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Perception of and Practice in Salt and Fruit Consumption and Their Associations with High Blood Pressure: A Study in a Rural Area in Bangladesh

Fakir M. Amirul Islam [1,2,*], Carrie K. Wong [1], Mohammad Arzan Hosen [2] and Jahar Bhowmik [1]

[1] School of Health Sciences, Swinburne University of Technology, Hawthorn, VIC 3122, Australia
[2] Organisation for Rural Community Development (ORCD), Dariapur, Narail 7500, Bangladesh
* Correspondence: fislam@swin.edu.au

Abstract: Background: Minimizing raw salt and increasing fruit consumption are important factors for controlling blood pressure. The study aimed to investigate the following associations: (i) the association between socio-demographic characteristics and awareness of, and attitudes towards, raw salt and fruit consumption and (ii) the association between salt and fruit consumption and blood pressure. Methods: In a cluster-RCT, 307 adults, aged 30 to 75 years, with hypertension were recruited in 2021. Blood pressure was the primary outcome, and knowledge, attitudes and intakes of raw salt and fruit were secondary outcomes. Results: Of the participants, 271 (78.5%) consumed raw salt. More than 80% of the participants knew that reduced raw salt was good for controlling blood pressure and almost everyone knew that fruits and vegetables were good for health. Despite this, 95% of the participants had a habit of eating fruit irregularly. A lower proportion (64%) of the participants having at least a secondary school certificate (SSC) consumed raw salt, compared with those having an education level SSC (82%), $p = 0.002$. Blood pressure was not significantly different for participants, irrespective of raw salt or fruit consumption. Conclusions: Raw salt consumption among rural people was high and regular fruit consumption was deficient. They intended to reduce raw salt consumption. Appropriate intervention programs should be implemented to reduce salt consumption and increase fruit consumption.

Keywords: salt and fruit consumption; blood pressure; factors associated; rural Bangladesh

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1. Introduction

High systolic blood pressure (SBP), a cardiovascular disease (CVD) risk factor, was responsible for the most significant number of all-cause deaths between 2000–2017 [1]. Globally, hypertensive heart disease accounts for over 460,000 deaths annually, whilst contributing to a loss of more than 2.8 million Disability-adjusted life years (DALYS) amongst Non-communicable diseases (NCDs) [1]. Dietary risk factors, such as high sodium intake and low wholegrain intake, further contribute to DALYs linked with hypertension [1]. In low- and middle-income countries (LMICs), prevalence of adult hypertension continues to rise compared to high-income countries, and continues to fall behind in terms of education and treatment, hence creating health disparities [2]. In Bangladesh, a LMIC in Southeast Asia (SEA), studies have revealed hypertension as a concern amongst adults, with increasing prevalence amongst certain sub-populations, such as working adults, the elderly and those living in rural areas [3,4]. A systematic review [5] reported an overall weighted pooled prevalence of 20.0%. Islam et al. [4] reported stage 1 high blood pressure (systolic blood pressure $\geq$ 130 mmHg or diastolic blood pressure (DBP) $\geq$ 80 mmHg, or taking antihypertensive medications) in the same location as the current research was conducted in to be 40% in 2016.

The WHO recommends that sodium consumption should not exceed 5 g/day to prevent cardiovascular disease [6], whilst the Bangladeshi Dietary Guidelines recommends

fruit consumption between 1–3 servings daily, with one serving being approximately 80 g [7]. Lifestyle changes, such as dietary modification, have been shown to have positive effects on CVD risk factors [8]. For instance, reduction in dietary sodium intake can help manage high blood pressure and improve health outcomes by decreasing, or slowing, complications associated with high blood pressure and other CVDs [9–15]. Higher fruit and vegetable intake has been shown to result in lower SBP overall; however. their effects may be dependent on type of fruit or vegetable consumed and cooking method [16,17]. The cardioprotective effects of fruit and vegetable consumption may be linked to high dietary fiber, and mineral and antioxidant contents amongst these foods [18,19].

