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Incidence of Diabetes Mellitus in Children and Adolescents; A Systematic Review

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ABSTRACT

Aims Diabetes mellitus is one of the most prevalent chronic diseases among pediatric patients. Current research indicates that efforts to prevent diabetes in children and teenagers have not been successful. The aim of this study was to evaluate the risk factors associated with diabetes among children and adolescents.

Information & Methods This systematic review was conducted through literature searches in PubMed, ScienceDirect, Cochrane Library, and Medline databases. The search filter incorporated terms such as diabetes mellitus, T1DM, T2DM, child, and adolescent.

Findings The initial database search retrieved 9,949 articles. Ultimately, only 15 studies met the criteria and proceeded to the next stage for extraction and analysis. Based on the analysis of the eligible studies, various risk factors for the incidence of diabetes in children and adolescents were identified and categorized into non-modifiable and modifiable risk factors. Non-modifiable factors included family history of diabetes, ethnicity, gender, and age. Additionally, maternal pregnancy and unmarried parents were found to contribute to the incidence of diabetes in children. Modifiable risk factors included obesity, sedentary behavior, physical activity, smoking history, and diet.

Conclusion Family history of diabetes mellitus and obesity are the main risk factors for diabetes. There is a significant relationship between modifiable and non-modifiable risk factors.

Keywords Diabetes Mellitus; Diabetes Mellitus, Type 1; Diabetes Mellitus, Type 2; Child; Adolescent; Obesity

CITATION LINKS

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Introduction

Diabetes mellitus (DM) is a chronic metabolic condition that cannot be cured but can be managed. It may develop due to hereditary factors or environmental influences and lifestyle choices. DM arises from impaired insulin secretion or action, leading to abnormalities in carbohydrate, protein, and lipid metabolism. The reduction in insulin secretion and increased resistance form the basis for categorizing DM into type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). According to global surveys, a majority of children and adolescents across various age groups are affected by T1DM [1].

While T1DM remains the most commonly observed type among children and adolescents, there has been a notable rise in the occurrence of T2DM within this age demographic [2, 3]. Additionally, other less prevalent types of diabetes have been identified within the community, including monogenic diabetes, medication-induced diabetes, and diabetes triggered by secondary diseases [4]. The diagnostic criteria used for identifying DM and the heightened risk of developing diabetes (prediabetes) in children and adolescents mirror those employed for adults [5]. Nonetheless, the treatment and management of diabetes in youngsters involve unique considerations [6]. These factors include alterations in insulin sensitivity, reliance on medication, and neurological issues associated with the instability of blood sugar levels [7]. The escalating prevalence of childhood obesity correlates directly with the increased incidence and prevalence of T2DM, complicating the differentiation between T2DM and T1DM since more children diagnosed with T1DM are overweight at diagnosis. Additionally, research has indicated the presence of β-cell autoimmunity in children affected by T2DM [8].

Identifying the factors influencing shifts in the epidemiology of DM in children and adolescents is crucial. This age group represents a vital phase for shaping habits and mitigating the risk of diabetes onset from adjustable factors like obesity and sedentary behavior [9]. Studies have highlighted that preventive strategies for T1DM have not achieved maximum success, and the precise risk factors remain unclear [10]. Nevertheless, certain research has unveiled connections between modifiable and non-modifiable factors linked to DM in children and teenagers [11]. Apart from a strong hereditary predisposition to the disease, additional elements such as rapid economic growth leading to dietary shifts, breastfeeding practices, and epigenetic modifications associated with an unfavorable prenatal environment have been recognized [12]. Similar risk factors are prevalent in children and adolescents residing in Asia [13], as well as in the Middle East and North Africa [14], regions witnessing a significant surge in diabetes cases within this age range. Both types of diabetes (T1DM and T2DM), along with an elevated susceptibility to pre-diabetes, are indeed present among children and adolescents [15, 16].

One review encountered during our literature search focused on interventions tailored for adolescents dealing with T2DM. The study emphasized the underuse of pediatric registries, recognizing their role as platforms for sharing data, swiftly generating insights, and guiding decisions to enhance health outcomes [17]. Additionally, Lascar *et al.* [18] conducted a study summarizing the epidemiology, risk factors, complications, and management of T2D in adolescents. They concluded that there is a necessity to explore lifestyle measures for prevention within family dynamics and improve health education within school programs. Despite the growing attention toward T2D, gaps in knowledge persist regarding its epidemiology due to incomplete enrollment and limited population-based investigations examining the widespread presence of prediabetes and undiagnosed T2DM in adolescents [19].

