JOURNAL OF
EMERGING INVESTIGATORS

Article

Knowledge gaps for recommended daily sugar intake and variations in McDonald's Coca-Cola sugar levels

Arush Gupta[1], Jonathan Philip[2], Sajita Setia[3]

[1] Saint Kentigern College, Auckland, New Zealand

[2] Botany Downs Secondary College, Auckland, New Zealand

[3] Medical and Health Education, Transform Medical Communications Limited, Auckland, New Zealand

SUMMARY

Lack of awareness of daily sugar limits may lead individuals to be ignorant of sugar levels in popular beverages and exceed their recommended daily sugar intake. Additionally, these beverages could exhibit variability in sugar content. Hence, we conducted a cross-sectional study to test two hypotheses: (i) people are not mindful of the daily limits for sugar intake, and (ii) the sugar levels of McDonald's Coca-Cola at different outlets and time points show variability. A total of 97 people aged 11 – 72 years old were surveyed regarding their awareness for recommended limits on sugar consumption, intake of sugar drinks and taste preferences for Coca Cola drinks during Phase 1. Phase 2 included testing visit-to-visit and store-to-store variability in sugar levels for medium-sized McDonald's Coca-Cola in four selected stores in East Auckland, New Zealand. The majority of the children (86.3%, n=51) were unaware of the recommended limits for daily sugar intake for their age group. Additionally, even some adults lacked clarity on the recommended sugar intakes for men (10.8%, n=46) and women (32.6%, n=46). We also identified statistically significant sugar content variations across most stores. Sugar levels varied on a visit-to-visit basis at the Botany store and exceeded the advertised level for the last two visits at the Ormiston store. Our findings suggest that limited public understanding of daily sugar recommendations and inconsistent sugar levels in commonly consumed beverages may hinder efforts to moderate sugar intake. Intersectoral collaboration across governments, educational institutions, community centers, and the food industry is required to improve awareness of recommended sugar intake and ensure consistent product formulations.

INTRODUCTION

Excessive intake of sugar-sweetened beverages (SSBs) is a known cause of non-communicable, or non-infectious, diseases like obesity, diabetes, and heart diseases (1). These drinks are the leading source of added sugars in Western diets (2). Several health organizations have issued public health recommendations and guidelines for dietary sugar intake (3). However, the existing research suggests that often the public has little knowledge of sugar consumption advice (4-6). The lack of awareness could be problematic in countries like New Zealand that still count on individuals' self-regulation and responsibility to restrict the intake of these beverages and do not impose a tax on sugary drinks (1). However, there is a lack of recent research from New Zealand regarding knowledge among public on recommended daily limits for SSBs and sugar intake.

Since 2015, the World Health Organization (WHO) has recommended reducing the intake of free sugars (sugar added to foods, and sugar found in fruit juices, honey, syrups, etc.) to less than 10% of the daily energy intake (7). Similarly, the most recent 2020−2025 Dietary Guidelines for Americans also recommend <10% of total daily calories from added sugars (8). The WHO recommendation has been adopted by the New Zealand government since 2022 (9). However, very often, the added sugars are overconsumed, putting individuals at risk for poor health (10). One medium-sized serving of McDonald's Coca-Cola contains 37.5 g of sugar (11). This sugar content exceeds the generally recommended maximum consumption for women (24 g), men (36 g), and children over the age of 11 (30 g) (12). Additionally, despite all the recommendations, on average, children consume more than twice the recommended amount of sugar per day in developed countries (13). A study across 53 countries found that more than half of young adolescents (aged 12 – 15 years) consume carbonated soft drinks at least once daily (2). Another study found that 96% of children between the age group 8-12 years consumed ≥1 serving of SSBs/week, with 62% of children reporting ≥5 servings/ week (14). Specific to New Zealand, in general, SSBs constitute about 5% of the whole household food expenditure (15). An understandable result is overconsumption of sugar: a study in New Zealand reported that only 42% of adults consumed <10% of their energy intake from free sugars (16). The health issues resulting from SSB consumption (resulting from contributing health issues) would cost an estimated NZ$17.37/L in New Zealand (17).

The above data highlight high consumption of SSBs; an additional challenge arises when the sugar content in popular drinks is inaccurately labeled or varies across different outlets and time points, further hindering efforts to control overall sugar intake. For instance, as per the advertised label, the sugar content in McDonald's Coca-Cola is 11 g/100 mL, while the sugar content in bottled/canned Coca-Cola is 10.6 g/100 mL (11, 18).This variation might lead some people to perceive that McDonald's Coca-Cola tastes better than bottled/canned Coca-Cola (19). There also has been a documented heterogeneity in the sugar content of popular SSBs (20). Yet, there are no research publications comparing or testing the sugar levels in McDonald's Coca-Cola at different locations or timepoints.

