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SUGAR BOARDS IN CBSE SCHOOLS: A STRATEGIC SCHOOL-BASED APPROACH TO REDUCE SUGAR CONSUMPTION AMONG INDIAN STUDENTS

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ABSTRACT

Unhealthy sugar consumption in childhood remains a serious public health concern, contributing to rising rates of obesity, diabetes and dental disease. School-based initiatives that raise awareness and promote healthier eating habits offer a practical and adaptable pathway to address this issue. This paper synthesizes current scientific evidence on the health impacts of excessive sugar intake among children, assesses intake patterns among Indian school-aged populations, and reviews global and national interventions effective in reducing childhood sugar consumption. Unlike a conventional narrative review, this article integrates scientific evidence, policy guidance, and international best practices to develop a practical implementation framework tailored to CBSE schools. Drawing on international best practices and adapting them to the Indian educational ecosystem, the framework integrates five core pillars: curriculum-linked visual boards, interactive student activities, parent and community engagement, multi-stakeholder collaboration, and advocacy for supportive policies. A concise monitoring and evaluation approach is outlined to assess implementation fidelity, student behavior change and school-level policy compliance. This paper translates policy into action by proposing a practical and scalable school-based intervention that supports India's broader goals for non-communicable disease prevention.

Key words: Sugar Boards, Health, Nutrition Education, CBSE, Policy implementation, Public health intervention

Excessive sugar consumption among children has emerged as a critical public health issue worldwide. Diets high in added or free sugars contribute to excess energy intake with low nutrient density, increasing the risk of obesity, metabolic syndrome, type 2 diabetes (T2DM) and dental caries. In India, recent evidence indicates a worrying rise in T2DM and diabetes incidence among younger age groups over the past decade (Yan *et al.,* 2022; Huang *et al.,* 2023).

Despite this growing public health burden, there is no consolidated, evidence-based guidance tailored specifically for school-level sugar-reduction interventions in India. While several studies such as a cluster randomized trial in Chandigarh (Kaur *et al.,* 2025) demonstrating the effectiveness of school-based health promotion on dietary behaviours and obesity risk factors, (O'Brien *et al.,* 2021) and an intervention in Udupi reporting improvements in lifestyle practices and body fat reduction (Nayak and Bhat, 2016) have addressed broader nutrition education or obesity prevention, none have specifically targeted sugar intake or established a replicable framework for implementing "Sugar Boards."

In response, on May 14, 2025, the Central Board of Secondary Education (CBSE), an autonomous organisation under the Ministry of Education, Government of India, issued a directive (following a recommendation by the National Commission for Protection of Child Rights) requiring all affiliated schools to establish "Sugar Boards" and conduct sugar-awareness programs. These visual boards are intended to display daily sugar limits, sugar content in commonly consumed snacks and beverages, health risks associated with excess sugar intake, and healthier dietary alternatives. Schools are also required to conduct workshops and report implementation status to CBSE as per given schedules (Khalatkar, 2025).

This paper presents a comprehensive, India centric, and evidence based synthesis of the impact of sugar consumption on child health, current intake trends, relevant dietary guidelines, and global school-based interventions effective in reducing sugar intake. In doing so, it addresses a critical policy-to-practice gap in the Indian school health landscape, namely the absence of a scalable and operational model for implementing sugar-reduction boards within schools.

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To address this gap, this paper proposes a structured, school-based implementation framework for the CBSE "Sugar Boards" initiative. The framework translates existing scientific evidence and policy intent into practical strategies for school implementation, supported by stakeholder engagement and a monitoring and evaluation framework to assess implementation fidelity, adoption, and outcomes. Unlike conventional narrative reviews, this article extends beyond evidence synthesis to develop a practical framework for operationalizing the CBSE Sugar Board directive. To the best of our knowledge, this is the first paper to translate the recent CBSE directive into an evidence-informed implementation framework supported by measurable implementation and evaluation indicators. The strategic framework and monitoring approach are described in the subsequent sections.

