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ORIGINAL ARTICLE

Adequate and excessive food consumption in Suriname: a multiethnic middle-income country

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Abstract

Objectives To explore food consumption among different sex, age, ethnic, urban, education and income groups in Suriname.

Methods Data from a cross-sectional population study (n = 5748; 15–64 year) were used. Food consumption was defined *adequate* if (1) fruit and vegetable intake was conformable to WHO recommendations, (2) mostly vegetable oil was used, and (3) whole-wheat products were used $\geq$ 3 days/week. Food consumption was defined *excessive* if 3 out of the following 5 items scored positive: consumption of (1) snack, (2) sweet, (3) fast food, or (4) soft drink $\geq$ 3 days/week, or (5) salt was always added while preparing a hot meal.

Results 6.4% (95% CI 5.8–7.1) had an *adequate* and 21.9% (95% CI 20.9–23.0) an *excessive* food consumption pattern, with differences among ethnic groups ($p < 0.05$). Adequate consumption increased, while excessive consumption decreased with increasing age ($p < 0.05$). Both adequate and excessive consumption increased with higher degree of urbanization, level of education and income ($p < 0.05$). Except for level of education for adequate consumption, all characteristics remained in both models with adequate and excessive consumption as outcome ($p < 0.09$).

Conclusions Our study suggests interventions to promote adequate food consumption in general and to limit excessive food consumption mainly focused on youngsters and those living in urbanized areas of higher socioeconomic status.

Keywords Food consumption · Fruit and vegetable intake · Ethnicity · Urbanization · Middle-income country · Suriname Health Study

Introduction

Unhealthy diet and other modifiable risk factors such as smoking, physical inactivity and harmful use of alcohol all increase the risk of (dying of) non-communicable diseases (NCDs) (Berentzen et al. 2013; GBD Collaborators 2016; Jankovic et al. 2014; Struijk et al. 2014; WHO 2003). Worldwide, it was estimated that unhealthy diet was the second highest modifiable risk factor for NCD-related mortality (GBD Collaborators 2016). The NCD epidemic afflicts both developed and developing countries (NCD Alliance 2016). In the Republic of Suriname, a middle-income country (MIC) (World Bank 2014) in the Northeast of South America, the main four causes of death in 2011 were cardiovascular disease (25.3%), cancer (12.8%), external causes (accidents and violence) (12.5%) and diabetes mellitus (8.3%) (Punwasi 2012).

In order to combat the NCD epidemic in Suriname, a national surveillance survey, the Suriname Health Study

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(Krishnadath et al. 2015), was conducted to gain insight into the prevalence of risk factors for NCDs. Results of this survey among the Surinamese population showed that 26% suffered from hypertension (Krishnadath et al. 2016a). Diabetes mellitus was present in 13% of the population, with the highest prevalence of 27% among Hindustani (descendants from Indians) (Krishnadath et al. 2016b). Overweight and obesity were present in 47 and 18% of men, and in 31 and 32% of women, respectively (Department of Public Health 2017).

Nutrition transition, meaning major dietary change with an increase in the consumption of fat and added sugar in the diet, often a marked increase in animal food products contrasted with a fall in total cereal intake and fiber, is linked to the economic development of a country (Popkin 2001; Mayen et al. 2014). Findings of Mayen et al. (2014) suggested that in low- and middle-income countries, socioeconomic factors and geographical location have an impact on quantities and patterns of food intake with high socio-economic status (SES) and urban individuals generally consuming healthier food. However, in MICs, high SES was also related to unhealthy dietary patterns such as higher energy and saturated fat intake. But there are many exceptions and the available foods that drive nutrition transition in developing countries differ by region (Popkin 2001). To date, food consumption of subjects living in Suriname is unreported and how nutrition transition presents itself in Suriname is unknown. The Surinamese population is multiethnic and lives in urban, rural and interior geographical areas. In order to identify high-risk groups among the Surinamese population with an unhealthy diet, diet-related questions of the Suriname Health Study and their association with sex, age, ethnicity, degree of urbanization and socioeconomic status were explored.

Methods

Subjects and study design

This study is part of a nationwide cross-sectional study, conducted between March and September 2013: the Suriname Health Study (n = 5748) (Krishnadath et al. 2015). The survey was designed according to the World Health Organization (WHO) STEPS design for chronic disease surveillance (WHO 2014), using a stratified multistage cluster sample of households adequate to represent the ethnic and geographical diversity of the Surinamese population by sex in 5 different age groups. Respondents between 15 and 64 years old were included. The participants who lived in Suriname for less than 1 year and those with health issues that rendered them incapable of participating in the study were excluded. Within 343 randomly selected clusters, 8815 households were randomly selected and 7493 subjects were invited, using the Kish method. The overall response rate was 77%. A more comprehensive description of its methodology can be read in the paper of Krishnadath et al. (2015).