https://doi.org/10.59720/24-062

Considering the above-mentioned limitations in literature, we decided to examine the awareness of sugar levels in Coca-Cola among children and adults, and to test and compare the sugar levels on different days in McDonald's Coca-Cola at four East Auckland stores. Our two hypotheses were (i) people are generally unaware of the daily limits for sugar intake and sugar content in McDonald's Coca-Cola, and (ii) there is a difference in the sugar levels of McDonald's Coca-Cola at different outlets and time points. Both of our hypotheses were supported by findings: most of the general public that we surveyed was unaware of the recommended daily sugar limits and the sugar levels of McDonald's Coca-Cola in relation to their daily sugar levels. There were also statistically significant differences in the sugar levels of Coca-Cola both within and across the four McDonald's stores in East Auckland, New Zealand. Overall, our study indicates a need for collaborative efforts to improve the general public's awareness of recommended sugar intake and consistency in sugar levels in McDonald's Coca-Cola.

RESULTS

Phase 1 research – survey results

The survey was completed by all the respondents to whom it was offered. There were a total of 97 participants: 51 children in the age group 11–13 years from two of the Year 8 classes of Somerville Intermediate School (SIS), Auckland; and 46 from a church group in East Auckland with ages ranging from 19–72 years. The gender distribution across both groups of respondents was fairly even. There were 54.9% girls and 45.1% boys among children respondents, and 48% men and 52% women among adult respondents (**Table 1**).

The survey revealed that the majority of the children from SIS (86.3%, n=51) were naive about the recommended limits for daily sugar intake for their age group (**Figure 1**). Similarly, a significant proportion of adults were unaware of the recommended sugar intake for men and women (10.8% and 32.6%, respectively, n=46; **Figure 2**). The majority of respondents (53%, n=97) believed that the sugar content in a medium-sized McDonald's Coca-Cola drink was <30 g of sugar.

Turning to the taste preference of respondents, Coca-Cola Zero Sugar was favored over classic Coca-Cola by 33% of the total participants. When asking about the taste comparison between McDonald's Coca-Cola and canned/bottled Coca-Cola (available in bottles and cans in most local grocery stores and supermarkets), we found that more children preferred McDonald's Coca-Cola over classic Coca-Cola (33.3% vs 29.4%, n=51, rest were indecisive), and most adult respondents preferred classic Coca-Cola over McDonald's Coca-Cola (52.2% vs 34.8%, n=46).

Regarding soft drink consumption, most surveyed children (84.3%, n=51) and adults (98.7%, n=46) reported consuming 1–2 sugary soft drinks per week or less. This frequency is within the recommended amount of sugary soft drinks that should be consumed per week (21, 22).

Demographic details	Category	n (%)
Class respondents (n = 51)*		
Gender	Male	23 (45.1%)
	Female	28 (54.9%)
Church respondents (n = 46)		
Gender	Male	22 (48%)
	Female	24 (52%)
Age (years)**	19-30	2 (4.35%)
	31-40	6 (13.04%)
	41-50	3 (6.52%)
	51-60	10 (21.74%)
	60+	25 (54.34%)

Table 1: Demographic data for survey respondents.
*All class respondents were 11-12 years of age.
**Percentages for age in the church demographic add up to 99.99% because of rounding.

Phase 2 research – testing sugar levels for McDonald's classic Coca Cola

During the Phase 2 research, we selected four McDonald's locations and visited each location four times on different days. The sugar levels were tested three times in each sample. There was visit-to-visit variability recorded in sugar levels at different stores (**Figure 3**). However, a statistically significant variability in sugar values between different visits was found only at the Botany store (one-way ANOVA, $p<0.05$). Furthermore, there was a relatively consistent ranking among the four shops. The Ormiston store consistently had the highest sugar levels, followed by Botany, and then Pakuranga and Ti Rakau.

The sugar values at the Ormiston Store were higher for Visits 3 and 4 than McDonald's advertised label for its Coca-Cola. However, the three stores other than Ormiston had sugar levels below the advertised level.

There was also store-to-store variability recorded in sugar levels at different stores (**Table 2**). Apart from Pakuranga vs Ti Rakau, a comparison of sugar levels at all different stores showed statistically significant variability.

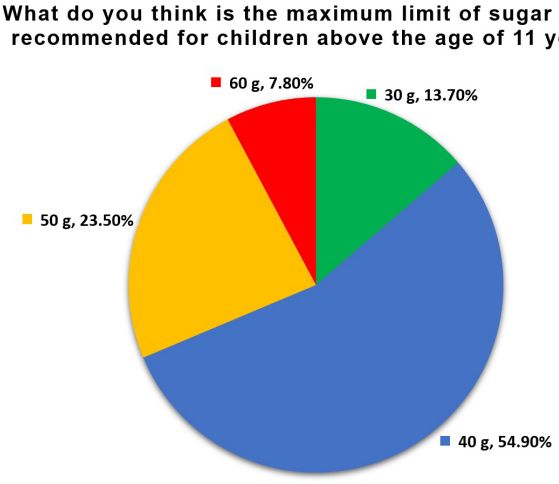

Figure 1. Children's knowledge of the maximum recommended limit for daily sugar intake. Survey questionnaire of respondents' (children) knowledge of their daily sugar levels. A maximum of 30 g of sugar per day is recommended for children over the age of 11. However, only 13.7% of respondents (n=51) selected 30 g as the maximum limit. The rest (86.3%) selected one of the other three choices.