2. Methodology for Strategic Framework Development

The proposed strategic framework for implementing "Sugar Boards" in CBSE schools was developed using a multi-step, evidence-informed planning approach. First, an extensive narrative review of peer-reviewed literature, publicly available national policy documents, and international guidelines on childhood sugar intake, school-based nutrition interventions, and visual education tools was conducted using databases such as PubMed, Scopus, and Google Scholar. The literature search covered publications from January 2010 to May 2025 and used combinations of keywords including "sugar," "free sugar," "added sugar," "children," "adolescents," "schools," "school-based intervention," "nutrition education," and "policy."

Studies were included if they were published in English and comprised systematic reviews, randomized or quasi-experimental intervention studies, observational studies with policy relevance, or authoritative policy and guideline documents. Studies focusing exclusively on adult populations, clinical treatment of metabolic disease, or non-school settings without relevance to child or adolescent dietary behavior were excluded. Particular emphasis was placed on identifying successful global models of school-based behavior change programs (e.g., "Water Wins" in Slovenia, Chile's front-of-pack labeling reforms, and India's Eat Right campaign).

Subsequently, the CBSE directive issued in May 2025 was examined for operational feasibility using a policy-to-practice lens. A purposive selection approach was adopted to prioritize high quality evidence and policy relevant studies rather than exhaustive quantitative screening, consistent with the objectives of a narrative, translational review. Potential barriers and enablers were assessed in the context of prior Indian school-based health initiatives, with attention to behavioral and environmental factors influencing sugar consumption and health literacy among students.

The framework was then designed to be adaptable to diverse Indian school contexts, incorporating mechanisms such as peer-led learning, local language adaptation, CSR-supported implementation, and context-sensitive visual tools. A monitoring and evaluation (M&E) logic model was constructed to support phased implementation and iterative refinement. The proposed model was further refined through expert consultations involving professionals from public health nutrition, school health programs, food regulation, and education (nH"6–8), whose feedback was used to strengthen feasibility, clarity, and policy alignment. The framework was cross-referenced with existing CBSE and FSSAI guidelines to ensure alignment with current educational and regulatory policies and practical applicability across varied settings.

The framework was developed using evidence-informed principles of policy translation and implementation planning. Evidence synthesis was combined with contextual adaptation to the Indian school system, considering implementation feasibility, existing educational policies, and contextual factors likely to influence adoption across CBSE schools. The proposed framework is conceptual and is intended to guide future pilot implementation and empirical validation rather than represent outcomes from an intervention that has already been tested.

3. Health Impacts of Excess Sugar Intake and Recommended Limits in Children

Excessive consumption of added sugars referred to as "free sugars" by the World Health Organization (WHO) in children is strongly associated with multiple adverse health outcomes. Sugar-

sweetened beverages (SSBs) and sweets contribute calorie-dense, nutrient-poor "empty" calories that promote weight gain and increase the risk of obesity and metabolic syndrome. An umbrella review concluded that high sugar intake is "generally more harmful than beneficial for health, especially in cardiometabolic disease," recommending a limit of less than 25 g/day of added sugars (Huang *et al.,* 2023). Multiple studies have documented clear associations between high-sugar diets in children and increased adiposity as well as insulin resistance (Gulati and Misra, 2014; Das *et al.,* 2020; Raghupathy *et al*., 2010). Indian research further emphasizes the population's heightened susceptibility to abdominal obesity and diabetes, strengthening the case for reducing sugar intake below the commonly cited threshold of approximately 10% of total energy (Gulati and Misra, 2014).

