ORIGINAL PAPER

Nagoya J. Med. Sci. **83**. 589–599, 2021
doi:10.18999/nagjms.83.3.589

Dietary salt intake and its correlates among adults in a slum area in Dhaka, Bangladesh: a cross-sectional study

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ABSTRACT

High dietary salt intake increases the risk of noncommunicable diseases (NCDs). NCDs are increasing among the urban poor in Bangladesh, but the data of their dietary salt intake are yet scarce. This study aimed to explore the amount of dietary salt intake among adults in an urban slum area in Dhaka, Bangladesh. A cross-sectional community-based study was conducted. We randomly selected 100 residents (39 men and 61 women) aged 20–59 years without history of NCDs. A modified World Health Organization standard instrument was used for behavioral risk factor assessment and physical measurements. Dietary salt intake was estimated from the measurement of sodium (Na) excretion in spot urine samples.The estimated mean dietary salt intake was 7.8 ± 2.5 g/day, and the mean Na/potassium (K) ratio in urine was 4.9 ± 3.4. More than half (54%) of them always took additional salt in their meals, but only 6% of them consumed 5 or more servings of fruits and vegetables per day. A quarter of them perceived salt reduction not at all important. Increased mean salt intakes were marginally associated with lower waist circumference and lower waist-hip ratio. Dietary salt intake among urban slum residents was higher than the recommended level of 5 g/day; however, its association with NCD risk factors was not significant. Further studies are required to identify the urban poor specific factors.

Keywords: dietary salt intake, spot urine sodium excretion, noncommunicable diseases, slum residents, Bangladesh

Abbreviations:
NCDs: noncommunicable diseases
WHO: World Health Organization
Na: sodium
K: potassium
Cr: creatinine

Received: July 22, 2020; accepted: January 19, 2021

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BMI: body mass index
SBP: systolic blood pressure
DBP: diastolic blood pressure

INTRODUCTION

Non-communicable diseases (NCDs), including cardiovascular diseases and diabetes, are rising public health issues in developing countries. NCDs are responsible for 41 million deaths each year, of which over 85% take place in low- and middle-income countries.[1]

Increased dietary salt intake associates raised blood pressure, and thus increases the risk of cardiovascular diseases such as coronary heart diseases and stroke.[2,3] An increase of 5 g per day in salt intake is reported to increase the risk of stroke by 23% and that of cardiovascular diseases by 17%.[4] The amount of potassium (K) excretion in urine inversely associated with blood pressure.[5-7] The ratio of urinary sodium (Na) and K excretion is reported to be significantly higher in the hypertensive group than the normal blood pressure group in the same population.[8] Therefore, a diet rich in K (fruits and vegetables) and low in Na could contribute to preventing hypertension.[9]

Cardiovascular diseases account for 17% of all deaths in Bangladesh.[1,10,11] Dhaka, the capital city of Bangladesh, is the 11th largest city in the world with a population of 17 million, of which one third live in slum areas.[12] Previous studies reported that the burden of NCDs was increasing among urban slum dwellers.[12-14] However, data of their dietary salt intake are yet scarce.

Our research group conducted a cross-sectional epidemiological survey in an urban slum area in Dhaka between October 2015 and April 2016.[15] We found that the prevalence of overweight/obesity was 18.9% in men and 39.2% in women, that of hypertension was 18.6% in men and 20.7% in women, and that of diabetes was 15.6% in men and 22.5% in women. We also found that the majority of the people (55.9% of men, 51.2% of women) always added table salt to already seasoned meals.[15,16]

The current study aims to explore the amount of dietary salt intake among the residents in the same urban slum area by measuring the levels of urine Na and K excretion.