https://doi.org/10.59720/24-062

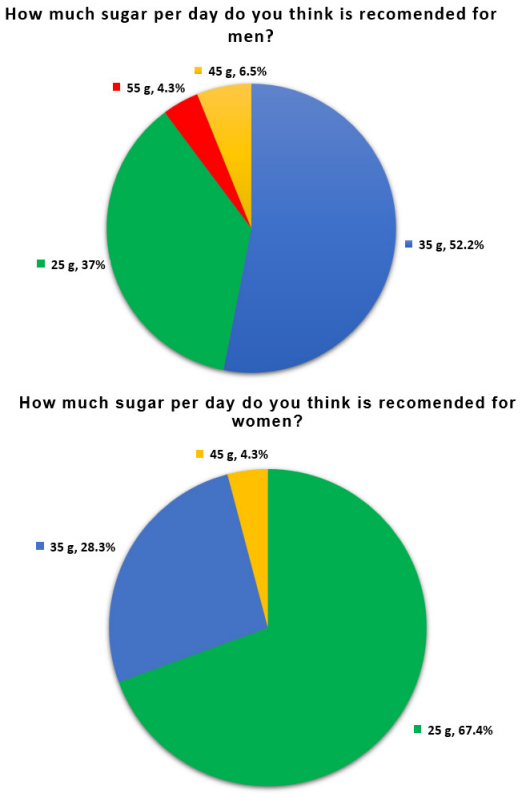

Figure 2. Adults' knowledge of the maximum limit for daily sugar intake for men and women. Survey questionnaire of respondents' (adults) knowledge of men's and women's recommended daily sugar levels. Over 89% of respondents (n=46) chose the correct answer (35 g) or less for men, and almost 70% of the respondents (n=46) selected the correct answer for women (25 g). However, over 30% (n=46) of respondents were unaware of the daily sugar limits for women.

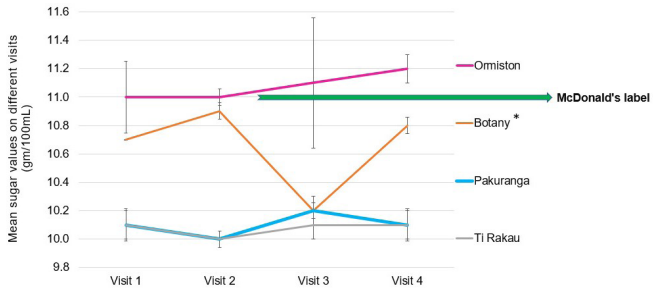

Figure 3. Mean Coca-Cola sugar levels at four McDonald's stores in East Auckland. Each store was visited four separate times, each on a separate day. Error bars display the standard deviation across the three readings of the same sample (variation in repeated measurements of the same sample and not across multiple different samples). P-values were calculated using one-way ANOVA, and values < 0.05 were considered significant. There was a significant difference in sugar levels across visits only at the Botany store (*p<0.001). The sugar values for the last two visits at the Ormiston Store were higher than the advertised label for the sugar content in McDonald's Coca-Cola (11 g/100 mL), as shown by the green arrow in the above figure.

DISCUSSION

We found that respondents to our survey were generally unaware of daily sugar limits and the sugar content in McDonald's Coca-Cola. In line with our first hypothesis, 86.3% of 11–12-year-olds in our study sample were not aware of how much sugar they consume relative to the recommended limits, although adults were slightly better informed. Our second hypothesis that McDonald's Coca-Cola sugar levels differ by outlet and time was also supported, with visit-to-visit differences at Botany reaching statistical significance and all studied stores, except Pakuranga vs. Ti Rakau stores, showing statistical significance in store-to-store variability in sugar levels.

Phase 1 of our study examined the general public's practice and knowledge regarding their sugar intake. We elucidated a common misconception or lack of awareness regarding the sugar content in Coca-Cola products, which needs to be addressed. Roughly half (53%, n=97) of all respondents believed that the sugar content in a medium-sized McDonald's Coca-Cola drink was less than the maximum daily recommended limit of <30 g. As one medium-sized McDonald's Coca-Cola has well over 30 g of sugar, the lack of awareness of this concept can have potentially led to poor decision-making of life-style choices (e.g., having SSBs with each meal or opting for SSB when thirsty instead of water) among communities, and the public should be well informed on the quantity of sugar in their drinks (23).