Type 2 diabetes (T2DM), once considered rare in children, is now increasing in parallel with the rise in childhood obesity. The CBSE has cited "a sharp increase in type 2 diabetes among children" as a key rationale for introducing the Sugar Board directive. Although comprehensive national data on pediatric diabetes incidence remain limited, regional evidence indicates a growing prevalence among adolescents and young adults (Nanditha *et al.*, 2024). A cohort study from southern India reported a 73% increase in T2DM prevalence among individuals aged 20–39 years over a decade, with obesity identified as the primary driver (Goyal and Vanita, 2025). While not all participants were school-aged, these findings reflect broader dietary and metabolic transitions relevant to youth populations. Supporting this, a school-based study in urban eastern India found that 32% of overweight or obese children exhibited insulin resistance, a key precursor to T2DM (Das *et al*., 2021). Diets high in added sugars are implicated in this trend by increasing insulin demand and accelerating â-cell dysfunction.

Beyond metabolic outcomes, frequent sugar exposure is the primary driver of childhood dental caries, leading to pain, infection, and school absenteeism. WHO has emphasized that dental pain and untreated caries negatively affect learning and long-term oral health. In India, several studies report strong associations between consumption of SSBs and sweets and high caries prevalence (Honne *et al.,* 2012; Shah *et al*., 2024). For example, obese Indian adolescents were found to have 3.7 times higher odds of developing dental caries compared with their peers, with daily sugar intake identified as a significant risk factor (OR 3.1, 95% CI 1.25–7.85) (Honne *et al*., 2012). These findings highlight that sugar reduction is not only central to obesity prevention but also critical for children's immediate well-being and educational outcomes (Yan *et al*., 2022).

High sugar intake has also been independently linked to adverse lipid profiles and liver health. Regular consumption of sodas and sweets increases triglyceride levels and hepatic fat deposition, contributing to non-alcoholic fatty liver disease. The BMJ umbrella review reported associations between sugar intake and increased risks of coronary heart disease and mortality (Huang *et al.,* 2023). Collectively, this evidence links excessive dietary sugar in children to overweight and obesity (with downstream cardiometabolic consequences), dental decay, and broader metabolic dysfunction (Malhotra *et al*., 2025). The CBSE directive explicitly acknowledges that high sugar availability in schools contributes to "diabetes, obesity, dental issues and other health problems," which may adversely affect academic performance, reinforcing the need for decisive school-based interventions.

Global and national nutrition authorities consistently recommend stringent limits on added and free sugar intake in children to mitigate these health risks. WHO advises reducing free sugar intake to less than 10% of total daily energy, with a conditional recommendation to further reduce intake to 5% for additional benefits (Yan *et al*., 2022). The American Heart Association similarly recommends limiting added sugar intake to no more than 25 g/day (approximately 6 teaspoons) for children aged 2–18 years (Vos *et al*., 2017). In India, the ICMR - National Institute of Nutrition recommends restricting free sugar intake to less than 5% of total daily energy for children over two years of age and advises avoiding added sugars altogether for children under two (ICMR-NIN, 2023). These recommendations reflect India's heightened vulnerability to insulin resistance and central adiposity (Gulati and Misra, 2014). The Food Safety and Standards Authority of India (FSSAI) has further strengthened this policy

environment by mandating front-of-pack labelling of added sugar content based on a 50 g daily reference intake (Bera *et al*., 2023).

Despite these clear guidelines, evidence indicates that Indian children consistently exceed recommended sugar intake levels. CBSE-cited data show that children aged 4-10 years derive approximately 13% of daily energy from sugars, while adolescents aged 11-18 years consume around 15%, far exceeding the WHO's 5% benchmark (Khalatkar, 2025). Independent studies corroborate these findings: in an urban Mumbai cohort, more than half of children aged 0-6 years consumed sugary snacks or beverages daily (Kumar *et al.,* 2023; Yeom and Cho, 2019). Among children aged 3-6 years, nearly 60% consumed sweet snacks daily, and 11-12% regularly consumed sugary drinks (Yeom and Cho, 2019). Similarly, a recent study reported that 55% of Indian adolescents aged 10-16 years had high sugar intake, accompanied by poor overall diet quality, including low fruit and vegetable consumption (Kaur *et al*., 2025).

