



'Prediabetes' as a practical distinctive window for workable fruitful wonders: Prevention and progression alert as advanced professionalism

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Specialty type: Pediatrics

Provenance and peer review:

Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B
Grade C (Good): 0
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Galanakis C, Greece

Received: October 24, 2023

Peer-review started: October 24, 2023

First decision: November 30, 2023

Revised: December 1, 2023

Accepted: December 19, 2023

Article in press: December 19, 2023

Published online: March 9, 2024



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Abstract

Diabetes is a devastating public health problem. Prediabetes is an intermediate stage in the disease processes leading to diabetes, including types 1 and 2 diabetes. In the article "Prediabetes in children and adolescents: An updated review," the authors presented current evidence. We simplify and systematically clearly present the evidence and rationale for a conceptual framework we term the '3ASS': (1) Awareness Sensible; (2) Algorithm Simple; and (3) Appealing Strategies. Policy makers and the public need to be alerted. The prevalence of prediabetes should send alarm bells ringing for parents, individuals, clinicians, and policy makers. Prediabetes is defined by the following criteria: impaired fasting glucose (100-125 mg/dL); impaired glucose tolerance (2 h postprandial glucose 140-199 mg/dL); or hemoglobin A1c values of 5.7%-6.4%. Any of the above positive test alerts for intervention. Clinical guidelines do not recommend prioritizing one test over the others for evaluation. Decisions should be made on the strengths and shortfalls of each test. Patient preferences and test accessibility should be taken into consideration. An algorithm based on age, physiological stage, health status, and risk factors is provided. Primordial prevention targeting populations aims to eliminate risk factors through public education and encouraging practices through environmental modifications. Access to healthy foods is provided. Primary prevention is for individuals with a prediabetes diagnosis and involves a structured program to reduce body weight and increase physical activity along with a healthy diet. An overall methodical move to a healthy lifestyle for lifelong health is urgently needed. Early energetic prediabetes action is necessary.

Key Words: Obesity; Overweight; Awareness; Algorithm; Lifestyle; Physical exercise; Screening; Primordial prevention; Primary prevention; Adolescents

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Core Tip: Prediabetes provides a window for preventive action. The prevalence of prediabetes should send alarm bells ringing for parents, individuals, clinicians, and policy makers. Algorithms should delineate based on age, physiological stage, health status, and risk factors. Diabetes is dangerous and its management is difficult; hence, attention on prediabetes, which provides early opportunity for health promotion and prevention. Primordial prevention should target at-risk populations and primary prevention should target individuals for healthy lifestyles. Doctors should be proficient in modern technologies proficient to optimize prevention strategies.

Citation: Jain S. 'Prediabetes' as a practical distinctive window for workable fruitful wonders: Prevention and progression alert as advanced professionalism. *World J Clin Pediatr* 2024; 13(1): 89201

URL: <https://www.wjgnet.com/2219-2808/full/v13/i1/89201.htm>

DOI: <https://dx.doi.org/10.5409/wjcp.v13.i1.89201>

INTRODUCTION

Obesity is a global public health crisis. Prevalence rates are increasing among children and adolescents. Prediabetes identifies individuals at high risk of developing diabetes[1]. Prediabetes provides a preventive action window against progression and is considered an intermediate stage in all the disease processes leading to diabetes. The expanded list of diabetes etiologies is shown in Figure 1. All entities need necessary attention, particularly in prevention with increased efforts on identifying and acting on prediabetes.

"Discoveries many!

Necessitating strategies novel;

Innovative & inspiring".

In the article "Prediabetes in children and adolescents: An updated review" Ng *et al*[2] comprehensively present current evidence. They aim to provide pediatricians and primary care providers with an updated overview of this important condition. A clear understanding of the condition is essential for success with advancements professionally presented. Policy makers and the public need to be alerted and apprised. A simplified conceptual framework is presented as the '3ASs' in Figure 2.

AWARENESS SENSIBLE

As many as 34% or 88 million United States adults have prediabetes, as per the most recent estimate (2020) by the Centers for Disease Control and Prevention[3]. Children are likely to be similarly affected considering the increasing rate of obesity. Ng *et al*[2] reported a pooled prevalence of up to 8.84% from a recent systematic review and meta-analysis[2,4]. This increasing prevalence should send alarm bells ringing for parents, individuals, clinicians, and policy makers.