Children's inadequate knowledge of recommended sugar intake may significantly contribute to overconsumption of SSBs. We found that 86.3% (n=51) of child respondents were unaware of their daily sugar allowance, revealing a concerning gap in nutritional literacy. Children's lack of awareness may be translated into excessive consumption of SSBs, as revealed by a 2021 survey of a total of 578 children aged from 8-12 years from Auckland to understand their intake of SSBs (14). Carbonated SSBs were consumed ≥1 serving a week by 39% of children, while plain water was consumed fewer than 2 times a day by 22%. Furthermore, children's incorrect perception of adequate SSBs was associated with a higher consumption of SSBs (14). Our findings align with these observations, suggesting that a lack of awareness about sugar guidelines is a persistent and critical issue, and targeted age-appropriate educational initiatives may help reduce the consumption of SSBs among children.

To reduce consumption of SSBs, especially among young people, several public health initiatives have been developed in different countries. For example, the introduction of a Soft Drinks Industry Levy ("sugar tax") in the United Kingdom led to reformulation of products and reductions in the sugar content and portion size of many beverages (24). Similarly, SSB tax in Mexico was associated with a decrease in purchases of taxed SSBs especially middle-price beverages (25). New Zealand also experienced favorable outcomes from increasing import taxes on SSBs in 2018, as import volumes initially declined; however, these gains were reversed when the tax was later lowered in 2014 (26). Within school environments, restricting access to SSBs and encouraging water consumption has shown positive health effects among children (27). Yet, evidence suggests that well-designed communication interventions in schools may have an even greater impact on reducing SSB intake than environmental measures alone, and the most effective approach often combines both

https://doi.org/10.59720/24-062

McDonald's Stores (mean sugar levels across all visits)	Comparator McDonald's Store	p-value
Botany (10.7 g/100 mL)	Ormiston	<0.001
	Pakuranga	<0.001
	Ti Rakau	<0.001
Ormiston (11.1 g/100 mL)	Botany	<0.001
	Pakuranga	<0.001
	Ti Rakau	<0.001
Pakuranga (10.1 g/100 mL)	Botany	<0.001
	Ormiston	<0.001
	Ti Rakau	0.375
Ti Rakau (10.1 g/100 mL)	Botany	<0.001
	Ormiston	<0.001
	Pakuranga	0.375

Table 2: Pairwise comparison of Coca-Cola sugar levels between selected study stores (store-to-store variability). Standard error of mean for all stores was 0.04. P-value was calculated using two-way ANOVA with Tukey's post hoc test, and values < 0.05 were considered significant. There was significant variability in mean sugar levels across all visits between store locations ($p < 0.001$) except for the Pakuranga vs. Ti Rakau comparison.

strategies (28). In New Zealand, for instance, a national "water-only" initiative has been implemented in some schools, permitting only water or unflavored milk. Although this policy aims to remove SSBs entirely from school premises, limited community or family support remains a significant barrier to its broader adoption (29).

Surprisingly, many adults were also unaware of the recommended sugar intake for men (10.8%, n=46) and women (32.6%, n=46). This finding resonates with broader beverage consumption patterns observed in New Zealand and Australia. For instance, data from nationally representative 2008-2009 New Zealand Nutrition Survey of 4,721 adults showed that the WHO recommendation of intake of free sugars <10% of daily total energy intake was met by less than half (42%) of the country's adult population (16). Furthermore, a systematic assessment of beverage intake in 187 countries in 2010 found that fruit juice consumption was highest in Australia and New Zealand (30). While this particular study did not measure knowledge of recommended sugar limits, it highlighted a notable preference for this SSB in New Zealand (30). Another New Zealand study reported that SSB consumers were more likely to follow an overall unhealthy eating pattern and less likely to consciously control their diet, raising concerns about the effectiveness of individual self-regulation and industry-led initiatives to curb sugar intake (1). Additionally, while not covered in the present study, the level of awareness and consumption patterns may vary across socioeconomic backgrounds, as highlighted by a recent observational study on data from 2015–2019 for purchases of sugar-sweetened, unsweetened beverages, and artificially sweetened beverages by households in New Zealand (31). Although there has been a reduction in the purchase of SSBs, it is, however, quite marginal (overall drop by only 5.9 L) and, as concluded by the authors, is unlikely to improve health. Furthermore, households with an annual income <$NZ 30,000 purchased fewer unsweetened and artificially sweetened beverages than households with an annual income >$NZ 90,000 (31). Hence, the findings from our study and previous surveys support the necessity for bridging knowledge and implementation gaps through targeted interventions (like public education on the harmful effects of excessive sugar intake and age-appropriate daily limits for sugar along with implementing extra taxes on SSBs and "water only" policy in all schools) to reduce SSB consumption in New Zealand (14, 31). Additionally, our survey showed many soft drink consumption patterns, including taste preferences. Most children did, in fact, prefer the taste of McDonald's Coca-Cola over classic Coca-Cola, suggesting that the common myth might be a fact. However, this preference was not observed for adults, and this may also indicate potential age-related differences in how brand cues influence taste perception (32). For children, the effects of marketing and brand exposure appear especially pronounced. In one experimental study, children tasted five pairs of identical foods and beverages - one set in McDonald's packaging and one set in unbranded packaging and were asked if they tasted different or the same. Children consistently preferred items they believed came from McDonald's, and this preference was even stronger in those who had more television sets at home and ate McDonald's food more often (33).

