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Research paper

Primordial prevention: Reducing consumption of sugar-sweetened beverages in racial/ethnic populations

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ABSTRACT

Beyond pharmacotherapy in adulthood, primordial prevention in United States (U.S.) children and adolescents is needed to avoid the upcoming tsunami of cardiometabolic and cardiovascular disease (CVD). Healthcare disparities were unmasked by the disparate morbidity and mortality of COVID-19 in racial/ethnic populations, especially in persons with obesity, diabetes, and CVD. One potential successful strategic improvement of childhood cardiovascular health is to reduce sugar consumption in early life as CVD is the number one cause of death in patients with Type 2 diabetes (T2D). Furthermore, cardiologists treat more patients with T2D than endocrinologists. This commentary challenges cardiovascular specialists and other clinicians to address the increasing burden of cardiometabolic and CVD in adults, especially in racial/ethnic populations, by supporting primordial prevention in childhood.

1. Introduction

Due to multiple factors, including an aging population, increasing obesity, adverse dietary patterns, and physical inactivity, there is a tsunami of cardiometabolic and cardiovascular disease (CVD) looming in the United States (U.S.). This health crisis includes ischemic heart disease, stroke, heart failure, chronic kidney disease and hypertension [1]. The increasing burden of CVD, specifically in individuals with T2D, requires additional patient care by cardiologists, even more so than by endocrinologists [2]. High fasting plasma glucose and T2D are major modifiable risk factors for CVD [1]. Control of these risk factors is an opportunity to prevent CVD events, through utilization of therapeutic lifestyle modifications along with pharmacologic therapies [3]. Nevertheless, early childhood is the most critical life stage to alter the course of CVD; primordial prevention bolsters cardiovascular health (CVH) in early life and is the best safeguard from acquiring related disease in adulthood [4]. Primordial prevention entails healthy lifestyles and behavioral choices before disease or even traditional risk factors are evident [4].

In a recent report quantifying CVH, children with high CVH have a lower burden of subclinical CVD later in adult life [5]. Therefore, maintaining high CVH in youth is a necessary preemptive measure for reducing CVD risk. Obesity increases the risk of both T2D and

hypertension, highlighting the covariate nature of these CVD risk factors [6,7]. Hence, early onset of additive or even multiplicative CVD risk factors leads to poor CVD outcomes [8].

Cardiometabolic health in the U.S. continues to worsen, with only 6.8 % of adults having optimal cardiometabolic health and perhaps the largest adverse outcomes are in adiposity and dysglycemia [9]. There is a need for beneficial public health measures restricting excess nutrients in childhood and potential policy changes may include mandating healthy kid meal options in restaurants and removing sugar-sweetened beverages (SSBs) in schools [5,10].

Non-Hispanic Black (NHB) populations, compared to other racial/ethnic groups, have a higher burden of CVD and suboptimal cardiometabolic health in later years [9]; substandard primordial prevention initiatives are to blame for the rising hypertension and diabetes in the U.S. [4]. Furthermore, both NHB and Hispanic/Latino communities are vulnerable to SSB company marketing tactics, including extensive visual advertisements and reduced soda prices in areas with a higher proportion of NHB and Hispanic/Latino residents. These communities report 65 % lower soda costs and higher healthy beverage prices [11]. Moreover, a negative association exists between higher income and body mass index (BMI) in zip codes with predominantly Black and Hispanic populations, suggesting that the built environment is more predictive of BMI, a CVD risk factor, than socioeconomic status [12]. It is

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important that legislators consider improving food access by incentivizing the creation of grocery stores over convenience stores in food desert areas, which can be identified by zip codes [12]. Dollar stores are a significant food source in low food access areas, however, once a dollar store enters these areas, they often remain low access and without a grocery store [13]. A USDA study determined that dollar store purchases correlate negatively with the purchase of healthful food while conventional grocery stores positively correlate with the purchase of higher quality fresh fruits and vegetables, especially in low-income households [14]. These communities continue to endure disparities in the choices of supermarkets versus convenience stores, making SSBs easier to obtain and less expensive to purchase than healthy drinks [12].