In adults, obesity is considered a significant contributor to the risk of DM, alongside other key factors like age, race/ethnicity, family medical history, lack of physical activity, and unhealthy dietary habits [20]. Consequently, there's a pressing need for more extensive research focused on understanding and tackling the diabetes and prediabetes epidemic, specifically investigating the primary risk factors affecting children and adolescents.

The present study aimed to systematically review and assess the risk elements linked to diabetes within this younger age demographic.

Information and Methods

Protocol

The present systematic review complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [21]. The review included published studies from 2000 to 2023.

Search strategy

We conducted searches across multiple databases, including PubMed, ScienceDirect, Cochrane Library, and Medline. The search terms used for articles were "Diabetes Mellitus," "T1DM," "T2DM," "Child," and "Adolescent," tailored to match the vocabulary of each specific database. These keywords were combined using Boolean operators like "AND" and "OR." Our search was restricted to articles available in English. We further refined the filters to yield more precise and relevant results.

Inclusion and exclusion criteria

This review encompassed all research examining risk factors for DM in children and adolescents. There was no restriction on the search timeframe to ensure a thorough compilation of relevant studies. However,

studies published in conference proceedings, reviews, meta-analyses, commentaries, book chapters, reports, case studies, and letters to the editor were excluded from consideration.

Selection process

Two authors independently and separately screened the titles or abstracts of the studies. In cases of conflicting opinions between the two screening authors, the first author made the final decision. This rapid screening involved assessing the titles, objectives, and conclusions of the pertinent studies. Further investigation into specific studies was pursued by delving into the main text to gather additional information as needed.

Study quality

The evaluation of article quality utilized the National Institutes of Health (NIH) tool designed for controlled intervention studies. This assessment tool comprises 14 statements gauging the comprehensiveness of reports derived from the reviewed studies. The assessment criteria are categorized based on the number of affirmative responses (YES). Results were categorized as follows: a score of <30% labeled as "poor," 30-70% as "fair," and a score exceeding 70% considered as "good" according to the provided guidelines.

Table 1. Characteristics of the included studies

Author(s), Year, Country	Aim	Design	Participants	Type of diabetes	Non-modifiable parameter	Modifiable parameter	Main findings (main risk factors)
Amed *et al.*, 2010, Canada [1]	Determining the incidence of type 2 diabetes (T2DM) in Canadian 18-year-old children	Prospective	345 children aged <19 years	T2DM	Family History Ethnicity	Obesity	Family history (91%) Obesity (95%)
Gaidhane *et al.*, 2017, India [23]	Assessing awareness about T2DM and distribution of risk factors for T2DM in adolescents	Cross-sectional	412 adolescents aged 11-19 years	T2DM	Family history of DM	Sedentary lifestyle Dietary	Sedentary lifestyle Dietary Family history
Kolahdooz *et al.*, 2018, Canada [24]	Examining the risk factors for type 2 diabetes in multiethnic urban youth	Cross-sectional	557 (328 girls and 229 boys) multiethnic youth 11 to 23 years of age	T2DM	-Sex -Ethnicity Family history of DM	Obesity Physically inactive No use of sufficient amounts of fruits and vegetables	Boys were more at risk than girls Asian youth>than any other ethnic group
Lee *et al.*, 2015, Korea [25]	Investigating the incidence and factors related to T1DM and T2DM in children and adolescents under 15 years of age	Cohort	328 patients (160 males and 168 females) living in Busan and Gyeongnam, aged 15 years of age or younger	T1DM & T2DM	Age Sex	-	The 10-year mean crude T1DM incidence for children and adolescents under 15 years was 2.01/100,000, which was 2.68 times higher than the rate of 0.75/100,000 The age-adjusted incidence risk ratio was highest in the 10-14-year age group for T1 diabetes and T2DM
Majeed & Hassan, 2011, Iraq [26]	Determination of potential maternal, neonatal, and early childhood risk factors for T1DM in children and adolescents	Case-control	96 children and adolescents with T1DM and 299 non-diabetic children	c	Family history	Thyroid diseases Tea drinking	Family history of T1DM & T2DM and thyroid diseases Tea drinking during pregnancy
de Vasconcelos *et al.*, 2010, Brazil [27]	Identifying DM2 risk factors among adolescents in private schools	Cross-sectional	794 students aged 12-17 years	T2DM	Family history	Sedentary lifestyle	Of those with larger incomes, 73.5% had a family history of DM2 65% were sedentary 51% had a family history of DM2
Young *et al.*, 2002, Canada [28]	Identifying explanatory factors that the child may have been exposed to in the intrauterine environment and early infancy	Case-control	46 patients aged <18 years	T2DM	-	Gestational diabetes Breastfeeding longer than 12 months - Birth weight Maternal obesity	Gestational diabetes Breastfeeding longer than 12 months Low (2500 g) and high (4000 g) birth weight and maternal obesity