'Alarming statistics necessitate advanced strategies'.

Prediabetes is defined by the following criteria: Impaired Fasting Glucose (IFG) (100-125 mg/dL [5.6-6.9 mmol/L]), OR: Impaired Glucose Tolerance (IGT) (2 h postprandial glucose 140-199 mg/dL [7.8-11 mmol/L]), OR: Hemoglobin A1c (HbA_{1c}) values of 5.7%-6.4% (39-47 mmol/mol)[5].

Suspensions of prediabetes induce actions, and tests advance the actions to restore healthy status. Any of the above positive test alerts practitioners that intervention is necessary. Clear concepts are necessary for practitioners, and this should provide the impetus to the Core tip given by Ng *et al*[2] "child health practitioners are struggling with the definition".

'Knowing, understanding, & knack,

Testing, numbers, & tact'.

ALGORITHM SIMPLE

Evidence needs to be expertly incorporated into algorithms. We present an algorithm based on American Diabetes Association Professional Practice Committee recommendations (Figure 2)[6]. An algorithm based on age, physiological stage, health status, and risk factors is best.

The current comprehensive evidence is that: (1) 1 in 5 United States adolescents with obesity have prediabetes[7,8]; (2) The comorbidities of pediatric overweight and obesity are that prediabetes and diabetes occur more frequently among children ≥ 10 years of age, are in early pubertal stages, or have a family history of type 2 diabetes mellitus (T2DM)[8]; (3) The risk profile for diabetes mellitus and nonalcoholic fatty liver disease in children < 10 years of age is lower (especially in the absence of severe obesity). Hence, obtaining tests for abnormal glucose metabolism or liver function is not universally recommended for these children[8]; (4) Prediabetes is often associated with insulin resistance syndrome (also known as metabolic syndrome), which has dyslipidemia of the high-triglyceride or low- or high-density lipoprotein type, or both, and hypertension[5]; and (5) Progression of IFG to overt T2DM appears to be lower in the pediatric obese

Type 1 diabetes, (insulin resistance or deficiency)
Type 2 diabetes
Other specific types
<input type="checkbox"/> Genetic defects of β -cell function (monogenic diabetes)
<input type="checkbox"/> Genetic defects of insulin action
<input type="checkbox"/> Genetic syndromes associated with diabetes (insulin resistance or deficiency)
<input type="checkbox"/> Autoimmune syndromes associated with diabetes
<input type="checkbox"/> Drug or chemical induced diabetes
<input type="checkbox"/> Diseases of exocrine pancreas causing diabetes
<input type="checkbox"/> Infections leading to diabetes
<input type="checkbox"/> Endocrinopathies associated with diabetes
<input type="checkbox"/> Diseases of exocrine pancreas
<input type="checkbox"/> Infections leading to diabetes
<input type="checkbox"/> Endocrinopathies associated with diabetes
Gestational diabetes

Figure 1 Etiologic classes of diabetes mellitus.

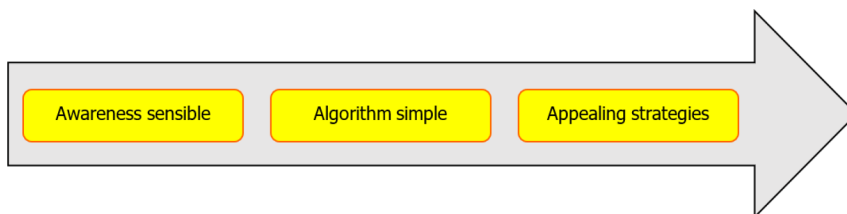


Figure 2 'Prediabetes' conceptual framework '3ASs'.

population than in adults[9]. However, the transition from IGT to T2DM is more rapid in children and adolescents than adults[10].

To encourage a pragmatic and efficient evaluation strategy (avoiding repeated testing), it is recommended that in children with obesity, evaluation for lipid abnormalities, abnormal glucose metabolism, and liver dysfunction be performed at the same time, beginning at 10-years-old[8].

