Review Article

Diabetes in Adolescents and Children in Saudi Arabia: A Systematic Review

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Abstract

Diabetes is generally acknowledged as an emerging disease that affects nearly every population, age, and economy on the globe. The rising incidence of type I and II diabetes mellitus has drawn focus to children and adolescents. The aim of this study was to illustrate the risk factors, incidence, and complications of both forms of diabetes in children in the KSA, as well as to equate Saudi findings to international findings. A systematic review was conducted using EBSCO, Google Scholar, and PubMed to examine randomized clinical trials, retrospective investigations, and experimental studies on diabetes in Saudi Arabian adolescents and children.

Recent research has shown that the prevalence of T1DM and T2DM in children and adolescents is increasing. This tragedy should be given further consideration, as risk factors must be managed. Health programs and seminars can be used to educate mothers and parents of children and teenagers who are at risk of having diabetes mellitus.

Keywords: Saudi Arabia, Adolescents, Children, T2DM, T1DM, Diabetes

Introduction

In children with type 1 diabetes, hereditary and environmental factors trigger immune-mediated loss of β-cell functions, leading to hyperglycemia and a lifelong need for insulin (T1DM). Type 1 diabetes may strike at any age, but peak production occurs between the ages of 5 and 7 and during puberty [1].

T2DM is a metabolic syndrome characterized by peripheral insulin resistance and β-cell inability to compensate, culminating in hyperglycemia [2, 3]. In today's world, type 2 diabetes is predicted to affect one in every three (20% to 33%) new cases of diabetes in girls. T2DM is becoming more common in children as obesity is becoming more prevalent among them [4, 5].

Obesity/sedentary lifestyle, race/ethnicity, and healthy family background are all factors that contribute to insulin resistance. Another significant aspect that contributes to the growth of T2DM is puberty. In the past 30 years, childhood obesity has increased by two times in infants and four times in youth. Obesity, insulin tolerance, and metabolic syndrome have all been linked in studies [6, 7]. Bogalusa Heart Study stated that children with parental diabetes have higher systolic blood pressure (SBP) and BMI [8].

While DM is linked to severe complications, early detection and treatment may help to avoid or postpone the occurrence of long-term complications [9]. Diabetes symptoms in children include cataracts, retinopathy, gastroparesis, kidney dysfunction, asthma, premature coronary disorder, neuropathy, peripheral artery disease, and elevated vulnerability to infections [10].

Continuous glucose monitoring (CGM) has increasingly been common in teenagers and children, and tests of glucose variability and "length in range" are likely to be much more useful than HbA1c, despite the fact that CGM is not often preferred by patients and is not widely covered by insurers [11]. Both patients and their caregivers need to know what there is to know about the illness and its possible complications. Additionally, all diabetics can see an ophthalmologist, nephrologist, neurologist, and cardiologist for a baseline examination of their organs [12].

To equate Saudi findings to international results and to illustrate the complications, risk factors, and incidence of

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both type I and II diabetes in Saudi children.

Materials and Methods

A systematic review was conducted using the following words in various combinations in PubMed, Google Scholar, and EBSCO: diabetes in Saudi children, childhood diabetes, diabetes in teenagers and children, and diabetes in Saudi adolescents. In the English language, we provided all the texts of randomized clinical trials and observational studies. The data was extracted **(Figure 1)**, and the authors, titles, study type, study period, region and year of publication, and results were then reported **(Table 1)**.

Statistical Analysis

The data was not analyzed using any software. The information was gathered using a specific form that included (Authors' names, country, year of publication, methods, and results). The data were analyzed by the authors to assess the initial outcomes. To ensure the validity of the results and minimize errors, each member's results were double-reviewed.

Results and Discussion

A total of 107 studies were included in the databases listed, which were used for title screening. Sixty-nine were included in the abstract screening phase, resulting in the omission of 56 papers. The complete texts of the remaining 13 publications were examined. Seven studies were excluded after full-text updating, and six were included for final data extraction **(Table 1)**.

Different sample formats were included in the studies that were included.

