

Regulating the Unregulated: A Public Health Case for Setting Sugar Thresholds and Package Caps on Energy Drinks in Nigeria

CHRISTOPHER ENASOR FREGENE

chrisfregene@gmail.com

UNIABUJA/NAFDAC <https://orcid.org/0009-0005-0126-6104>

Dike Bevis Ojji

UNIABUJA

Abimbola Opeyemi Adegboye

Federal University of Technology, Minna, Nigeria

Research Article

Keywords:

Posted Date: July 9th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10290672/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: The authors declare no competing interests.

Abstract

Background

The Nigerian nutrition landscape is experiencing a rapid transition, characterized by an escalating burden of diet-related non-communicable diseases (NCDs) alongside persistent undernutrition. Energy drinks (formulated caffeinated beverages) have achieved high market penetration across diverse socioeconomic groups. While the National Agency for Food and Drug Administration and Control (NAFDAC) regulates caffeine concentration thresholds (14.5–32 mg/100 mL), the concurrent sugar density and package volumes remain largely unlegislated. This study models free sugar exposure from commercial energy drinks in Nigeria, assesses the public health implications against World Health Organization (WHO) guidelines, evaluates recent legislative shifts from volume-based to retail-price excise levies, and proposes structural policy interventions.

Methods

A deterministic exposure assessment and mathematical simulation modeled sugar intake from 10 commercial energy drink brands across standard Nigerian market volumes (250 mL, 330 mL, and 500 mL). A comparative policy analysis evaluated global regulatory models (the United Kingdom, South Africa, and Saudi Arabia) against Nigeria's legislative architecture, including the marketing bans to children under the NAFDAC 2025 frameworks.

Results

The mean sugar density across the sampled brands was 10.27 g/100 mL, ranging from 5.2 g/100 mL to 13.5 g/100 mL. A single 500 mL serving of the market leader delivers 67.5 g of free sugars, which represents 135% of the daily limit (50 g/day) strongly recommended by the WHO for a 2,000-kcal diet. The newly enacted retail-price levy creates a stronger fiscal instrument than the previous ₦10/litre volume tax, but lacks nutrient-profile indexing to incentivize product reformulation.

Conclusions

Uncapped sugar density and escalating container sizes in the energy drink sector present major metabolic and dental health risks for the Nigerian population. To protect public health, the federal government should implement a two-pronged strategy: introduce a statutory sugar cap of 5.0 g/100 mL and mandate a maximum package volume of 250 mL for high-caffeine beverages. Furthermore, the retail-price levy should be restructured into a tiered system based on nutrient profiles to encourage product reformulation and advance national nutrition goals.

Introduction

The global nutrition transition is accelerating across low- and middle-income countries (LMICs), shifting consumption patterns away from traditional diets toward ultra-processed foods and sugar-sweetened beverages (SSBs). Nigeria, the most populous nation in Africa, is currently navigating a complex public health challenge. The country faces persistent micronutrient deficiencies and wasting alongside rising rates of overweight, obesity, and related metabolic NCDs like type 2 diabetes and hypertension [12].

Within this landscape, the market for formulated caffeinated beverages—commonly known as energy drinks—has grown substantially. Once premium imported items, local manufacturing advances and competitive pricing have turned these products into mass-market commodities. They are heavily consumed by long-distance commercial drivers, manual laborers, artisanal workers, and students seeking a low-cost tool to manage fatigue and sustain physical output.

From a regulatory perspective, Nigeria's oversight of these beverages has focused on acute toxicity rather than long-term metabolic health. NAFDAC strictly enforces chemical and compositional baselines for these drinks, stipulating that a formulated caffeinated beverage must contain between 14.5 mg and 32 mg of caffeine per 100 mL [2].

However, the sugar content that accompanies these stimulants has remained largely unregulated. By focusing regulatory attention primarily on caffeine caps, a policy gap has emerged: manufacturers can include high amounts of free sugars without facing legal limits on concentration or total package volume.

The health consequences of this policy gap are significant. The WHO guidelines strongly recommend that both adults and children reduce their daily intake of free sugars to less than 10% of total energy intake (approximately 50 g per day for an average adult) to lower the risk of unhealthy weight gain, metabolic syndrome, and dental caries [3].

