

# Adolescent Obesity and Type 2 Diabetes Mellitus: Synaptics and Heuristics

MEENAKSHI VERMA\*, DAVINDER SINGH BATTH†, MOHAN T SHENOY‡, SUNEET K VERMA#

## ABSTRACT

The adolescent population is the foundation for a Nation's progress. Their shoulders therefore must be emboldened with health and dignity to ensure a developed Nation. However, the multitude of prevailing epidemics have left nostone unturned to enfeeble their strength. Type 2 diabetes mellitus (T2DM) and obesity stand amongst the top shotguns. There is a dire need to execute preventive as well as therapeutic actions to contain the epidemic, for which one must be well versed with the attributable risk factors. In this article, we will understand the synaptics of adolescent obesity and T2DM and what strategies are recommended by the health authorities to prevent and overcome this rising epidemic.

**Keywords:** Adolescent obesity, diabetes mellitus, adolescent health, healthy lifestyle, motivation, obesity

Until recently, young children and adolescents almost never got type 2 diabetes (T2DM), which is why it used to be called as 'adult-onset diabetes'. The majority of cases of diabetes mellitus among this population were immune-mediated type 1a diabetes. However, over the past two decades, the incidence of T2DM among the adolescents has shown a dramatic rise. In a systematic review of literature on the incidence of T2DM among children and adolescents from 25 countries/territories, Wu et al estimated ~41,600 new cases of youth-onset T2DM globally in 2021.<sup>1</sup>

Most of these cases were irrefutably preventable. Youth with T2DM have more rapid disease progression resulting in earlier and more severe micro- and macrovascular complications compared to both adult-onset T2DM and youth-onset type 1 diabetes (T1DM).<sup>2</sup> Such complications include but are not limited to atherosclerotic cardiovascular disease, stroke, myocardial infarction and sudden death, renal insufficiency and chronic renal

failure, limb-threatening neuropathy and vasculopathy, and retinopathy leading to blindness.<sup>3</sup> Moreover, the available treatment options for children and adolescents with T2DM are more limited than for adult patients.

## SYNAPTICS OF ADOLESCENT OBESITY AND TYPE 2 DIABETES MELLITUS

Insulin resistance is the major risk factor for T2DM at all ages. In adolescent population, the exogenous factor responsible for most cases of insulin resistance is obesity which, when coupled with relative insulin deficiency particularly the physiologic insulin resistance of puberty, leads to the development of overt T2DM. A systematic review and meta-analysis of 53 studies including 8,942 participants found that 75.27% of children with T2DM had obesity, and 77.24% had obesity at diagnosis.<sup>4</sup>

The increasing frequency, earlier onset and greater severity of childhood obesity in the past 50 years together with increasingly sedentary lifestyles and an increasing frequency of intrauterine exposure to diabetes are important drivers of the epidemic of youth-onset T2DM.<sup>5</sup>

## STRATEGIES TO CONTROL ADOLESCENT OBESITY AND PREVENT TYPE 2 DIABETES MELLITUS

The following strategies should be implemented to help an adolescent child with obesity lead a healthy lifestyle and prevent the onset and progression of T2DM as per Table 1.

\*Consultant Pediatrician, Dept. of Pediatrics, Sparsh Clinic, Zirakpur, Punjab, India

†Director and Consultant Pediatrician and Adolescent Expert, Dept. of Pediatrics and Adolescent Medicine, Sehat Hospital, Ludhiana East, Punjab, India

‡Consultant Endocrinologist, Sree Gokulam Medical College and Research Foundation, Venjaramoodu, Trivandrum, Kerala, India

#Consultant Physician, Dept. of Internal Medicine, Alchemist Hospital, Panchkula, Haryana, India; Sparsh Clinic, Zirakpur, Punjab, India

### Address for correspondence

Dr Meenakshi Verma

Consultant Pediatrician, Dept. of Pediatrics, Sparsh Clinic, Zirakpur, Punjab, India