Diets that are high in a combination of fruit, vegetables, wholegrains, legumes, seeds, nuts, fish and dairy have been found to lower SBP and DBP [20], hence, suggesting that a combination of multiple dietary modifications may provide better improvements to BP compared with individual dietary modifications. The Dietary Approaches to Stop Hypertension (DASH) diet is one such diet that employs multiple dietary elements, with its emphasis on high vegetable and fruit intake and low-fat dairy products, and has been demonstrated to have positive effects on BP [21,22]. Sacks et al. [23] studied the effects of varied dietary sodium intake and the DASH diet on BP amongst US hypertensive and non-hypertensive adults in a randomized, controlled trial, revealing that those who followed a low sodium DASH diet had significantly greater reductions in systolic and diastolic blood pressure compared to those who followed a reduced sodium or DASH diet alone. The study revealed that a combination of low sodium and DASH diet reduced SBP amongst people who were hypertensive by 11.5 mmHg and 7.1 mmHg amongst those who were non-hypertensive ($p = 0.004$).

In LMICs, the impact of behavioral risk factors, such as poor diet and tobacco use, are more pronounced and linked with greater mortality, compared to high-income countries [24]. As a result, the WHO [25] called for an extension of the Global Action Plan for the Prevention and Control of NCDs to 2030. The plan includes a 30% mean reduction in population sodium intake and a 25% reduction in blood pressure prevalence, whilst pharmacological intervention is recommended for persons with SBP $\geq$ 140 or DBP $\geq$ 90 mmHg [26].

Health literacy (HL) has been recognized to play a key role in the prevention of NCDs in a recent report by the WHO [27]. At an individual level, HL involves having knowledge, confidence and comfort to perform daily activities and social interactions [27]. At an individual level, HL includes access to, understanding of, appraisal of and application of health information [27,28]. This can be assessed using tools such as the HLS-EU [28]. People with low HL have been shown to possess less knowledge of health conditions and their management [29,30], to be less likely to engage in self-care of chronic health [31–33]; and to be less likely to seek help from healthcare providers [30,33,34]. In Bangladesh, studies have found that a lack of education and knowledge impacts the ability to engage in and practice health behavior related to chronic disease management [35,36]. Hence, there is an importance in empowering individuals with knowledge and skills to make health-related behavior changes through appropriately tailored and targeted interventions.

Dietary interventions to manage blood pressure in LMICs have included educational components, such as information delivery through lectures and advice sharing, which have demonstrated positive effects on reducing blood pressure [37–40]. In particular, some interventions in LMICs involve visits by healthcare professionals in home and community-based settings to deliver tailored and targeted lifestyle modification information [41]. Furthermore, emerging evidence reveals potential in non-traditional methods of information delivery through various digital health means, such as mobile phone-based follow-up text messages to cater to current needs [42]. Understanding the target communities' knowledge and strengths is necessary to ensure design of appropriate and effective health interventions [27]. Community-based interventions have been found to be effective in reducing salt intake in Bangladesh [43,44], as well as in other LMICs [45]. In particular, the importance of addressing low health education to empower and support Bangladeshi individuals living in rural areas so as to encourage the undertaking of behavior change for chronic disease

management has previously been demonstrated [46]. The significance of community-based or social environments in skill development and behavioural change may be derived from social learning theories, whereby learning of new skills occurs more effectively in the presence of other people [47,48], and that social environments encourage attempts at new and unfamiliar tasks [49]. Despite this potential, the literature published on such community-based interventions in LMICs are usually small in scale (i.e., small target groups) and are undertaken in upper income–middle income countries [45]. There is a need to investigate the potential and effectiveness of interventions to reduce hypertension prevalence in low-income countries.

Presently, the attitudes and awareness of dietary factors, related to the management of blood pressure, and the association of these factors with socio-demographic factors amongst rural Bangladeshi residents are still being determined. Therefore, this study aimed to investigate the factors associated with the following, among people with hypertension in a rural area in Bangladesh:

1. Knowledge of the health benefits of fruit intake and the potential risks regarding excess raw salt intake in managing blood pressure.
2. The current practice of raw salt and fruit intake.
3. The association of dietary raw salt and fruit intake with blood pressure.