METHODS

Study setting and data collection

A cross-sectional community-based study was conducted between August and September 2016 in a slum area in Dhaka, Bangladesh. Our research group had conducted a census-like population survey, a cross-sectional epidemiological survey of NCD risk factors, and a socio-anthropological study exploring perception and behavior related to NCDs in the same area.[15-17] There were 8,604 households and 34,170 people lived in the whole area. Most of them had access to safe water, but only 16% had a toilet in their houses.[17]

A total of 100 adults aged 20–59 years were randomly selected from one of the five blocks consisting of the whole area. Pregnant women and those previously diagnosed as hypertension or any other chronic diseases including chronic kidney disease, liver disease, stroke, and ischemic heart disease were excluded, as they might have reduced dietary salt intakes because of the diseases.

We used a modified World Health Organization (WHO) standard instrument for the NCD risk factor survey.[18] Using a structured questionnaire, we first interviewed the respondents about socio-demographic characteristics, behavioral factors, and medical history. Then we measured blood pressure, height, weight, waist and hip circumferences, mostly following the WHO standard procedures. Bodyweight and height were measured after removing heavy clothing and shoes. Blood pressures were measured after resting 15 minutes by the left arm using automatic digital equipment (Omron HEM 8721, Kyoto, Japan). Two consecutive readings were taken at a 3-minute interval and the mean of two readings was taken. The pulse rate was also recorded.

Respondents were asked to give the second urine sample before breakfast on the next morning of the interview. A sterile plastic container was supplied to each respondent during the interview. The urine samples were collected by a trained data collector in the next morning and sent to the biochemistry laboratory of Bangabandhu Sheikh Mujib Medical University within 2 hours. The levels of Na, K, and creatinine (Cr) were measured by an automated analyzer (Dimension RXL Max, Siemens, Washington DC, USA). Five percent of samples were split and cross-checked in the laboratory of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders, and confirmed the consistency of the test results.

Data analysis

Age was categorized into two groups: 20–39 years and 40–59 years.[5] Respondents' wealth category was defined by a single count of ten household items, namely electricity, flush toilet, land phone, mobile telephone, television, radio, refrigerator, car, motorcycle, and washing machine.[19] The total score was counted by adding all the items resulting in a total score ranging from 0 to 10. Finally, the score was categorized into 3 groups based on the total score: 0–4 as low status; 5–7 as medium status; and 8–10 as high status.

All the continuous readings of physical and biochemical measurements were categorized according to well-defined standards with slight modification. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, and categorized into 2 groups: <25 and ≥25 kg/m^2.[20] The waist-hip ratio was categorized into 2 groups: <0.9 and ≥0.9. Blood pressure was categorized into 3 groups: systolic blood pressure (SBP) / diastolic blood pressure (DBP) ≤120/80; >120/80, <140/90; and ≥140/90 mmHg.[21,22] Fruit/vegetable intake was categorized into 2 groups: <3 and ≥3 servings/day.

The 24-hour urinary Na excretion and the 24-hour urinary K excretion was estimated from the Na/Cr or K/Cr ratio by using 'Kawasaki' formula from the morning fasting urine sample.[23] The predictive value of 24-hour urinary Cr excretion was calculated from the respondents' age, weight, and height.[24] The dietary salt intake per day was calculated from the estimated 24-hour urinary Na excretion (17.1 mmol urinary Na = 1 g salt).[25]

The association of mean dietary salt intake and respondents' characteristics (age, sex, blood pressure, BMI, waist circumference, waist-hip ratio, fruit/vegetable intake, frequency of salty food intake, addition of salt at the table, education, and wealth category) were examined by using a one-way analysis of covariance (ANCOVA). The results of blood pressure, BMI, waist circumference, waist-hip ratio, fruit/vegetable intake frequency of salty food intake, addition of salt at the table, education, and wealth category were adjusted by age and sex. For age and sex, the results were adjusted with each other.

Ethical consideration

This study was approved by the Institutional Review Board of Bangabandhu Sheikh Mujib Medical University and conducted according to the guidelines laid down in the Declaration of Helsinki. Written informed consent was obtained from all respondents. Respondents with no education provided fingerprints on the consent sheets after receiving sufficient verbal explanation.

