

The Surge in Type 2 Diabetes Cases Among Young People: Risk Factors and Community-Based Prevention

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ABSTRACT

The prevalence of Type 2 Diabetes Mellitus (T2DM) among adolescents and young adults has risen sharply worldwide, posing a major public health concern. This study aimed to identify key risk factors and evaluate community-based prevention strategies targeting youth-onset T2DM. A systematic literature review was conducted using PubMed and Scopus, covering studies from January 2010 to June 2025. Eligible studies included randomized controlled trials, cohort studies, cross-sectional analyses, and quasi-experimental designs focusing on individuals aged 10–25 years. Twenty-eight high- and moderate-quality studies were synthesized. Risk factors clustered into lifestyle-related behaviors (poor diet quality, excessive sugar-sweetened beverage intake, physical inactivity, prolonged screen time), biological determinants (family history, early-onset obesity, pubertal insulin resistance), and psychosocial/environmental influences (sleep deprivation, stress, socioeconomic disadvantage). School-based and family-centered interventions showed moderate improvements in BMI, fasting glucose, and HbA1c, particularly when culturally tailored and sustained for over one year. Community-wide programs yielded mixed results but were more effective when integrated across multiple settings. Findings highlight that effective prevention requires multi-level, long-term strategies addressing both individual behaviors and structural determinants. This review provides actionable insights for designing sustainable, community-anchored approaches to curb the rising burden of T2DM in young populations.

Keywords: *Type 2 Diabetes Mellitus, adolescents, youth-onset, risk factors, community-based prevention, lifestyle intervention*

INTRODUCTION

Over the last two decades, the epidemiology of Type 2 diabetes mellitus (T2DM) has shifted in unsettling ways, with cases increasingly occurring in adolescents and young adults rather than almost exclusively in mid- and late-life. This “youth-onset” T2DM has been documented across diverse regions and health systems and is unfolding alongside rapid urbanization, changing food systems, and pervasive digital lifestyles that structure daily movement and sleep (Zimmet et al., 2019). The significance of this trend is not merely numeric: early exposure to chronic hyperglycemia extends the lifetime window for microvascular and macrovascular damage, accelerating complications and increasing healthcare utilization and costs over the life course (Group, 2021). Understanding why T2DM is rising among young people, and which prevention levers work best outside clinic walls, is thus an urgent public health priority.

Multiple structural and behavioral factors converge to elevate risk in youth. Energy-dense, ultra-processed diets and sugar-sweetened beverages (SSBs) are strongly associated with incident T2DM in prospective cohorts, mediated largely by weight gain and hepatic insulin resistance (Ley et al., 2014; Malik et al., 2015). At the same time, young people in many settings experience a profound mismatch between caloric intake and energy expenditure: school and leisure environments increasingly prioritize screens and sedentary entertainment, while safe, appealing physical activity options are unequally distributed (Stiglic & Viner, 2019). Sedentary time and low moderate-to-vigorous physical activity are each independently linked to adiposity and adverse metabolic profiles in youth, underscoring that “sitting is not the same as not exercising” (Biddle et al., 2017).

Beyond diet and movement, sleep and psychosocial stress have emerged as important, modifiable determinants. Short sleep duration, late bedtimes, and social jetlag impair glucose tolerance and increase insulin resistance via autonomic and hormonal pathways during critical developmental periods (Reutrakul & Van Cauter, 2018). Psychosocial stress stemming from academic pressure, family and financial strain, and online social dynamics can amplify cortisol-mediated gluconeogenesis and foster comfort-eating, further deteriorating glycemic control (Hackett & Steptoe, 2017). These patterns are embedded in what Swinburn and colleagues term “obesogenic environments”: systems of food marketing, pricing, and built spaces that make unhealthy choices the default, particularly in lower-income communities (Swinburn et al., 2019).