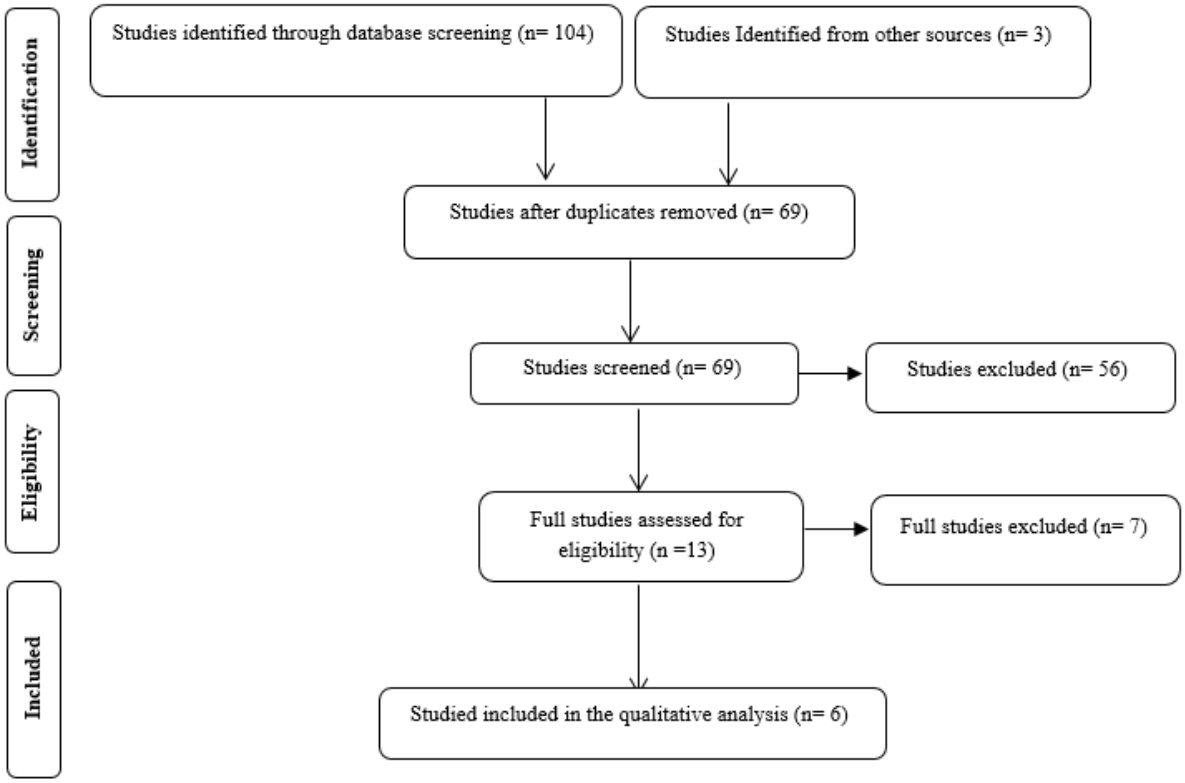

Figure 1. Flow chart representing the process of data extraction

Diabetes mellitus and impaired fasting glucose (IFG) are very prevalent in the population included in the study of Al-Rubeaan K. [13], and the majority of patients are unaware of their condition, necessitating immediate diagnosis, early identification, medication, and prevention steps.

Obstacles in treating diabetic adolescents and children in the KSA include a shortage of awareness regarding children and their families with T1D, symptoms of the condition, and issues with non-compliance with therapy, according to Alaqeel [14]. There is often a lack of social care, as well as a warning of the patient's desire to change and inadequate self-management skills.

Because of the increasing prevalence of T1DM in KSA, especially in babies and infants, the interferences must be significantly improved, according to Alwin *et al.* [15]. Furthermore, finding suitable management programs for T1DM and appropriately allocating health funds for this distressing condition is critical.

The clinical appearance at diagnosis involves polyuria, polydipsia, and weight loss with a high prevalence of DKA, according to Ghandoora [16]. T1DM is often linked to coeliac disease and autoimmune thyroiditis. T1DM is also linked to hepatopathy, lung dysfunction, and vitamin D deficiency in the T1DM community.

