Salt and sugar intakes of adults in the central division of Fiji: findings from a nutrition survey in 2022

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Summary

Background Excess salt and sugar consumption contribute to diseases, such as diabetes and hypertension. This study aimed to estimate salt and sugar intakes and main sources, in a population of adults in the Central Division of Fiji.

Methods One adult per household was randomly selected to participate (n = 700). Sociodemographic characteristics; blood pressure, weight, and height; a 24-h diet recall; and spot-urine samples were collected, with 24-h urine samples from a sub-sample (n = 200). Sugar intake was estimated from the 24-h diet recalls and salt intake from the spot-urines. 24-hr diet recall was used to identify main sources of salt and sugar by food groups.

Findings 534 adults (response rate 76%, 50% women, mean age 42 years) participated. Salt intake was 8.8 g/day (95% CI, 8.7–9.0), and free sugar intake was 74.1 g/day (67.5–80.7), 16.1% of total energy intake (15.0–17.1%). Main sources of salt were mixed cooked dishes (40.9% (38.2–43.5)), and bread and bakery products (28.7% (26.5–31.0)). Main sources of sugar were table sugars, honey, and related products (24.3% (21.7–26.8)), non-alcoholic beverages (21.4% (18.8–24.0)) and bread and bakery products (18.0% (16.2–19.9)).

Interpretation Salt and sugar intakes exceeded World Health Organization recommendations in this sample of adults. Given dietary sources were foods high in salt and sugar, along with the addition to food or drinks, interventions focused on behavior along with environmental strategies to encourage healthier choices are needed.

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Keywords: Salt; Sugar; Small Island developing states (SIDS); Pacific; Hypertension; Obesity

Introduction

Fiji has a non-communicable disease (NCD) crisis, with NCDs accounting for 84% of mortality in 2019,[1] primarily due to cardiovascular disease.[1,2] There is a high prevalence of diet-related cardiovascular disease risk factors in Fiji, including diabetes, hypertension, and obesity.[3] This poses a significant and ongoing health and economic burden[4] that hinders Fiji in reaching its sustainable development goals.[5]

The rising prevalence of diet-related disease has in part been attributed to a nutrition transition in Fiji.[6–8] Over time there has been an increased reliance on imported foods and decrease in self-sufficiency, with imported processed foods replacing traditional staples.[6,7] Salt and sugar are prominent ingredients in many imported foods and key contributors to hypertension, diabetes and obesity, when consumption is high, making them specific nutrients to target for reduction.[9–11] The 2014 Nutrition Survey of people aged ≤45 years in Fiji reported an average carbohydrate intake of 481 g/day, with most carbohydrates coming from flour products and rice. Sugar intake was not determined as it was not

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Research in context

Evidence before this study

Excess dietary salt and sugar intake are known to increase the risk of hypertension, obesity, and diabetes, with Pacific Island Countries experiencing some of the highest rates of diet related ill health globally despite proactive food policy setting. The last nationally representative survey on non-communicable disease risk factors in Fiji was in 2011, estimating that 31% of the adult population had raised blood pressure, and 32% were living with obesity. Research conducted in 2016 estimated that adults consume approximately 10 g of salt per day, twice the maximum recommended amount by the World Health Organization (WHO). Sugar intake is assumed to be high, given the accessibility of sugar and products high in sugar in the Fijian market and reported behaviors of people adding sugar to drinks from the Fiji National Nutrition Survey conducted in 2014/15. However, information on how much sugar adults in Fiji were consuming was unknown, making an important gap in the literature.

Added value of this study

This cross-sectional survey of over 500 adults in the Central Division of Fiji, found that people were consuming just under double the maximum recommended amount of salt, and three times the "ideal" amount of sugar, according to WHO. Further, it was evidenced that people are consuming salt and sugar in their diets from foods high in salt and sugar (such as bread and bakery products) and from adding salt and sugar to food (for example to home cooked mixed dishes) and drinks. For sugar, people were consuming approximately 50% of their sugar intake by drinking it, in the form of adding sugar to hot drinks or via sugar sweetened beverages. These findings add important new data, identifying that food policies and diet focused interventions need to be strengthened in Fiji and targeted at the individual and food environment levels.

Implications of all the available evidence

This study confirms the hypothesized high intakes of sugar in the Central Division of Fiji. We have also shown that there has been limited reductions in salt consumption since 2016. Urgent action and interventions are needed in parallel with policy support and strengthening to reduce the amount of salt and sugar in foods available on the Fijian market and to encourage the reduction of salt and sugar use when preparing food and drinks. Such efforts are required to curb intakes of salt and sugar in Fiji and aid the reduction of the diet related burden of disease, the leading cause of premature death in Fiji.

available in nutrient composition tables. However, almost 90% of respondents reported adding sugar to their hot drinks each day, with more than 30% of the households consuming "fizzy drinks" (sugar sweetened beverages) weekly.[12] In a 2016 study based on a random sample of 272 adults, salt intake was estimated to be 10 g/day using 24-h urine samples.[13] It is not known if salt intake has changed since the 2016 survey.

Fiji has been progressive in introducing diet-related health policy with a focus on prevention, management, and behavior change.[14–16] For example, in 2018, Fiji implemented a Sugar Sweetened Beverage (SSB) Tax, by an excise duty of 35 cents per litre of SSB (approximately $0.17USD).[17] These policies may have reduced consumption of sugar, however, monitoring data are not available. With a view to helping Fiji achieve Sustainable Development Goal 3 "Good Health and Wellbeing",[18] this study aimed to estimate salt and sugar intake, and the main sources of salt and sugar in the diet, in a representative sample of adults from two areas within the central division of Viti Levu, Fiji as a baseline against which policy implementation can be monitored.

Methods

This study was part of a project designed to strengthen food policy interventions in Fiji.[14] The objective of this larger project was to identify factors needed to achieve effective food policy implementation for a healthier food environment in the Pacific.