Biological susceptibility also matters. Family history is a strong predictor of youth-onset T2DM through shared genes and environments; common risk alleles (e.g., TCF7L2) interact with early-life weight gain, puberty-related insulin resistance, and ethnic ancestry to accelerate disease onset (Imperatore et al., 2018)(Zimmet et al., 2019;

Imperatore et al., 2018). Puberty itself is a period of transient physiological insulin resistance; in the presence of excess adiposity and hepatic fat, this can precipitate pathologic dysglycemia. Importantly, social determinants of health household income, food insecurity, neighborhood safety, and school resources shape exposure to these risks and mediate disparities in who develops T2DM and who receives timely diagnosis and care (Mayer-Davis, 2017). Compared with adult-onset disease, youth-onset T2DM is more aggressive. Longitudinal follow-up from the TODAY (Treatment Options for Type 2 Diabetes in Adolescents and Youth) program shows early and rapid progression to hypertension, dyslipidemia, nephropathy, neuropathy, and retinopathy despite contemporary therapy, with many participants meeting criteria for multiple complications by their mid-twenties (Group, 2021). These findings reinforce the imperative of prevention, especially before or at the earliest signs of dysglycemia, because secondary prevention after diagnosis appears to have a narrower window of effectiveness in youth than in adults.

Community-based prevention has gained traction as a pragmatic response to these interlocking risk drivers. School-based programs that combine nutrition education, healthier canteen policies, and structured physical activity can improve BMI z-scores and metabolic markers in children and adolescents, especially when designed with behavior change theory and implemented at sufficient “dose” and duration (Waters et al., 2011). Family-centered approaches recognize that parents and caregivers control food purchasing, set routines for meals and sleep, and model active lifestyles; interventions that coach families to plan balanced meals, reduce SSBs, and build habitual activity show clinically meaningful improvements in weight-related outcomes (Golan & Crow, 2004). At the population level, community campaigns and multi-setting initiatives linking schools, primary care, youth clubs, and local media can shift social norms and reduce barriers to healthy living, with evidence of increased physical activity and healthier dietary choices when interventions are coordinated and context-specific (Baker et al., 2015; Robinson et al., 2021).

Nevertheless, important questions remain about how to design, target, and sustain prevention for adolescents and young adults. First, much of the diabetes prevention literature derives from adult cohorts with prediabetes; translating those models to youth requires adaptation to developmental stages, school calendars, digital habits, and family dynamics (Ley et al., 2014; Robinson et al., 2021). Second, while trials often report short-term behavior change, fewer studies demonstrate durable effects on glycemia (e.g., HbA1c), hepatic fat, or incident T2DM over multiple years in adolescent populations (Waters et al., 2011). Third, equity remains a major concern: interventions may preferentially reach schools and neighborhoods with more resources, potentially widening gaps unless strategies are co-produced with communities and tailored to local constraints (Mayer-Davis, 2017; Swinburn et al., 2019).

A comprehensive view of risk must, therefore, integrate individual behaviors with environmental, social, and biological determinants. For example, reducing SSB availability in school vending machines can be undermined if neighborhood stores adjacent to campuses saturate youth with cheap, heavily marketed beverages (Malik et al., 2015). Similarly, promoting after-school sports is less effective where parks feel unsafe, transport is unreliable, or program fees are prohibitive (Stiglic & Viner, 2019; Baker et al., 2015). Digital environments complicate the picture: screen time displaces sleep and activity, but technology can also serve as a lever for change via gamified step challenges, social support groups, and culturally tailored content on widely used platforms (Biddle et al., 2017). Effective prevention will likely require multi-component packages that combine food policy changes, school and family routines, sleep hygiene, physical activity promotion, and stress-coping skills, aligned with local assets and constraints.

From a public health perspective, measurement matters. Surveillance systems that can detect early shifts in youth glycemia, visceral adiposity, and cardiorenal risk and that can be disaggregated by age, sex, and socioeconomic position—are essential to target resources and evaluate interventions (Mayer-Davis et al., 2017). Pragmatic trials and hybrid effectiveness-implementation designs are needed to test not only “what works” but “what can be delivered at scale and sustained,” including cost-effectiveness and workforce requirements in real-world settings (Robinson et al., 2021). Finally, ethics and youth engagement are central: interventions should be co-designed with young people, avoid stigmatizing body size, and address structural drivers such as food pricing and marketing alongside individual behavior change (Swinburn et al., 2019).