Data collection

The Suriname Health Study contains information on subject characteristics such as sex, age, ethnicity, geographical area, education and income, as well as on risk factors such as diet. Data relevant to this study were collected, using questionnaires.

A person was categorized into a certain ethnic group if at least three of the four grandparents were considered to be of that specific ethnicity. All others were categorized as 'mixed ethnicity'. The present population distribution in Suriname is as follows: 27.4% Hindustani (descendants from Indians), 21.7% Maroons (descendants from Africans who escaped slavery and formed independent settlements in the hinterland), 15.7% Creoles (descendants from African plantation slaves), 13.7% Javanese (descendants from Indonesians), 13.4% Mixed and 8.2% other ethnicities, including Amerindians (original habitants) (Paramaribo 2013). Traditionally, Creoles, Hindustanis and Javanese have inhabited the urban and rural coastal areas, whereas the rural interior has been inhabited by Amerindians and Maroons, who both live in isolated villages in primitive settings. Suriname has a population of 541,638 inhabitants, which is mainly concentrated in the coastal areas. To indicate geographical area, residential addresses were divided into urban areas, rural coastal areas and the rural interior according to the residential areas as formulated by the General Bureau of Statistics Suriname (Suriname Ministry of Social Affairs and Housing 2013). Income is expressed in Surinamese Dollars (SRD). In the inclusion period, 1 USD was equivalent to 4 SRD. The gross national income per capita was approximately US $8800/annum (General Bureau of Statistics Suriname 2013). Apart from income, the other subject characteristics corresponding to these questions were composed, using 5652/5748 to 5748/5748 of valid data (Krishnadath et al. 2015). Of the data on income, 4052/5748 were valid.

The dietary assessment was done with a food-frequency questionnaire (FFQ) by trained interviewers according to a study protocol (Krishnadath et al. 2015). The respondents were interviewed at home on food consumption in an ordinary week over the past year. The inclusion period included both the dry season and the rainy season. An ordinary week meant that food consumption was not affected by cultural, religious or other events. The first set of questions (5) in the FFQ was conformable to the WHO STEPwise approach, using the predefined questions and

pictures of local products and portion sizes to inform the participant (WHO 2014). This section dealt with the frequency and the quantity of fruit and vegetable consumption. The WHO questions also included the kind of oil used in food preparation. Although not validated against other methods for dietary assessment, the second set of questions (6) was formulated by local specialists and pre-tested among the Surinamese population together with the WHO question set, also using picture sets. This second set included the frequency (every day, 3–5 days/week, 1–2 days/week, 1–3 days/month, or rarely) of consuming whole-wheat products, fast food meals, snacks, sweets and soft drinks, asked in days per week or month, and the frequency (always, frequently, sometimes, seldom and never) that salt was added during hot meal preparation. (The questions of the FFQ are mentioned as footnotes of Tables 2 and 3).

To our knowledge, no dietary score or index had been adapted to or validated yet among the Surinamese population. The available information was too limited to perform posteriori methods to analyze dietary patterns in-depth, using principal cluster analyses or reduced rank regression. To describe desirable and undesirable food consumption, diet-related questions were summarized in consultation with experts in the field into: (1) desirable *adequate* food consumption, referring to an adequate amount of micronutrients, fiber and unsaturated fat. A person's food consumption was scored adequate if fruit and vegetable intake was according to WHO recommendations ($>$ 5 servings or $>$ 400 g per day; 1 standard serving was defined at 80 g, or a small piece of fruit like a small apple, or 1 tablespoon of cooked vegetables, or half a cup of raw vegetable or salad (WHO 2014); oil or fat consumption while preparing a hot meal was mostly vegetable oil and whole-wheat products were used for 3 or more days per week, and (2) an *excessive* food consumption, referring to an excessive intake of calories, (saturated) fat, sugar and salt. Consumption of snacks, sweets, fast food or soft drinks for 3 or more days a week was considered excessive. Adding salt 'always' while preparing your hot meal instead of 'frequently, sometimes, seldom or never' was also considered excessive. A person's food consumption was scored excessive if 3 out of these 5 food items were excessive.

Statistical analyses

Proper weighting variables transformed the data set into a nationally representative sample. Detailed methods are described elsewhere (Krishnadath et al. 2015). Descriptive statistics were calculated to describe the participants' characteristics, food consumption and their associations. Results were presented in tables for the total study population and for subgroups in frequencies and percentages. The Pearson Chi-square test was used (two sided, $p < 0.05$) to assess differences in food consumption among subgroups. Two separate multivariate logistic regression models were constructed to explore the independent association of sex, age, ethnicity, geographical area, educational level and level of income with both adequate and excessive food consumption. A backward procedure was performed to select those variables found to be associated with outcome ($p_{\text{removal}} > 0.20$). To identify high-risk groups with an adequate or excessive food consumption pattern, the highest Wald statistic was used to define the best 'predictor'. A variable was selected for the backward procedure if the association in the univariate analysis was found to be at a p value < 0.20 ($= p_{\text{in}}$). The goodness-of-fit of the resulting model was assessed, using the Hosmer-and-Lemeshow test.