Sample size and recruitment

We focused on the Central Division of Fiji, the most populated area of Fiji. This area was also selected for ease of collection of urine samples as they needed same-day analyses. Two enumeration areas within the Central Division of Fiji were randomly selected. A minimum sample size of 700 (350 for each area) was calculated to achieve at least 80% power to detect a 0.6 g/day change in salt intake (SD 3.6) and a 0.9 absolute percent change in free sugar intake (SD 5.4) if the survey was to be repeated in 5 years, accounting for 16% non-response rate.[14] As the most recent census data from 2017 was inaccessible at the time of this study, a comprehensive household listing of the two areas was conducted from October to December 2021. Basic demographic data were collected from each household for each individual aged 18 years or older. These data were used to select a proportionate stratified sample by age, sex, and ethnicity.

Permission to enter villages and conduct the survey was gained through local village chiefs. Research assistants visited the houses of selected participants to inform them of the study and invite them to participate. If no-one, or only a person under the age of 18, was at home, then a repeat visit was made at a later time. Participant information sheets and consent forms were available in English, Hindi and Fijian. Research assistants orally translated written material into the local language when needed. Surveys were mainly conducted on weekdays (Monday—Friday), unless specifically arranged with a participant to collect data on a Saturday. The surveys took approximately an hour to complete, taking place in the participant's home or another convenient space. Digital survey questionnaires, administered using Samsung tablets, were used to record: 1) a general questionnaire on basic demographics, disease history and medication use; 2) a 24-h diet recall survey; 3) a Knowledge, Attitudes and Behaviours survey for salt and sugar, and questions on food security; 4) measurement of height, weight, waist circumference and blood pressure; and 5) results of a spot-urine sample. A random sub-sample of the population (n = 200) completed a 24-hr urine sample (Fig. 1).

Demographic and health questionnaire and physical measurements

Participant demographic data were collected, including information on sex, age, ethnicity, highest education level attained, and household type (living alone vs sharing). Physical measurements, including height, weight and waist circumference and three blood pressure readings, were taken following the WHO STEPS standardized procedure.[19] Blood pressure was measured using a digital automatic blood pressure monitor (OMRON M6). Living with hypertension was classified as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or self-report of taking anti-hypertensive medications. During data analysis the mean of the second and third readings was calculated. Height was measured using a portable height measuring board. The height in centimeters at the exact point to the nearest mm was recorded. Weight was measured in kilograms using a portable weighing scale.

24 hr multiple pass dietary recall survey

Multiple pass 24 h dietary recalls were chosen to collect diet intake information based on having a lower respondent burden, compared to other methods (for example weighed food diaries or seven day recalls).[20] The validated Intake24 diet recall application[21–23] was adapted for Fiji from the Intake24 UK and New Zealand food composition database.[21] We updated by inputting the top 100 most consumed foods in Fiji based on the 2014 national nutrition survey and discussed with key stakeholders (including authors AK, AD, see Supplementary Methods "List of 100 commonly consumed foods, used to inform adaptation of Intake24"). These items were matched to food items

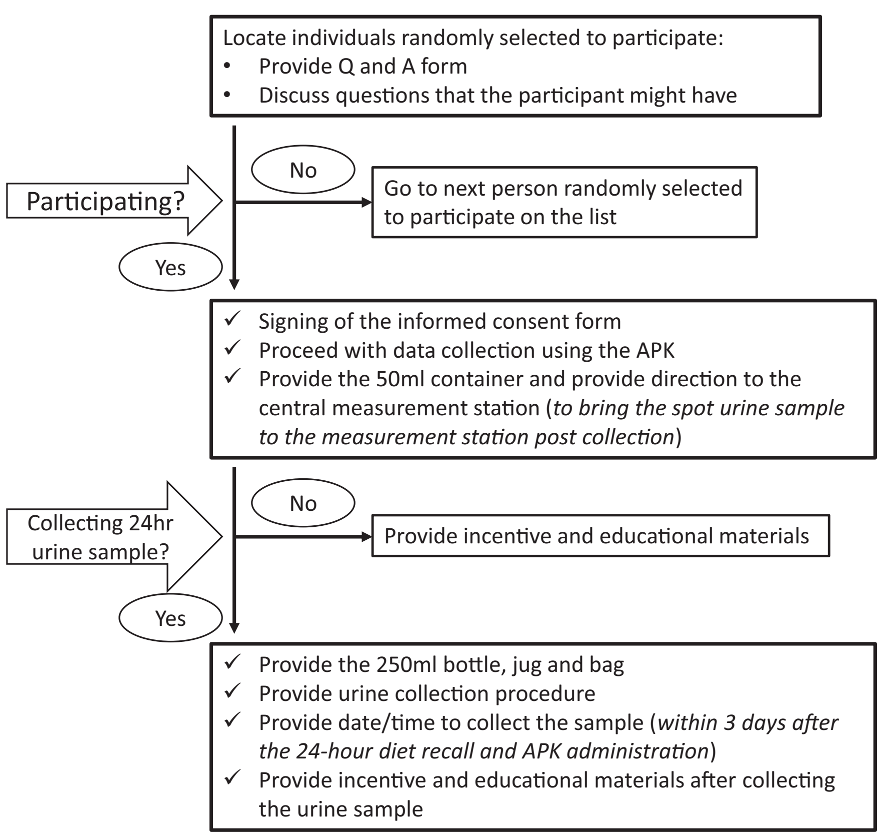

Fig. 1: **Flow chart of survey data collection** ("Q and A", Question and Answer form, "APK", the data collection application).

already within the Intake24 food composition database, following guidance by the Intake24 team and Food and Agriculture Organization, by matching foods to other foods within 25% for key nutrient components.[24] Foods that were not in the system were matched with those close in description. For instance fern fronds with spinach, shark meat with fish, and meaty bone soup with beef soup. Use of the adapted Intake24 application and database meant data on the sugar content of foods was available, which is currently lacking from the Pacific Island Food Composition Tables.[25] Foods and drinks consumed in the past 24-h were entered directly into the Intake24 application by the research assistant. Food and drink items entered into Intake24 link automatically with the food composition database, with automatic conversion into nutrient intake data (including information on mean energy, salt and sugar intake).