In Nigeria, where oral health infrastructure is limited and out-of-pocket medical expenses are high, the widespread availability of high-sugar, large-volume beverages presents a distinct public health risk. Figure 1 shows how present regulatory focus creates a policy gap and poses public health risk.

This health risk is further compounded by the introduction of larger container sizes. The local market has shifted from traditional 250 mL slim cans to 330 mL and 500 mL plastic (PET) bottles, which encourage the consumption of larger volumes in a single sitting.

Recognizing these risks, Nigeria has updated its fiscal policies, transitioning from a flat, volume-based tax (₦10 per litre) to an ad valorem retail-price levy on SSBs [4]. Additionally, NAFDAC has draft *Marketing of Foods and Non-Alcoholic Beverages to Children Regulations*, which prohibit advertising these products to children [5–6].

While these legislative changes represent positive steps toward alignment with global nutrition frameworks like the Scaling Up Nutrition (SUN) Movement, UNICEF’s Child Nutrition Fund priorities, and the WHO’s Global Action Plan for the Prevention and Control of NCDs, their public health impact remains limited [1]. The current retail-price levy does not differentiate between beverages based on their actual sugar density, meaning a high-sugar energy drink faces the same tax structure as a lower-sugar alternative.

This paper provides a public health evaluation of the sugar profiles and package sizes of popular energy drinks in Nigeria. Through predictive exposure modeling and comparative policy analysis, we assess the current regulatory landscape and propose evidence-based policy adjustments—specifically statutory sugar thresholds and package size caps—designed to encourage industry reformulation, support national public health goals, and reduce the burden of preventable chronic diseases.

Methods

Product Matrix and Nutrient Data Compilation

Sugar concentration parameters (g/100 mL) were systematically extracted from the mandatory nutrient declarations on the packaging of 10 dominant commercial energy drink brands distributed across urban and peri-urban retail markets in Nigeria: Predator, Supa Komando, Fearless, Climax, Power Horse, Bullet, Red Bull, Monster, Reaktor, and Maga. Three standard commercial container volumes were utilized as volumetric anchors to assess real-world exposure: 250 mL (can), 330 mL (can/bottle), and 500 mL (PET bottle).

Predictive Mathematical Modeling of Sugar Exposure

A deterministic exposure model was constructed to simulate the absolute mass of free sugars ingested during a single consumption event (S_{total}), defined as the complete consumption of an individual package unit:

$$S_{total} = (C_{sugar} \div 100) \times V_{pack}$$

Where C_{sugar} represents the brand-specific sugar concentration (g/100 mL) and V_{pack} represents the container volume (mL).

To measure deviation from international nutritional benchmarks, the percentage exhaustion of the WHO’s strongly recommended health threshold (50 g/day of free sugars) was calculated using the equation:

$$\% \text{ WHO Threshold} = (S_{total} \div 50) \times 100$$

Comparative Policy Analysis

A comparative analysis evaluated three international regulatory models that have addressed liquid sugar consumption through fiscal and structural mechanisms:

1. **The United Kingdom's Soft Drinks Industry Levy (SDIL):** A tiered fiscal system designed to incentivize product reformulation by exempting beverages below specific sugar thresholds [7].
2. **South Africa's Health Promotion Levy (HPL):** A gram-based taxation system applied directly to sugar content exceeding a defined baseline per 100 mL [8].
3. **Saudi Arabia's Food and Drug Authority (SFDA) Standard:** A comprehensive framework combining high excise taxes with strict package size caps and targeted marketing restrictions on energy drinks [9].

These models were compared against Nigeria's current regulatory framework, which includes the ad valorem retail-price levy and NAFDAC's marketing restrictions, to identify areas for policy optimization.

Results

Market Profile and Sugar Density Analysis

The evaluated market portfolio demonstrated a high baseline sugar density. The mean sugar concentration across the 10 surveyed brands was **10.27 g/100 mL**.

The distribution shows a wide range, from a low of 5.2 g/100 mL (Maga) to a maximum peak of 13.5 g/100 mL (Predator). A notable characteristic of the local market is the standardization of sugar content; 60% of the evaluated brands maintain a static sugar density of exactly 11.0 g/100 mL, establishing a highly uniform, high-sugar profile across competing products.

Total Sugar Ingestion by Container Volume

Adjusting for actual purchasing options demonstrates how larger package sizes increase total sugar exposure during a single consumption event (Table 1).