Continue of Table 1 from the last page.

Zamani *et al.*, 2021, Iran [29]	Investigating the relationship between T1DM and diet in the remaining two years of life, as well as a group of demographic variables	Case-control	76 children with T1DM and 209 non-diabetic children	T1DM	Maternal pregnancy history	BMI Breastfeeding	BMI of the mother being <18.5 before pregnancy (OR=4.4) Mothers without a history of diabetes Mother's weight before pregnancy Mother's excess weight during pregnancy Exclusive breastfeeding for more than six months Low weight gain in the first two years of life Breastfeeding less than 12 months
Barakat *et al.*, 2021, UAE [30]	Identifying other characteristics of those with diabetes, including parental marital status, smoking/illegal drug use, quality of life, and nationality	Cross-sectional	6365 school-attending adolescents (12-22 years; mean=16 years)	T1DM & T2DM	Age Unmarried parents	Smoking	The overall prevalence of DM was higher in Males (1.5%) than in females (0.5%) Children of unmarried parents had more than twice the odds of self-reporting diabetes than those with married parents Adolescents reporting smoking/using illegal drugs had more than three times the odds of DM
Bang *et al.*, 2022, Korea [31]	Identifying significant factors for diabetes and prediabetes in adolescents aged 12 to 18 years	Retrospective surveillance	416 Korean adolescents aged 12-18 years	T1DM & T2DM	-	BMI Fasting plasma glucose (FPG), Hemoglobin A1c Insulin	BMI Sleeping hours/day Sitting time Increased FPG, HbA1c, and insulin levels
Xie *et al.*, 2019, China [32]	Determining the incidence of diabetes and identifying the risk factors of this complication in pediatric and adult CP patients	retrospective -prospective cohort	324 pediatrics diagnosed with DM <18 years	T1DM & T2DM	-	BMI Smoking history	Higher BMI Smoking history
Ouyang *et al.*, 2023, US [33]	Investigating the national trends in the prevalence of diabetes and pre-diabetes and their major risk factors in adolescents	Cross-sectional	3717 youth aged 11-21 years	Diabetes and pre-diabetes	Age	BMI Obesity	Adolescents aged 17-19 years were more involved than those aged 12-16 years Obesity
Belsky *et al.*, 2023, US [7]	Investigating risk factors for progression to T2D	Retrospective	552 patients aged <18 years	T2DM	Family history	- BMI	94% had a family history of T2D 89% had an increasing BMI
Lee, 2014, China [34]	Investigating the relationship between physical activity and sedentary behavior patterns in adolescents on the future increase in BMI and the risk of developing diabetes in youth	Longitudinal	3717 participants aged 11 to 21 years	T2DM	Family history	Sedentary behaviors BMI Smoking Physical activity	Family History The low physical activity and high sedentary behavior (LPAHSB) cluster had significantly greater odds of developing diabetes The HPALSB cluster had a lower increase in BMI
Jaja & Yarhere, 2015, Nigeria [35]	Investigating easily identifiable risk factors for T2DM in adolescents	Cross-sectional	880 students aged 10 to 19 years	T2DM	Age Family history	Impaired fasting glucose (IFG)	Family history IFG Hypertension

Risk of bias

The Risk of Bias in Non-Randomized Studies-Exposure Studies (ROBINS-E) tool was used to evaluate the types of bias in each study [22]. It consists of seven domains that assess the internal and external validity of the study. The assessment results of these domains are categorized as low, some concerns, high, and very high. The risk of bias assessment results were reviewed and approved by all authors, considering the opinions of external reviewers.

Data extraction and synthesis

To facilitate comprehension of the eligible studies' contents, crucial information was summarized (Table 1). Two authors collaborated in this extraction process. In cases where there were differing opinions regarding the extracted data, they were reconciled through consensus. The extraction criteria included the first author and publication year, study aim, observational design, participants, modifiable and non-modifiable factors, as well as key findings.