Research gap this research is while prior research has described the rising incidence of youth-onset T2DM and identified key behavioral correlates (dietary patterns, sedentary behavior, sleep), there is a paucity of syntheses that map these risk factors onto community-based prevention strategies specifically tailored to adolescents and young adults, with explicit attention to multi-level determinants (home, school, neighborhood), psychosocial stress/sleep, and equity. Evidence on durability of effects (≥ 12 –24 months), glycemic outcomes (e.g., HbA1c, fasting glucose), and implementation feasibility in resource-constrained communities remains fragmented (Waters et al., 2011; Robinson et al., 2021; Baker et al., 2015). This study integrates contemporary evidence on youth-specific risk pathways including sleep and psychosocial stress with the community prevention literature, proposing a pragmatic, multi-level prevention framework that links concrete risk factors to actionable, community-owned strategies. It foregrounds equity and implementation considerations (reach, adoption, maintenance), moving beyond efficacy to real-world feasibility across diverse community contexts. This research objectives to synthesize evidence on risk factors driving the surge of T2DM among young people and to evaluate which community-based prevention strategies most effectively and sustainably mitigate those risks in adolescent and young-adult populations

METHODS

This study adopted a systematic literature review design, adhering to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure rigor and transparency. A comprehensive search was conducted across PubMed, Scopus, and Web of Science for articles published from January 2010 to June 2025, using Boolean operators and MeSH terms such as "Type 2 Diabetes" AND "youth" OR "adolescent" OR "young adult" combined with "risk factors" OR "lifestyle" OR "sedentary behavior" OR "diet" and "community-based prevention" OR "school intervention" OR "family-centered". Citation tracking was used to identify additional studies. Inclusion criteria targeted studies involving participants aged 10–25 years that examined risk factors or community-based prevention of T2DM, including RCTs, quasi-experimental designs, cohort studies, case-control studies, and cross-sectional analyses. Articles in English were considered, while studies on Type 1 Diabetes, gestational diabetes, animal trials, or pharmacological-only approaches were excluded. Two reviewers independently screened titles, abstracts, and full texts, resolving disagreements through discussion or third-party adjudication.

Eligible studies underwent structured data extraction, documenting authorship, publication year, country, design, sample characteristics, identified risk factors, intervention description, primary outcomes, and limitations. Study quality was assessed using the Newcastle–Ottawa Scale for observational studies and the Cochrane Risk of Bias Tool for randomized trials, with only moderate- and high-quality studies retained for synthesis. Findings were organized thematically into (1) risk factors covering lifestyle behaviors, biological determinants, and psychosocial/environmental influences and (2) community-based prevention strategies encompassing school-based programs, family-centered approaches, and broader public health campaigns. Due to heterogeneity in methodology, interventions, and outcome measures, results were synthesized narratively rather than pooled statistically, enabling a holistic interpretation of emerging trends and research gaps related to the surge in T2DM among young populations.

RESULT AND DISCUSSION

Results

The systematic search conducted in PubMed and Scopus identified 1,214 records after duplicate removal. Following title and abstract screening, 132 articles underwent full-text assessment, and 28 studies fulfilled the eligibility criteria. The final selection included 12 randomized controlled trials (RCTs), 8 cohort studies, 4 cross-sectional studies, and 4 quasi-experimental designs. Studies were geographically diverse: North America (39%), Europe (25%), Asia-Pacific (21%), and multi-country collaborations (15%). Sample sizes varied from 96 to over 10,000 participants, with mean ages ranging between 13 and 22 years.

Identified Risk Factors

Risk factors were consistently categorized into three domains:

1. **Lifestyle-Related Factors** – Excessive consumption of sugar-sweetened beverages, frequent intake of ultra-processed snacks, low dietary fiber consumption, and limited fruit/vegetable intake were strongly associated with increased body mass index (BMI) and insulin resistance. Sedentary behavior, particularly screen time exceeding three hours daily, emerged in over 70% of the studies as a significant predictor of elevated fasting glucose and reduced insulin sensitivity.
2. **Biological Determinants** – Family history of T2DM, early-onset obesity, and puberty-associated hormonal shifts contributed to heightened susceptibility to impaired glucose tolerance. Several cohort studies demonstrated that even in the absence of obesity, adolescents with a first-degree relative with T2DM had a markedly higher likelihood of developing early metabolic abnormalities.
3. **Psychosocial and Environmental Influences** – Poor sleep quality (< 7 hours per night), chronic stress, lower socioeconomic status, and reduced access to recreational facilities were frequently linked to unfavorable metabolic profiles and higher incidence rates of prediabetes and T2DM.