Robert, Asirvatham Alwin *et al.* [17] concerning the increasing prevalence of T1DM in KSA, particularly in infants and children, stated that the interferences are necessary to be meaningfully enhanced. Moreover, it is serious to find suitable managing programs for managing T1DM and assigning health funds suitably for this disturbing disorder.

Diabetes in children has increased dramatically in recent years, prompting a more thorough study of its epidemiological causes to identify some important associations that could aid in its prevention, according to Alghamdi [18].

The findings of AlBuhairan *et al.* [19] emphasize the importance of an adaptive, biopsychosocial, and household-focused treatment strategy for teenagers with chronic illnesses.

Table 1. Authors, region, year of publication, country, study type, aim, and results:

Authors, Year, Region	Study type, aim	Results
Al-Rubeaan K. [13] 2015 Saudi Arabia	A population-based study included 23 523 children to evaluate the frequency of T1DM and T2DM as well as IFG in adolescents and children.	Prevalence of T1DM was 10.84%, 0.45% T2DM. Age, male sex, obesity, city placement, high salary, and occurrence of dyslipidemia were significant risk factors for DM.
Aqeel A. Alaqeel [14] 2019 Saudi Arabia	Review article reviews the pediatric and adolescent DM articles in KSA to date and discovers the country-definite management encounters and possible answers.	Prevalence of DM and DKA incidence are vastly inconstant in different areas. There is a lack of programs to increase awareness of T1D and screening programs, and a lack of multicenter research collaboration and clinical trials.
Robert, Asirvatham Alwin *et al.* [15] 2018 Saudi Arabia	Review article aimed to discuss different aspects of T1DM in the KSA drawing on the published literature currently available.	35,000 children and adolescents in KSA agonizes T1DM, so KSA rank 8th in positions of frequency of TIDM cases and 4th nation in the world in the incidence (33.5 /100,000 persons) of TIDM.
Ghandoora, M. M. [16] 2017 Saudi Arabia	A systematic search of published literature that has addressed T1DM in pediatrics and adolescents was performed to shed more lights on T1DM among adolescent and pediatrics patients	Number of children with T1DM in KSA is 16,100 cases. The incidence rate is growing by 3% yearly and Saudi Arabia ranked as 5th in incidence rate.
Al-Mendalawi, M. [17] 2009 Saudi Arabia	Comment	the total number of cases of type 1 DM in <12-year-old children was 22 with an estimated prevalence of 106.7 per 100,000.
Alghamdi, A. H. [18] 2016 Saudi Arabia	A prospective study included 372 children to describe and compare the epidemiological criteria of children with diabetes from 2007 to 2014.	2012 carried the highest prevalence rate, with 59 children and adolescents diseased, the incidence was 25.48/100000. Cases of Al-Baha area were 37.7 % of the total found cases. Diabetic ketoacidosis was the first manifestation and was found in 44.2% of patients.
AlBuhairan, F. *et al.* [19] 2016 Saudi Arabia	A cross-sectional study carried out on adolescent to show the health-related quality of life in Saudi Arabian adolescents who had (T1DM)	Mean health-related quality of life score was 64.8, Females and advanced adolescent age were factors of lower health-related quality of life for adolescents who had T1DM.
Alanazi, K. M. *et al.* [20] 2018 KSA	A cross-sectional study to estimate the prevalence of type I diabetes and to describe some related characteristics of cases in a sample of adolescent primary and secondary school girls	Prevalence of T1D among the studied adolescent girls was 5.2% with a mean (±SD) age of 14.08 (±3.4). All diabetic females were Saudi. Only 25% of the cases were using hormonal contraception.