24 hr multiple pass diet recall process

Research assistants guided participants through the 24-hr diet recall, with prompts to gain extra information on portion size of foods consumed, how the food was cooked, and exact brands of foods (where applicable). The diet recall process was aided by the Intake24 application, which is designed to prompt the "gold standard" multiple pass diet recall method, whereby general information on food eaten at a specific time (for example, breakfast, morning snack, lunch, afternoon snack, dinner) is recorded and then there are multiple rounds of checks for further information on each specific food and drink item. Each food item was searched for within Intake24, and then images were provided for each food item with portion size prompts (for example, pictures of the food items on plates, or in terms of cups or spoons, along with fullness levels), to aid accuracy in reporting the portion size of the food or drink consumed.

Spot and 24-h urine samples

All participants were asked to provide a spot urine sample at the time of the survey to estimate urinary salt. A sub-sample of stratified participants (n = 200) were also asked to provide a 24-hr urine sample so that we were able to compare measurements from these different approaches.[26] Those selected for 24-hr urine collection, collected their urine for a 24-h period within three days of the initial survey. Participants provided the time of the first and final void, and reported any issues with collection, such as missed collection or spillage. Urine samples were collected on the day of completion and transferred to a local laboratory where the volume of both the spot and 24-h urine collections was measured.[14] Urinary sodium and potassium were determined using ion selective electrode method on electrolyte analyzer (XI-921) using reagents from Caretium, Shenzhen, China. Urinary creatinine was measured by the Jaffe method using an autoanalyzer (C 311) with reagents from Roche Diagnostics, Switzerland.

Data processing

From the 24-h diet recall, mean salt and sugar intakes were calculated as grams per day. We also reported sugar intake as a percentage of total energy intake overall, and as a percentage of energy intake excluding sugars from fruits, vegetables, and milk to obtain an estimate of free sugar consumption.[9] The contribution of sugar intake to total energy intake was calculated by multiplying sugar intake (in grams) by an Atwater factor of 17 and dividing by the energy intake.[27]

A food categorization system was developed based on previous surveys in Fiji.[12,28] Foods reported during the 24-h diet recall were assigned to one of 17 food categories (1–alcohol, 2–bread and bakery products, 3–cereal and grain products, 4–coconut products, 5–confectionery, 6–convenience foods (including takeaway meals), 7–dairy, 8–edible oil and oil emulsions, 9–egg and egg products, 10–fruit, vegetables, nuts and legumes, 11—meat, poultry and meat alternatives, 12—mixed cooked dishes, 13—non-alcoholic beverages, 14—sauces, dressings, spreads and dips, 15—seafood and seafood products, 16—snack foods (sweet and savory snacks), and 17—table sugars, honey and related products (such as syrups and molasses), Supplementary Table S1. The main sources of sugar and salt in the diet were identified by calculating the percent contribution of each of the 17 major food categories, by dividing the sugar/salt consumed from each category by the total sugar/salt intake.

For spot urine samples, salt intake was estimated using the INTERSALT with potassium equation.[29] To determine daily salt intake from 24-h urine samples, 24-hr sodium excretion (in mmol/day) was obtained by multiplying the sodium concentration (in mmol/L) by the urine volume (L). This was transformed to mg/day by multiplying by 23 (the molar mass of sodium is 23 g/mol) and then by 2.5 (1 mg sodium = 2.5 mg salt). The resulting value was divided by 1000 (1 g = 1000 mg) to obtain salt intake in g/day. 24-hr urine samples were excluded from analysis if the volume was <500 ml, if creatinine <4 or >25 mmol/24 h for females or if creatinine <6 or >30 mmol/24 h for males.

Each participant had a unique identifier common across the data collection application and the Intake24 application. Participant specific information was consolidated across spreadsheet based on unique identifier in an excel spreadsheet and imported into STATA BE V17.0 for data analysis.

Data analysis

Complete case analyses were conducted, after 45 people (7%) were removed from the analysis due to missing, or implausible data, based on World Health Organization NCD STEPs survey guidance.[30] We analysed the survey data using STATA BE V17.0 for Windows (Stata Corp LP, College Station, TX, USA). Analyses were weighted to reflect the probability of individual selection (sample weight) and to match the population structure of Deuba and Waidamudamu (population weight). Weights were based on age (18–44, 45–85), sex (female, male), and ethnicity (iTaukei (Indigenous Fijian) and Fijian of Indian descent or others)) and the reported population structure of the respective regions in Viti Levu (population weights), based on the community listing responses. The *svy* command in STATA was used, and the Taylor linearization method was employed for variance estimation. Results were reported as mean (for continuous variables) or proportion (for categorical variables) with standard error (SE) or 95% confidence interval (CI) as appropriate. The results were reported for major participant subgroups according to sex (women, men), age group (18–44 and 45–85) and ethnicity (iTaukei (Indigenous Fijian) and Fijian of Indian descent or others). The differences (in intakes and percent contribution) by subgroups were determined using survey-weighted regression analyses.

Ethical standards disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the University of New South Wales (# HC200469) and Fiji National University College of Human Health Research Ethical Committee (CHHREC264.20). Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Role of the funding source

The funders had no role in the study design, data collection, data analysis, data interpretation, drafting or writing of this manuscript.

Results

Baseline characteristics

534 people participated in the survey (response rate: 76%), of which 50.4% were women (n = 272), and the mean age was 42 years. Sixty percent of the population were aged 18–44 years of age at the time of the survey and approximately half of the population were iTaukei. A third had a tertiary education or higher, and most people lived with others (Table 1). Ninety percent reported that their health was either good, very good or excellent. A third reported that they had been diagnosed with high blood pressure (28.0% (24.5–31.7)), and a third reported that they were current smokers (28.7% (95% CI, 25.4–32.3), Table 2.