These patterns accentuate a substantial gap between dietary recommendations and real world intake among Indian children. Excessive sugar exposure during formative years, when lifelong dietary habits are established, strengthens the rationale for structured educational, environmental, and policy-driven interventions within school settings. In this context, initiatives such as CBSE's "Sugar Boards" represent a timely and evidence-informed approach to reducing sugar intake and addressing diet related non-communicable disease risk early in life.

4. School-Based Evidence and Rationale for Sugar Boards

Experience from around the world shows that schools are a critical venue for effective dietary interventions. A variety of school-based programs that combine education, environmental modification, and policy support have demonstrated success in reducing children's sugar consumption and improving health outcomes. While India has long-standing school meal initiatives such as the Mid-Day Meal Programme that primarily address calorie adequacy and undernutrition, there has been limited emphasis on school-level policy instruments explicitly targeting added sugar consumption, nutrition literacy related to processed foods, or regulation of sugar-rich snacks and beverages within school environments.

4.1 Education and Communication Interventions in Schools

Evidence from diverse global settings demonstrates that structured, school based communication and nutrition education can meaningfully reduce sugar consumption among children. In a randomized controlled trial in Korean preschools, an interactive sugar-reduction curriculum incorporating cooking activities, games, visual aids, and a "sugar board game" significantly reduced total sugar intake while increasing protein and fiber consumption in the intervention group (Ickovics *et al*., 2019). Similarly, a U.S. school-based pilot integrating classroom lessons with supportive school policies reported that, over three years, students in intervention schools consumed fewer sugar-sweetened beverages and showed minimal increases in BMI compared with peers who gained approximately 2 lb per year without intervention (Kamin *et al*., 2022).

Beyond curriculum-based instruction, social and behavioral communication strategies further enhance impact. The Slovenian "Water Wins" campaign illustrated the effectiveness of combining behavior focused messaging with peer involvement and school-level engagement. In this primary school intervention, visible messaging, contests and student participation implemented alongside environmental changes, resulted in significantly higher water consumption and lower soda intake than environmental measures alone (Olvera *et al*., 2024). These findings suggest that communication strategies that actively engage students help translate knowledge into sustained behaviour change.

School based nutrition education also plays a critical role in habit formation and long-term dietary tracking. Longitudinal evidence from a Canadian cohort followed over two decades showed that children exposed early to healthier dietary patterns were more likely to maintain those habits into adulthood, whereas high-fat, high-sugar "Western" dietary patterns tended to persist over time (Movassagh *et al.,* 2017). Schools are uniquely positioned to influence this process by providing repeated, structured exposure during formative years and by building practical skills such as food label interpretation and healthier snack choices. The Korean preschool intervention further demonstrated that sugar-focused education not only reduced sugar intake but also improved overall dietary quality, indicating broader nutritional benefits (Ickovics *et al.,* 2019).

Importantly, the benefits of improved nutrition extend beyond physical health. Diets high in sugar and low in essential nutrients have been associated with poorer cognitive performance, lower academic achievement, and behavioural difficulties, whereas healthier dietary patterns support learning and concentration (Yan *et al*., 2022). Programs that integrate peer learning and parental engagement further reinforce these effects by promoting consistent dietary norms across home and school environments. In this context, CBSE's emphasis on workshops, peer-led learning, and parental involvement aligns well with evidence that education centered approaches are most effective when socially reinforced (Ickovics *et al*., 2019; Olvera *et al*., 2024; Movassagh *et al.,* 2017).