Phase 2 of our study examined the sugar content of Coca-Cola beverages at different McDonald's locations. This is the first study known to us of its kind performed in the set location and factors. The results revealed statistical variations in sugar content across different visits to the Botany store. The observed differences in sugar content between various McDonald's stores could be attributed to various factors, such as local preferences or specific operational practices. These operational practices include differences in how often the syrup dispensers are calibrated, fluctuations in staff training or adherence to standard procedures, and variations in equipment maintenance (34-36). The variations in the sugar levels may come from differences in preparation methods such as inconsistent syrup-to-water ratios due to improper calibration of soda machines, or differences in syrup storage and freshness across locations. These operational inconsistencies can result in location-based fluctuations in the sugar content of McDonald's Coca-Cola drinks. (37). Our results on testing sugar quantity levels in McDonald's Coca-Cola may have important real-world implications. Excessive sugar intake has been linked to several health problems, including obesity, diabetes, and heart disease (38, 39). The sugar quantity levels in a large McDonald's Coca-Cola exceed an adult's recommended daily sugar intake by over 18 g (12, 40). Our experiment highlights the importance of knowing the sugar quantity levels in all food and beverage products. By making informed choices and limiting sugar intake, people can take steps to protect their health and sugar levels within their bodies (41).

A strength of our Phase 1 research is that we were able to obtain a similar number of responses from both our school classes and church group. This allowed us to accurately compare the knowledge of both pre-teens and the general adult public without bias across the two age ranges by sample size. However, roughly half of the respondents from the church group were older adults, which may not fully represent the general adult demographic. Additionally, all child participants were from the same school, and all adult participants were

https://doi.org/10.59720/24-062

members of the same church group. As a result, respondents within each subgroup may share similar socioeconomic or cultural backgrounds, potentially limiting the generalizability of our findings beyond these contexts. Further, we did not collect more detailed background information (e.g., household income, education level) as part of the survey. This constrains our ability to analyze how social or economic factors might have influenced knowledge and attitudes. Future studies could address these limitations by recruiting participants from multiple, diverse schools or congregations, and by including additional demographic measures.

Some limitations should also be acknowledged when interpreting the findings from Phase 2 of this study. First, the study only examined McDonald's locations in a specific region, which may limit the generalizability of the results to other locations or regions. Secondly, our Brix refractometer was sensitive for 0.2 g/100 mL meaning very small fluctuations below this threshold may not have been fully captured. However, to remain consistent with the instrument's sensitivity, we reported mean values in one decimal point to ensure that the data accurately reflects the refractometer's precision limits. Hence, in practice, this limitation likely had only a modest impact on our findings. Still, future research could address it by employing more sensitive instruments. Furthermore, we used the Automatic Temperature Compensation (ATC) model. ATC automatically adjusts the measured value based on any temperature fluctuations in the sample or the environment, thereby enhancing the overall accuracy of the refractometer. This feature reduces the risk of measurement error introduced by temperature variations (42). In summary, most of the general public from our study sample was unaware of the recommended daily sugar limits and the sugar levels of McDonald's Coca-Cola in relation to their daily sugar levels. There was a statistical difference in the sugar levels of Coca-Cola both within and across the four McDonald's stores in East Auckland, New Zealand. These findings are important for gaining insights into the effectiveness of existing health promotion campaigns and unmet needs. Similarly, it is crucial to understand the extent of consistency in sugar levels on different days and stores for a popular SSB. The results call for multidimensional partnerships across governments, educational institutions, community centers, and the food industry to improve awareness of recommended sugar intake and consistency in sugar levels in McDonald's Coca-Cola.

MATERIALS AND METHODS

Data collection

A preliminary anonymous survey was conducted as Phase 1 of the study prior to our actual experiment to check perspectives and preferences on recommended sugar intake for children, men and women, soft drink consumption, preferences between McDonald's and canned/bottled Coca-Cola, and choice between classic Coca-Cola and Coca-Cola Zero Sugar. A customized survey was offered to a total of 97 participants: 51 from two of the Year 8 classes of SIS, Auckland (**Appendix; item 1**), and 46 from one of the church groups in East Auckland (**Appendix; item 2**). Both surveys were mostly constructed with a four-level Likert scale with related questions providing four response options to limit the central tendency of response.

Phase 2 of the study analyzed the sugar levels in McDonald's medium-sized Coca-Cola from May 21, 2023, to June 6, 2023. Four McDonald's locations were selected: McDonald's Ti Rakau, McDonald's Botany Town Centre, McDonald's Pakuranga, and McDonald's Ormiston. Each location was visited four times on different days to collect multiple samples. The Coca-Cola samples were collected without ice and in medium-sized packs, with the same person analyzing the samples each time to control for confounding factors (i.e., differences in ice volume, cup size, sample handling procedures, and variability between analysts).