This commentary challenges cardiologists and other clinicians must address the increasing burden of cardiometabolic diseases in adults, especially in racial/ethnic populations, by taking action to support primordial prevention in children. The COVID-19 pandemic sounded a clarion call for the elimination of unacceptable cardiovascular and cardiometabolic disease disparities and there is a clear need to start with primordial prevention [15].

2. The case for primordial prevention: addressing increased cardiovascular risk in childhood

During the pandemic, pediatric obesity in youths aged 5 to 22 years rose from 36.2 % to 45.7 % in over 200,000 children [16]. This rapid weight gain in youth is worrisome, with long-term health consequences including the development of T2D and CVD. Landmark studies such as the Bogalusa Heart Study, Muscatine Study, Cardiovascular Risk in Young Finns Study, and the International Childhood Cardiovascular Cohorts Outcomes Study, link childhood and adolescent health outcomes with adult life (Fig. 1) [4,17–24]. In consideration of these studies, primordial prevention strategies involving healthy lifestyle and behavioral choices may prevent obesity, hypertension, and diabetes. Thus, clinicians and public health officials must become advocates for primordial prevention to interrupt the progression of CVD in adult populations [25,26].

Regrettably, 20 % of America's youth population is obese, with rates tripling since 1980. Obesity is especially prevalent in NHB and Hispanic/Latino youth [27]. The incidence rate of T2D also varies across racial/ethnic populations among youth (Fig. 2) [27,28] and the disparate childhood obesity is reflected in adult prevalence: NHB adults 49.9 %; Hispanic/Latino adults 45.6 %, White adults 41.4 % and Asian adults 16.1 % (Fig. 3) [29].

3. Recognition of excessive U.S. sugar consumption: a primary target for primordial prevention

The American Heart Association recommends a daily sugar intake of no more than 6 teaspoons for women and 9 teaspoons for men and the World Health Organization recommends added sugar should represent less than 10 % of total energy intake [30,31]. Despite these recommendations, U.S. children and adults consume an average of 17 teaspoons per day [32,33].

The increase of sugar in U.S. dietary patterns has not occurred by chance alone. Starting in the 1960s, the Sugar Association, formerly known as the Sugar Research Foundation, funded studies that would emphasize fats' association with heart health, while minimizing the link between sugar and cardiovascular health [34]. Soda companies have targeted communities of color, employing tactics that disproportionately reach into Hispanic/Latino and NHB communities. In 2013, almost 17 % of all soda advertisements targeted Spanish-language television, with one major soda company spending \$33.6 million on all Hispanic/Latino-targeted media [35–37]. Furthermore, Hispanic/Latino youth are 93 % more likely to visit beverage company websites compared with all youth, while NHB teenagers are three to four times more likely to view soda television ads as compared to White teenagers [38].

Moreover, celebrities of color enhance marketing directed towards Hispanic/Latino and NHB youth, by encouraging consumption of these products [38].

Interestingly, Hispanic/Latino communities are primary targets for “toddler milk,” or added sugar milk products that may be confused with infant-formula [39]. A strong primordial prevention is to encourage mothers to initiate breastfeeding and to also emphasize the health benefits for both the mothers and their infants [40]. Breastfeeding decreases the risk of T2D, CVD, and cancer for the mother and is also protective for the risk of childhood obesity in children [41]. More effort is needed to support this practice since infants from racial/ethnic families who are at risk for these conditions are among the least likely to be breastfed: in 26 states and Washington, D.C., the breastfeeding initiation rate is lowest among Black mothers while in 13 states, the initiation rate is lowest among American Indian and Alaska Native mothers [42]. To counter messages that interfere with the initiation of breastfeeding, The American Academy of Pediatrics recommends displaying positive image of breastfeeding, refraining from giving out free formula samples, gifts, or coupons, and advocating for positive media coverage about breastfeeding [43].