Diagnostic tests for prediabetes are Fasting Glucose, Glucose Tolerance test, and HbA_{1c}. Clinical guidelines do not recommend preferring one test over the other for evaluation. Practitioners need to know and understand the strengths and shortfalls of each test for judicious use. Patient preferences and test accessibility should be taken into consideration [8].

In view of these, we recommend the following tests for abnormal glucose metabolism and discuss significance: (1) IFG: > 99 mg/dL (5.5 mmol/L) is the upper limit of normal, and alerts action because when left uncontrolled, it causes a progressively greater risk for the development of microvascular and macrovascular complications[5]; (2) IGT: Hyperglycemia when challenged with the oral glucose load, necessitates strict dietary measures, and adherence is improved when coupled with counselling; and (3) HbA_{1c}: The HbA_{1c} test is easy to obtain as it can be done anytime and fasting is not required. This provides stronger and more specific associations with cardiometabolic risk[11] (Figure 3).

Further, Ng *et al*[2] have provided a simplified approach algorithm, which leads with risk factors. One size does not fit all, especially in the growing pediatric age group. Ng *et al*'s[2] algorithm proposes oral glucose tolerance test or fasting plasma glucose, +/- HbA_{1c}. Based on the definition above that states that any one positive test of the 'Tests for abnormal glucose metabolism' is sufficient to diagnose prediabetes, it is unclear what happens in the following situations: (1) Whether an IGT test will be performed in 'severely obese' children < 10-years-old when there are no risk factors and FBG is normal. Their algorithm suggests that the test should be performed only if risk factors are present. It should be performed, as (i) Individuals with IFG often manifest hyperglycemia only with the oral glucose load challenge, as in the standardized oral glucose tolerance test. Results will motivate a prevention rationale because (ii) subjects with both IFG and IGT have dangers of additive metabolic defects and are more likely to progress to overt T2DM[10]. Furthermore, should IGT be performed on overweight only patients with a positive IFG? No, as unnecessary testing is burdensome for individuals and healthcare institutions. Further, many individuals with IFG are euglycemic in their daily lives and may have normal or nearly normal HbA_{1c} levels[5]. Thus, they have healthy diets, do not binge eat, and even if bingeing, their body is taking care of sugar levels. Lifestyle interventions for ideal weight should suffice, rewardingly!

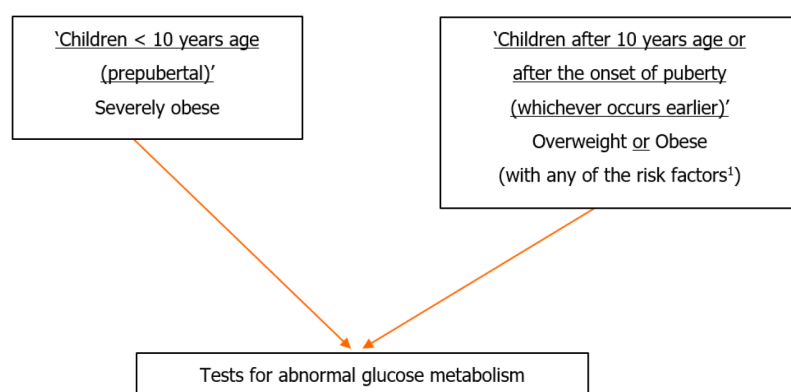


Figure 3 Algorithm for screening. 'Risk factors: Maternal history of diabetes or gestational diabetes; Family history of diabetes in 1st- or 2nd-degree relative; Race/ethnicity (Native American, African American, Hispanic, Asian/Pacific Islander); Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome); Use of obesogenic psychotropic medications[1,8].

'Simple choices – comprehensive success'.

APPEALING STRATEGIES

Diabetes is dangerous, and its management can be difficult for good glucose control and complication prevention. Prediabetes provides an early opportunity for health promotion and prevention. Hence the need for energetic strategies with appeal that ensure success.

'Methods scientific, Motivation strong,
Success major over morbidity & mortality'.