E-mail: drmeenakshi28@gmail.com

**Table 1.** Strategies to Control Adolescent Obesity and Prevent Type 2 Diabetes Mellitus

<b>Physical activity</b>	<ul style="list-style-type: none"> <li>• How much</li> <li>• How often</li> <li>• Parents' role</li> </ul>
<b>Family-based approach</b>	<ul style="list-style-type: none"> <li>• Food choices</li> <li>• Lifestyle</li> </ul>
<b>Screening</b>	<ul style="list-style-type: none"> <li>• Whom to screen</li> <li>• When to screen</li> <li>• How often to screen</li> <li>• Role of genetic testing</li> <li>• Diagnostic criteria</li> <li>• Confirming diabetes type</li> </ul>

### PHYSICAL ACTIVITY

There is no denying the fact that adolescent population is overburdened with today's education trends. But a good education is of no worth if the body is not in synchronization with the mind. One of the constants in approach towards a healthy body is physical activity. One must make conscious efforts to inculcate the habits of involving themselves into one or the other physical activities.

- A daily moderate to vigorous physical activity of 30 to 60 minutes, either at once or in 2 to 3 sessions, at least 5 days per week (and strength training on at least 3 days per week), aiming to achieve 7% to 10% decrease in excess weight, is recommended.<sup>6</sup>
- Parents should appreciate even a small amount of progress shown by their child.
- Engage the child into a fitness or sport activity.
- Active family outings must be planned every fortnight to keep the children away from screens, especially during the weekends.
- Involving the children in household chores in the form of fun activities helps to keep them moving on daily basis.

### FAMILY-BASED APPROACH

Family is a child's first school. The journey towards a healthy body would not be difficult for a child with obesity if the whole family commits to a healthy lifestyle. Bringing the following lifestyle changes in the family is as mandatory as sending the child to school for good education. Table 2 illustrates the suggestions that could be included in family-based approach.

**Table 2.** Suggestions that can be Included in the Family-based Approach in Adolescent Obesity and Type 2 Diabetes Mellitus

- Eliminate or gradually reduce sugar intake for everyone in the family
- Include more of fruits and vegetables in the plate
- Adopt healthier alternatives of favorite foods
- Involve kids in food shopping and preparation
- Teach the children to read food labels
- Demonstrate and encourage them to eat slowly
- Discourage TV or gadgets while eating
- Have family meals more often
- Reward them with praises instead of food
- Serve smaller portions and let them to ask for seconds

### SCREENING

Risk-based screening for prediabetes and/or T2DM is recommended in the adolescents having one or more of the following risk factors.<sup>5</sup>

#### ➤ Risk Factors

- Body mass index (BMI) >85th percentile for age and sex, weight for height >85th percentile or weight >120% of ideal for height.
  - Genetics/epigenetics manifested as a strong family history of T2DM in first- or second-degree relatives.
  - Offspring of a pregnancy complicated by gestational diabetes mellitus (GDM)
  - Minority race/ethnicity (Native American, African American, Latino, Asian American, Pacific Islander).
  - Small-for-gestational-age birth weight.
  - Physiologic insulin resistance of puberty.
  - Having signs of insulin resistance or conditions associated with insulin resistance like acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome.
- **Time of screening:** After the onset of puberty or after 10 years of age, whichever occurs earlier.
  - **Frequency of screening:** Every 3 years, until the diagnosis is established or refuted.
  - **Role of genetic testing:** Testing for monogenic forms of diabetes (Maturity-onset diabetes of the young [MODY], Donohue syndrome and Rabson-Mendenhall syndrome) should be considered as

well, especially if impaired insulin sensitivity and reduced insulin secretion are present in otherwise healthy youth with a family history of T2DM.<sup>7</sup>