4. Call to action: reducing SSB consumption in children

The growing burden of diabetes and obesity can be mitigated by reducing sugar intake. In a meta-analysis of population-based epidemiological studies ($n = 93,095$), consumption of sugar-sweetened and artificially sweetened beverages had a dose-response association with risk of metabolic syndromes [44]. A meta-analysis of 17 randomized control trials (RCTs) found an association between low calorie or non-caloric sweetened beverage substitutions and reductions in cardiometabolic risk factors [45].

Considering that young adults and adolescents drink the most SSBs, primordial prevention in adolescence is prime time to develop healthy dietary practices and to unlearn unhealthy habits [46]. Disturbingly, SSB intake is the highest among NHB and Hispanic/Latino adolescents, furthering the need for policies to address racial/ethnic health disparities [47].

5. Legislative initiatives to address targeting of racial/ethnic populations

5.1. Nutrient warning labels

Mandated warning labels incentivize healthy beverage campaigns and help consumers quickly and easily make informed choices when grocery shopping [48,49]. As of now, the U.S. has not implemented a nationwide front-of-package warning label in contrast to North American neighbors like Canada and Mexico. As of September 2022, the Food and Drug Administration (FDA) proposed a rule to update the definition of the “healthy” nutrient content claim on food labels [50]. This proposal requires food manufacturers to limit saturated fat, sodium, and added sugars if labeled as “healthy” [51]. Some states and localities such as in New York City, NY and Philadelphia, PA, already require restaurants to post excess sodium warnings on restaurant menus [52].

5.2. Assessing strength of evidence in support of nutrient warning labels

This 2022 FDA proposal falls short of warning consumers about excessive nutrients. Nutrient warning labels help grocers quickly evaluate food products that have an excessive amount of nutrients compared to no labels or normative guideline daily amount labels [49,53]. In Uruguay, nutritional warnings alerting to excess sodium, saturated fat, total fat, sugars, and sodium resulted in a 14 % decrease in the food order, compared to no nutritional warning [54]. In Canada, where front-of-package nutrition labels exists, grocers purchased beverages with 11 % less sugar or a difference in 2.5 g compared to grocers who were not

Landmark Primordial Prevention Studies

A History



Fig. 1. Primordial prevention aims to prevent the development of risk factors for disease. Shown here are landmark primordial prevention studies linking childhood and adolescent health with CV adult health [14,17–24].