Findings

The initial database search retrieved 9949 articles. After removing 5430 duplicates and ineligible articles which were not relevant to the review's theme, 4519 articles remained for screening. During the eligibility assessment, 54 studies were evaluated, and 39 articles were excluded for various reasons. Ultimately, only 15 studies met the criteria and proceeded to the next stage of extraction and analysis (Figure 1).

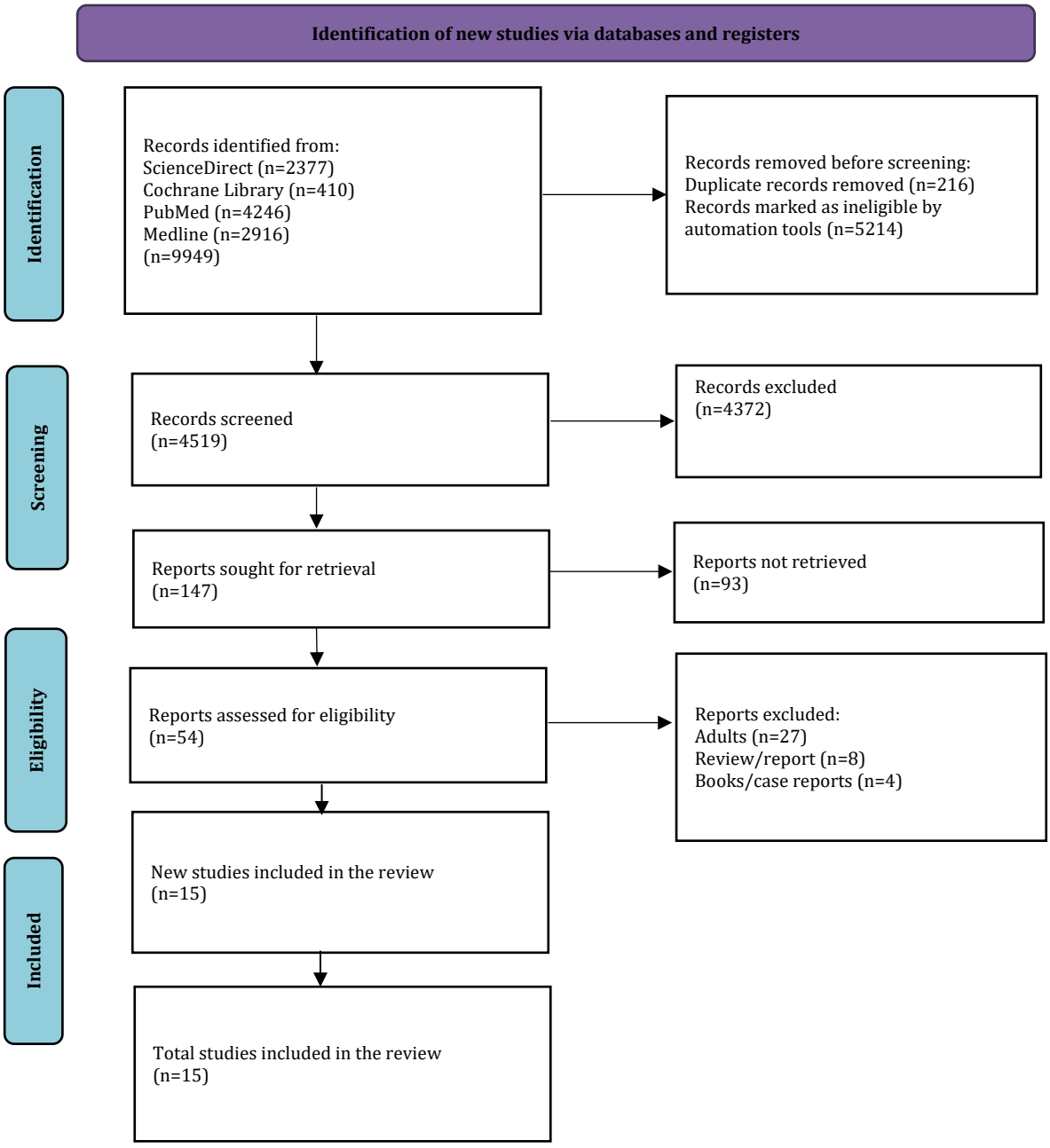

Figure 1. PRISMA flow diagram for literature search

Characteristics of the included studies

The 15 studies reviewed in this analysis came from several countries, including Canada (n=3), Korea (n=2), China (n=2), the US (n=2), and one each from India, Iraq, Brazil, Iran, the UAE, and Nigeria. The study designs included cross-sectional, prospective, cohort, case-control, retrospective, and longitudinal studies. The total number of participants involved in these studies amounted to 19235 children and adolescents.