Table 1
Relationship between sugar density and package sizes

Brand Name	Sugar Density (g/100 mL)	Sugar Content in 250 mL Can (g)	Sugar Content in 330 mL Bottle (g)	Sugar Content in 500 mL Bottle (g)
Predator	13.5	33.75	44.55	67.50
Bullet	11.3	28.25	37.29	56.50
Supa Komando	11.0	27.50	36.30	55.00
Climax	11.0	27.50	36.30	55.00
Power Horse	11.0	27.50	36.30	55.00
Red Bull	11.0	27.50	36.30	55.00
Reaktor	11.0	27.50	36.30	55.00
Fearless	9.7	24.25	32.01	48.50
Monster	8.0	20.00	26.40	40.00
Maga	5.2	13.00	17.16	26.00
Market Mean	10.27	25.68	33.89	51.35

Predictive Modeling Against WHO Nutritional Benchmarks

When evaluated against the WHO's strongly recommended health allowance for free sugars (50 g/day), the predictive modeling indicates significant threshold violations across nearly all available configurations:

- **250 mL Configuration:** The average 250 mL can deliver 25.68 g of sugar, reaching **51.36%** of the daily recommended limit in a single serving. For the highest-sugar brand (Predator), a 250 mL serving supplies 67.5% of the daily allowance.
- **330 mL Configuration:** A single mid-sized beverage exposes consumers to a mean sugar load of 33.89 g, representing **67.78%** of the maximum daily intake.
- **500 mL Configuration:** The larger 500 mL package volume, which offers a lower cost per fluid ounce, results in a mean sugar intake of 51.35 g—or **102.7%** of the total daily recommended limit. Consuming a single 500 mL container of Predator provides 67.5 g of free sugar, which is **135.0%** of the daily threshold. Figure 2 compares sugar intake from the consumption of different pack sizes against the WHO recommended daily sugar limit.

Discussion

Pathophysiological Consequences and Systemic Risks

The predictive modeling indicates that the energy drink market in Nigeria acts as a significant contributor to unmonitored free sugar consumption. From a metabolic perspective, liquid sugars are absorbed more rapidly than sugars contained within solid food matrices. This rapid absorption triggers a high glycemic response, forcing a corresponding spike in insulin secretion. Over time, consistent exposure to high liquid sugar volumes can overwhelm hepatic metabolic pathways, leading to *de novo* lipogenesis, increased visceral fat accumulation, hepatic steatosis, peripheral insulin resistance, and an elevated risk of type 2 diabetes and metabolic syndrome [10–11].

Furthermore, the high sugar density is combined with systemic acidity—primarily from citric acid and carbonation stabilizers—resulting in a low beverage pH. This combination poses a distinct risk for dental health, specifically dental caries and enamel erosion. The low pH initiates chemical demineralization of the tooth enamel, while the abundant free sugars are fermented by cariogenic oral bacteria, producing localized organic acids that accelerate decay [12].

In Nigeria, where access to restorative oral healthcare is uneven and concentrated in urban centers, widespread consumption of these products can worsen dental disease burdens, particularly among younger populations and low-income demographics who may lack access to regular dental treatment. Figure 3 shows how high liquid sugar ingestion results in metabolic and dental diseases.

Critical Analysis of Nigeria's Current Fiscal and Structural Policies

The recent passage of the ad valorem retail-price levy bill on SSBs represents an update over the previous flat volume tax of ₦10 per litre [4]. Volume-based taxes apply an identical financial penalty to a beverage regardless of its nutritional composition, meaning a high-sugar energy drink and a low-sugar alternative face the same tax rate per unit of volume.

The ad valorem retail-price levy addresses this to some degree by scaling the tax obligation with the market value of the product, capturing higher absolute revenue from premium brands. However, it still lacks a nutrient-profile index. Because the tax rate is tied to retail price rather than sugar density, it does not create a direct financial incentive for manufacturers to reformulate their products to contain less sugar. High-sugar, low-production-cost brands can maintain high sugar levels while adjusting retail pricing to minimize the impact on consumer demand.

On the structural side, NAFDAC's draft regulations prohibiting the marketing of these drinks to children represent an important public health measure [5]. However, energy drink marketing in Nigeria often targets broader demographic categories, utilizing themes of physical endurance, economic resilience, and social vitality. These campaigns are frequently deployed in transit hubs, open-air markets, and

fitness venues, reaching adolescent and young adult populations who fall outside the strict legal definition of children but remain vulnerable to aggressive advertising.