Health status measures

Mean systolic blood pressure was 136.4 mmHg (95% CI, 134.9–137.8), diastolic blood pressure was 84.7 mmHg (83.7–85.8), and 50.8% (46.8–54.8) of participants had hypertension. Mean waist circumference

Variables	Weighted estimates	Women	Men
Sex (%, 95% CI)			
Female	50.4 (45.9–54.8)		
Male	49.6 (45.2–54.1)		
Age, years (mean, 95% CI)	41.7 (41.0–42.4)	42.5 (41.5–43.5)	40.8 (39.9–41.8)
Age group (%, 95% CI)[b]			
18–44 years	63.6 (59.4–67.6)	61.4 (55.4–67.1)	65.8 (60.0–71.3)
45 years and above	36.4 (32.4–40.6)	38.6 (32.9–44.6)	34.2 (28.7–40.0)
Ethnic background (%, 95% CI)			
iTaukei	46.3 (41.9–50.8)	48.6 (42.5–54.8)	44.0 (37.8–50.4)
Fijian of Indian descent or other[c]	53.7 (49.2–58.1)	51.4 (45.2–57.6)	56.0 (49.6–62.2)
Area (%, 95% CI)			
Deuba	60.0 (55.7–64.1)	58.5 (52.4–64.3)	61.5 (55.5–67.2)
Waidamudamu	40.0 (35.9–44.3)	41.6 (35.7–47.6)	38.5 (32.8–44.5)
Education (%, 95% CI)			
Secondary education or below	69.4 (65.4–73.1)	71.7 (66.1–76.6)	67.1 (61.2–72.4)
Tertiary education (University)	29.4 (25.8–33.4)	27.3 (22.4–32.8)	31.6 (26.3–37.4)
Postgraduate or higher	1.2 (0.5–2.6)	1.0 (0.4–3.1)	1.3 (0.4–4.2)
Household type (%, 95% CI)			
Live alone	4.2 (2.9–6.0)	3.9 (2.2–6.7)	4.5 (2.8–7.3)
Shared household	95.8 (94.0–97.1)	96.2 (93.3–97.8)	95.5 (92.8–97.2)

[a]534 people participated (262 women, 272 men), note numbers per characteristic are not presented as we have presented weighted estimates. [b]The estimates for the variables *age group*, *sex*, *ethnic background* and *area* were derived prior to considering stratification (since these were the variables used to form the strata). [c]Other ethnicities contributed 2.00% (1.09–3.66%) to the Fijian of Indian descent or other category.

Table 1: **Characteristics of nutrition survey participants.**[a]

Variables	Weighted estimates	Women	Men
Self-assessed health (%, 95% CI)			
Excellent	21.1 (17.8–24.7)	19.7 (15.4–24.8)	22.5 (17.8–28.0)
Very good	33.1 (29.3–37.1)	32.3 (27.2–37.9)	33.9 (28.4–39.8)
Good	35.7 (31.87–39.8)	33.4 (28.2–39.0)	38.0 (32.4–44.0)
Fair	8.6 (6.6–11.1)	12.1 (8.9–16.2)	5.0 (2.9–8.5)
Poor	1.6 (0.9–2.9)	2.6 (1.3–5.1)	0.6 (0.2–2.3)
Current smoker (%, 95% CI)	28.7 (25.4–32.3)	14.8 (11.2–19.2)	42.9 (37.3–48.7)
Ever smoked regularly (%, 95% CI)	26.2 (22.9–29.8)	12.5 (9.2–16.9)	40.2 (34.6–46.0)
Time since last alcoholic drink (%, 95% CI)			
1 week or less	14.9 (12.2–18.2)	6.23 (3.85–9.93)	23.78 (18.93–29.43)
More than 1 week to less than 12 months	22.1 (18.8–25.8)	17.4 (13.4–22.2)	26.9 (21.8–32.7)
12 months or more	23.9 (20.5–27.7)	20.9 (16.6–26.1)	27.0 (21.8–32.8)
Never	39.0 (35.5–42.7)	55.5 (50.0–60.7)	22.4 (17.9–27.5)
History of disease (%, 95% CI)			
High blood pressure	28.0 (24.5–31.7)	28.3 (23.7–33.4)	27.6 (22.6–33.3)
Low blood pressure	9.9 (7.7–12.5)	15.8 (12.1–20.4)	3.8 (2.1–6.8)
High cholesterol or fat in blood	8.6 (6.6–11.2)	9.0 (6.1–12.9)	8.3 (5.7–12.0)
Heart attack	1.6 (0.9–2.9)	1.6 (0.7–3.7)	1.6 (0.7–3.5)
Stroke	1.0 (0.5–2.1)	0.7 (0.2–2.9)	1.2 (0.5–3.1)
Angina	12.6 (10.1–15.7)	12.8 (9.5–17.0)	12.5 (8.8–17.3)
Diabetes	9.7 (7.7–12.2)	10.3 (7.5–14.0)	9.1 (6.5–12.6)
Systolic blood pressure, mmHg (mean, 95% CI)	136.4 (134.9–137.8)	136.2 (133.9–138.5)	136.5 (134.7–138.4)
Diastolic blood pressure, mmHg (mean, 95% CI)	84.7 (83.7–85.8)	84.3 (82.8–85.8)	85.2 (83.8–86.6)
Hypertension (%, 95% CI)	50.8 (46.8–54.8)	48.7 (43.5–53.9)	52.9 (46.9–58.9)
Height, cm (mean, 95% CI)	165.8 (165.1–166.5)	159.5 (158.5–160.5)	172.2 (171.2–173.1)
Weight, kg (mean, 95% CI)	79.4 (77.8–81.0)	77.6 (75.3–79.9)	81.2 (79.1–83.4)
Waist circumference, cm (mean, 95% CI)	96.5 (95.0–98.0)	97.5 (95.4–99.6)	95.4 (93.4–97.5)
BMI, kg/ma (mean, 95% CI)	28.8 (28.2–29.3)	30.3 (29.4–31.2)	27.2 (26.5–27.9)
BMI classification (%, 95% CI)[b]			
Underweight	5.4 (3.8–7.5)	4.5 (2.6–7.6)	6.3 (4.0–9.6)
Normal	25.5 (22.0–29.3)	19.5 (15.4–24.4)	31.5 (26.1–37.4)
Overweight	27.8 (24.3–31.7)	25.8 (21.1–31.3)	29.8 (24.7–35.4)
Obese	41.4 (37.5–45.4)	50.2 (44.6–55.8)	32.5 (27.2–38.3)

[a]Hypertension classified as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or self-report of taking medications for hypertension. [b]BMI classification: *underweight* (<18.5 kg/m^2); *normal weight* (18.5–24.9 kg/m^2); *overweight* (25.0–29.9 kg/m^2); *obese* (≥30.0 kg/m^2).