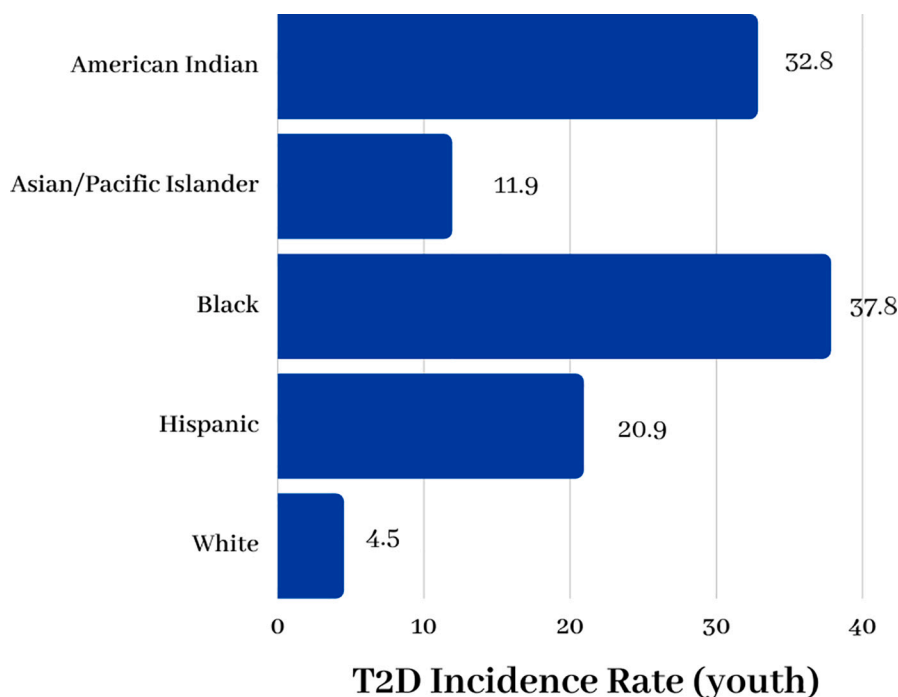


Fig. 2. The incidence rate of T2D varies across racial/ethnic populations among youth. The incidence rate (per 100,000) for type 2 diabetes shown here was based on a population-based registry of 69,457,475 youths [27,28].

Obesity Prevalence Percentages, Aged 20 and Over (2017-2020)

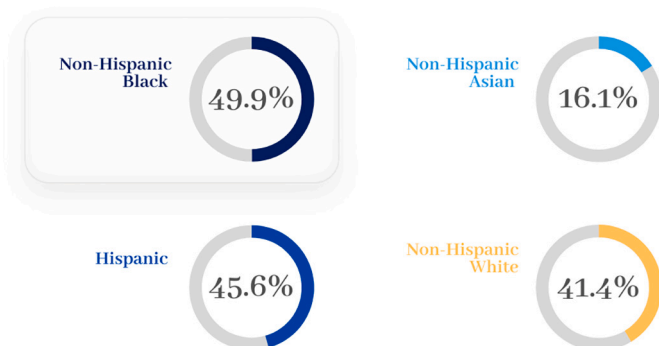


Fig. 3. Pre-pandemic prevalence of obesity in adults aged 20 years and over [29].

exposed to warning labels [55]. Several studies evaluating purchasing data in Chile also show a 10.2 % decline in calories from sugar, 7.5 % decrease in calories from beverage purchases, and reductions in sugar content per dollar spent at a supermarket retailer [56,57].

Using warning labels for primordial prevention may be effective in addressing teenage attitudes towards sugar consumption, especially with labels that quantify the number of teaspoons of sugar in a sugary drink versus labels that only note calories or “high in sugar” [58]. A 2020 meta-analysis of 23 studies found that sugary drink warnings reduced SSB purchases and caused stronger emotional responses to sugary drinks causing disease, thereby reducing purchasing and consumption of SSBs [59]. In addition, warning labels may promote equity, with larger benefits for racial/ethnic populations and lower-income adults [60].

5.3. SSB excise taxes

Excise taxes discourage consumption of SSBs. A 2022 systematic

review of 86 studies and a meta-analysis of 62 studies across 45 countries determined that excise taxes reduce beverage sales by 15 % [61]. Despite a somewhat weak association between the taxes and BMI, a study conducted in Mexico observed a 3 % relative decrease in overweight or obesity prevalence and a 0.35 kg weight loss in adolescent girls due to a SSB tax [62]. Furthermore, a study of U.S. high school students (n = 86,928) concluded that a SSB tax decreased consumption by 1.2 servings per week in those with obesity and 1.13 servings per week in Hispanic/Latino participants [46].

There is concern that SSBs adversely impact the poor by fiscal regressivity because taxes take a larger percentage of income from lower socioeconomic households compared to higher earners [63]. However, the SSB tax is favorably cost-saving when calculating for health gains, taxes paid, and health savings [64]. Furthermore, a recent analysis on the economic benefits of SSB taxes concluded that tax revenues promote equity by re-investing those earnings into vulnerable populations [65,66].

