

## Weight, Sodium and Potassium Intake Perceptions among University Students in Barbados: Results from a Cardiovascular Health Perception Survey

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### ABSTRACT

**Objective:** To evaluate undergraduates' student sodium and potassium intakes, their perceptions towards these parameters and their cardiovascular health at The University of the West Indies, Cave Hill Campus.

**Methods:** The study is a cross-sectional study with a self-administered on-line questionnaire which included a three-day semi-quantitative food frequency questionnaire. The variables measured were: sodium and potassium intakes, body mass index (BMI) and the students' perceptions of their health and dietary intake. The data analyses included: descriptive statistics, t-tests and one-way analysis of variance (ANOVA) with Tukey post-hoc test with statistical significance at the 95% confidence level.

**Results:** One hundred and five students aged  $24.3 \pm 7.9$  years participated with a response rate of 8.8%. Ninety-three (89%) of the participants were Afro-Caribbean. Dietary sodium ( $3446 \pm 1889$  mg/daily) and potassium ( $2740 \pm 1957$  mg/daily) were estimated. The students with under-estimated sodium and potassium intakes consumed significantly more compared to the students who over-estimated their intake ( $p < 0.05$ ). The participants who under-estimated their weights had higher BMI values. Thirty per cent of the sample also indicated that they were unaware if they were at risk of developing a cardiovascular disease.

**Conclusions:** There is excessive dietary sodium and suboptimal potassium intakes which are coupled with the students' poor health perceptions. The findings support the need for more robust studies which can support the establishment of interventions to decrease cardiovascular (CVD) behavioural risk factors among undergraduate students.

**Keywords:** Body mass index, dietary intakes, health perceptions, potassium, sodium

## Percepciones del Peso y de la Ingestión de Sodio y Potasio Entre Estudiantes Universitarios en Barbados: Resultados de una Encuesta de Percepción de Salud Cardiovascular

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### RESUMEN

**Objetivo:** Evaluar las ingestiones de sodio y potasio de los estudiantes de pregrado, sus percepciones hacia estos parámetros, y su salud cardiovascular en la Universidad de West Indies, campus Cave Hill.

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**Métodos:** Se trata de un estudio transversal con un cuestionario en línea autoadministrado que incluyó un cuestionario semicuantitativo de frecuencia alimentaria de tres días. Las variables medidas fueron: las ingestas de sodio y potasio, el índice de masa corporal (IMC) y la percepción de los estudiantes de su salud y su consumo dietético. Los análisis de datos incluyeron: estadísticas descriptivas, pruebas t, y análisis de varianza unidireccional (ANOVA) con prueba post-hoc Tukey de valor estadístico a un nivel de confianza de 95%.

**Resultados:** Ciento cinco estudiantes de  $24.3 \pm 7.9$  años de edad participaron con una tasa de respuesta de 8.8%. Noventa y tres (89%) de los participantes eran afrocaribeños. Se hizo un cálculo estimado del sodio dietético ( $3446 \pm 1889$  mg/diario) y el potasio ( $2740 \pm 1957$  mg/diario). Los estudiantes que subestimaron sus ingestas de sodio y potasio consumieron significativamente más en comparación con los estudiantes que sobrestimaron su consumo ( $p < 0.05$ ). Los participantes que subestimaron sus pesos tenían valores más altos de IMC. El 30% de la muestra también indicó que no sabían si corrían el riesgo de desarrollar una enfermedad cardiovascular.

**Conclusiones:** Hay exceso de sodio en la dieta e ingestas de potasio subóptimas que se suma a las pobres percepciones de la salud por parte de los estudiantes. Los hallazgos apoyan la necesidad de estudios más robustos que puedan apoyar la puesta en práctica de intervenciones para disminuir los factores de riesgo conductuales cardiovasculares (ECV) entre los estudiantes de pregrado.

**Palabras clave:** Índice de masa corporal, ingestas dietéticas, percepciones de salud, potasio, sodio

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## BACKGROUND

Hypertension, a major risk factor for cardiovascular diseases, is usually described as having elevated blood pressure equivalent or greater than systolic blood pressure of 140 mmHg and diastolic blood pressure of 90 mmHg, or taking medications for blood pressure (1). The relationship between the risk of developing hypertension and ethnicity has been of interest as multiple studies from Europe and the United States of America (USA) have reported a higher prevalence, and earlier onset of hypertension in Black individuals than Whites (2). This may be explained by influences of both genetic and environmental factors (3). The higher prevalence is coupled with a reported lower level of hypertension awareness in Black people (2).