Additionally, the availability of large-format 500 mL containers acts as an effective marketing and distribution tool, enabling high sugar exposure per purchase occasion despite existing marketing restrictions.

Global Insights for Policy Integration

To build a more comprehensive regulatory framework, Nigeria can adapt strategies from international models that combine fiscal tools with structural limits:

1. **The United Kingdom's Reformulation Thresholds:** The UK Soft Drinks Industry Levy utilizes clear, tier-based sugar thresholds (< 5.0 g/100 mL is untaxed; ≥ 5.0 to 8.0 g is moderately taxed; >8.0 g faces a higher tax tier) [7]. This framework incentivized more than 45% of manufacturers to reformulate their products below the 5.0 g threshold prior to formal implementation, demonstrating that targeted fiscal structures can drive industry-wide recipe changes.
2. **South Africa's Mass-Based Taxation:** The Health Promotion Levy applies a tax directly to each gram of sugar exceeding a baseline of 4.0 g/100 mL [8]. This design links the tax burden directly to the total mass of sugar distributed into the food supply, making high-sugar formulations less economically viable for manufacturers.
3. **Saudi Arabia's Combined Structural Framework:** The Saudi Food and Drug Authority applies a flat 100% excise tax to energy drinks, enforces a maximum volume cap on individual containers, and prohibits their sale in educational, governmental, and public sports facilities [9]. This model demonstrates how combining fiscal policies with physical availability limits can reduce population-level exposure to high-sugar, high-caffeine products.

Policy Recommendations for Nigeria

To address the high sugar density and increasing package sizes in the energy drink sector, a coordinated strategy involving NAFDAC, the Federal Ministry of Health, and international public health organizations is recommended (Fig. 4):

1. Enact a Statutory Sugar Cap for High-Caffeine Formulations

NAFDAC should expand its current composition regulations for formulated caffeinated beverages by introducing a mandatory upper limit on sugar density [2]. It is recommended to set a statutory cap of **5.0 g of sugar per 100 mL** for any beverage containing between 14.5 mg and 32 mg of caffeine. Products that exceed this threshold should be denied product registration, preventing their local manufacture, importation, or distribution.

2. Implement a Mandatory Package Size Cap

To limit single-occasion overconsumption, the Federal Ministry of Health, in coordination with NAFDAC, should mandate a maximum container volume of **250 mL** for all formulated caffeinated beverages sold in the retail market. Manufacturing or importing energy drinks in 330 mL or 500 mL containers should be prohibited, eliminating large-format packaging that encourages high sugar intake.

3. Restructure the Retail-Price Levy into a Tiered System

The Federal Inland Revenue Service (FIRS) should adjust the recently passed ad valorem retail-price levy on SSBs to incorporate sugar-density tiers, creating an economic incentive for product modification:

- **Tier 1 (< 5.0 g sugar/100 mL):** Baseline minimum ad valorem rate to encourage low-sugar options.
- **Tier 2 (5.0–9.0 g sugar/100 mL):** Standard elevated ad valorem tax rate.
- **Tier 3 (> 9.0 g sugar/100 mL):** High excise tax rate designed to discourage production and retail consumption.

4. Require Front-of-Pack Nutrition Labeling (FOPL)

NAFDAC should mandate high-visibility, front-of-pack warning labels on all registered energy drinks. Products that exceed a sugar density of 5.0 g/100 mL during transition periods must display a prominent, black octagonal warning symbol on the front of the packaging stating: **"HIGH IN SUGAR"**. This ensures nutritional information is accessible to consumers regardless of literacy level or language.

5. Expand Marketing Restrictions and Enforcement

The federal government should strengthen current child-marketing protections by prohibiting any energy drink advertising on media platforms where children make up more than 25% of the audience. Furthermore, a mandatory 100-metre alcohol- and stimulant-free sales perimeter should be established around all primary, secondary, and tertiary educational institutions across Nigeria to limit availability to youth.

Conclusion

The high sugar content and growing package sizes of energy drinks (formulated caffeinated beverages) in Nigeria present a clear, addressable public health risk. By introducing structural sugar caps, establishing container volume limits, and adjusting the national retail-price levy to reflect nutrient profiles, Nigerian regulatory bodies can protect consumers from excessive sugar exposure. These measures will support product reformulation, reduce the long-term strain on national healthcare infrastructure, and help lower the incidence of preventable metabolic and dental diseases across the country.