Quality assessment of the included studies

The study quality assessment using the NIH tool for observational cohort and cross-sectional studies is summarized in Table 2, including the assessment process and summary of the results for each study. According to the findings, the majority of the studies fell within the good quality category. This classification was derived from scores surpassing 70% of the total NIH criteria designated for observational cohort and cross-sectional studies.

Table 2. Summary of study quality assessment

Studies	NIH criteria													
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Amed *et al.*, 2010 [1]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	CD	Y	Y
Gaidhane *et al.*, 2017 [23]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NR	Y	Y
Kolahdooz *et al.*, 2018 [24]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Lee *et al.*, 2015 [25]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Majeed & Hassan, 2011 [26]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Vasconcelos *et al.*, 2010 [27]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Young *et al.*, 2002 [28]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	CD	Y	Y
Zamani *et al.*, 2021 [29]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	CD	Y	Y
Barakat *et al.*, 2021 [30]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	CD	Y	Y
Bang *et al.*, 2022 [31]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Xie *et al.*, 2019 [32]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Ouyang *et al.*, 2023 [33]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Belsky *et al.*, 2023 [7]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Lee, 2014 [34]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	CD	Y	Y
Jaja & Yarhere, 2015 [35]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	CD	Y	Y

*Q=Question; Y=Yes; N=No; CD=Cannot determine.

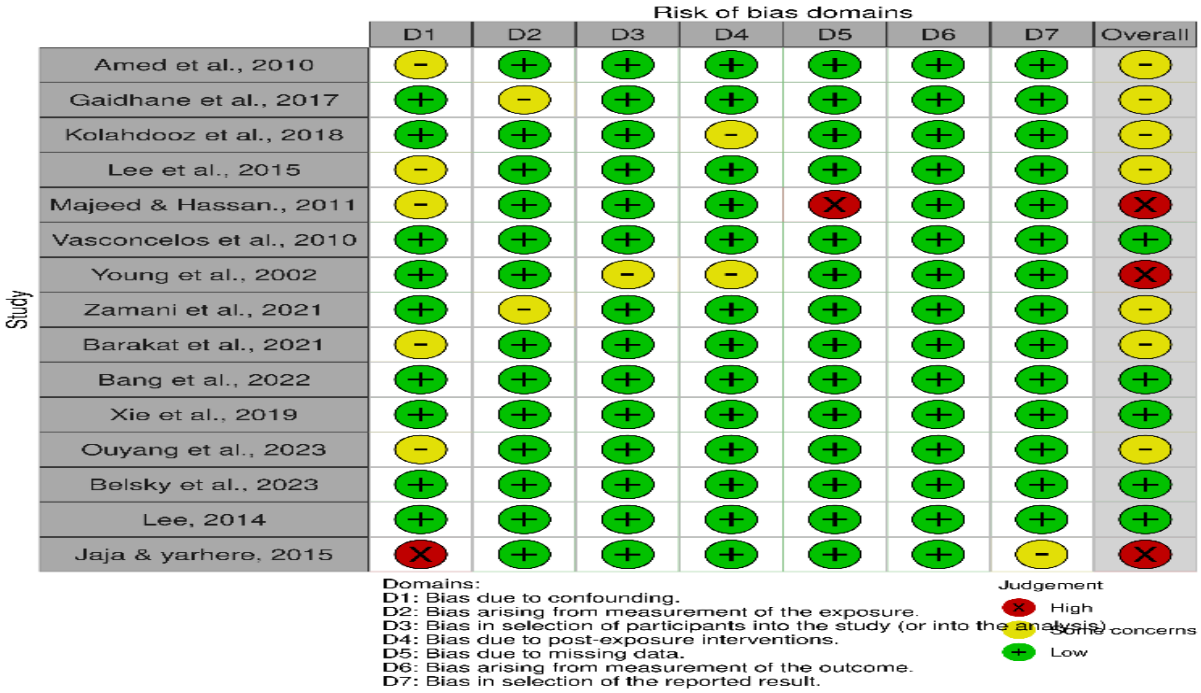

Figure 2. Summary of the risk of bias of the included studies

Assessment of risk of bias from included studies

The outcomes of the risk of bias assessment for the included studies were showcased through a traffic-light plot (Figure 2). During the assessment process, all authors unanimously concurred with the assessment outcomes without significant debate. External reviewers provided valuable feedback, particularly concerning domain five, which focuses on Missing Data for certain studies.