Table 2: **Self-reported health status, and anthropometric measurements.**

was 96.5 cm (95.0–98.0). Mean body mass index was 28.8 kg/m^2 (28.2–29.3), significantly higher for women than men (30.3 kg/m^2 (29.4–31.2) vs 27.2 kg/m^2 (26.5–27.9)). Almost 70% of people were living with overweight or obesity, and more women than men were living with overweight or obesity, Table 2.

Estimates of salt and sugar intake

Salt intake

From the spot urine analysis, salt intake was estimated at 8.8 g/day (95% CI, 8.7–9.0), higher for men than women (10.1 g/day (9.8–10.4) vs 7.7 (7.4–7.9)), for the younger age group compared to older (9.1 g/day (8.8–9.3) vs 8.5 (8.2–8.7)) and for iTaukei Fijians compared to Fijians of Indian descent or other (9.1 g/day (8.8–9.4) vs 8.6 (8.4–8.9)), Fig. 2.

From the 24-hr diet recall, salt intake was estimated at 5.5 g/day (5.2–5.8), Supplementary Table S2. This was higher for men than women (6.0 g/day (5.6–6.5) vs 5.1 (4.7–5.4)) and higher for the younger age group compared to older (5.9 g/day (5.5–6.3) vs 4.9 (4.5–5.2)).

For the subsample of 24-hr urines we attained 82 samples after exclusion of suspected inaccurate urine collections. The analysis of the 82 samples provided a sodium intake estimate lower than that found by the spot urine samples and diet recall estimates (Supplementary Table S2), suggesting that we did not receive complete urine samples. Because of this underestimate and the limited number of analyzable urine samples, we have not included the results in the main paper (but see Supplementary Table S2).

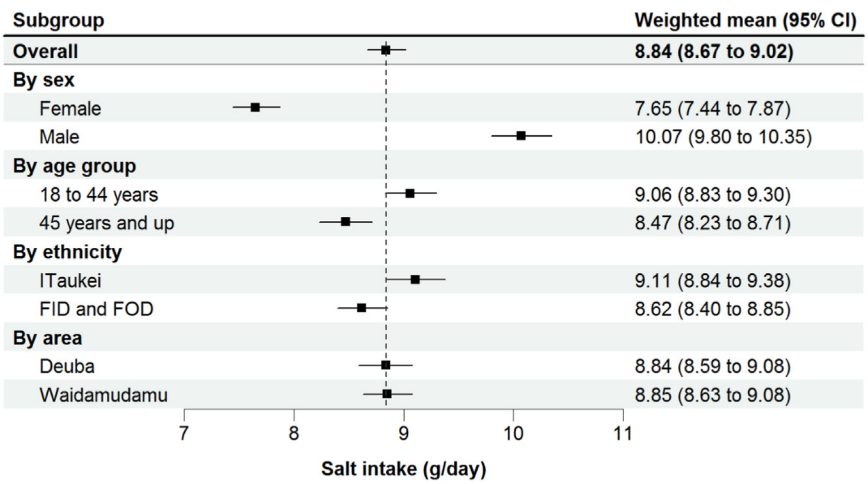

Fig. 2: Salt intake estimate, based on INTERSALT with potassium equation, presented overall and by key population subgroups, g/day (weighted mean, 95% CI).

Sugar intake

From the 24-hr recall, sugar intake was estimated at 81.8 g/day (95% CI, 74.8–88.7), contributing to 17.7% of total energy intake (16.7–18.8%). Free sugar intake was estimated at 74.1 g/day (67.5–80.7), contributing to 16.1% of total energy (15.0– 17.1%), Table 3. Sugar intake was not significantly different between women and men, however, sugar intake in grams per day differed by age, area, and ethnicity, Supplementary Table S3. Both total sugar intake and free sugar intake as a percentage of energy intake differed by ethnicity (higher for iTaukei Fijians). Free sugar intake also differed by age (higher for the younger age group), Supplementary Table S3.

Main sources of salt and sugar in the diet

The main contributors to salt were mixed cooked dishes (40.9% of salt intake (38.2–43.5)), bread and bakery products (28.7% (26.5–31.0)), Fig. 3 and Supplementary Table S4. There were differences in food group contribution to salt intake by ethnicity (differences in bread and bakery products, coconut products, dairy, oils and sugars, honey, and related products categories), by age group (differences in contribution from mixed cooked dishes, and snack foods) and by location (difference in contribution from sauces, dressings, spreads, and dips). There were no differences evidenced by sex (Supplementary Table S4).

The main sources of sugar in the diet were table sugars, honey, and related products (such as syrups) (24.3% (21.7–26.8)), non-alcoholic beverages (21.4% (18.8–24.0)) and bread and bakery products (18.0% (16.2–19.9)), Fig. 3 and Supplementary Table S5. There were marked differences by ethnicity for the contribution of sugars, honey, and related products, contributing 31.6% (27.4–35.8%) for iTaukei Fijians compared to 17.9% (14.9–20.8%) for Fijians of Indian and other descent. Conversely, bread and bakery products contributed to 22.3% (19.6–25%) of sugar intake vs 13.2% (10.7–15.7%), and mixed cooked dishes contributed 19.0% (16.6–21.5%) vs 12.7% (10.4–14.9%) for Fijians of Indian and other descent compared to iTaukei Fijians, respectively. Contributions of foods to sugar intake also differed by sex for the categories of cereal and grain products (women vs men, 2.6% (1.4–3.9%) vs 1.3% (0.8–1.8%)), confectionery (0.9% (0.1–1.7%) vs

Measure	Overall	By sex	
		Female	Male
Energy intake, kJ/day[a]	7743 (7359–8127)	7150 (6727–7572)	8342 (7698–8985)
Energy intake excluding alcohol intake, kJ/day[a]	7648 (7293–8003)	7147 (6725–7570)	8154 (7581–8727)
Total sugar intake, g/day	81.8 (74.8–88.7)	80.5 (70.0–90.9)	83.1 (74.0–92.1)
Total sugar intake, % energy	17.7 (16.7–18.8)	18.2 (16.6–19.8)	17.2 (15.9–18.6)
Free sugar intake, g/day	74.1 (67.5–80.7)	71.9 (62.0–81.9)	76.3 (67.7–84.9)
Free sugar intake, % energy	16.1 (15.0–17.1)	16.3 (14.7–17.9)	15.8 (14.4–17.2)

Free sugar intake excludes the following minor categories: milk, fruit, and vegetables. [a]Significant difference by sex.