2. Methods

2.1. Study Design, Setting and Participants

Bangladesh consists of 64 administrative districts with a population of 163 million people. There are 3–8 sub-districts in each of the districts, which are again sub-divided into 10–15 rural Unions and one urban Pourashava. Each Union has 15–20 villages and each urban Pourashava has six to ten urban wards [50]. We conducted a cross-sectional study, known as the Bangladesh Population-based Diabetes and Eye Study (BPDES), on a sample size of 3104 adults aged 30–80 years in the Banshgram Union of the Narail district, in 2012 [36,51]. Currently, we are conducting a cluster RCT for the lowering of blood pressure, by changing lifestyle, on participants who were diagnosed with hypertension in 2012. For this RCT, the baseline data were collected in 2021 [52], and the present research is based on this baseline data. The inclusion criteria for participants were the following: (i) a clinical blood pressure of more than, or equal to, 130/80 mm Hg among people who were not taking medication, (ii) blood pressure < 130/80 mm Hg but using anti-hypertensive medication for a minimum of six weeks. In terms of comparison of the study location with the national population, the population density of the study location was 722 per km^2 compared to the population density of 873 per km^2 in rural districts in Bangladesh. The study location was selected as it was considered to be typical of a rural demographic in Bangladesh. Narail has a literacy rate of 48.6%, which is comparable to the national literacy rate of 51.8%.

2.2. Sample Size

The current research was an initial investigation into raw salt intake and fruit consumption habits of the participants, and the and participants' knowledge of the health benefits in lowering blood pressure by reducing raw salt and increasing fruit consumption, as a secondary aim in a cluster randomized, controlled trial (RCT). The primary objective was to lower blood pressure by changing lifestyles. We recruited 307 participants with hypertension for this cluster RCT. The study objectives were discussed elsewhere. [52]. A previous US study [53] reported that 13% of people intended to reduce their salt intake. With 5% precision and 95% confidence interval, the required sample size would be 186 or more participants, for the study to have more than 80% power to detect a moderate effect size. Therefore, our sample size of 307 was sufficient for this initial investigation.

2.3. Recruitment and Data Collection

Investigators from the Swinburne University of Technology, in collaboration with a local non-government organization, the Organization for Rural Community Development (ORCD) in the Narail district of Bangladesh, recruited participants and collected data in 2021. Data were collected through face-to-face interviews. The ORCD investigators and trained data collectors communicated with the potential participants over the telephone or by direct contact. Upon establishment of contact with potential participants, they were assessed for inclusion and exclusion. The inclusion criteria were the following: (i) clinical blood pressure more than, or equal to, 130/80 mm Hg for people who were not taking medication, (ii) blood pressure < 130/80 mm Hg but using anti-hypertensive medication for a minimum of six weeks, and (iii) living in the Banshgram Union only. The exclusion criteria were the following: (i) aged >75 years of age, (ii) pregnant, (iii) advanced CVDs or had any serious condition that restricted their participation in the study. The study location, the source population's demographic characteristics, and the cluster RCT have been described in detail [51,52].

2.4. Outcome Variables

1. Blood pressure
2. Knowledge of association of raw salt consumption and fruit intake with blood pressure.

2.5. Outcome Variable: Blood Pressure

We measured systolic and diastolic blood pressure using a calibrated Omron Premium Blood Pressure Monitor Device, Omron HEM-7322. We measured blood pressure twice from the right arm with the person sitting upright; the second measure was taken after 5 min of rest after the first measure. A third measure was taken if the difference between the first two measurements was more than 20%, otherwise we took the average of the first two readings. For more than 20% variation, average was taken from the closest two measures. To check the accuracy of the readings, we measured blood pressure from 10 adults using both Omron HEM-7322 and a standard analog device for comparison. Our data showed that the Omron HEM-7322 over-estimated SBP on average by only 6% (standard deviation (SD) 8%) and DBP by 3% (SD 5%). Given the variation was less than 10% between the two devices, we used our data measured by Omron HEM-7322 without further adjustment for overestimation.