The sugar levels were tested three times to yield an average number in each sample using a calibrated Automatic Temperature Compensation Brix refractometer (43, 44). The analytical sensitivity of the refractometer is 0.2 grams per 100 milliliters of liquid. Calibrations using distilled water were performed before the measurements.

Statistical analysis

Significance in all tests was deemed significant as being $p<0.05$. The collected data was statistically analyzed using One-Way ANOVA for visit-to-visit variability. A two-way ANOVA with Tukey's post hoc test for multiple comparisons was conducted to investigate the variability of McDonald's Coca-Cola sugar levels across different outlets and time points. A significance level of 0.05 was used. SPSS version 28 was used for statistical analyses.

Ethics clearance

None of the survey questionnaires recorded any personal information from the respondents. Informed consent was sought from all participants before they responded to the anonymized survey. New Zealand Health Research Council requires ethics committee review only for observational research with more than minimal risk (45). The research project was reviewed and approved by SIS management for clearance from an ethical perspective.

ACKNOWLEDGMENTS

The authors would like to thank Mr. Stuart Reed for his guidance and mentorship in overseeing this project at Somerville Intermediate School. The authors would also like to thank Dr. Soundravally Rajendiran, MD, PhD, FRCPath, Professor, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry, India, for her assistance with statistical analysis and critical review and insightful feedback on this manuscript.

Received: January 29, 2024
Accepted: August 22, 2024
Published: August 24, 2025

REFERENCES

1. Robertson, K. *et al.* "Supporting a sugar tax in New Zealand: Sugar-sweetened beverage (''fizzy drink'') consumption as a normal behaviour within the obesogenic environment." *PeerJ*, vol. 6, 19 October 2018, p. e5821, https://doi.org/10.7717/peerj.5821.
2. Yang, L. et al. "Consumption of carbonated soft drinks among young adolescents aged 12 to 15 years in 53 low- and middle-income countries." *American Journal of Public Health*, vol. 107, no. 7, 2017, pp. 1095-1100, https://doi.org/10.2105/ajph.2017.303762.
3. Erickson, J. et al. "The scientific basis of guideline recom-