RESULTS

The socio-demographic and anthropometric characteristics of the respondents are shown in Table 1. Among the respondents, 60% were in the 20–39 age group and 40% were in the 40–59 age group, and 39% were men and 61% were women. The majority (59%) of the respondents had education up to primary level while 29% had no formal education. About half (47%) of the respondents were homemakers and 17% were engaged in small businesses. More than half (52%) of the respondents were in the low wealth category, while 48% were in the medium wealth category. One third (34%) were overweight (BMI ≥25 kg/m^2), two-thirds were abdominally obese, and 23% had hypertension (SBP/DBP ≥140/90 mmHg).

Table 1 Socio-demographic and anthropometric characteristics (n=100)

Variable	%	Variable	%
Age, years		Body mass index, kg/m^2	
20–39	60	<25	66
40–59	40	≥25	34
Sex		Waist circumference, cm	
Male	39	≤80	39
Female	61	>80	61
Education		Waist-hip ratio	
No formal education	29	<0.9	41
Primary	59	≥0.9	59
Secondary and above	12	Blood pressure, mmHg	
Occupation		≤120/80	46
Employed	14	>120/80; <140/90	31
Small business	24	≥140/90	23
Day labor	7		
Homemaker	47		
Others	8		
Wealth category*			
Low	52		
Medium	48		

*Defined by a single count of 10 household items: 0–4 as low status; 5–7 as medium status; and 8–10 as high status.

Table 2 shows the knowledge, attitude, and behavior on diet and salt intake. More than half (54%) of them considered that they consumed right amount of dietary salt, but 17% acknowledged that they took too much salt. More than half (54%) of them always added table salt in their already seasoned meals. Most (82%) of them thought that high salt diets could cause health problems, but only 19% perceived salt reduction very important, while 25% perceived it not important at all. All respondents took meals three times per day, and 23% took at least one meal from outside home. Half (50%) of them took snacks once a day between meals, while 41% did not take snacks. About half (46%) of them sometimes or often took salty food such as packed food, restaurant food, and fast food, while 24% never took them. Only 6% consumed 5 or more servings of fruits and vegetables per day, as recommended by the WHO.

Table 2 Knowledge, attitude and behavior on salt intake and diet (n=100)

Variable	%
Frequency of salty food intake*	
Never	24
Rarely	30
Sometimes	31
Often/Always	15
The perceived amount of salt intake	
Far too much	17
Too much	12
Just the right amount	54
Too little/Far too little	12
Addition of salt at the table	
Never	16
Rarely	4
Sometimes/Often	26
Always	54
Perceived possibility of health problems caused by a high salt diet	
Yes	82
No	7
Don’t know	11
Perceived importance of salt reduction	
Not at all important	25
Somewhat important	55
Very important	19
Don’t know	1
Perceived measures for salt reduction	
Limit consumption of processed food	
Yes	53
No	47
Buy low salt/Na alternatives	
Yes	1
No	99
Avoid eating out	
Yes	30
No	70
Frequency of outside meals, times/day	
0	77
1	23
Frequency of snacks, times/day	
0	41

1	50
2	9
Fruit/vegetable intake, servings/day	
<1	7
1–4.9	87
≥5	6

*Salty food includes packed food, restaurant food, and fast food.

Table 3 shows levels of Na, K, Cr, and mean Na/K ratio in urine samples and estimated dietary salt intakes. The mean urinary Na, K and Cr excretion was 119.2 mmol/day, 33.1 mmol/day, and 107.7 mg/day, respectively. The mean Na/K ratio was 4.9, which was higher in women than in men (data not shown). The mean dietary salt intake was 7.8 g per day with a range of 2.2 to 15.7 g per day.