5.4. Workplace and school bans

Workplace sales and school bans on SSBs exist despite legal contention. In 2014, the New York Court of Appeals ruled that the New York City Board of Health does not have the authority to cap sugary drink sizes [67]. Nevertheless, the health benefits of these bans are clear despite the opposition to sales regulation. A RCT evaluating a workplace ban on SSB sales concluded that participants who previously drank SSBs on a regular basis, consumed less SSBs as a direct result of the ban; from a mean 1050 mL to 540 mL per day and those with high-BMI reported reductions of 588 mL per day, indicating a greater change in high-BMI groups [68]. The participants experienced reductions in abdominal adiposity which is a significant link to myocardial infarction [27,69].

A systematic review (n = 152,001) concluded that school-based interventions are effective at reducing SSB consumption [70]. A recent cross sectional survey, studying race, ethnicity and neighborhood food environments, determined that sugary drink reduction campaigns significantly reduces consumption among sixth graders [71]. However, there is a greater proportion of racial/ethnic students living in high

exposure zones which correlates to notable differences in SSB consumption [71].

5.5. Soft drink marketing and children

The beverage industry specifically target communities of color and historically lobbies against legislation restricting soda consumption [67]. Soda industries opportunistically direct advertisements towards school aged NHB and Latino children as these groups claim the highest consumption of SSBs in addition to having an inordinate prevalence of obesity and heart disease [27,47,72].

Deceptive claims of nutrition on food packaging confuse parents to choose less healthy drink options [73]. However, a RCT studying Hispanic/Latino parents found that counteracting marketing messages with water promotion changed purchasing behavior and reduced sugary fruit drink selections [74]. More efforts should be made to realign advertisements and marketing of health claims to actual expert advice about child nutrition [75].

5.6. Clinicians addressing societal issues

The Healthy Checkout Aisle, a novel ordinance passed in 2020, bans SSBs from grocery checkout aisles in Berkeley, CA [76]. Product placement at checkout lines encourages impulse buys and, if visible at children's eye level, can cue requests for unhealthy foods and beverages [77,78]. Other legislative initiatives could reduce the number of sugary products sold, limit advertisement of unhealthy food products to children, standardize sugar in school food servings, or limit size and portion of vending machine foods.

Clinicians can actively engage with developing legislation by submitting public comments whenever meetings are scheduled to discuss proposed state and federal government laws or regulations. Public meetings are posted on state and city health department websites; Federal meetings are posted on [regulations.gov](https://www.regulations.gov).

Additionally, clinicians can advocate at the community level by hosting meetings and classes at neighborhood centers to educate about diabetes, CVD and other health issues. Multi-week sessions can encourage lifestyle changes. Advocating for safe walking environments, parks, and other environmental changes could also make a difference.

Legislators and public health workers can help fix societal issues to improve CV health outcomes. Clinicians, undoubtedly, also have an important role in optimizing lifestyles associated with CVD by influencing public policy, participating in health promotion, and actively improving the physical environments of the communities they serve.

6. Implementing policies to make a change: the New Orleans, LA experience

Unfortunately, there is scant evidence that warning labels and excise taxes help achieve health equity across vulnerable populations. The Center for Science in the Public Interest conjectures warning food labels should be accessible to those of varying nutrition and numeracy literacy and designed in a way that is easily understood across all racial/ethnic groups [79–81].

Access to food retailers is a key social determinant of health and increasing availability of fresh food is an effective strategy in promoting healthy dietary behaviors [82]. A New Orleans study determined individuals who live in food deserts have a 14 % difference in glycemic control compared to the general population with T2D [83]. Food insecurity is also disproportionately noted within NHB and Hispanic/Latino populations while reduced food security is associated with higher reports of CVD [84–86]. Thus, addressing food insecurity in predominantly NHB neighborhoods may lower the risk of CVD: grocery store access is effective in changing dietary habits, and may even lower CVD among predominantly NHB populations [12].