***Table 3:* Sugar and energy intake estimates overall and by sex, g/day (weighted mean, 95% CI).**

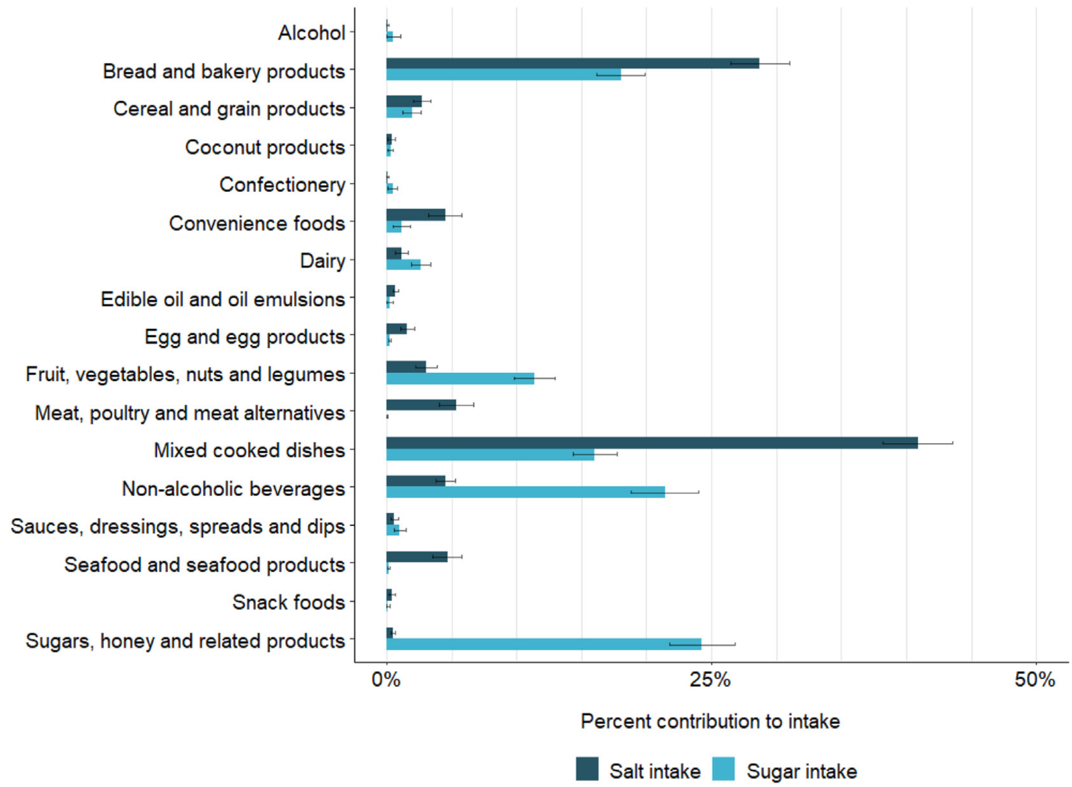

Fig. 3: Percent contribution of food categories to dietary salt and sugar (mean, 95% CI).

0.0% (0.0–0.1%)), dairy (3.9% (2.5–5.2%) vs 1.4% (0.8–2.1%)) and egg and egg products (0.4% (0.2–0.6%) vs 0.1% (0.1–0.2%)), and by age group for bread and bakery products (18–44 years vs 45 years and over, 16.2% (13.8–18.5%) vs 21.3% (18.3–24.3%), confectionery (0.7% (0.1–1.4%) vs 0.0% (0.0–0.0%)), dairy (1.9% (1.1–2.7%) vs 4.0% (2.4–5.6%)), and non-alcoholic beverages (24.1% (20.5–27.7%) vs 16.8 (13.4–20.2%)), Supplementary Table S5.

Discussion

From this representative survey of adults in the Central Division of Fiji, we found that salt intake was almost double the maximum recommended level by the World Health Organization, at 8.8 g/day, and sugar intake was over three times the ideal recommended amount, with free sugars contributing 16% of total energy intake.[9,11] The main sources of salt and sugar in the diet indicate the need for interventions at a food environment level, by reducing the availability of high salt and sugar foods, and at the individual level, by helping people make healthier choices.

Our survey also demonstrated differences in salt and sugar intake and main food sources by participant characteristics. Those in the younger age grouping (18–44 years) and people of iTaukei ethnicity had higher intakes of sugar and salt intake, with food sources tending to be discretionary or processed foods (non-alcoholic beverages and snack foods). This may indicate a greater reliance on processed and convenience food in theses populations, and a greater influence of the nutrition transition. Previous qualitative work has highlighted that older iTaukei Fijians are concerned about the eating practices of younger generations.[31] We, thus, suggest that future research focus on the diets of young Fijians with a view to preventing the diet-related burden of disease.

Strengths and limitations

Our study has several strengths. We conducted a community listing before the main survey meaning the sampling was done using up to date information. Our response rate was high at 76% which is similar to the National Nutrition Survey conducted in Fiji in 2014/15.[12] The areas surveyed were randomly selected from the areas included in the National Nutrition Survey, allowing for comparison between surveys. Working with local and trained research assistants and engaging with local stakeholders allowed us to communicate in common languages and obtain buy-in from communities. We also engaged with local stakeholders prior to conducting the survey (for example the heads of the villages) to ensure the survey was conducted in line with community protocols and priorities. We used tablet-based applications for the collection of survey data, that were developed and/or adapted specifically for this survey. Lastly, adapting Intake24 for this survey makes this the first study to comprehensively measure sugar intake in a region of Fiji.