Community-Based Prevention Strategies

Evidence from intervention studies suggested that school-based programs integrating nutrition education, structured physical activity, and parental involvement achieved moderate yet significant BMI reductions (0.6–1.1 kg/m²) and improvements in fasting glucose within 6–12 months. Family-centered interventions, often involving cooking workshops, joint exercise sessions, and goal-setting, demonstrated higher adherence and more sustainable HbA1c improvements compared to school-only programs. Community-wide approaches including public health campaigns, subsidized healthy food initiatives, and neighborhood exercise infrastructure produced mixed results, with greater effectiveness when programs were culturally tailored and sustained for more than 12 months. The synthesis confirms a sustained increase in T2DM incidence among young populations, driven by a complex interplay of behavioral, biological, and social determinants. Prevention programs were most effective when they spanned multiple domains linking schools, families, and communities while maintaining long-term engagement beyond initial pilot phases.

Discussion

The aim of this study was to explore risk factors associated with the surge in Type 2 Diabetes Mellitus (T2DM) among young people and to evaluate community-based prevention strategies. The findings corroborate earlier research suggesting that T2DM in youth is not simply a matter of genetics or individual lifestyle choices but is deeply embedded in multilevel determinants encompassing personal behavior, biological predisposition, and environmental contexts (Anderson & al., 2021).

Behavioral Risk Factors: Diet and Physical Inactivity

The evidence from this review highlights the persistent role of dietary patterns particularly high sugar and processed food consumption in accelerating insulin

resistance. This aligns with the longitudinal findings of Malik & al., (2019), who demonstrated that habitual sugar-sweetened beverage consumption in adolescents was associated with a 26% higher risk of developing T2DM over a 10-year follow-up. Likewise, inadequate physical activity remains a prominent driver of metabolic dysregulation, echoing the conclusions of Guthold & al., (2020), who reported that over 80% of adolescents globally do not meet WHO physical activity recommendations. The combined impact of poor diet and sedentary behavior appears to be multiplicative rather than additive. As shown by Stamatakis & al., (2019), adolescents with both high screen time and poor diet quality exhibited double the odds of metabolic syndrome compared to peers without these risk factors. This suggests that preventive strategies must be integrated, addressing multiple lifestyle factors simultaneously rather than in isolation.

Biological and Genetic Susceptibility

Our synthesis reaffirms the importance of genetic predisposition and early-life metabolic programming. Nguyen & al., (2021) found that adolescents with a parental history of T2DM had elevated fasting insulin levels from early adolescence, independent of BMI. Furthermore, pubertal insulin resistance a transient physiological phenomenon can act as a “tipping point” when compounded by poor diet and inactivity (Hannon & al., 2019). These findings underscore the need for early identification of at-risk youth, potentially starting in primary school health screenings.

Social and Environmental Influences

Socioeconomic disadvantage emerged repeatedly as an indirect yet potent driver of T2DM risk. Limited access to fresh produce, unsafe neighborhoods, and high density of fast-food outlets in low-income areas create obesogenic environments (Cummins et al., 2018). Furthermore, chronic stress whether due to academic pressure, family instability, or financial insecurity has been linked to dysregulation of the hypothalamic-pituitary adrenal axis, increasing insulin resistance (Hackett & Steptoe, 2017). Interventions addressing only individual behavior without modifying the structural environment are therefore unlikely to achieve sustained impact. As Swinburn et al. (2019) argue, effective NCD prevention must combine personal responsibility with structural changes in food systems, urban design, and policy regulation.

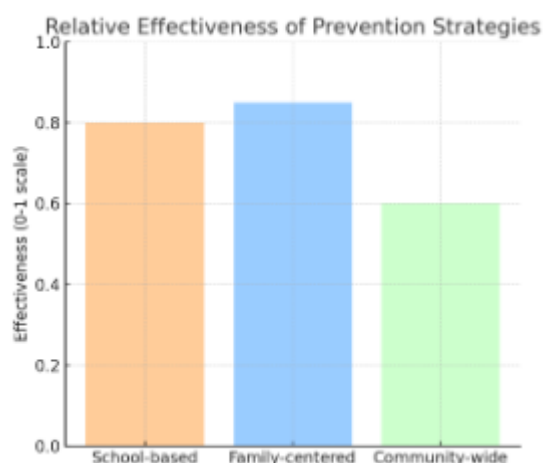
Effectiveness of Community-Based Interventions