In Barbados, where over 90% of its residents are of African descent, the issues of the residents' susceptibility to hypertension and "salt-sensitivity" should be of public health importance (4). In recent years, an on-going nutrition transition has been witnessed in Barbados, mainly characterized by the wide replacement of nutrient-dense foods with fast and processed foods. Experts believe that the nutrition transition has contributed to the rise of non-communicable diseases like hypertension in Barbados (5). Evidence from a

number of large randomized controlled trials, point to a direct dose-response relationship between dietary sodium intake and blood pressure (6). The diet habitually consumed by Barbadians is suggested to be high, and likely well in excess of the Institute of Medicine's (IOM) sodium tolerable upper intake level of 2300 mg/daily (7, 8). "Salt-sensitive" persons are defined as individuals whose blood pressures fluctuate with changes in their dietary sodium intake (9). Whereas in most healthy normotensive individuals, the changes in their dietary sodium consumption do not adversely affect their blood pressure since their renal sodium excretion can normally compensate for the change. Along with hypertension, several recent trials have shown that "salt-sensitivity" may also be more prevalent among Blacks (3).

On the other hand, dietary potassium is found to have a blood pressure lowering effect (10). Recent NHANES survey showed that the dietary intake of potassium among Americans in general, as well as the subgroup of African Americans seemed to be sub-optimal, compared with the adequate intake of level of 4700 mg/daily (8). The major sources of potassium can be found in nutrient-dense foods like fruits, lean meat and low-fat dairy products (11).

The increase in processed foods engendered by the recent nutrition transition in Barbados leads to the postulation that a dietary intake pattern of excessive sodium and sub-optimal potassium may be observed among Barbadians (12). Taking into consideration that Afro-Caribbean Barbadians are likely to be at a high susceptibility of developing hypertension, understanding their perception regarding their current dietary habits and the associated risks of developing hypertension will be important to policy-makers to formulate necessary intervention strategies to this wide-spread health issue (13). Particularly given the likelihood of an earlier onset of hypertension among Blacks, focussing on a subgroup of young adults regarding their current nutritional habits and health perceptions would be important to pinpoint potential intervention strategies (2). Another advantage with earlier intervention with lifestyle modification would be prolonged health benefits.

Currently, no research has yet investigated the health perceptions of young adults in Barbados with regards to their sodium and potassium intakes and CVD risks. The undergraduate student body at the UWI Cave Hill is a good site for this, as the campus is widely regarded as the microcosm of the Barbadian society within the adult age group of 18 to 25 years. With this study, we explored this area of research interest.

## **SUBJECTS AND METHODS**

The ethical considerations of this project were reviewed and approved by The University of West Indies/Ministry of Health Institutional Review Board.

### **Participants and recruitment**

A total of 7319 undergraduate students were registered at the UWI's Cave Hill campus for the academic year 2014 to 2015 (14). The past internet-based studies done among college students from the USA have reported response rates in the range of 30% to 60%, thus, for this study, the expected response rate was assumed to be around 50% (15–17). A sample of 1200 students were randomly selected to produce a projected representative sample size of 555 undergraduate students at 95% confidence level with a 4% confidence interval. A study invitation letter with a URL link to the survey questionnaire was sent to the students by enrolling them to an on-line course developed within the UWI's Moodle e-Learning system. Students accessed the questionnaire from their user specific access to the e-Learning system.

### **Survey questionnaire development, validation and administration**

A questionnaire was developed and validated specifically for the purpose of this study after consulting numerous sources (5, 7, 18, 19). Established items from other food frequency questionnaire instruments were incorporated in the semi-quantitative food frequency questionnaire. The questionnaire was piloted among undergraduate students and modified to suit the population being tested. Food items that represent significant sources of sodium and potassium in the typical Barbadian diet were included in the questionnaire. Household measurement units like “scoop” and “glass” were used as the standard units of measurements (18). The administration of the survey questionnaire was done through Google Forms and facilitated by the Moodle e-Learning system. The survey instrument has 24 items with mainly multiple choice and dichotomous questions and included a semi-quantitative food frequency questionnaire that explores a three-day dietary intake of sodium and potassium rich foods. The semi-quantitative food frequency component included ten questions which were used to estimate the subject's daily dietary sodium and potassium intakes. The other questions addressed their perceptions of health and self-reported data on physical attributes were used to estimate their BMI. The questionnaire was administered over a seven-day period, as wide variations in internet-based survey responses have been reported (15).