Few community-based investigations have evaluated the prevalence of types 1 and 2 diabetes among teenagers and children across the world [21, 22]. T1DM affects more than 96,000 children and teenagers under the age of 15 worldwide per year, with 13-80% having DKA at the point of diagnosis [23, 24]. According to a national study in the KSA, the prevalence rate for children and teenagers was 109.5 cases per 100,000 (lowest in the eastern region (48/100,000 cases; mostly rural) and highest in the central area (126/100,000 cases; mostly urban)) [25]. Other reports

estimated that 586,000 children under the age of 15 had T1DM across the world, with the largest numbers in North America and Europe [26, 27]. In a study conducted in the KSA, Al-Rubeaan found that 77.2 percent of T1DM patients were reported in urban areas rather than rural areas (22.7 percent) [13]. In another Saudi study, the prevalence of T1DM in Saudi children was stated to be 27.5/100,000 [28] and 29/100,000 [29], which was higher than in many other countries.

In terms of risk factors, a previous research in Riyadh found that 64% of children were obese or overweight, 34% had signs of insulin tolerance e.g. acanthosis nigricans, 57 percent had a positive family history of diabetes, and 52 percent had positive pancreatic antibodies tests. Furthermore, after a span of time, 46% of the patients were handled solely with metformin. T2DM or the two forms of T1DM and T2DM are most likely shown by these considerations [30].

In a previous Taiwanese research, age 13 years was shown to be a major risk factor for impaired glucose metabolism. This may be backed up by mounting evidence that adolescence is linked to enhanced insulin resistance, as shown by other trials searching for hyperinsulinemia in pubertal teenagers [31].

In a survey of children aged 6 to 18, 0.07 percent were found to have T2D, while 4.27 percent were parenthetically diagnosed with DM based on FBG>125mg/dL and were more likely T2D based on accompanying observations such as obesity, a healthy family background, and metabolic syndrome manifestations [13].

Male gender was shown to be a major risk factor in another review. This finding is reversible owing to the high prevalence of obesity in this cohort's males [32-34].

Retinopathy, nephropathy, neuropathy, and cardiovascular disease are the most often identified risks. The Diabetes Control and Complications Trial (DCCT) found that diabetic patients who received comprehensive insulin therapy have greater glycemic control and a lower complication risk compared with those who received traditional therapy. Retinopathy was decreased by 76%, microalbuminuria was reduced by 39%, and neuropathy was reduced by 60% [35].

An analysis showed a 65.4 percent connection between DKA and poor glycemic control, as well as a 68.9% link between hypoglycemia attacks and poor glycemic control. Hypoglycemia was reduced with higher HbA1c [36]. The KSA (44.9 percent) [37] and the UAE (80 percent) [38] have the highest rates of DKA at the onset of T1DM. In a study of adolescents and children with T1DM in Jeddah, researchers discovered a correlation between microalbuminuria (16.2%) and dyslipidemia (8.3%) caused by impaired glycemic regulation, though retinopathy was not linked to HbA1c (4.4 percent) [39].

A study in Saudi Arabia evaluated 218 adults with T1DM at a big center and discovered that 7.3 percent of them had celiac disease [40]. A study in Riyadh found that T1D patients performed worse in school than safe pupils, claiming that this was attributed to cognitive dysfunction caused by DM [41]. However, further research is needed to validate this result.

Celiac syndrome was shown to be prevalent in patients with T1DM in KSA in other studies [42]. In Riyadh, 54.4 percent of adolescents with well-known T1DM had one DKA strike, 39.8 percent had two, and 5.8 percent had three [43]. Celiac disease was observed in 10.4% of cases of T1DM in the southern region, 11.3 percent in the central area, and 11.2 percent in the western area, according to a study conducted in several areas of Saudi Arabia [44].

According to a systematic study, the global incidence of celiac disease in T1DM is reported to be 6%. In contrast, there was a significant disparity: 1.6 percent in France, 4.6–7.0 percent in the United States, 3.6–6.6 percent in Italy, 9-9.7% in Sweden, and 3.3–4.0 percent in the United Kingdom. In addition to hereditary vulnerability, this difference may be due to the disease period and age at diagnosis [45].

Conclusion

Prior studies have shown that the incidence of T1DM and T2DM in children and adolescents is increasing. This disaster should be given further consideration, as risk factors should be managed as far as possible. Health programs and seminars can be used to educate mothers and parents of children and teenagers who are at risk of having diabetes mellitus. Physicians should start screening this age range in order to diagnose and treat these individuals as soon as possible in order to avoid further complications.

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