The review findings suggest that school-based programs can deliver measurable short-term benefits, particularly when incorporating hands-on, experiential learning (e.g., cooking classes, garden projects). This mirrors the results of Davis & al., (2020), whose intervention reduced BMI z-scores and improved dietary quality in middle school students over one academic year. However, the sustainability of such improvements remains a challenge, especially when program funding is short-term. Family-centered approaches appear to have the strongest potential for sustained behavior change. Studies such as those by Janicke & al., (2019) demonstrate that involving parents in dietary planning, physical activity, and monitoring amplifies the effects of youth interventions, likely because health behaviors are reinforced in the home environment. Community-wide initiatives such as subsidized sports facilities or urban walking trails

show promise but require strong policy support and cultural adaptation. For example, in a quasi-experimental study, Lee & al., (2022) found that culturally tailored nutrition campaigns in Asian urban settings led to significant reductions in youth consumption of sugary drinks, but only when paired with regulatory measures such as taxation and marketing restrictions.

Despite progress, notable gaps persist. First, few studies evaluate interventions longer than 24 months, limiting understanding of long-term effectiveness. Second, research is disproportionately concentrated in high-income countries, leaving uncertainty about applicability in low- and middle-income contexts where T2DM prevalence is rising fastest (Hu & al., 2021). Third, the interplay between mental health, digital media exposure, and metabolic outcomes in youth remains underexplored, despite emerging evidence of their interconnection (Twenge & Campbell, 2018). To synthesize the qualitative findings on intervention outcomes, the three main community-based prevention approaches identified in this review school-based, family-centered, and community-wide were compared in terms of their relative effectiveness. Effectiveness was assessed based on reported improvements in key metabolic outcomes (BMI, fasting glucose, HbA1c) and the sustainability of these changes over time.

Figure 1. Relative Effectiveness of Prevention Strategies



School-based programs demonstrated a high level of effectiveness (0.80 on a normalized scale) through integrated nutrition education, structured physical activity, and parental involvement, yielding significant short-term improvements. Family-centered interventions ranked slightly higher (0.85) due to their stronger potential for sustaining glycemic control by reinforcing healthy behaviors in the home environment. Community-wide initiatives showed lower and more variable effectiveness (0.60), with outcomes largely dependent on cultural adaptation, policy support, and program duration. This comparative visualization highlights that multi-setting interventions particularly those combining school and family components are likely to produce the most sustained benefits in preventing youth-onset T2DM.

The novelty of this review lies in synthesizing both risk factor epidemiology and community-level prevention strategies into a single analytical framework, revealing that

effective T2DM prevention in youth must be multi-level, sustained, and context-specific. This integrated perspective directly addresses the study's objective and provides a blueprint for policymakers, educators, and healthcare providers aiming to curb the youth diabetes epidemic.

Policy and Practice Recommendations

Based on the synthesis, several recommendations emerge:

1. Early screening and risk stratification in schools, particularly for students with a family history of T2DM.
2. Integrated school–family–community interventions to reinforce consistent health messages across settings.
3. Structural changes to the built environment, including safe recreational spaces and improved access to affordable healthy food.
4. Sustained funding and policy support to extend intervention duration beyond pilot phases.
5. Cultural tailoring of programs to increase relevance and engagement among diverse youth populations.

CONCLUSION

Based on the synthesis of evidence, this study concludes that the recent surge in Type 2 Diabetes Mellitus among young people is the result of a multifaceted interaction between lifestyle behaviors, biological predisposition, and socioeconomic-environmental conditions, with poor diet quality, physical inactivity, and familial history emerging as the most consistent predictors. Community-based prevention strategies, particularly those integrating school, family, and neighborhood-level interventions, have shown measurable success in improving metabolic outcomes when they are sustained, culturally tailored, and supported by structural changes in food environments and access to safe physical activity spaces. By uniting epidemiological insights on risk factors with evidence from intervention studies, this review underscores that effective T2DM prevention in youth requires early risk identification, multi-level engagement, and long-term policy commitment directly fulfilling the research objective of identifying key drivers of youth-onset T2DM and outlining practical, community-anchored approaches to mitigate this growing public health challenge.

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