### **Statistical analyses**

The variables measured were: sodium and potassium intake, BMI and the subject's perceptions of health and dietary intake. The results of sodium and potassium intake were categorized into either “lower”, “about”, or “higher” than the dietary intake recommendations from IOM, 2.3 g/L and 4.7g/L for sodium and potassium, respectively. The results were then compared with the participants' self-perception toward their sodium and potassium intake. The participants were marked as having either “under-estimated”, “correctly estimated”, or “over-estimated” their dietary sodium and potassium intakes. Their reported perception of BMI is compared to the computed BMI from reported weight and height in a similar fashion, where BMI of < 18.5 is considered as underweight, between 18.5 and 24.9 is considered as normal weight, and between 25 and 29.9 is considered as overweight and > 30 is regarded as obese as used in other studies done in Barbados (5).

All the data were analysed using GraphPad Prism (Version 6, GraphPad Software, La Jolla, CA, USA). The statistical analyses used included: descriptive statistics (mean, SD, SEM, proportion), unpaired *t*-tests and one-way (ANOVA) with Tukey *post-hoc* test. Significance was determined at the 95% confidence level ( $p < 0.05$ ).

## RESULTS

In total, the preliminary results showed 105 out of the sample of 1200 undergraduate students who were randomly selected from the undergraduate student database ( $n = 7319$ ) responded to the survey during the course of its administration, yielding a response rate of 8.8%.

Out of the 105 responses, 78% were from females ( $n = 82$ ) and 22% were from males ( $n = 23$ ), with a mean age of 24.3 years ( $SD = 7.9$ ). Eighty-nine per cent of the participants were Afro-Caribbean ( $n = 93$ ). The results from the three-day dietary intake section of the questionnaire were computed to obtain the average daily sodium and potassium intakes for each participant. Table 1 provides a summary of participants' characteristics. The average sodium intake was estimated to be 3462 mg/daily, with the major contributing dietary sources being bread, fried meat or fish, rice and peas, macaroni pie and pasta with sauce. On the other hand, the average potassium intake was estimated to be 2890 mg/daily, which is well below the recommended amount of 4700 mg/daily (8). The major sources of potassium included: fried fish, French fries, milk, fresh fruit, fresh vegetables and fruit juices.

Table 1: Participants' demographics on the dietary intake study ( $n = 105$ ).

Variable	Survey findings/ unit
Number of participants (n)	105
Afro-Caribbean	89%
Resided in Barbados for >10 years	81%
Mean age (years)*	24.3 ± 7.9
Mean body mass index (kg/m <sup>2</sup> )*	25.00 ± 5.62
Three-day dietary Sodium (mg)*	3446 ± 1889
Three-day dietary Potassium (mg)*	2740 ± 1957
Current drinker	5 %
Current smoker	3 %

\*Data are presented as mean ± SD; Current drinker = 1 glass/day or more of alcohol.

The dietary intake results showed that 50 (48%) of the students had under-estimated their dietary sodium intake. On the other hand, only 13 (12%) of the students under-estimated their dietary potassium intake. The number of students who correctly estimated their

sodium and potassium intakes were 35 (33%) and 54 (52%), respectively. While 20 (19%) and 38 (36%) of the students over-estimated their sodium and potassium intakes, respectively. Of those surveyed, 30% were not sure if they were at risk of hypertension.

The data analyses showed significantly less dietary sodium intake from the participants who had over-estimated their three-day dietary sodium intake, compared to those who had either under-estimated or correctly estimated their sodium intake. With regards to potassium, the analyses showed significant differences between the students who had under-estimated their potassium intake with those who had either correctly estimated or over-estimated their potassium intake. These results are presented in Figs. 1 and 2. All the data are presented as mean ± SD.

In terms of weight perception, 23 (22%), 72 (69%) and 10 (9%) of the students had under-estimated, correctly estimated and over-estimated their weights, respectively. Table 2 provides detailed summaries regarding the participants' weights and the prevalence of their underestimation.

Table 2: The prevalence of weight underestimation among participants in the dietary intake study.