4.2 Environmental and Policy Interventions in Schools

Evidence from global interventions consistently shows that modifying school food environments alongside education leads to greater and more sustained reductions in sugar consumption. In Mexico, the installation of purified water dispensers in classrooms, combined with nutrition education, increased daily water intake by approximately 200 mL and reduced energy and sugar intake within six months (Olvera *et al.,* 2024). Chile's comprehensive 2016 food policy which restricted the sale of high-sugar products in schools and mandated front-of-pack warning labels was associated with a 24% decline in household purchases of sugary beverages within two years, demonstrating spillover effects beyond the school setting (Rebolledo *et al*., 2025). Similar national regulations in Mexico removing sugary drinks from school campuses have contributed to declining childhood obesity trends.

Public health campaigns and school nutrition standards further reinforce these structural changes. The UK's "Change4Life" Sugar Smart initiative successfully influenced parental behaviors and reduced children's sugar intake by promoting healthier food choices, particularly at breakfast (Ogundijo and Tas, 2025). In the United States, implementation of federal "Smart Snacks" standards reduced added sugars in school meals, highlighting the role of national policy in reshaping dietary exposure. Across these contexts, a consistent conclusion emerges: education is most effective when reinforced by supportive food environments and policy measures (Kamin *et al.,* 2022).

By integrating visible communication tools with school-level reforms such as workshops and potential canteen regulations, CBSE's "Sugar Boards" initiative reflects this evidence-based, multi-component approach. The convergence of education, environmental change, and policy support positions Sugar Boards as a robust and contextually appropriate strategy for reducing sugar intake among Indian schoolchildren.

5. Implementation Framework for CBSE "Sugar Boards"

Building on the evidence and best practices discussed earlier, we propose a strategic implementation framework (Fig. 1) to operationalize the CBSE Sugar Board directive across urban and rural Indian school contexts. The framework comprises five interlinked pillars, each adaptable to local resources and supported by institutional collaboration and policy alignment.

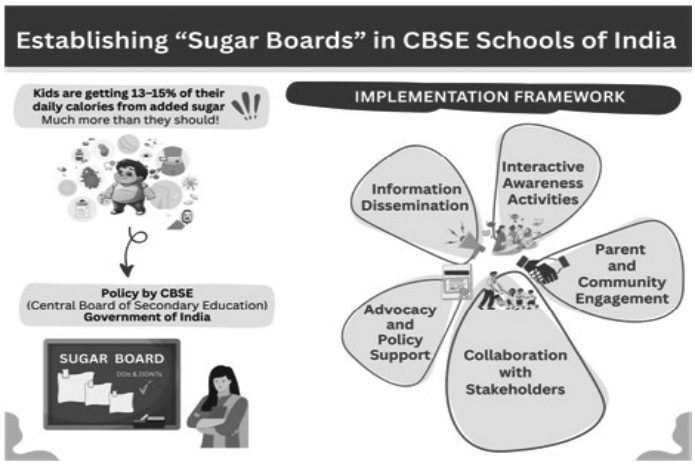

Fig 1. Establishment of Sugar Boards in CBSE Schools: A strategic framework outlining the formation, roles, and operational components of Sugar Boards to reduce sugar consumption among school children.

Pillar 1: Information Dissemination through Visual Sugar Boards and Curriculum Integration

At the core of the CBSE directive are visually engaging "Sugar Boards" positioned in prominent school locations such as classrooms, canteens, hallways, and near drinking water stations. These boards should clearly communicate WHO or ICMR-National Institute of Nutrition recommended limits for free sugar intake (expressed in grams and teaspoons), the sugar content of commonly consumed snacks and beverages, associated health risks, and healthier alternatives. The use of infographics, age-appropriate language, and visually appealing formats is essential to ensure comprehension and engagement across different age groups. For sustained impact, information conveyed through Sugar Boards must be reinforced through systematic curriculum integration. Nutrition concepts can be embedded across subjects such as carbohydrate metabolism in science, sugar intake calculations in mathematics, dietary transitions in social studies, and poster or creative content development in art classes. This cross-disciplinary approach aligns with the National Education Policy (NEP) 2020 emphasis on holistic health education and experiential learning, thereby embedding nutrition literacy into routine academic instruction rather than treating it as a standalone activity (Misra *et al*., 2024; Ambikapathy *et al.,* 2024).