As of 2020, New Orleans and 50 local governments passed policies to

limit the number of dollar stores, mostly with the aim of addressing the lack of healthy food options [87]. In one large New Orleans neighborhood, only two grocery stores serve the community while 12 dollar stores exist nearby [88]. These dollar stores or small box discount stores fill the gap where full-service grocery stores are scarce, however, convenience stores do not necessarily promote healthfulness; they perpetuate the stagnation of the food landscape [87]. Once a dollar store enters a food desert, the community continues to carry lower quality foods and remains low access compared to areas that have full-service grocery stores offering higher quality produce [13]. Dollar stores tend to have limited healthy options and individuals shopping at dollar stores are more likely to purchase lower-quality foods such as ultra-processed snacks, candy, and SSBs [89]. Thus, legislators must monitor and control the proliferation of dollar stores, especially in vulnerable communities of color where these dollar stores are often densely concentrated [87].

Generally, zip codes with higher income tend to have higher fruits and vegetable consumption [12,85]. However, within zip codes with predominantly NHB populations, higher income does not predict better diet health or lower the likelihood of obesity [12]. In fact, higher income is associated with lower fruit and vegetable consumption and higher likelihood of obesity, suggesting that NHB communities may have other factors preventing good health, including the built environment, racial/ethnic discrimination, and other stressors [12].

7. Future considerations beyond the U.S.: global initiatives

The projected increased burden of cardiometabolic conditions and CVD is a worldwide concern [90,91]. Starting in 2022, high-nutrient foods sold in Canada are required to carry a front-of-package warning if the packaged foods exceed 15 % of the recommended daily value of sodium, sugar, or saturated fat (Fig. 4) [92]. Pre-packaged meals must be labeled if exceeding 30 % of the recommended daily value [93].

A meta-analysis of 60 studies across 11 countries found that mandatory food labels not only influence consumer behaviors but also the food suppliers, evidenced by the decreasing sodium and trans-fat levels in manufactured products [94]. At least 40 countries already utilize nutrient and calorie interpretive food labels (Fig. 5) [95]. The U. S. is notably excluded from this list.

As many as 54 countries have also implemented SSB taxes to influence consumer behaviors and manufacturer practices [96]. In Mexico, there was a 37 % reduction in total volume of SSBs purchased between 2014 and 2016 [96]. The United Kingdom demonstrated similar results after the introduction of a 2018 SSB tax, observing a 43.7 % reduction in the sugar content of drinks and a 35.4 % reduction in consumption of SSBs [96,97]. In Chile, there are multiple food labeling laws requiring front-of-package warnings and restrictions on food advertisements targeting children [98]. These changes resulted in a 23.7 % reduction in



Fig. 4. Example of a front-of-package warning label in Canada, enforced in 2022 [92].

