diagnosis. Interventions should then also be offered to support these parents. According to recent guidelines from the National Institute for Health and Care Excellence (NICE), this could involve anything from guided self-help to individual cognitive behavioural therapy (CBT).[62] Additionally, recommendations from the International Society for Paediatric and Adolescent Diabetes (ISPAD) state that family-based behavioural interventions should be offered, which could include goal setting, problem-solving and the use of behavioural contracts.[63] This could prevent severe depression developing in these parents and reduce the risk of complications in diabetes management for the child.

Studies did not report whether parents had a history of depression. Therefore, it is unclear whether parents had depression before their child's diagnosis or whether they developed it following the child's diagnosis. Future research could explicitly explore this. Furthermore, research could consider the prevalence of depression in parents before their child's diagnosis and how this is associated with the child's diabetes management. Research is needed to explore differences in the prevalence of depression among parents of children with T1D compared to those with healthy children. As previously discussed, parenting has been associated with lower psychological well-being. Therefore, it is unclear to what extent the high levels of depression found in the population of parents in the current study is a result of the child having T1D or the demands of parenting in general. There is a scarcity of data on the prevalence of depression in fathers of children with T1D. In the current study, of the 17 studies that reported the proportion of mothers, 12 reported that over 85% of the included participants were mothers. Further research is required to further explore the rates of depression in fathers of children with T1D. Finally, potential risk factors associated with the development of depression in parents of children with T1D have been explored. For example, systemic factors, disease management, traumatic memories, or appraisals. However, further research exploring the processes involved in the development of depression in this population is needed.

4.4 | Strengths and limitations

This study is strengthened by minimal publication bias and by being the first meta-analysis, to our knowledge, to report the prevalence of depression in parents of children with T1D. However, several limitations should be considered. Although some level of heterogeneity is expected in a meta-analysis, the level of heterogeneity in the current study was considerable, making it challenging to make comparisons across studies. Heterogeneity may exist due to differences in measures, culture, age of children, study design, measures and cut-offs used, and whether measures were administered online or face-to-face. Furthermore, all studies were considered non-representative, with limited diversity in race and ethnicity, and recruitment within each study was restricted to a particular geographical locality. However, overall, this meta-analysis represents several geographical areas: Europe; Asia; North America; Northern Africa; and South America. Although the overall prevalence of depression was found to be high in the moderate plus category, the range of depression scores was wide, ranging from 17.9% to 46.6%, making it challenging to make inferences from these results. The majority of participants in the included studies were mothers. With a limited sample size, less is known about the prevalence of depression in fathers of children with T1D. Furthermore, with a limited sample size of fathers, the current sample may not be representative of all fathers of children with diabetes. Finally, all studies included in this review used self-report measures of depression, which are at risk of response bias.

The period 1980–2022 was chosen as the search criteria due to the implementation of the DSM-III. However, the treatment of T1D has developed in recent years, and therefore the experience of families is likely to be different, making it problematic to make comparisons between the oldest and youngest studies included in this meta-analysis. Fortunately, all studies except one included in the current paper were published after the year 2000. However, it is important to note this as a potential limitation, as T1D management is continually developing.

It is important to consider the variation in time since diagnosis as a potential limitation, which ranged from the acute period to 5 years post-diagnosis. The experience of families is likely to vary from the immediate aftermath of diagnosis compared to several years post-diagnosis, and therefore making comparisons between these studies is problematic. However, our sensitivity analysis showed little difference in the prevalence of depression when studies that recruited parents in the acute period following T1D diagnosis were excluded.

5 | CONCLUSION

To our knowledge, this study is the first to meta-analyse data on the prevalence of depression among parents of children with T1D. The estimated prevalence of moderate depression and above (moderate plus) was 18.4% in the total sample; 17.3% in mothers; and 9% in fathers. The estimated prevalence of mild depression and above (mild plus) was 32.7% in the total sample; 29.4% (95% CI 17.8–42.6) in mothers; and 13.6% in fathers. These results suggest that a significant minority of parents of children with T1D meet diagnostic criteria for depression, which highlights the psychological impact of having a child diagnosed with T1D. However, all results were characterised by high levels of heterogeneity. Further research is required to provide more understanding of premorbid depression, the comparison of prevalence among parents of healthy children, depression in fathers and risk factors for developing depression.

AUTHOR CONTRIBUTIONS

Hayley Ryan: Conceptualization; data curation; formal analysis; methodology; project administration; visualization; writing – original draft; writing – review and editing. **Aaron Burgess:** Supervision; writing – review and editing. **Clare Jackson:** Writing – review and editing. **Alyssa Hewson-Ravenscroft:** Data curation; writing – review and editing. **Richard Meiser-Stedman:** Conceptualization; data curation; formal analysis; methodology; project administration; software; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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