Declarations

Ethics approval and consent to participate

Not applicable. This study utilizes public nutritional information obtained directly from commercially available product packaging and does not involve human participants, tissues, or animals.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

This policy evaluation received no specific grant funding from any public, commercial, or not-for-profit sector agencies.

Authors' contributions

All authors conceived the study design, performed the mathematical exposure modeling, conducted the comparative policy analysis, and drafted the manuscript. They read and approved the final manuscript.

Acknowledgements

The authors acknowledge the regulatory transparency provided by the National Agency for Food and Drug Administration and Control (NAFDAC) through its published draft regulations and public hazard alerts, which served as structural baselines for this policy review.

Availability of data and materials

All data analyzed during this study are included within this published article (specifically presented in the Product Matrix and Nutrient Data Compilation section).

References

1. Scaling Up Nutrition (SUN) Movement (2021) SUN Movement Strategy 3.0 (2021–2025): Country-led action for a world free from malnutrition. SUN Secretariat, Geneva
2. National Agency for Food and Drug Administration and Control (NAFDAC) (2019) Available from: nafdac.gov.ng. Formulated Caffeinated Beverages Labelling Regulations. NAFDAC, Abuja. Accessed 8 July 2026.

3. World Health Organization (2015) Guideline: Sugars intake for adults and children. World Health Organization, Geneva
4. Federal Inland Revenue Service (FIRS) (2024) Excise Duty Act Amendments: Implementation Guidelines for Ad Valorem Retail-Price Levies on Non-Alcoholic Beverages in Nigeria. FIRS, Abuja
5. National Agency for Food and Drug Administration and Control (NAFDAC). (Draft) (2025) Available from: nafdac.gov.ng. Marketing of Foods and Non-Alcoholic Beverages to Children Regulations. NAFDAC, Abuja. Accessed 8 July 2026.
6. National Agency for Food and Drug Administration and Control (NAFDAC) (2023) Available from: nafdac.gov.ng. Public Alert No. 034/2023 – Alert on Recall of G Fuel Brand Energy Drinks Due to High Levels of Caffeine. NAFDAC, Abuja. Accessed 8 July 2026.
7. Briggs ADM, Mytton OT, Madden D, O’Shea D, Rayner M, Scarborough P (2017) Financial and health impacts of the UK soft drinks industry levy: a simulation study. *Lancet Public Health* 2(4):e185–e193
8. Manyema M, Veerman LJ, Chola L, Tugendhaft A, Sartorius B, Labadarios D et al (2014) The potential impact of a 20% tax on sugar-sweetened beverages on obesity in South Africa: a mathematical model. *PLoS ONE* 9(8):e105287
9. Saudi Food and Drug Authority (SFDA) (2019) Executive Regulations for Food Excise Tax Legislation on Energy Drinks and Sugar-Sweetened Beverages. SFDA, Riyadh
10. Popkin BM (2010) Relationship between fluid intake and overweight: the American experience. *Nutr Rev* 68(11):671–678
11. Malik VS, Popkin BM, Bray GA, Després JP, Willett WC, Hu FB (2010) Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care* 33(11):2477–2483
12. Sheiham A, James WP (2014) A new understanding of the relationship between sugars, dental caries and fluoride application: implications for future dietary guidelines. *Public Health Nutr* 17(10):2176–2184