Pillar 2: Student Engagement through Interactive and Experiential Learning Activities

To complement visual information, schools should implement interactive and recurring engagement activities that actively involve students in learning about sugar and health. These may include "Sugar Awareness Weeks," hands-on demonstrations measuring sugar content in beverages, food label reading exercises, quizzes, exhibitions, and simple cooking demonstrations focused on low-sugar alternatives. Such experiential activities translate abstract nutritional information into tangible understanding and practical skills. Peer-led initiatives, in which older students serve as "health ambassadors" to mentor younger peers, can further reinforce learning and help normalize healthier dietary choices within the school environment. Evidence suggests that interactive, participatory approaches are more effective in improving knowledge retention and influencing behavior when implemented as regular, structured programs rather than one-time events (Ickovics *et al.,* 2019). Urban schools may leverage guest experts and digital engagement tools, whereas rural and semi-urban schools can rely on trained teachers and community health workers, ensuring inclusivity, contextual relevance, and sustainability of implementation.

Pillar 3: Parent and Community Engagement

Recognizing that children's dietary behaviors are shaped strongly by their home environments, schools should actively involve parents and communities in sugar-reduction efforts. Parent-teacher meetings, newsletters, and workshops can highlight sugar content in commonly consumed foods and promote healthier alternatives. Disseminating "Sugar Facts" in local languages and organizing nutrition booths at community events reinforce key messages. Collaboration with local health professionals, including pediatricians and dentists, for talks and health camps helps link sugar intake to visible health outcomes such as obesity risk and dental health. Such engagement promotes consistency between school and home environments and enhances the overall effectiveness of school-based interventions (Wang *et al.,* 2016).

Pillar 4: Stakeholder Engagement and Policy Advocacy

Effective implementation requires coordinated action across education, health, food systems, and regulatory stakeholders (Nikniaz *et al.,* 2022; Brown *et al*., 2022; Guariguata *et al*., 2020). Key elements include:

- **Healthcare professionals and dietitians:** Providing technical guidance for awareness activities and supporting healthier canteen offerings (e.g., replacing flavored milk with plain milk, fruit instead of juice). Periodic consultations can help refine interventions based on observed outcomes.
- **School leadership and staff:** Principals and administrators play a central role by allocating time, resources, and oversight. Trained teachers can deliver credible messaging, while parent-teacher associations assist with logistics and outreach.

- **Food vendors and canteen operators:** Enforcing vendor policies that restrict sugary drinks and packaged sweets is critical. Promoting healthier options such as fruit chaat, roasted nuts, or salad sandwiches aligns with existing FSSAI guidance, including restrictions on junk food near schools (Yeom and Cho, 2019). Evidence from states such as Maharashtra demonstrates the feasibility of enforcing "no sugar" canteen norms through contractual clauses and periodic monitoring.
- **Regulatory bodies and advocacy platforms:** Alignment with initiatives such as FSSAI's *Eat Right* campaign and front-of-pack labelling reforms reinforces school-level messaging. Schools can also advocate for broader measures such as clearer sugar labelling or restrictions on marketing to children through district and state education forums. Voluntary networks such as a "Sugar-Smart Schools" coalition could further amplify advocacy efforts.

Pillar 5: Scale-up, Contextual Adaptation, and Sustainability

To ensure equitable reach and long term sustainability, the framework emphasizes flexible scale-up and contextual adaptation. Although CBSE school density is lower in deeply rural regions, implementation can be initiated in semi-rural and peri-urban CBSE-affiliated institutions, including Kendriya Vidyalayas and Jawahar Navodaya Vidyalayas.