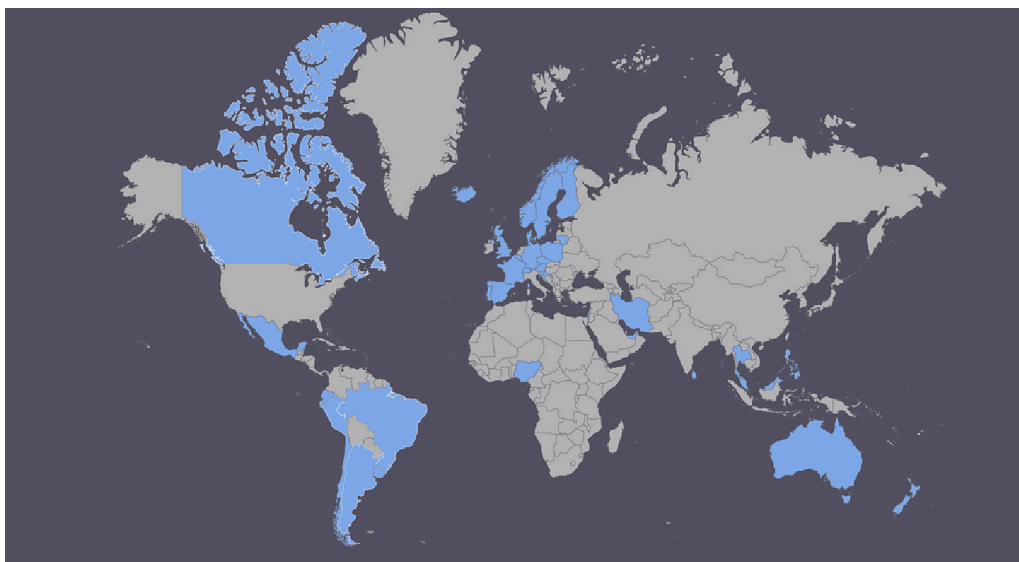


Fig. 5. Countries with interpretive labels on packaged foods and drinks (highlighted blue) [95]. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

SSB consumption in addition to manufacturer reformulations of packaged foods [99,100].

8. The urgent need to eliminate cardiometabolic and cardiac disparities: lessons learned from the COVID-19 pandemic

For decades, American health care has failed various racial/ethnic communities in preventing primary and secondary CVD [15]. The COVID-19 pandemic revealed the harm of the disparate burden of risk factors as harbingers of severe complications for COVID-19 [101].

The pandemic was a *sentinel event*, revealing glaring health disparities caused by preventable deep-rooted health care failures, especially fueled by the racial/ethnic disparities in morbidity and mortality related to cardiometabolic conditions [15,102]. In the U.S., NHB populations, with limited or absent primordial prevention, compared to other racial/ethnic populations, have consistently demonstrated a higher prevalence of hypertension, obesity, T2D and CVD [102]. This has been described as "...a toxic gumbo of CVD...profoundly diminishing overall African American life expectancy" [15]. Disparities in access to quality clinical care, discrimination, education, social support, physical environment, and socioeconomic status further exacerbate existing CVD in vulnerable populations. The COVID-19 pandemic heightens the case for ongoing efforts to counteract the burgeoning growth of U.S. cardiometabolic conditions and CVD, especially among at-risk racial/ethnic communities. Primordial prevention, in addition to evidence-based care, must be embraced to eventually eliminate healthcare disparities.

9. Conclusion

One of the earliest studies of effective primordial CVD prevention was Gerald Berenson's Bogalusa Heart Study, which was the longest-running biracial epidemiologic study in history spanning nearly 40 years [103]. This NIH-sponsored study determined CVD starts in early childhood and adolescence; it was pivotal in connecting biological and behavioral CVD risk factors in early life to adult cardiovascular health outcomes [17]. This landmark research highlighted the importance of primordial prevention, especially in racial/ethnic populations [4]. Today, the conclusions from the Bogalusa Heart Study still ring true; early childhood behaviors predict adult CVD. It emphatically begins in childhood. Important positive approaches to stymie the growing CVD crisis include awareness campaigns, education, and legislation to

improve children's health and narrow the racial/ethnic gaps in health outcomes.

In conclusion, primordial CVD prevention is key to addressing this national crisis of adverse cardiometabolic health and obesity in children. Evidence-based strategies are urgently needed to reduce SSB consumption especially in youth, including nutrient warning labels, regulating soft drink marketing, and creating a more equitable food system. The limited actions taken thus far are inadequate to cultivate health equity and optimal health for all in the U.S. This commentary is a call-to-action for our communities, clinicians, and policymakers to act upon what we know, and to make the changes that have been decidedly long overdue.

Credit authorship contribution statement

Vi Nguyen: Conceptualization, Software, Investigation, Resources, Data Curation, Writing – Original Draft, Visualization.

Keith C. Ferdinand: Validation, Writing – Review & Editing, Supervision, Project administration.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Keith C. Ferdinand is a consultant for Amgen, Novartis, Pfizer, Medtronic, Boehringer-Ingelheim, Janssen and principal investigator of HHCPP.

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