Results

Subjects

The majority (almost 3 out of 4) of subjects lived in the urban coastal area, 16% in the rural coastal area and 11% in the rural interior area, as described together with other weighted population characteristics in Table 1 (For unweighted characteristics of the study population, see Supplements Table S1). Of the subjects living in the interior, 79.9% were Maroons and 19.5% were Amerindians. Hindustani were highest represented in both urban and rural coastal areas (31.8 and 27.5%, respectively). Level of education and income was lower in the less urbanized areas (Table 1).

Food consumption

It was estimated that 6.4% (95% CI 5.8–7.1) of the Surinamese population had an adequate food consumption pattern (Table 2) and 21.9% (95% CI 20.8–23.0) an excessive food consumption pattern (Table 3). In addition, 5.3% (95% CI 4.7–6.0) of the study population had an overall healthy consumption, i.e., adequate and not excessive (Fig. 1). The majority of the population did not categorize under 'excessive food consumption,' but not under 'adequate food consumption' either (Fig. 1). From the diet-related questions, 30 (whole-wheat products) up to 502 (fruit and vegetables) records were missing. For analysis purposes of adequate food consumption, 602 records and for analysis purposes of excessive food consumption, 169 records had to be excluded (10.5 and 2.9%, respectively). A comparison of the participants' characteristics between reporters and non-reporters of adequate food consumption

Table 1 Population characteristics per geographical area in Suriname, 2013[#]

	Total (n = 5744)		RIA (n = 637)	RCA (n = 922)	UCA (n = 4185)
	%	n	%	%	%
Men	49.3	2830	47.6[a]	51.3[a]	49.1[a]
Women	50.7	2914	52.4[a]	48.7[a]	50.9[a]
15–24 year	25.5	1466	24.1[a]	25.4[a]	25.8[a]
25–34 year	23.7	1364	25.2[a]	22.2[a]	23.8[a]
35–44 year	21.0	1207	23.5[a]	21.7[a]	20.5[a]
45–54 year	18.7	1075	16.9[a]	19.3[a]	18.8[a]
55–64 year	11.0	634	10.2[a]	11.4[a]	11.1[a]
Hindustanis	27.6	1567	0.0[a]	27.5[b]	31.8[c]
Creoles	12.5	707	0.0[a]	10.7[b]	14.7[c]
Javanese	14.0	796	0.0[a]	25.1[b]	13.7[c]
Maroons	21.5	1222	79.9[a]	9.2[b]	15.5[c]
Amerindians	5.9	335	19.5[a]	11.5[b]	2.6[c]
Mixed	17.0	963	0.6[a]	14.7[b]	19.9[c]
Others	1.5	86	0.0[a]	1.2[b]	1.8[c]
Low EL	54.8	3019	92.7[a]	64.4[b]	46.8[c]
Middle EL	38.6	2129	7.2[a]	33.2[b]	44.6[c]
High EL	6.6	365	0.2[a]	2.4[b]	8.6[c]
Income 1	34.5	1487	73.2[a]	33.2[b]	28.2[c]
Income 2	32.8	1417	19.3[a]	38.0[b]	33.9[b]
Income 3	14.2	613	3.9[a]	16.2[b]	15.5[b]
Income 4	6.2	269	1.2[a]	5.7[b]	7.2[b]
Income 5	12.2	528	2.5[a]	6.9[b]	15.2[c]

[#]Based on weighted data

RIA rural interior area, *RCA* rural coastal area, *UCA* urban coastal area, *EL* education level (*Low* primary school, *Middle* secondary school, *High* higher education and university), Income 1; < 800 SRD/m, 2; 800–1499 SRD/m, 3; 1500–2199 SRD/m, 4; 2200–2899 SRD/m, 5; > 2900 SRD/m

Each superscript letter denotes a subset of geographical area categories whose column proportions do not differ significantly from each other at the .05 level using the Chi-square test

showed that more men, more Maroons and Amerindians, those living in the interior, and those with lower level of income and education misreported ($p < 0.05$; data not shown). A comparison of the participants' characteristics between reporters and non-reporters of excessive food consumption showed that more men, more younger aged, Maroons, subjects living in the interior and fewer subjects with high education misreported ($p < 0.05$; data not shown). In advance of the results, after multiple imputation of missing data, similar results were found (data not shown).