Diet-related lifestyle modifications that effectively lower blood pressure questions, with possible answers, were as follows:

1. Do you eat raw salt with dishes? Possible answers: "Yes" and "No"
2. Do you know reduced salt intake is good for lowering blood pressure? Possible answers: "Not at all", "A little", "A lot", and "Enormously"
3. At the moment, do you consider reducing salt (sodium chloride) intake from your daily meals? Possible answers: "Not at all", "A little", "A lot", and "Enormously"
4. At the moment, do you consider taking more vegetables, instead of carbohydrates, such as rice, potato or bread, and sugar? Possible answers: Not at all", "A little", "A lot", and "Enormously"
5. Do you ever feel unhappy if you eat lots of sugar or carbohydrates? Possible answer: "Never", "Sometimes", "Often", and "very often".
6. Do you know eating ripe or green fruits regularly is good for health? Possible answers: "Yes", "No".
7. How are you habituated to eat fruits regularly? Possible answers:

"I eat some seasonal fruits every day", "I eat some seasonal fruits 3–4 times per week", "I eat some seasonal fruits 1–2 times per week", "I eat fruits irregularly, eat some fruits if I have them and I do not eat fruit if I do not have fruit", and "I almost never eat fruits".

2.6. Exposure Variables

The exposure variables were age, gender, level of education, SES, occupation and diabetes status. Age was categorized into young adults who were 30 to 40 years of age, adults aged 40 to 59 years and older adults, aged 60 years or older. Gender was categorized as male or female. The level of education was categorized as no schooling, primary to high school, secondary school certificate or any higher-level education. Socio-economic status was assessed according to Cheng et al. [54]. Since most participants had no taxable income, a crude measure of SES was used, following Cheng et al. [54], where we asked whether "over the last twelve months, in terms of household food consumption, how would you classify your socio-economic status?" The possible answers were: (i) Insufficient funds for the whole year, (ii) Insufficient funds some of the time, (iii) Neither deficit nor surplus (balance) and (iv) Sufficient funds most of the time. We re-categorized these four categories as poor being those who had insufficient funds at least some of the time, categories 1 and 2, and middle class or rich being those who had neither deficit nor surplus (balance) or better SES, categories 3 and 4. Occupations were categorized as farmers, homemakers, self-managed businesspersons, laborers (digging soils, pulling rickshaws or any laborious work), and government and non-government employees.

3. Ethics Approval and Consent to Participate

We received ethics approval from the Swinburne University of Technology's Human Research Ethics Committee (Review reference: 20202723-5020). Written information about the project was provided to the participants prior to collecting their written consent. We made it clear that participation was voluntary, and they could withdraw from the study at any time after they had consented to participate. The ORCD investigators verbally discussed the project with those who were unable to read or who were illiterate before collecting their informed consent. The participants were also informed that their decision to participate would not influence their relationship with ORCD.

4. Statistical Analysis

Descriptive statistics of the socio-demographic factors, including sex, age, level of education and occupation, were presented as frequency and percentages. Associations of sociodemographic factors with outcome variables, including raw salt and fruit consumption were investigated using unweighted bivariate Chi-square tests and binary logistic regression analysis. Associations of raw salt and fruit consumption with blood pressure were evaluated using one way analysis of variance (ANOVA), and systolic and diastolic blood pressure were presented as mean with 95% confidence intervals. Statistical software SPSS (SPSS Inc, version 27) was used for data analysis.

5. Results

The participants' sociodemographic characteristics are shown in Table 1. Of the total of 307 participants, half were male, half were 40–59 years of age, and one-third of the participants did not have any formal education. In terms of occupation, half were homemakers, about one-fifth were farmers, and 18% were professionals (government or private).

Of the total participants, 271 (78.5%) consumed raw salt. The proportion of people who consumed raw salt was higher among people with no education (85.9%), compared to people with a secondary school certificate (SSC) or anything above a secondary school certificate (64.4%), $p = 0.002$. Other than education, all other factors were not associated with raw salt consumption. In response to the knowledge question, "Is less salt good for managing blood pressure", other than sex and age, all other factors were significantly associated with the knowledge question. For example, 100% of people with SSC level education or above, compared to 69.7% without an education, agreed that less salt was good for managing blood pressure.