In resource-constrained settings, public–private partnership (PPP) models can support implementation. Corporate Social Responsibility (CSR) funding may be used for developing visual materials, awareness kits, and teacher training, while child-focused NGOs can assist with local language adaptation, cultural tailoring, and on-ground facilitation. This decentralized approach mirrors successful strategies used in school-based hygiene, nutrition, and life-skills programs and offers a pragmatic alternative to reliance on long-cycle government funding mechanisms (Lawania and Kapoor, 2018; Prakash and Chandra, 2024; Sengupta, 2016). Urban schools may additionally adopt digital displays and interactive tools, whereas rural schools can rely on hand-drawn posters, wall art, and local media such as community radio. In all contexts, messaging should be culturally relevant and locally grounded, for example, addressing both traditional sweets and modern packaged snacks to maximize acceptability and impact.

6. Monitoring and Evaluation

To ensure that the "Sugar Boards" initiative translates into measurable progress, a robust monitoring and evaluation (M&E) framework is proposed (Fig. 2). The framework integrates process, outcome, and impact indicators, enabling schools and regulators to assess implementation fidelity, behavioral change, and potential health effects over time.

Fig 2. Monitoring and Evaluation Framework: Key indicators and evaluation methods for assessing implementation, compliance, and impact of Sugar Boards in CBSE schools.

6.1 Key Indicators: Table 1 summarizes the core indicators for monitoring the Sugar Boards initiative. These indicators are derived from the existing process and outcome measures described earlier and are organized to allow rapid assessment of feasibility and effectiveness.

These indicators collectively capture implementation fidelity, engagement, and short- to medium-term effects, while allowing flexibility based

on school capacity and resources (Kumar *et al*., 2023; Yeom and Cho, 2019; Ickovics *et al.,* 2019; Kamin *et al.,* 2022; Olvera *et al*., 2024; Hassan and Othman, 2025).

6.2 Evaluation Design and Timeline

A before-after evaluation design is recommended. Baseline measurements (knowledge surveys, brief dietary recalls, and available canteen sales data) should be conducted during the first academic term prior to full implementation. Follow-up assessments at 6–12 months can quantify changes in knowledge, behaviors, and selected health metrics. Where feasible, a phased rollout across schools would allow comparison with institutions not yet implementing Sugar Boards, strengthening attribution of observed effects. Data may be disaggregated by age/grade and gender, as evidence suggests differential sugar consumption patterns among sub-groups (Hassan and Othman, 2025). Repeated annual measurements can provide valuable longitudinal insights.

6.3 Reporting and Use of Data

Schools should incorporate M&E findings into their annual reports and internal reviews. Progress toward defined targets (e.g., increased student awareness of sugar limits, reduced availability or sales of sugar-sweetened beverages, improved vendor compliance) can guide mid-course corrections. At the system level, anonymized aggregation of school level data by district or state education authorities would enable monitoring of broader trends without compromising student privacy. Over time, sustained implementation may contribute to shifts in population-level indicators captured by national surveillance systems such as the National Family Health Survey and the National Nutrition Monitoring Bureau. While attribution would be indirect, consistent improvements could reasonably reflect the cumulative impact of school-based sugar reduction efforts.

Overall, this consolidated M&E framework strengthens accountability and supports evidence-based refinement of the Sugar Boards initiative, ensuring that policy intent is translated into meaningful and measurable outcomes.

7. Limitations and foreseeable caveats for the proposed interventions

The proposed Sugar Boards initiative and its evaluation have several methodological and practical limitations that should be acknowledged. Dietary self-report may under-estimate discretionary sugar intake and bias effect estimates; triangulation with objective proxies (e.g., canteen sales, spot checks, validation subsamples) is therefore recommended (Gibson *et al.,* 2017; O'Brien *et al.,* 2021). Implementation quality, intensity and reach commonly vary across schools in multicomponent programmes, complicating interpretation of heterogeneous outcomes; structured process evaluation is needed to document these differences (Ickovics *et al*., 2019; Wilson *et al*., 2009).