BMI classification	n	Weight under-estimation (n, %)	
		n	%
Underweight BMI group	7	0	0
Normal weight BMI group	55	4	7%
Overweight BMI group	21	4	19%
Obese BMI group	22	15	68%

BMI: body mass index

The statistical analyses showed significantly higher average BMI ± SD among the participants who had under-estimated their weights ( $30.26 \pm 5.78$  kg/m<sup>2</sup>) compared to  $23.74 \pm 4.82$  kg/m<sup>2</sup> and  $21.98 \pm 2.41$  kg/m<sup>2</sup> for the correctly estimated and over-estimated groups ( $p < 0.0001$ ). All the data in the figures are presented as mean ± SD.

## DISCUSSION

This study highlights the inadequacy of health perceptions among a sample of university students in Barbados. The students' responses indicated an average BMI of 25 kg/m<sup>2</sup>, suggesting a trend tending towards overweight weight-status. The participants from the obese BMI group were observed to have the highest likelihood to underestimate their weights, which is consistent with other findings among university students in 21 countries

globally (20). In total, about 30% of all the 105 students misinterpreted their weight-status. This relatively high proportion suggests the probable need for more educational programmes to address this knowledge deficit, as unhealthy weight status may lead to negative cardiovascular health consequences (21, 22).

The results from the three-day semi-quantitative food frequency questionnaire demonstrated that the students consumed inappropriate quantities of sodium and potassium from dietary sources on the consideration of the IOM’s dietary sodium and potassium recommendations (8). The findings in this study showed that the average sodium intake was estimated to be above the IOM’s recommendations. The main sources of dietary sodium

agrees with the results from the Barbados Salt Intake Survey, where these sources have also been identified (7). On the other hand, the average potassium intake was estimated to be below the IOM’s daily recommendation. No data regarding the dietary potassium intake level among the young adult Barbadian population have been reported. Evidence from a sample of normotensive Barbadian adults also points to the pattern of suboptimal dietary potassium consumption (23). The findings also highlight the possible need for interventions to augment dietary potassium intake in the Barbadian population.

In terms of dietary intake perceptions, only 35% of the sampled students correctly identified their dietary sodium intake, while about half (48%) of the students under-estimated their sodium intake. Conversely, for potassium, the over-estimation appears to be more common than the under-estimation (36% vs 12%). Significantly lower sodium intake has been observed among participants who have over-estimated their sodium intake (1612 mg vs 3889 mg, 3478 mg).

Whereas for potassium, the participants who have under-estimated their three-day potassium intake reported a significantly higher intake level (7444 mg/daily), compared to both the correctly estimated (2248 mg/daily) and the over-estimated (2246 mg/daily) groups. These results confirm the pattern of nutritional imbalance as depicted by the over-consumption of sodium and the sub-optimal consumption of potassium. This imbalance agrees with the observations in other parts of the world (8). This health risk is further heightened by participants from the obese BMI group having the

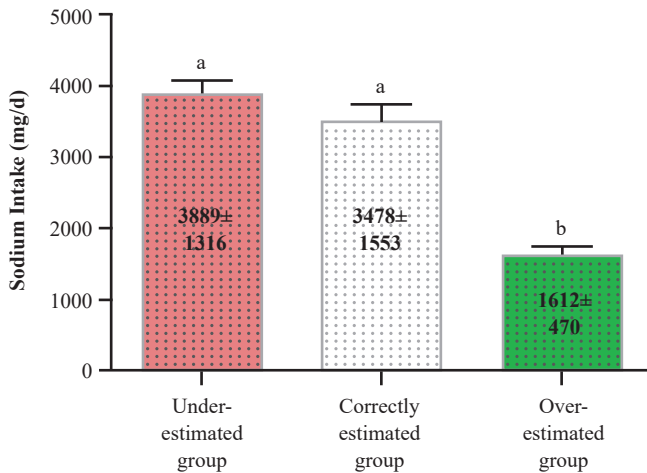


Fig. 1: Measured and estimated dietary sodium intake among the undergraduate students. Note that “a” and “b” in the figure indicate statistical differences between the under-estimated group and the other comparative groups at  $p < 0.0001$ .