Table 3 Urinary Na, K, Cr, and estimated salt intake (n=100)

	Mean	Median	SD	Range
Na, mmol/day	119.2	123.0	56.7	15.7–264.0
K, mmol/day	33.1	24.5	22.8	3.2–100.8
Cr, mg/dl	107.7	95.0	72.2	21.0–435.0
Na/K ratio	4.9	3.9	3.4	0.19–20.0
Estimated 24-hour urinary Na, mmol/day	133.14	124.11	42.95	39.1–268.6
Estimated dietary salt intake, g/day	7.8	7.25	2.5	2.2–15.7

SD: standard deviation
Na: sodium
K: potassium
Cr: creatinine

Table 4 shows mean values of salt intake by respondents' characteristics. Increased mean salt intake was marginally associated with lower waist circumference and lower waist-hip ratio (p=0.114 and 0.104, respectively). The mean salt intake was higher in lower blood pressure groups than the hypertensive groups. Although the differences were statistically insignificant, observed mean salt intakes were slightly higher in the younger, men, non-overweight, less fruit/vegetable intake, higher education, and lower wealth category groups.

Table 4 Mean values of salt intake by respondents' characteristics (n=100)

	Mean value of salt intake per day (g) ± Standard Error			
	Crude	*p*	Adjusted	*p*
Age, years				
20–39	7.88 ± 0.348	0.669	7.89 ± 0.328	0.633[a]
40–59	7.66 ± 0.353		7.64 ± 0.402	
Sex				
Men	7.94 ± 0.455	0.624	7.99 ± 0.405	0.524[b]
Women	7.69 ± 0.294		7.66 ± 0.323	
Blood pressure, mmHg				
≤120/80	8.20 ± 0.384	0.278	8.17 ± 0.373	0.362[c]
>120/80; <140/90	7.58 ± 0.442		7.57 ± 0.453	
≥140/90	7.24 ± 0.491		7.31 ± 0.539	
Body mass index, kg/m^2				
<25	7.99 ± 0.312	0.250	7.98 ± 0.310	0.300[c]
≥25	7.38 ± 0.420		7.42 ± 0.433	
Waist circumference, cm				
≤80	8.32 ± 0.444	0.091	8.29 ± 0.401	0.114[c]
>80	7.45 ± 0.293		7.47 ± 0.320	
Waist-hip ratio				
<0.9	8.28 ± 0.412	0.103	8.30 ± 0.397	0.104[c]
≥0.9	7.45 ± 0.311		7.43 ± 0.329	
Fruit/vegetable intake, servings/day				
<3	7.96 ± 0.317	0.330	7.97 ± 0.305	0.300[c]
≥3	7.43 ± 0.403		7.41 ± 0.445	
Frequency of salty food intake				
Never/Rarely	7.70 ± 0.345	0.891	7.77 ± 0.356	0.992[c]
Sometimes	7.97 ± 0.455		7.83 ± 0.472	
Often/Always	7.73 ± 0.655		7.75 ± 0.672	
Addition of salt at the table				
Never/Rarely	7.40 ± 0.729	0.650	7.48 ± 0.748	0.748[c]
Sometimes/Often	7.93 ± 0.300		7.91 ± 0.303	
Always	7.43 ± 0.613		7.47 ± 0.653	
Education				
No formal education	7.39 ± 0.464	0.214	7.54 ± 0.547	0.425[c]
Primary	7.75 ± 0.325		7.71 ± 0.338	
Secondary and above	8.90 ± 0.721		8.75± 0.780	
Wealth category*				
Low	7.96 ± 0.349	0.460	7.98 ± 0.350	0.431[c]
Medium	7.59 ± 0.363		7.58 ± 0.365	

[a]Adjusted for sex.
[b]Adjusted for age (continuous).
[c]Adjusted for sex and age (continuous).
*Defined by a single count of 10 household items: 0–4 as low status; 5–7 as medium status; and 8–10 as high status.

DISCUSSION

Our study estimated the mean dietary salt intake of slum residents in Dhaka at 7.8 g/day, based on the measurement of urine Na and Cr concentration. As far as we know, this is the first study that showed the level of dietary salt intake of such population, who are considered to be at high risk of NCDs.