Table 1. Key monitoring and evaluation indicators for the Sugar Boards initiative

Indicator level	Key indicators
Process indicators	• % of classrooms/common areas displaying Sugar Boards • Number of sugar-awareness workshops, assemblies and parent meetings conducted • Number of students trained as peer leaders ("Sugar Ambassadors") • Number of student-led activities (posters, competitions, exhibitions) • Extent of curriculum integration (number of lessons/modules addressing sugar intake) • % of school canteens/vendors compliant with sugar-reduction guidelines
Outcome indicators	• % of students correctly identifying recommended sugar limits and high-sugar foods (pre/post surveys) • Change in self-reported frequency of sugary snack and beverage consumption • Change in canteen sales of sugar-sweetened beverages or packaged sweets (units/week), where feasible
Impact indicators	• Change in BMI or waist circumference at annual health check-ups, where resources permit • Incidence of new dental caries reported during routine school health examinations

Several additional caveats merit consideration. Measurement bias may persist due to under-reporting in surveys and limited resources for objective assessment. The surrounding food environment, particularly informal vendors and outside-school food sources, can undermine in-school gains; vendor mapping and local engagement are therefore necessary (Bassi *et al.,* 2021). Compensatory or substitution behaviours such as sourcing sugary products outside the school or switching to other unhealthy alternatives may attenuate observed effects and should be explicitly measured to avoid overestimation of impact (Andreyeva *et al.,* 2022). Variability in implementation across schools may dilute observable effects, particularly in resource-constrained settings. Short follow-up durations limit detection of sustained anthropometric or metabolic changes; longer-term and phased evaluations improve causal inference. Finally, equity and sustainability concerns including resource constraints, reliance on external funding, and enforcement challenges may affect scalability, indicating the need for context-adapted strategies and basic economic tracking (O'Mahony *et al*., 2021). Addressing these limitations prospectively through validation, process evaluation, phased rollouts, and equity-sensitive financing plans will enhance the interpretability and policy relevance of pilot evaluations. The proposed framework has not yet undergone pilot implementation in CBSE schools and therefore its effectiveness remains to be empirically validated.

8. Expected outcomes and policy implications

If implemented as intended, the Sugar Boards framework is expected to produce measurable short and medium term benefits. Short term outcomes include increased student awareness of recommended sugar limits, improved ability to interpret food labels, greater parent and peer engagement, and reduced availability and sales of sugary products in school settings. Medium term effects may include reductions in self-reported sugary snack and beverage consumption and, where resources permit and follow-up is sufficient, stabilization or modest improvement in anthropometric and oral-health indicators (e.g., BMI trends, new dental caries).

At the policy level, successful pilots could support curriculum integration, stronger school food policies, and broader advocacy for labeling and vendor regulation. However, attribution of long-term population-level shifts (Ex: changes detectable in national surveillance such as NFHS) is speculative and would require sustained, scaled implementation combined with rigorous longitudinal evaluation and triangulation with national datasets. Thus, policy implications should remain cautiously framed: pilot evidence can justify scale-up trials, inform national guidance, and catalyze multisectoral actions (education, health, food regulation, and local governance) while recognizing limits to causal attribution at the population level. Future research on pilot rollouts with phased evaluation (including comparator schools), mixed methods process evaluation, and longer-term follow-up are essential to quantify effectiveness, understand mechanisms, assess equity, and estimate cost-effectiveness.

CONCLUSION

Excessive sugar intake in childhood poses clear health risks and warrants focused, practicable school based responses. This paper presents an evidence-informed implementation blueprint designed for operational use by school administrators and policymakers that combines educational messaging, student engagement, stakeholder collaboration, and an monitoring and evaluation toolkit to translate policy into action. Rigorous pilot testing, sustained partnerships, and careful monitoring are the next steps to determine real-world effectiveness and guide fair and inclusive scale-up.

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