https://doi.org/10.59720/24-062

mendations on sugar intake: A systematic review." *Ann Intern Med,* vol. 166, no. 4, 2017, pp. 257-267, https://doi.org/10.7326/m16-2020.
4. Waqa, G. et al. "Assessing knowledge, attitudes and behaviours toward salt and sugar consumption in the central division of Fiji." *Nutrients*, vol. 16, no. 19, 2024, https://doi.org/10.3390/nu16193288.
5. Santana, I.P. et al. "University students' knowledge and perceptions about concepts, recommendations, and health effects of added sugars." *Front Nutr*, vol. 9, 2022, p. 896895, https://doi.org/10.3389/fnut.2022.896895.
6. Chen, Q. et al. "Knowledge, attitude, and practice toward non-nutritive sweeteners among the population with reduced sugar intake requirement." *Front Nutr*, vol. 10, 2023, p. 1268599, https://doi.org/10.3389/fnut.2023.1268599.
7. "Guideline: sugars intake for adults and children." Geneva: World Health Organization, 4 March 2015. www.who.int/publications/i/item/9789241549028. Accessed 4 January 2024.
8. U.S. Department of Agriculture and U.S. Department of Health and Human Services. "Dietary Guidelines for Americans, 2020-2025." 9th Edition. December 2020. www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf. Accessed 14 January 2023.
9. "Behind the hype: Sugar - NPA263." HealthED, April 2022. https://healthed.govt.nz/products/behind-the-hype-sugar-npa263. Accessed 25 January 2025.
10. Lee, S.H. et al. "High added sugars intake among us adults: Characteristics, eating occasions, and top sources, 2015-2018." *Nutrients*, vol. 15, no. 2, 2023, https://doi.org/10.3390/nu15020265.
11. "Mcdonald's New Zealand main menu allergen - ingredients - nutrition information." McDonald's New Zealand, November 2023. https://mcdonalds.co.nz/menu/coke%C2%AE. Accessed 2 January 2024.
12. "How much sugar is too much? " American Heart Association, 23 September 2024. www.heart.org/en/healthy-living/healthy-eating/eat-smart/sugar/how-much-sugar-is-too-much#. Accessed 2 January 2024.
13. Atherton, M. "Sugar intake in children is double daily allowance. " Food manufacture, 11 September 2016. https://www.foodmanufacture.co.uk/Article/2016/09/12/Children-eating-twice-as-much-sugar-as-recommended-daily-allowance. Accessed 2 January 2024.
14. Smirk, E. et al. "Sugar-sweetened beverages consumption among New Zealand children aged 8-12 years: A cross sectional study of sources and associates/correlates of consumption." *BMC Public Health*, vol. 21, no. 1, 2021, p. 2277, https://doi.org/10.1186/s12889-021-12345-9.
15. Ni Mhurchu, C. et al. "Food prices and consumer demand: Differences across income levels and ethnic groups." *PLoS One*, vol. 8, no. 10, 2013, p. e75934, https://doi.org/10.1371/journal.pone.0075934.
16. Kibblewhite, R. et al. "Estimating free and added sugar intakes in New Zealand." *Nutrients*, vol. 9, no. 12, 2017, p. 1292, https://doi.org/10.3390/nu9121292.
17. Ding, N. et al. "Measuring the harm of sugar sweetened beverages and internalities associated with it." *Frontiers in Public Health*, vol. 12, 2024, https://doi.org/10.3389/fpubh.2024.1152710.
18. "Coca Cola soft drink." Woolworths New Zealand, 2025. https://woolworths.co.nz/shop/productdetails?stockcode=659936&name=coca-cola-soft-drink. Accessed 25 January 2025.
19. Laliberte, M. "This is why coke tastes better at McDonald's than anywhere else." Reader's Digest, May 2023. www.rd.com/article/mcdonalds-coke/. Accessed 2 January 2024.
20. Ventura, E.E. et al. "Sugar content of popular sweetened beverages based on objective laboratory analysis: Focus on fructose content." *Obesity*, vol. 19, no. 4, 2011, pp. 868-874, https://doi.org/10.1038/oby.2010.255.
21. "Sugary drinks." Harvard TH CHAN School of Public Health. August 2023. www.hsph.harvard.edu/nutritionsource/healthy-drinks/sugary-drinks/. Accessed 4 January 2024.
22. "The best (and worst) drinks for heart health." Heart Foundation, 10 January 2025. www.heartfoundation.org.au/bundles/healthy-living-and-eating/heart-healthy-drinks. Accessed 24 January 2024.
23. Kleiner, S.M. "Water: An essential but overlooked nutrient." *J Am Diet Assoc*, vol. 99, no. 2, 1999, pp. 200-206, https://doi.org/10.1016/s0002-8223(99)00048-6.
24. Luick, M. et al. "The impact of the UK soft drink industry levy on the soft drink marketplace, 2017-2020: An interrupted time series analysis with comparator series." *PLoS One*, vol. 19, no. 6, 2024, p. e0301890, https://doi.org/10.1371/journal.pone.0301890.
25. Salgado Hernández, J.C. et al. "Changes in sugar-sweetened beverage purchases across the price distribution after the implementation of a tax in mexico: A before-and-after analysis. *BMC Public Health*, vol. 23, no. 1, 2023, p. 265, https://doi.org/10.1186/s12889-023-15041-y.
26. Teng, A.M. et al. "Impact of sugar-sweetened beverage taxes on price, import and sale volumes in an island: Interrupted time series analysis." *Public Health Nutr*, vol. 24, no. 7, 2021, pp. 1828-1835, https://doi.org/10.1017/s1368980021000185.
27. Spiga, F. et al. "Interventions to prevent obesity in children aged 5 to 11 years old." *Cochrane Database Syst Rev*, vol. 5, no. 5, 2024, p. Cd015328, https://doi.org/10.1002/14651858.CD015328.pub2.
28. Kamin, T. et al. "Water wins, communication matters: School-based intervention to reduce intake of sugar-sweetened beverages and increase intake of water." *Nutrients*, vol. 14, no. 7, 2022, https://doi.org/10.3390/nu14071346.
29. Mansoor, O.D. et al. "Regional survey supports national initiative for 'water-only' schools in New Zealand." *Aust N Z J Public Health*, vol. 41, no. 5, 2017, pp. 508-511, https://doi.org/10.1111/1753-6405.12705.
30. Singh, G.M. et al. "Global, regional, and national consumption of sugar-sweetened beverages, fruit juices, and milk: A systematic assessment of beverage intake in 187 countries." *PLoS One*, vol. 10, no. 8, 2015, p. e0124845, https://doi.org/10.1371/journal.pone.0124845.
31. Eyles, H. et al. "New Zealand household purchases of sugar-sweetened, artificially sweetened, and unsweetened beverages: 2015-2019." *Public Health Nutr*, vol. 27, no. 1, 2023, p. e22, https://doi.org/10.1017/s1368980023002793.
32. Kühn, S. et al. "Does taste matter? How anticipation of