Our survey has several limitations. Firstly, we conducted the survey in the Central Division of Fiji, and as such findings may not be generalizable to the rest of Fiji, particularly more remote areas or Islands, that likely have a different food environment to central Fiji. We conducted just one diet recall and one spot urine per person. Therefore, we are limited in our ability to explore habitual intake, as intake fluctuates from day to day. It is also possible that specific days of feasting were included in this survey, particularly if participants were surveyed on a Monday, following feasting on the weekend.[31,32] However, we believe this reflects typical eating in Fiji as feasting on Sundays is common. We did not collect data on Sundays, and therefore we do not have information on what people eat on Saturdays. Previous research has found that diet surveys underestimate total energy intake,[33] and underestimate intakes of specific food groups due to recall bias, particularly snack foods and drinks.[34] Snack foods and certain types of drinks tend to be high in salt and/or sugar, as such consumption may have been underestimated. While our response rate was high, it is still possible that non-response bias affected the results, particularly if non-responders had different dietary patterns to those who participated in the study. For estimating sugar intake and sources of salt and sugar in the diet, we used a food composition table that was developed in New Zealand with additional foods from Fiji, given that New Zealand is a major exporter of foods to Fiji,[35] as such these composition data may not fully represent the sugar and salt content of foods available in Fiji specifically. The community listing and survey were both conducted during the COVID19 pandemic, following governemnt guidance at the time. This may have influenced where the participants were based (with people returning to home villages during periods of isolation), and it may have also influenced diet behavior and the risk factors described. Other data collected and published by our research group in the same study population found that the COVID19 pandemic negatively impacted on peoples' self reported food security, however, there was no association between reported food security and intakes of salt, sugar and fruits and vegetables.[36]

While we followed best practice methods to measure salt intake from our survey population,[26] the findings from the 24-h urine subsample were lower than the salt intake estimated from the 24-h diet recall, which is known to underestimate salt intake significantly.[26] We compared findings to previous 24-h urine surveys in Fiji and identified that the volumes of the urine samples were also lower than expected.[13] It is possible that the 24-h urine samples were impacted by multiple factors, including incomplete collections, spillage of sample, and heat (with possible evaporation of the samples). This process has highlighted the complexity of collecting 24-h urine samples, and the burden on both participants and research teams to ensure proper collection with reliable findings.

There are limitations to using spot urine samples to estimate population level salt intake. A systematic review and meta-analysis found that estimates of salt intakes based on spot urine samples can provide a good, overall, indication of population mean intake. However, they tend to underestimate salt intake at higher levels of consumption, and overestimate at lower levels of consumption.[37] A previous study comparing spot and 24-h urine sample estimates in Fiji found that spot-urine samples underestimated salt intake by 0.9 g/day.[38] As such it is possible that the salt intake estimate from spot urines is an underestimation of the true population mean.

How salt and sugar intake and main sources compare to other literature

Salt intake was estimated at 8.8 g/day and was mainly derived from mixed cooked dishes (such as curries) and bread and bakery products. This indicates that excessive amounts of salt were added during cooking and the presence of salt as a preservative in store bought processed bread and bakery products. This estimate is lower than the last survey in Fiji that estimated salt intake based on 24-h urines to be 10 g/day,[13] albeit as highlighted in the limitations, this difference could be due to differences between spot and 24-hr urine samples for salt estimation. Conversely, our findings do show similarities to the national nutrition survey conducted in 2015,[12] where salt intake was also estimated at 8.8 g/day (3521.8 mg/day of sodium), estimated from food frequency data. Further, main sources of salt in the diet appear to have remained similar, with main sources being breads and buns, roti, salt added to foods and savory snacks in 2015.[12] Bread and bakery products have also been identified as prominent sources of salt in Vanuatu[6] and Kiribati, as well as Australia, New Zealand and the UK.[39] It may indicate a reliance on imported and longer shelf-life processed and ultra-processed foods in Pacific countries. Consumption of processed and ultra-processed foods appear to be increasing in Pacific countries[40] and globally.[41] Studies from Tonga and Samoa, show that imported foods account for half of participant energy and macronutrient intake, with many of these foods being processed or ultra-processed.[42]

Several studies report high SSB availability and consumption in Pacific populations.[17,43–45] What our study adds is the observation that sugar added to drinks and foods, and bread and bakery products were also major sources of sugar and energy intake in Fiji. The national nutrition survey in 2015 did not look at sugar in terms of contribution to energy intake but did explore the frequency of sugar sweetened beverage consumption and adding sugar to drinks at a household level, finding daily consumption to be low, at 2.8% of households, however, also found high frequency of raw/table sugar use, with 89% of households reporting daily use and consumption.[12] Studies from Kiribati have observed that sugar was added to nearly all meals[46,47] and also that SSBs were a leading source of sugar. That said, self-reported SSB consumption was considerably higher in Kiribati, (more than 3.5 servings of sugary beverages per day) compared to our study.[3] Recent literature has highlighted over-eating food and binge drinking fruit juices by Fijian adults after drinking kava.[32,48] We did not observe this, but it is likely that kava and alcohol were under-reported in our study.[34] Given high availability and high intakes of sugar from multiple sources, our findings indicate the need for reformulation targets and import regulations in addition to current measures such as SSB taxes.