Examination of the differences between subgroups showed that frequencies of adequate food consumption increased with higher age, urbanization, level of education and income (Table 2). Frequencies of adequate food consumption also differed between ethnicities. Fewer Maroons and Amerindians had adequate food consumption patterns (2.2 and 1.9%) compared to the other ethnic groups (7.7 up to 9.1%). (Table 2) In addition, fewer men than women consumed adequate food, but this was borderline significant (5.8 and 7.0%, $p = 0.075$). Frequencies of excessive food consumption decreased with higher age, but increased with urbanization, higher level of education and income, with the exception of the highest categories of education and income (Table 3). Among the highest categories of education and income, the amount of subjects with excessive food consumption dropped, although not statistically significant (Table 3). Fewer Amerindians and Maroons had excessive food patterns (11.7 and 15.5%) compared to the other ethnic groups (22.6 up to 29.4%). More men than women consumed excessive food (23.5 and 20.4%, respectively) (Table 3).

Examination of the individual food items, which are part of the adequate food consumption (Table 2), showed that the majority (98.1%, 95% CI 97.7–98.4) of the population used vegetable oil while preparing their hot meal, but only 16.4% (95% CI 15.4–17.4) consumed fruit and vegetables conformable to the recommendations of the WHO, and 28.6% (95% CI 27.4–29.8) consumed whole-wheat products for 3 or more days a week. There was no difference between men and women in fruit and vegetable consumption, but more women than men consumed whole-wheat products (30.3 and 26.7%, respectively). Consumption of vegetable oil was not associated with gender or age and less consistent with higher levels of education and income than the other items. The vegetable oils mostly used, were sunflower and soy oil (data not shown). In particular, fewer Amerindians used vegetable oil while preparing their hot meal (87.2%) compared to the other ethnic groups (97.6 up to 100%). Amerindians answered more frequently to use 'no oil' or 'no oil in particular'. Examination of the individual food items, which are part of the excessive food consumption (Table 2), showed that excessive soft drinks and salt consumption were highly prevalent (51.8% (95% CI 50.5–53.1) and 86.7% (95% CI 85.8–87.6), respectively). Only 4.6% (95% CI 4.1–5.2) of the population consumed excessive amounts of fast food. Women consumed an excessive amount of soft drinks less often than men, (46.5 and 57.2%). Similar results were seen for consumption of fast food meals (3.7 vs. 5.6%). No associations were found between sex and snacks, sweets or salt consumption. More Hindustanis, Javanese and Mixed populations (60.5, 57.6 and 57.4%) had an excessive intake of soft drinks compared to the other ethnic groups (36.9 up to 46.0%). More Amerindians and Maroons added salt

Table 2 Adequate food consumption among the total study population and in subgroups in Suriname, 2013[#]

	Fruit/vegetables[A] %	Vegetable oil[B] %	Whole-wheat[C] %	Adequate consumption[D] % (*n*)
Total	16.4	98.1	28.6	6.4 (331)
Men	16.9[a]	97.9[a]	26.7[a]	5.8 (144)[a]
Women	15.9[a]	98.3[a]	30.3[b]	7.0 (187)[a]
15–24 year	12.6[a]	98.2[a]	21.9[a]	3.4 (45)[a]
25–34 year	15.4[a,b]	98.0[a]	27.2[b]	5.8 (71)[b]
35–44 year	17.7[b,c]	98.1[a]	28.8[b,c]	7.3 (80)[b,c]
45–54 year	17.3[b]	98.6[a]	33.7[c,d]	7.8 (76)[b,c]
55–64 year	23.1[c]	97.9[a]	37.5[d]	10.4[#] (59)[c]
Hindustanis	17.3[a]	99.0[a]	33.2[a,b]	7.8 (115)[a]
Creoles	19.3[a]	97.6[a]	38.3[b]	8.3 (55)[a]
Javanese	19.1[a]	99.5[a]	30.0[a]	7.7 (58)[a]
Maroons	12.0[b]	98.7[a]	12.6[c]	1.9 (19)[b]
Amerindians	7.4[b]	87.2[b]	14.7[c]	2.2 (6)[b,c]
Mixed	18.5[a]	98.5[a]	36.4[a,b]	7.8 (70)[a]
Others	16.5[a,b]	100[a]	41.2[a,b]	9.1 (7)[a,c]
RIA	3.7[a]	93.0[a]	2.7[a]	0.5 (2)[a]
RCA	16.2[b]	97.2[b]	27.7[b]	5.7 (49)[b]
UCA	17.9[b]	99.0[c]	32.6[c]	7.2 (280)[b]
Low EL	15.2[a]	97.2[a]	21.0[a]	4.6 (122)[a]
Middle EL	16.9[a]	99.1[b]	35.1[b]	7.4 (150)[b]
High EL	20.2[a]	99.2[a,b]	52.1[c]	12.8 (45)[c]
Income 1	13.2[a]	98.4[a]	20.8[a]	4.2 (52)[a]
Income 2	16.5[a,b]	98.4[a]	28.9[b]	5.1 (69)[a]
Income 3	19.6[b,c]	98.8[a]	34.5[b]	8.9 (52)[b]
Income 4	19.1[a–c]	97.4[a]	36.2[b,c]	7.8 (20)[a,b]
Income 5	23.6[c]	99.0[a]	45.2[c]	12.1 (62)[b]