https://doi.org/10.59720/24-062

cola brands influences gustatory processing in the brain." *PLoS One*, vol. 8, no. 4, 2013, p. e61569, https://doi.org/10.1371/journal.pone.0061569.
33. Robinson, T.N. et al. "Effects of fast food branding on young children's taste preferences." *Arch Pediatr Adolesc Med*, vol. 161, no. 8, 2007, pp. 792-797, https://doi.org/10.1001/archpedi.161.8.792.
34. White, J.S. et al. "Fructose content and composition of commercial hfcs-sweetened carbonated beverages." *Int J Obes*, vol. 39, no. 1, 2015, pp. 176-182, https://doi.org/10.1038/ijo.2014.73.
35. Hashem, K.M. et al. "Cross-sectional survey of the amount of free sugars and calories in carbonated sugar-sweetened beverages on sale in the UK." *BMJ Open*, vol. 6, no. 11, 2016, p. e010874, https://doi.org/10.1136/bmjopen-2015-010874.
36. Chepulis, L. et al. "The nutritional content of supermarket beverages: A cross-sectional analysis of New Zealand, Australia, Canada and the UK." *Public Health Nutr*, vol. 21, no. 13, 2018, pp. 2507-2516, https://doi.org/10.1017/s1368980017004128.
37. Huse, O. et al. "Strategies used by the soft drink industry to grow and sustain sales: A case-study of the coca-cola company in East Asia." *BMJ Global Health*, vol. 7, no. 12, 2022, p. e010386, https://doi.org/10.1136/bmjgh-2022-010386.
38. Rippe, J.M. et al. "Relationship between added sugars consumption and chronic disease risk factors: Current understanding." *Nutrients*, vol. 8, no. 11, 2016, https://doi.org/10.3390/nu8110697.
39. Prada, M. et al. "Perceived associations between excessive sugar intake and health conditions." *Nutrients*, vol. 14, no. 3, 2022, https://doi.org/10.3390/nu14030640.
40. "Added sugar." Harvard TH CHAN School of Public Health, April 2022 www.hsph.harvard.edu/nutritionsource/carbohydrates/added-sugar-in-the-diet/. Accessed 4 January 2024.
41. Russell, W.R. et al. "Impact of diet composition on blood glucose regulation." Crit Rev Food Sci Nutr, vol. 56, no. 4, 2016, pp. 541-590, https://doi.org/10.1080/10408398.2013.792772.
42. "Three things to look for when buying a brix refractometer." Instrument Choice, 2020. www.instrumentchoice.com.au/news/three-things-to-look-for-when-buying-a-brix-refractometer. Accessed 29 January 2025.
43. Jaywant, S.A. et al. "Low-cost sensor for continuous measurement of brix in liquids." Sensors (Basel), vol. 22, no. 23, 2022, p.9169, https://doi.org/10.3390/s22239169.
44. Jaywant, S.A. et al. "Sensors and instruments for brix measurement: A review." Sensors (Basel), vol. 22, no. 6, 2022, p.2290, https://doi.org/10.3390/s22062290.
45. "HRC research ethics guidelines." New Zealand Health Research Council. 2021 www.hrc.govt.nz/resources/hrc-research-ethics-guidelines. Accessed January 29, 2024.

https://doi.org/10.59720/24-062

APPENDIX

Item 1: Survey distributed to school students

This form is for our 2023 NIWA Auckland Science & Technology Fair Project on sugar levels in McDonald's Coca-Cola. Your responses are anonymous, and there are no right or wrong answers. Please only proceed if you agree to take part in this survey and give your informed consent. We value your honest opinions. Thank you.

* Indicates required question

Gender: *

- Male
- Female
- Other

What do you think is the maximum limit of sugar intake recommended for children above the age of 11 years? *

- 30 g
- 40 g
- 50 g
- 60 g

Do you think your average daily sugar intake is within the recommended sugar limit? *

- Probably
- Possibly
- Probably not

Are you usually mindful of your sugar consumption when eating or drinking? *

- Very Often
- Sometimes
- Rarely
- Never

How often do you consume sugary soft drinks? *

- Seldom
- 1–2 per week
- 3–5 per week
- 5 or more per week

Do you think that McDonald's Coca-Cola (Coke) tastes better than canned/bottled Coca-Cola? *

- Yes.
- No.
- I'm not sure.
- I have not tried McDonald's Coca-Cola yet

How much sugar do you think is in one medium sized serving of McDonald's Coca-Cola? Answer in grams (g) *

(open text response)

If given a choice, would you rather have Classic Coca-Cola, or Coca-Cola Zero Sugar? *

- Classic Coca-Cola
- Coca-Cola Zero Sugar
- I don't mind

https://doi.org/10.59720/24-062

Item 2: Survey distributed to the church

This form is for our 2023 NIWA Auckland Science & Technology Fair Project on sugar levels in McDonald's Coca-Cola. Your responses are anonymous, and there are no right or wrong answers. Please only proceed if you agree to take part in this survey and give your informed consent. We value your honest opinions. Thank you.

* Indicates required question

Age:

(open text response)

Gender: *

- Male
- Female
- Other

How much sugar per day do you think is recommended for women? *

- 25 g
- 35 g
- 45 g
- 55 g

How much sugar per day do you think is recommended for Men? *

- 25 g
- 35 g
- 45 g
- 55 g

How often do you consume soft drinks? *

- Never.
- 1–2 per week
- 3–5 per week
- 5 or more per week

Do you think that McDonald's Coca-Cola tastes better than canned/bottled Coca-Cola? *

- Yes.
- No.
- I'm not sure.

How much sugar do you think is in one medium sized serving of McDonald's Coca-Cola? Answer in grams (g) *

(open text response)

If given a choice, would you rather have Classic Coca-Cola, or Coca-Cola Zero Sugar? *

- Classic Coca-Cola
- Coca-Cola Zero Sugar
- I don't mind