Figures

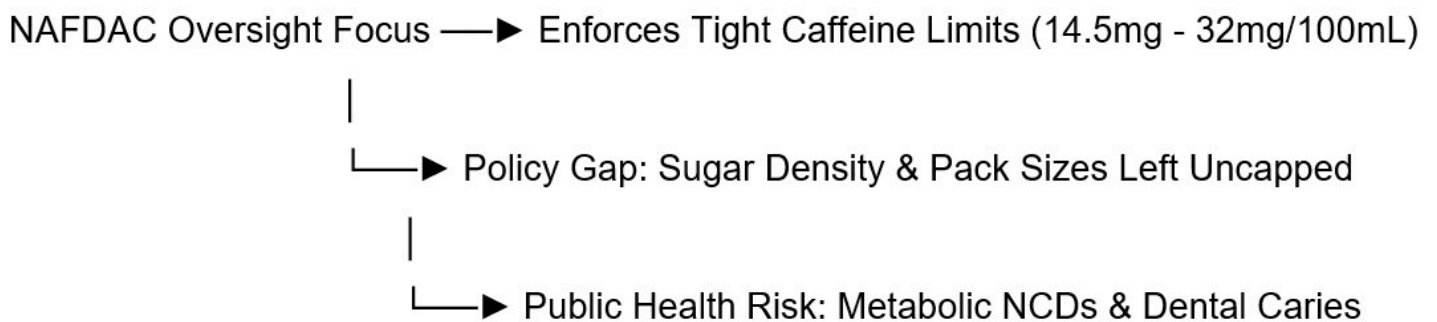


Figure 1

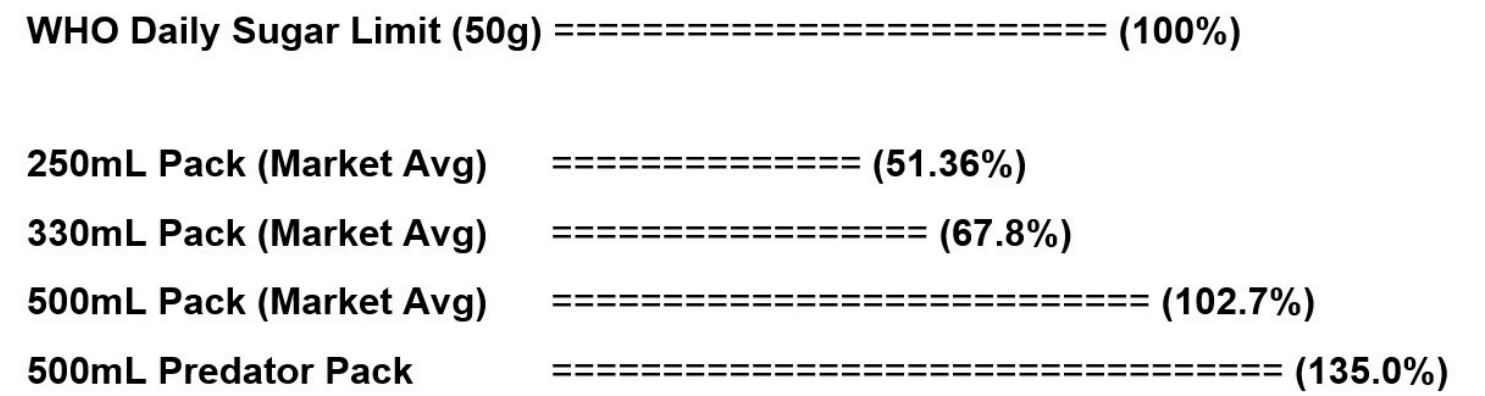


Figure 2

Sugar Intake from the Consumption of Several Pack Sizes against the WHO Recommended Daily Sugar Limit

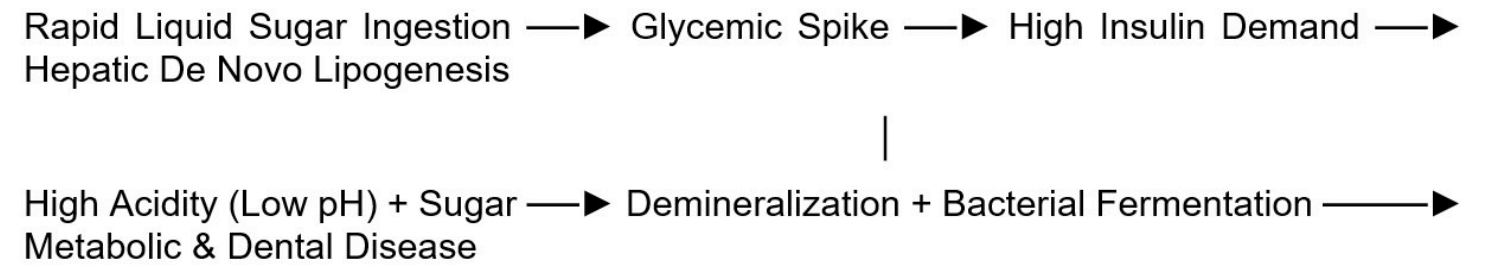


Figure 3

Relationship between Liquid Sugar Ingestion, Metabolic and Dental Diseases



Figure 4

Proposed National Strategy