[#]Based on weighted data, [A]meeting recommended level of 5 or more servings of fruit and/or vegetables per day (WHO) (Questions: In a typical week, on how many days do you eat fruit?, In a typical week, on how many days do you eat vegetables?, How many servings of fruit do you eat on one of those days?, how many servings of vegetables do you eat on one of those days?); [B]using most often vegetable oil instead of animal fat, no oil or no oil in particular while preparing their warm meal (Question: What type of oil or fat is most often used for meal preparation in your household?); [C]consuming whole-wheat products for 3 or more days per week (Question: How often do you consume whole-wheat products such as wheat bread?); [D]Consumption was scored *adequate* if fruit and vegetable intake was conformable WHO guidelines, and vegetable oil was most often used during meal preparation, and whole-wheat products were consumed for 3 or more days a week

RIA rural interior area, *RCA* rural coastal area, *UCA* urban coastal area, *EL* education level (*Low* primary school, *Middle* secondary school, *High* higher education and university), Income 1; < 800 SRD/m, 2; 800–1499 SRD/m, 3; 1500–2199 SRD/m, 4; 2200–2899 SRD/m, 5; > 2900 SRD/m

Each superscript non-capital letter denotes a subset of categories per subgroup whose row proportions do not differ significantly from each other at the .05 level using the Chi-square test

'always' while preparing their hot meal (94.2 and 91.6%), compared to the other ethnic groups (75.3 up to 87.9%).

Subject characteristics and food consumption

Multivariate backward logistic regression analysis showed that sex, age, ethnicity, geographical area and level of income, but not level of education ($p = 0.599$), remained in the model with adequate food consumption as outcome (Table 4). Higher level of income was the best 'predictor' for the presence of an adequate consumption (highest Wald statistic or i.e., lowest p value) (Table 4). Multivariate backward regression analyses showed that all variables: sex, age, ethnicity, geographical area, education and income level remained in the model with excessive food consumption as outcome (Table 5). Being of younger age

Table 3 Excessive food consumption among the total study population and in subgroups in Suriname, 2013[#]

	Snacks[A]	Sweets[B]	Fast food[C]	Soft drink[D]	Salt[E]	Excessive consumption[F]
	%	%	%	%	%	% (*n*)
Total	19.2	17.1	4.6	51.8	86.7	21.9 (1214)
Men	19.3[a]	16.7[a]	5.6[a]	57.2[a]	86.4[a]	23.5 (630)[a]
Women	19.2[a]	17.6[a]	3.7[b]	46.5[b]	86.9[a]	20.4[#](584)[b]
15–24 year	36.0[a]	26.6[a]	8.4[a]	64.6[a]	87.4[a]	38.9 (540)[a]
25–34 year	18.0[b]	17.3[b]	5.5[b]	50.0[b,c]	88.8[a]	19.4 (259)[b]
35–44 year	14.4[b,c]	16.0[b]	3.7[b]	53.6[c]	85.8[a,b]	20.9 (242)[b]
45–54 year	10.7[c,d]	11.2[c]	1.6[c]	44.6[b]	86.6[a,b]	12.3 (129)[c]
55–64 year	7.0[d]	7.2[c]	1.0[c]	34.4[d]	81.9[b]	7.2 (44)[d]
Hindustanis	18.5[a–d]	20.6[a]	2.9[a]	60.5[a]	82.6[a]	23.6 (359)[a]
Creoles	21.6[c–e]	19.3[a,b]	9.2[b]	45.2[b]	84.3[a,b]	24.5 (168)[a,b]
Javanese	22.1[b–e]	15.0[b,c]	3.5[a]	57.6[a]	86.6[a,b]	22.6 (175)[a]
Maroons	14.2[a]	11.2[c,d]	3.7[a]	40.8[b]	91.6[c,d]	15.5 (181)[c]
Amerindians	11.6[a]	6.3[d]	2.1[a]	36.9[b]	94.2[d]	11.7 (38)[c]
Mixed	25.1[e]	23.3[a]	7.1[b]	57.4[a]	87.9[b,c]	29.4 (273)[b]
Others	12.8[a–e]	18.6[a–c]	5.9[a,b]	46.0[a,b]	75.3[a]	15.1[#] (13)[a–c]
RIA	1.6[a]	2.1[a]	0.2[a]	20.2[a]	95.1[a]	2.0 (12)[a]
RCA	18.3[b]	15.9[b]	2.1[b]	55.9[b]	86.4[b]	20.8 (185)[b]
UCA	22.0[c]	19.6[c]	5.9[c]	55.5[b]	85.5[b]	25.1 (1018)[c]
Low EL	15.5[a]	12.9[a]	3.1[a]	51.0[a,b]	87.5[a]	17.2 (501)[a]
Middle EL	24.0[b]	21.3[b]	6.5[b]	54.3[b]	87.4[a]	28.1 (578)[b]
High EL	21.5[b]	24.7[b]	5.5[a,b]	45.6[a]	79.3[b]	23.4(84)[b]
Income 1	11.1[a]	9.5[a]	3.2[a]	43.5[a]	88.6[a]	12.3 (180)[a]
Income 2	16.5[b]	16.9[b]	3.3[a]	51.9[b]	86.5[a,b]	20.7 (286)[b]
Income 3	25.7[c]	20.1[b,c]	4.2[a,b]	54.3[b]	88.6[a]	27.6 (164)[c]
Income 4	23.3[b,c]	25.2[c]	7.5[b]	59.6[b]	85.7[a,b]	28.1 (74)[b,c]
Income 5	19.8[b,c]	20.1[b,c]	8.1[b]	52.2[b]	81.6[b]	25.0 (130)[b,c]