The traffic-light plot illustrates 3 studies classified under the high risk of bias category, 7 studies under some concern category, and 5 studies under the low risk of bias category. To ensure the thoroughness of this review, we included three studies despite their

placement within the high risk of bias category.

Type of diabetes mellitus targeted by each included study

The focus of most of the studies was on T2DM, with 8 studies specifically dedicated to T2DM, while only 2 studies concentrated on T1DM. Additionally, the remaining 5 studies addressed both types of DM collectively.

Non-modifiable risk factors associated with diabetes mellitus

Among the 15 studies included, the family history of DM emerged as the most extensively discussed and main risk factor [1, 7, 23-27, 34, 35]. Ethnicity was another notable risk factor elaborated in multiple studies (n=4) [1, 7, 24, 33]. Gender was also identified as a risk factor associated with the incidence of DM; statistical analysis results indicated boys>girls in T2DM [24] and male<female in both types of T1DM and T2DM [25]. Age was linked to DM across four studies [24, 25, 30, 33, 35]. Additionally, maternal pregnancy and unmarried parents were found to contribute to the incidence of DM in children, as indicated by two studies [29, 30].

Modifiable risk factors associated with diabetes mellitus

Modifiable risk factors were identified from the 15 studies included in this review. These risk factors included obesity (BMI) as the most dominant risk factor discussed in eight studies [1, 7, 24, 29, 31-34], sedentary behavior [23, 27, 34], physical activity [24, 34], smoking history [30, 32, 34], diet [23, 24, 26, 28, 29], and other conditions, including thyroid disease, gestational diabetes, and hypertension [26, 28, 35].

Discussion

This systematic review provided a comprehensive synthesis of the factors associated with DM in children and adolescents presenting with new-onset T1DM and T2DM. We discovered that obesity emerged as a predominant and frequent risk factor across the studies examined. Its significance surpassed other risk factors in terms of percentage, p-value, and OR. This consistent pattern underscores obesity as a major issue demanding focused attention in the future concerning children and adolescents. Additionally, the statistical significance of sedentary behavior as a risk factor indicates a substantial relationship. This is supported by prior research, which established a link between overweight and obesity with increased levels of sedentary behaviors (RRR=1.33; 1.27-1.39 and RRR=1.73; 1.63-1.84) [36]. Understanding the risk elements linked to diabetes in children and teenagers will aid in devising tailored strategies to prevent the onset of such risk factors or manage those already present, especially in younger populations [37]. The rise in diabetes prevalence among this demographic can amplify the occurrence of additional health issues or complications associated with diabetes, including high blood pressure, abnormal lipid levels, retinopathy, and cardiovascular ailments. Furthermore, the emergence and progression of diabetic complications during the early stages of life could potentially present a significant future public health issue [38].

In terms of non-modifiable risk factors, family history emerges as a potent predictor influencing the incidence of DM in children and adolescents, displaying strong significance in most of the studies reviewed. Individuals with first-degree relatives affected by T2DM face a notably heightened risk, being two to six times more prone to developing the disease than those without a family history of diabetes [39]. This strong association underscores the genetic component's pivotal role, indicating that individuals from parents with diabetes carry a five to tenfold higher likelihood of developing the condition compared to the general population [40]. Furthermore, other research indicates that this predisposition elevates the likelihood of obesity, decreased HDL levels, and heightened blood pressure among adolescents of Asian Indian descent [41]. Children and teenagers in Mexico with a family history of diabetes face higher occurrences of hypertension, obesity, elevated insulin and triglyceride levels, along with an increased insulin resistance index, in contrast to those from non-diabetic families [42].