Previous studies in Bangladesh reported that the mean salt intake was 6.8 g per day among coastal area residents, 10.6 g/day among the relatively well-off urban population and 5.1 g/day among the rural poor, which was close to the level of WHO recommendation (<5 g per day).[26-28] Dietary salt intake of Bangladesh nationals living in London was reported to be 10.5 g per day.[29] Our findings showed that the dietary salt intake was high in the urban population regardless of wealth levels. This might be due to the frequent use of ready-made processed food, which usually contains a lot of salt, by the urban population.[27] Our study also indicated that the majority of the respondents used such salty food. Besides, we found that majority of the respondents added table salt to the already seasoned meals. Adding salt to the meal is regarded as a luxury or a gesture of welcoming guests by the urban poor population, and thus it would not be easy to change such dietary habits.

We found that increased salt intakes were marginally associated with lower waist circumference and lower waist-hip ratio, contrary to our expectation. Overall higher dietary energy intake among the urban well-off population was considered to be one of the causes of the high dietary salt intake.[27] However, urban poor people, particularly non-obese people, were likely to have lots of rice with salt but have little animal products, unlike the urban well-off population. This might be the reason for higher salt intake among non-abdominal obese people, but further studies are required.

Although it is widely known that higher dietary salt intake associates with raised blood pressure, we found that mean dietary salt intake was the highest in the normal blood pressure group and the lowest in the hypertension group. Obesity is known to be a strong risk factor of raised blood pressure, and thus raised blood pressure groups were likely to be more obese than normal blood pressure groups.[30] The higher salt intake among normal blood pressure groups might be caused because the mean salt intake of non-obese people was higher than obese people in this population. We could not confirm this inverse association due to the small sample size; thus, further studies are required.

We found that the mean Na-K ratio was 4.9, similar to the findings of a previous study, which were 4.9 in the urban well-off population and 3.1 in the rural poor.[27] This ratio is higher than the approximate level, which was likely to be due to the low intake of fruits/vegetables by the respondents.[6,28,31]

Our study showed that most of the respondents perceived that high salt intake could cause health problems, but the majority perceived that they took a right or little amount of salt and commonly used additional salt. Similar findings were reported in other countries.[32-34] A quarter of the respondents perceived salt reduction, not at all important. The proportion of the people who were aware of the harm of excess dietary salt intake was higher in our study than the findings of a previous study in another slum area in Bangladesh, perhaps because of the relatively better education level of the respondents of our study. Over half of the respondents tried to limit processed food consumption, which was higher than the findings of previous studies.[33,34] While a third of respondents of the study in Australia used low salt alternatives, most of the respondents of the current study were unaware of it, similar to the findings of a previous study in Angola.[32,33] This might be due to the low educational level of the respondents of the current study; however a discrepancy between knowledge of the harm of salt intake and behavior of using additional salt was reported in a previous study targeting physicians in Bangladesh.[35] General knowledge is unlikely to change behavior regardless of the educational level, and thus interventions specifically targeted to salt reduction might be required in this community, as successful examples in Japan.[35,36]

The strength of our study is that we for the first time estimated dietary salt intake of the urban slum adult population, whose socio-demographic and health status we had studied previously. We measured urinary Na, K, and Cr for estimating dietary salt intake. There are several limitations to the study. First, due to the small sample size, the findings may not reflect the status of the wider population. Second, we used spot urine samples but did not collect 24-hour urinary samples.

CONCLUSION

We found that mean dietary salt intake was 7.8 g/day among the urban poor population. Less obese people tended to use more salt, perhaps due to their dietary habits having excess salt with rice. While the majority of the respondents knew the adverse health effects of excess dietary salt intake, they were mostly unaware of the importance of salt reduction. A community-wide targeted intervention might be required for salt reduction.

ACKNOWLEDGEMENTS

The authors wish to thank the residents and community leaders in the target area, data collectors of the field survey, and staff members of Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, National Heart Foundation Hospital and Research Institute, and Department of Public Health and Health Systems, Nagoya University School of Medicine for providing support and advice during the research.

CONFLICT OF INTEREST

All authors declared that no competing interest exist. This study was conducted by the in-house research budget of the Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University.

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