Ng *et al*[2] write that "The lack of prospective long-term longitudinal data to inform evidence-based practice for disease prevention and complication avoidance is the real challenge and major gap in pediatric prediabetic research"[2]. Waiting for evidence is unpardonable. The Diabetes Prevention Program strikingly showed that lifestyle or drug intervention intensified in individuals with IGT prevents or delays the onset of T2DM[12]. Similar beneficial effects in obese adolescents with IGT are likely[5]! Such benefits necessitate large scale strategies for more benefits for many. The provision by Ng *et al*[2] of only individualistic strategies needs further expansion[2].

Prevention is most beneficial if it is early and energetic. Given the rising burden of lifestyle diseases and associated risks, we outline succinct strategies as appealing advancements: (1) Primordial prevention: Targeting an entire population is important, and this focusses on social and environmental conditions[13]. This aims at eliminating risk factors in general populations through public education and encouraging practice through modifications in the environment. Access to healthy foods is provided[1]. Breastfeeding should be encouraged and ensured, as it is associated with protection against childhood overweight and diabetes[14]. In mothers with gestational diabetes, breastfeeding protects against obesity and T2DM[15,16]. A sedentary lifestyle is to be avoided and the advice should be to be physically active for at least 60 min per day every day[17]; (2) Primary prevention: Interventions aiming at ameliorating risk factors reward favorably. Individuals with a prediabetes diagnosis should be promptly referred to a structured program for reducing body weight and increasing physical activity. A healthy meal plan is provided and intensive encouragement provided for compliance.

Appeal is ensured by education of long-term health burdens, which culminate in decreased life-expectancy. Health benefits of lifestyle modification are emphasized.

Attractiveness and compliance need to be ensured with motivational methods like health education and inspirational encouragement – 'healthy lifestyle favorable & must for lifelong happiness'.

In a recent Systematic Review, the benefits of using new information and communications technologies for improving health and preventing obesity were highlighted, with improvements in knowledge for nutrition habits and promotion of physical activity[18]. Therefore, doctors should be educated to be proficient in new technology use[19].

Ng *et al*[2] highlighted the use of metformin as a second-line management in individuals refractory to lifestyle interventions[2,20]. However, a recent systemic review was inconclusive as to the benefits of metformin to prevent the progression to overt T2DM in children and adolescents with prediabetes[21]. Hence, the focus should be on the continuation of lifestyle interventions.

Summary

Important points for professional impact are summarized in Figure 4.

CONCLUSION

In summary, the message is that if left unattended, the high incidence and higher risks of prediabetes will require the

► Awareness sensible

Prevalence of prediabetes should send alarm bells ringing.
Diabetes is dangerous & its management difficult, hence attention to Prediabetes.
Prediabetes is observed as an intermediate stage in all of the disease processes leading to diabetes, including Types 1 & 2 Diabetes.

► Algorithmic screening

- ⇒ Based on age, physiological stage, health status, & risk factors
- ⇒ Diagnostic tests for prediabetes are FG, GT test, & HbA_{1c}
- ⇒ Testing tact: taking into consideration
 - Strengths and shortfalls of each test
 - Patient preferences and test accessibility

► Appealing strategies

Primordial prevention (targeting populations)

- Eliminating risk factors public education and encouraging practices through modifications in the environment.
- Provision of access to healthy foods

Primary prevention (individuals with Prediabetes diagnosis)

- Structured program to reduce body weight and increase physical activity, along with a healthy diet

Figure 4 Visual summary.

highest level of major comprehensive professionalism. Patients transition to a healthy lifestyle for lifelong health needs practitioner attention and advancement.

“Progress for health, contemporarily, future favorable completely;

Prediabetes alerting professional tact timely;

Energetic and rationale, ensuring lifelong smiles surely”.

ACKNOWLEDGEMENTS

The author is thankful to authors of all the references quoted for all of the interesting insights into advancing care of children.

FOOTNOTES

Author contributions: Jain S contributed fully to this work.

Conflict-of-interest statement: Sunil Jain declares having no real nor perceivable conflicts of interest.

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S-Editor: Liu JH

L-Editor: Filipodia

P-Editor: Zhao S

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