Non-modifiable risk factors also contribute to diabetes in children and adolescents. Lee [25] identify a substantial increase in the incidence rate ratio for both T1DM and T2DM within the age group of 10 to 14 years, ranging from 1.56 to 2.87. Furthermore, another study highlights a surge in diabetes incidence among individuals aged 17 to 19 years, showing statistically significant results [33]. Consistent with Lee's findings, Jaja & Yarhere [35] observe a rise in diabetes incidence within a similar age range of 10 to 12.9 years, which serve as the reference group in their study. A Korean study reinforces these patterns, indicating a 6.39 times higher prevalence of diabetes among adolescents aged 10 to 14 years and a 5.34 times higher prevalence among those aged 15 to 19 years. The increasing occurrence of diabetes in Korean teenagers is noticeable at younger ages, presenting challenges in comprehending and managing their health, particularly in handling diabetes-related risks, which can be arduous. Hence, the support and guidance provided by parents and school educators are vital in assisting these adolescents [31]. However, in the UAE, age does not seem to be a significant predictor for the incidence of diabetes in adolescents, as noted in a study by Barakat *et al.* [30]. Likewise, in a study in United States, the statistical results do not show significant concerning age. Regarding ethnicity, findings from different studies present varying outcomes. For Asian adolescents exhibit a higher incidence compared to other ethnic groups [24], while another study pointed out that Mexican-American ethnicity has a higher prevalence of diabetes [33]. As a

result, the authors have chosen to temporarily set aside ethnicity as a risk factor for diabetes incidence among children and adolescents. This emphasizes the importance of conducting comprehensive studies involving larger population samples with diverse ethnic backgrounds analyzed collectively or within a cohort framework.

Within modifiable risk factors, several elements exhibit significant importance, such as obesity, sedentary lifestyles, and physical activity. Obesity is a well-known crucial risk factor in the development of diabetes mellitus in children and adolescents. Children grappling with obesity face a significantly increased risk of encountering various health complications, both physical and psychological. The root of obesity often traces back to the concept of early adiposity rebound, signifying the phase when a child's BMI starts to rise after reaching its lowest fat level, typically occurring around the age of 5 or 6. Individuals experiencing adiposity rebound as early as 3 years old often observe a consistent increase in their BMI from early childhood through adolescence and into adulthood [43]. Understanding the link between obesity and T2DM involves complex physiological and cellular mechanisms, encompassing changes induced by excess fat in beta-cell function, adipose tissue biology, and insulin resistance across various organs. These factors can often improve and potentially normalize with significant weight loss.

In India, a sedentary lifestyle is more prevalent among adolescents aged 15-19 years compared to younger age groups [23]. Vasconcelos *et al.* highlight that the most significant risk factors are overweight and sedentary behavior [27]. Research clearly indicates that both sedentary behaviors and physical activity independently contribute to the development of T2DM among adults [44, 45]. However, this specific study concentrated on confirming the impact of sedentary behaviors [46] among adolescents without delving into the effects of physical activity. Several reasons could elucidate this observation. Initially, prior suggestions propose that the relationship between physical activity and type 2 diabetes might be influenced by body fat [47]. Consequently, the 14-year follow-up solely monitor body fat management through physical activity, necessitating a longer duration to comprehensively grasp the correlation between body fat and T2DM. Secondly, a previous study emphasizes on a stronger link between blood glucose levels and cardiorespiratory fitness in comparison to energy expenditure [48], indicating that the heart and lungs' ability to function effectively could act as the mediator between physical activity and T2DM. Thirdly, the most prevalent sedentary behavior in the studies examine TV viewing, which is associated with unhealthy dietary patterns [5], potentially elucidating the connection between sedentary behaviors and T2DM. Hence, it is plausible that a lack of physical activity contributes to changes in BMI.

This review may not comprehensively encapsulate studies published in reputable journals. It also encompassed three studies categorized as High Risk of Bias; hence, caution should be exercised when utilizing the results of this review. The findings advocate for a focus on diabetes prevention in children and adolescents by highlighting weight management, reducing sedentary behaviors, and promoting physical activity. Additionally, attention to other factors such as smoking, dietary patterns, and increasing fruit intake is advised [49, 50].

Conclusion

There are no significant differences in risk factors for T1DM and T2DM.

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Ethical Permissions: Not applicable.
Conflicts of Interests: The authors reported no conflicts of interests.
Authors' Contribution: Suharti S (First Author), Introduction Writer/Methodologist/Main Researcher (40%); Daryono D (Second Author), Assistant Researcher/Discussion Writer (20%); Dewi M (Third Author), Assistant Researcher/Statistical Analyst (20%); Masyitah D (Fourth Author), Methodologist/Assistant Researcher (20%)
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