Scope to improve dietary assessment and monitoring

The Ministry of Health in Fiji and supporting organizations (including the World Health Organization and the Food and Agriculture Organization) have conducted STEPs surveys in Fiji and the last National Nutrition Survey collected diet information on children and adults (up to the age of 45 years) was in 2014.[12] However, it was not possible to assess urinary salt or sugar intake from these surveys. The next national nutrition survey in Fiji is planned for 2025 and we recommend 1) updating the food composition tables to include sugar, separate to total carbohydrate, in time for this survey, or 2) using the method we applied in the present study, using sugar data from New Zealand and the United Kingdom, or 3) estimating sugar as a proportion of total carbohydrate intake based on the Pacific Island Food Composition Tables, drawing on comparisons to other similar foods as per a recent study from New Caledonia.[49]

The WHO STEPs surveys conducted in 2002 and 2011 included questions on fruit and vegetable consumption, and questions on salt related knowledge, attitudes, and behaviors.[3,50] The next WHO STEPs survey is planned for 2024, providing Fiji with nationally representative data capturing trends over time in fruit and vegetable consumption, and salt knowledge, attitudes and behaviours. Including questions in this STEPS survey on sugar added to beverages and sugar sweetened beverage consumption frequency, could be a feasible way to monitor sugar intake without having to conduct resource intensive 24-h diet recalls. Further, there is the opportunity to monitor salt intake using spot-urine samples as a component of STEPs surveys,[30] and we suggest that this will be important for monitoring and estimating changes in salt intake at a national level.

Diet interventions and policy implications

These findings demonstrate the value of dietary consumption data for countries for formulating evidence-based responses to the diet related burden of NCDs. New knowledge on sugar added to beverages and foods signals a need for a broad campaign that both informs consumers of main sources of sugar in the diet, and encourages workplaces, schools, restaurants, cafes, places of worship and homes to reduce the amount of sugar added to drinks. At an individual behavior level, behavior change communication and mass media campaigns could be used to highlight main sources of sugar and salt in the diet, and key behaviors to target for reducing this. For example, utilizing different modes of communication such as campaigns via TV, social media, talks through respected leaders and through Faith Based Organizations to encourage people to decrease or stop adding sugar to drinks and salt to cooked foods. However, evidence from a review of salt reduction behavior change interventions found inconsistent evidence of effectiveness and limited effect sizes of behavior change interventions on their own, and that interventions targeting food environments more generally (for example, reformulation of foods, and taxes on unhealthy foods) are needed to reduce population levels of intakes.[51] These findings are in line with the WHO "best buys" for reducing NCDs[52] and the Lancet Commission on the Global Syndemic of Obesity, Undernutrition and Climate Change.[53] As noted earlier, Fiji has a tax on imported and domestic SSBs.[16] Recently, the Fiji Government announced increased taxes on sugary drinks (from 35 cents per litre to 40 cents per litre), other processed foods, alcohol and tobacco in its new budget designed to tackle NCDs.[54] This increase is encouraging; however, evidence shows that a tax of at least 20% of total price is considered a minimum to reduce consumption.[17,55] Further, it is unclear whether this increase in tax will be applied to locally produced SSBs that have previously been exempt from tax increases.[17] The lack of a uniform application of the tax may shift consumption from higher-cost imported SSBs to lower cost, locally produced SSBs and not achieve the overall goal of reducing SSB consumption. The tax also needs to be expanded to target the full range of SSBs including in powdered form (e.g. 3-in-1 coffee/tea, chocolate drink, or energy drinks plus sugar and milk),[3,56] and given our findings taxes could also be considered for raw and table sugar. Complementary policies are also needed including restricting marketing and visibility of SSBs. While the present study did not collect data on children, previous research suggests SSB consumption starts at a young age[57] and previous studies in the Pacific Region have shown a high prevalence of SSBs for sale around schools.[44] Governments and communities can work to increase availability of improved water sources, and healthy locally produced drinks (for example, coconut water, from fresh and locally produced coconuts ('Bu')).

High sodium intakes were concerning given high and potentially increasing rates of hypertension in Fiji and around the Pacific, and the high unmet need for hypertension treatment.[3] Hypertension signals a pipeline of future NCDs in the Pacific with major implications for health systems.[58] Fiji adopted a salt reduction strategy ("Fiji Salt Action Challenge Strategy", 2010) targeting food manufacturers, consumers and bakers, but these were largely voluntary with limited impact on sodium intakes.[13,28] Bread and bakery products account for close to one third (29%) of sodium intake, and were also a key contributor to sugar intake, high salt and sugar content in this category could be addressed through policies that incentivize reformulation and reward lower-salt and sugar alternatives. Lessons can be learnt from other settings globally, where mandatory salt targets for bread and bakery products have been successful in lowering salt content of products,[59] aided in success by stringent monitoring to ensure these are adhered to. Evidence suggest that strengthening policy action in Fiji and other settings has been challenging in the past.[15,56] However, commitment from government to improving health is evident through the 2023–2024 Fiji budget announcement, with expansion of taxes to focus on a broader range of foods.[54] Taxes that focus on a range of food groups (for example targeting processed and ultra processed foods) will aid the decreased accessibility and therefore consumption of salt and sugar in Fiji. Implementation will likely require greater engagement by political leaders of non-health sectors to commit to, and follow through on, adopting, implementing and sustaining their inputs,[15] in addition to stronger institutional mechanisms overseeing budgeting, coordination and accountability.[15,56]

Conclusion

In this representative survey of adults in the central division of Fiji, we identified high levels of salt and sugar in the diet, with both consumed well in excess of the World Health Organization maximum recommendations. Our findings provide evidence for the need to reduce salt and sugar intake in Fiji at both the individual level and at the food environment level. Interventions are needed in parallel with policy support to reduce the amount of salt and sugar in foods available on the Fijian market. Such efforts are required to curb intakes of salt and sugar in Fiji and aid the reduction of the diet related burden of disease, the leading cause of premature death in Fiji.

Contributors

The survey was designed by AMS, GW, CB, MW, KR, JW and BLM. AMS, GW, SL and BLM managed the survey. UVM, LS, PN, SK, HT, EV, MS, AM, AUP collected the survey data. JAS led the data analysis in consultation with AMS, GW, AP, JW and BLM. AMS and BLM drafted the first version of the manuscript. DN, AD, AK, DP and ER provided specific insights on food policy context in Fiji. All authors reviewed, inputted, and have approved the final version of this manuscript for submission.

Data sharing statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of interests

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanwpc.2024.101074.

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