- **Diagnostic criteria for overweight and obesity:** The Indian cut-off levels as per Indian Academy of Pediatrics (IAP) are as below:<sup>8</sup>
  - Overweight: BMI  $\geq 23$  kg/m<sup>2</sup>
  - Obesity: BMI  $\geq 27$  kg/m<sup>2</sup>
  - Extreme obesity: BMI  $\geq 120\%$  of the 95th percentile or  $\geq 35$  kg/m<sup>2</sup>.
- **Diagnostic criteria for diabetes in adolescents:**<sup>9</sup>
  - Prediabetes: HbA1c level of 5.7 to  $<6.5$  or fasting glucose  $\geq 100$  but  $<126$  mg/dL or 2-hour plasma glucose  $\geq 140$  but  $<200$  mg/dL.
  - Diabetes: HbA1c level of  $>6.5$  or fasting glucose  $\geq 126$  mg/dL or 2-hour plasma glucose  $\geq 200$  mg/dL or random plasma glucose  $>200$  mg/dL in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis.
  - Confirming diabetes type:
    - ▶ Clinical signs helpful in distinguishing T2DM from T1DM are obesity and signs of insulin resistance.
    - ▶ Children and adolescents with overweight/obesity in whom the diagnosis of T2DM is being considered should have a panel of pancreatic autoantibodies tested to exclude the possibility of autoimmune T1DM.
    - ▶ Genetic evaluation to exclude monogenic diabetes should also be based on clinical characteristics and presentation.
    - ▶ The distinction between these forms of diabetes in youth with obesity has important implications for treatment, since Ab<sup>+</sup> youth (with phenotype of T2DM) present more like individuals with T1DM, progressing to insulin requirement more rapidly, and are at risk for other autoimmune disorders. Therefore, measurement of pancreatic autoantibodies (GAD-65 and insulinoma-associated protein 2) is recommended in all youth with clinical characteristics of T2DM.<sup>10</sup>

## TAKE HOME MESSAGE

- One should suspect and screen and be aware of Indian cut-offs for obesity.
- Support family-based, school-based and community-based interventions for prevention of this menace.
- Seek and stick to medical advice, as appropriate.

## REFERENCES

1. Wu H, Patterson CC, Zhang X, Ghani RBA, Magliano DJ, Boyko EJ, et al. Worldwide estimates of incidence of type 2 diabetes in children and adolescents in 2021. *Diabetes Res Clin Pract.* 2022;185:109785.
2. Bjornstad P, Chao LC, Cree-Green M, Dart AB, King M, Looker HC, et al. Youth-onset type 2 diabetes mellitus: an urgent challenge. *Nat Rev Nephrol.* 2023;19(3):168-84.
3. TODAY Study Group; Bjornstad P, Drews KL, Caprio S, Gubitosi-Klug R, Nathan DM, Tesfaldet B, et al. Long-term complications in youth-onset type 2 diabetes. *N Engl J Med.* 2021;385(5):416-26.
4. Cioana M, Deng J, Nadarajah A, Hou M, Qiu Y, Chen SSJ, et al. The prevalence of obesity among children with type 2 diabetes: a systematic review and meta-analysis. *JAMA Netw Open.* 2022;5(12):e2247186.
5. Arslanian SA, Bacha F, Grey M, Marus MD, White NH, Zeitler P. Evaluation and management of youth-onset type 2 diabetes: a position statement by the American Diabetes Association. *Diabetes Care.* 2018;41(12):2648-68.
6. Asif M. The prevention and control the type-2 diabetes by changing lifestyle and dietary pattern. *J Educ Health Promot.* 2014;3:1.
7. Hattersley AT, Greeley SAW, Polak M, Rubio-Cabezas O, Mlynarski W, Castano L, et al. ISPAD Clinical Practice Consensus Guidelines 2018: The diagnosis and management of monogenic diabetes in children and adolescents. *Pediatr Diabetes.* 2018;19 Suppl 27:47-63.
8. Bajpai A, Shenoy MT, Karia-Shah P. Standard treatment guidelines for childhood obesity 2022. Indian Academy of Pediatrics. Available at: <https://iapindia.org/pdf/Ch-026-Childhood-Obesity.pdf>
9. American Diabetes Association. 2. Classification and diagnosis of diabetes. *Diabetes Care.* 2015;38 Suppl 1:S8-S16.
10. Klingensmith GJ, Pyle L, Arslanian S, Copeland KC, Cuttler L, Kaufman F, et al; TODAY Study Group. The presence of GAD and IA-2 antibodies in youth with a type 2 diabetes phenotype: results from the TODAY study. *Diabetes Care.* 2010;33(9):1970-5.