[#]Based on weighted data, [A]snacks, [B]sweets, [C]fast food or [D]soft drink consumption for 3 or more days a week which was scored as 'excessive' (Questions: On how many days during a week or month do you eat snacks, sweets, fast food, or drink soft drinks?), [E]adding salt 'always' while preparing their warm meal which was scored as 'excessive' (Question: How often are salt or products high in salt such as bouillon cubes or salted meat added during meal preparation in your household?); [F] Excessive consumption scored as excessive if the intake of 3 out of 5 of snacks, sweets, fast food, soft drink or salt intake was scored as excessive

RIA rural interior area, *RCA* rural coastal area, *UCA* urban coastal area, *EL* education level (*Low* primary school, *Middle* secondary school, *High* higher education and university), Income 1; < 800 SRD/m, 2; 800–1499 SRD/m, 3; 1500–2199 SRD/m, 4; 2200–2899 SRD/m, 5; > 2900 SRD/m

Each superscript non-capital letter denotes a subset of categories per subgroup whose row proportions do not differ significantly from each other at the .05 level using the Chi-square test

was the best 'predictor' for the presence of excessive food consumption (i.e., highest Wald statistic) (Table 5).

Discussion

The results of this study suggest that only 6% of the Surinamese population had an adequate food consumption pattern, with only 15% consuming the WHO recommended amount of fruit and vegetables. Furthermore, it suggests that almost one-fifth of the Surinamese population had an excessive food consumption pattern. Soft drink use and salt consumption contributed largely to this excessive consumption. Frequencies of adequate and excessive food consumption differed by age, sex, ethnicity, geographical living area and socioeconomic status (SES). Nevertheless, all subgroups deviated largely from international recommendations.

Our study faced some limitations. Except for fruit and vegetable intake, there were no questions about

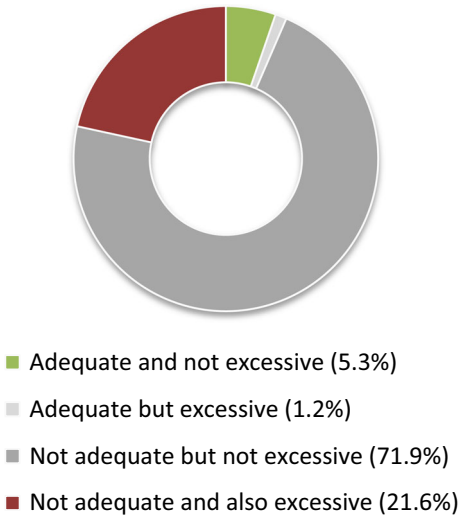

Fig. 1 Adequate and excessive food consumption in Suriname, 2013

standardized servings per day. However, although not all relevant data were in place to assess dietary patterns and some information bias might exist, data seemed valid to describe trends of adequate and excessive food consumption and their individual food items and identify high-risk groups for these specific patterns. To assess dietary patterns in-depth, it is advisable to validate a method like the Healthy Diet Indicator among the Surinamese population and relate it to disease risk (Berentzen et al. 2013). In addition, inherent to the method, the estimates might consist of random error because of re-call bias and systematically higher estimates for adequate consumption and lower estimates for excessive consumption because of social expectancy bias. Some selection bias might have occurred, but a high-quality nationwide sampling method, together with an adequate sample size and weighting of data, minimized this bias.