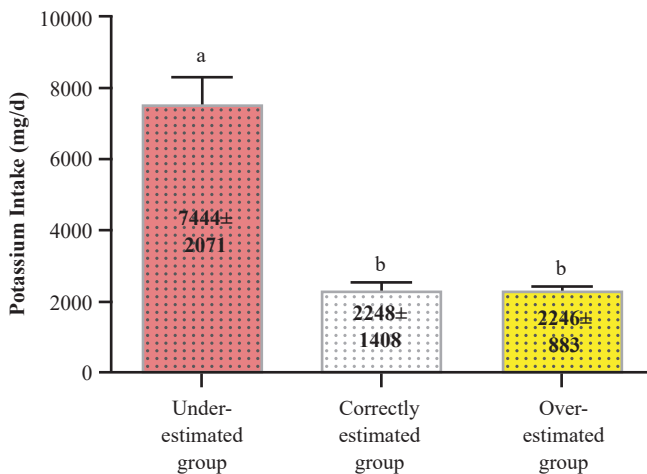


Fig. 2: Measured and estimated dietary potassium intake among the undergraduate students. Note that “a” and “b” in the figure indicate statistical differences between the under-estimated group and the other comparative groups at  $p < 0.0001$ .

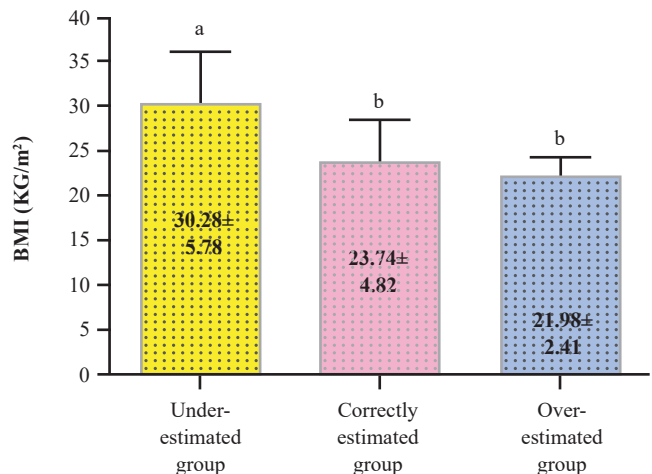


Fig. 3: Measured and estimated body mass index among the undergraduate students. Note that “a” and “b” in the figure indicate statistical differences between the under-estimated group and the other comparative groups at  $p < 0.0001$ .

highest likelihood to underestimate their weights. These results demonstrate a lack of understanding of CVD risks among the students regarding their weight, dietary sodium and potassium intakes, with those further away from the recommended dietary intake levels being more at risk of having misperceptions regarding their health. Especially taking the high uncertainty (30%) regarding hypertension risk detected from this study into consideration, educational programmes focussing on their CVDs and their associated risk factors, and potential lifestyle modifications will likely be beneficial to improve the students' understanding of their dietary sodium and potassium intakes and their health implications.

It is evident that there is nutritional inadequacy in the typical diets in Barbados, where dishes high in sodium, fat and carbohydrates are commonly consumed (5). Cooking methods commonly practised in Barbados may promote this nutritional imbalance. For instance, the results of the three-day semi-quantitative food frequency questionnaire identified potatoes by means of French fries as a major source of potassium among the students. Instead of frying, cooking methods like mashing or boiling may be considered as the healthier alternatives.

The low response rate in the study may be explained by the fact that the timing of the study coincided with the university's final examination period which was circumstantial and coincided with the data collection period of the study; thus, the students might have been occupied otherwise. Otherwise, the poor response rate may also reflect the indifference among undergraduates towards their health and dietary practices. Regarding the survey's length, Pealer *et al.*, reported one to 24 days of response time for a group of college students from Florida to complete a health survey questionnaire, with the mean response time being 9.75 days [SD = 7.12] (15). The seven days, during which they had to respond to this study's questionnaire might be inadequate.

Another limitation of this survey is the reliance on self-reporting, as the questionnaire was self-administered *via* Google Forms. In regards to weight reporting, most studies conducted in the adult population have found that self-reporting may lead to under-estimation of weight and to over-estimation of height, with a combined overall effect of under-estimating BMI (24). In terms of diet, the self-reporting of three-day dietary recall might be associated with inaccuracies like recall bias (25).

This study is the first that assesses young adults' health perceptions in Barbados and shows the inadequate perceptions of weight, sodium and potassium

intakes among a sample of undergraduate students in Barbados. Further results with a representative sample of the undergraduate population will be useful to direct appropriate interventional programmes in an effort to decrease the behavioural risk factors associated with cardiovascular disease, primarily hypertension and its sequela. Educational-based interventions at the tertiary level may be a consequence if the results of future population-based studies reflect similar findings.

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