Table 4 Results of multivariate logistic regression analysis with adequate food consumption as outcome, Suriname, 2013[#]

	Wald	*p*	OR	95% CI lower bound	95% CI upper bound
Sex	7.200	.007			
Women			1		
Men	7.200	.007	.697	.535	.907
Age (years)	21.357	.000			
15–24			1		
25–34	5.272	.022	1.757	1.086	2.844
35–44	8.653	.003	2.030	1.266	3.252
45–54	9.220	.002	2.099	1.301	3.388
55–64	20.409	.000	3.169	1.921	5.226
Ethnicity	13.095	.042			
Hindustanis			1		
Creoles	1.120	.290	1.228	.839	1.797
Javanese	.027	.871	1.032	.707	1.506
Maroons	8.021	.005	.404	.216	.756
Amerindians	2.208	.137	.509	.209	1.241
Mixed	.000	.992	.998	.688	1.448
Others	.315	.575	1.299	.521	3.239
Geographical area	4.907	.086			
RIA			1		
UCA	4.482	.034	4.886	1.125	21.223
RCA	3.602	.058	4.256	.954	18.996
Level of income	27.649	.000			
Income 1			1		
Income 2	.030	.863	1.034	.710	1.505
Income 3	8.584	.003	1.843	1.224	2.773
Income 4	1.920	.166	1.474	.852	2.550
Income 5	17.502	.000	2.368	1.581	3.547

Hosmer and Lemeshow goodness of fit ($p = 0.853$)

[#]Based on weighted data

UCA urban coastal area, *RCA* rural coastal area, *RIA* rural interior area, Income 1; < 800 SRD/m, 2; 800–1499 SRD/m, 3; 1500–2199 SRD/m, 4; 2200–2899 SRD/m, 5; > 2900 SRD/m

Table 5 Results of multivariate logistic regression analysis with excessive food consumption as outcome, Suriname, 2013[#]

	Wald	*p*	OR	95% CI lower bound	95% CI upper bound
Sex	4.577	.032			
Women			1		
Men	4.577	.032	1.200	1.015	1.419
Age (years)	169.460	.000			
15–24			1		
25–34	60.933	.000	.406	.324	.509
35–44	41.013	.000	.473	.376	.595
45–54	111.558	.000	.239	.183	.312
55–64	94.117	.000	.158	.109	.229
Ethnicity	13.522	.035			
Hindustanis			1		
Creoles	.021	.885	.981	.752	1.279
Javanese	.057	.812	1.031	.803	1.322
Maroons	4.556	.033	.727	.542	.974
Amerindians	2.302	.129	.699	.440	1.110
Mixed	1.551	.213	1.162	.918	1.471
Others	2.532	.112	.474	.189	1.189
Geographical area	40.872	.000			
RIA			1		
UCA	39.819	.000	11.266	5.310	23.904
RCA	33.060	.000	9.588	4.437	20.720
Education level	6.103	.047			
Low EL			1		
Middle EL	4.713	.030	1.223	1.020	1.466
High EL	.107	.744	.944	.670	1.331
Level of income	31.186	.000			
Income 1			1		
Income 2	14.709	.000	1.542	1.236	1.925
Income 3	22.646	.000	1.901	1.459	2.477
Income 4	16.497	.000	2.058	1.453	2.915
Income 5	15.326	.000	1.794	1.339	2.404

Hosmer and Lemeshow goodness of fit ($p = 0.984$)

[#]Based on weighted data

UCA urban coastal area, *RCA* rural coastal area, *RIA* rural interior area, *EL* education level (*Low* primary school, *Middle* secondary school, *High* higher education and university), Income 1; < 800 SRD/m, 2; 800–1499 SRD/m, 3; 1500–2199 SRD/m, 4; 2200–2899 SRD/m, 5; > 2900 SRD/m

Suriname was no exception where the results of fruit and vegetable consumption were concerned. In developed as well as in developing countries it turned out that 5–35% met the WHO recommended amount of fruit and vegetables (Moura et al. 2009; Ramírez-Silva et al. 2009; Kanungsukkasem et al. 2009; Li et al. 2000; Padrao et al. 2012; Peltzer and Phaswana-Mafuya 2012; Satheannoppakao et al. 2009). In line with our study, most studies reported higher numbers for adequate fruit and vegetable consumption among women, higher aged, more urbanized living areas, and higher level of education or income, i.e., higher socioeconomic status (SES). Some studies found inconsistencies for age (Kanungsukkasem et al. 2009; Satheannoppakao et al. 2009), sex (Kanungsukkasem et al. 2009; Peltzer and Phaswana-Mafuya 2012) or urbanization (Padrao et al. 2012).

Similar to our results, Mayen et al. (2014) concluded from their systematic review about socioeconomic determinants of dietary patterns in low- and middle-income countries, that high SES and living in urban areas were associated with higher fruit and vegetable intake and also with higher dietary diversity. However, at the same time, it

was seen that high SES and living in urban areas were related to higher energy and saturated fat intakes (Mayen et al. 2014; Sodjinou et al. 2009). In our study, this was reflected by a higher prevalence of excessive intake of snacks, sweets, fast food meals and soft drinks among those subjects with a high SES and who lived in urban areas. This trend is in line with the hypothesis that in low- and middle-income countries, nutrition transition affects people of high SES first (Mayen et al. 2014; Popkin 2001). In contrast, a drop in numbers of excessive consumption among the highest categories of education and income was found among the Surinamese population, although not statistically significant. This phenomenon was also reported for high-income countries, explained by several factors including the higher cost of healthier diets, unavailability of these healthy foods in low SES residential areas, and lower response to nutrition–disease prevention messages (Darmon and Drewnowski 2008; Mayen et al. 2014). To intervene effectively, future research has to reveal which of these factors are of importance for Suriname. For example, nutrition–disease prevention messages will not increase consumption of healthy products if these are not affordable. Our study demonstrated that higher level of income predicted the presence of adequate food consumption the best, regardless of sex, age, ethnicity, residential area and level of education.

It turned out that as regards excessive food consumption, particularly excessive intake of soft drinks and salt consumption are of public concern among the Surinamese. Frequent consumption of soft drinks, but also snacks, sweets and fast food in combination with less frequent adequate food consumption was particularly seen in youngsters and men. This overall unhealthy food consumption among youngsters and men is in line with other studies (Moura et al. 2009; Ramírez-Silva et al. 2009; Li et al. 2000; Nielsen and Popkin 2004), linking it to cultural issues and less health concern. To date, it should be stressed that the new generation of young adult Surinamese is also victim of the ongoing nutrition transition. The results of this study demonstrated that being at a younger age predicted the presence of excessive food consumption the best, regardless of sex, ethnicity, residential area and level of income and education. With regard to excessive salt consumption, it should be stressed that next to kitchen salt, Surinamese meals contain a diversity of products high in salt like beef/chicken cubes, tomato ketchup, soy sauce, chicken powder, salted meat and salted fish. Knowing that the majority of Surinamese consume a hot meal more than once a day, there is little doubt that population salt consumption far exceeds the WHO recommended maximum of 5 g per person per day (Appel et al. 1997; WHO 2012). Maroons and Amerindians might use more products high in salt than other ethnic groups because of preservation methods in the interior. However, Maroons and Amerindians had the lowest prevalence of hypertension compared to other ethnic groups in Suriname (Krishnadath et al. 2016a).

The results of our study implicate the need for a national policy to reduce the excessive soft drinks consumption, especially among Hindustani with the highest prevalence of excessive intake of soft drinks (Table 2) and diabetes mellitus (Krishnadath et al. 2016b). Sugar-sweetened beverages promote weight gain and increase the risk of type 2 diabetes (Greenwood et al. 2014; Malik et al. 2013). Reduction of salt consumption is also important to combat the NCD epidemic in Suriname (Appel et al. 1997; Collaborators 2016; WHO). However, improvement of fruit and vegetable consumption might be most effective. A wide range of research provides consistent evidence that fruit and vegetable intake is inversely associated with hypertension and cardiovascular disease, but also with obesity, diabetes, cancer and mortality (Bhupathiraju et al. 2013; Crowe et al. 2011; Kromhout et al. 2016; McCall et al. 2009; WHO 2003). Moreover, increased fruit and vegetable consumption helps to displace food high in saturated fats, sugar or salt.

Conclusions

The results of this study indicate that in Suriname higher degree of urbanization and higher level of SES are associated with higher frequencies of adequate consumption but also with higher frequencies of excessive food consumption, regardless of sex, age or ethnic group. However, it should be highlighted that being at a younger age predicted the presence of excessive food consumption the best. The presence of adequate food consumption was best predicted by higher level of income. Our study suggests interventions to promote adequate food consumption in general, and to limit excessive food consumption mainly focused on those in younger age groups and those living in urbanized areas of higher level of SES. Furthermore, the study implies that to improve diet among the Surinamese population, costs of healthy diets in relation to income and reasons for following an unhealthy diet among young adults should be further explored, resulting in keys to change behavior effectively. Of course, to reduce NCDs not only diet but the total picture of a healthy lifestyle should be taken into account (WHO 2013).

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Author's contribution LNV conducted statistical analysis, reviewed the data and results and wrote the manuscript. IK and others designed and coordinated the Suriname Health Study with assistance of CAS and EM. In specific, EM participated at the diet working group designing the diet module of the Suriname Health Study protocol. IK, CAS and EM collaborated with the interpretation of data, reviewed and edited the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

Ethical statement This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Ethics Committee of the Ministry of Health of Suriname (*Commissie mensgebonden wetenschappelijk onderzoek*, VG 004-2013). All subjects gave their informed consent in writing.

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