Table 1. Socio-demographic characteristics of the study participants.

		Number	Percentage
Gender	Woman	154	50.2
	Man	153	49.8
Age group, years	30–40	46	15.0
	40–59	160	52.1
	60 or older	101	32.9
Level of Education	No education	99	32.4
	Primary to high school	148	48.4
	Secondary School Certificate or above	59	19.3
Socioeconomic status *	Poor or very poor	92	30.1
	Middle class	214	69.9
Occupation *	Homemakers		
		146	50.5
	Businesspersons	24	8.3
	Labour	7	2.4
	Farmer (Agriculture)	59	20.4
	Professionals (government. or private)	53	18.3

* Indicates some missing cases; for example, information for one participants' SES was missing.

Similarly, middle-class, employed or businesspersons had better knowledge than their counterparts. In response to "Are you considering reducing raw salt use", the higher level of education, male gender, and employed or businesspersons were associated with a higher proportion of intention to reduce raw salt intake. For example, 41.8% of males compared to 29.2% of females had considered reducing raw salt intake a lot (Table 2).

A large majority (97%) of the participants knew that fruits and vegetables were good for their health. More than one-third of participants did not feel unhappy if they ate more carbohydrates, and 20.5% often felt unhappy if they ate more carbohydrates. A higher proportion of businesspersons claimed felt unhappy, compared to homemakers (25% vs. 19.7%, $p = 0.03$), when eating more carbohydrates. The majority (83%) of people ate fruits irregularly or on a sessional basis. In bivariate analyses, age, gender and level of education were found to be significant predictors of fruit eating habits; 20.3% of males, compared to 9.7% of females, consumed fruit a maximum of 1–2 times a week. SES, occupation, and diabetes status were not associated with fruit consumption habits (Table 3).

The proportion of people who did not consume raw salt was 21.5% (n = 66), and fruit consumption of 1–2 servings per week was 15% (n = 46). After adjusting for covariates, the proportion of people who did not consume raw salt (AOR = 4.27; 95% CI = (1.69, 10.79)), and 1–2 servings of fruit consumption per week (AOR = 4.41; 95% CI = (1.55, 12.5)) were significantly higher in people with a secondary school certificate (SSC) or education above secondary school level, compared to people with no education (Table 4).

Table 2. Raw salt consumption habits, and knowledge and attitudes towards raw salt consumption and their associated factors.

			Do You Eat Raw Salt?, n (%)		Is Less Salt Good for Managing Blood Pressure?, n (%)				Are You Considering Reducing Raw Salt Use?, n (%)			
		No at Risk	**Yes**	***p*-Value**	**Not at All**	**A Little**	**A Lot**	***p*-Value**	**Not at All**	**A Little**	**A Lot**	***p*-Value**
Sex	Total	307	271 (78.5)		54 (17.6)	124 (40.4)	129 (42.0)		16 (5.2)	182 (59.3)	109 (35.5)	
	Female	154	123 (79.9)	0.56	26 (16.9)	66 (42.9)	62 (40.3)	0.68	8 (5.2)	101 (65.6)	45 (29.2)	0.05
	Male	153	118 (77.1)		28 (18.3)	58 (37.9)	67 (43.8)		8 (5.2)	81 (52.9)	64 (41.8)	
Age in years	30–40	46	35 (76.1)	0.81	5 (10.9)	16 (34.8)	25 (54.3)	0.09	1 (2.2)	28 (60.9)	17 (37)	0.58
	40–59	160	129 (80.6)		31 (19.4)	62 (38.8)	67 (41.9)		8 (5)	96 (60)	56 (35)	
	≥60 years	101	77 (76.2)		18 (17.8)	46 (45.5)	37 (36.6)		7 (6.9)	58 (57.4)	36 (35.6)	
Level of Education	No education	99	85 (85.9)	0.002	29 (29.3)	49 (49.5)	21 (21.2)	<0.001	6 (6.1)	69 (69.7)	24 (24.2)	<0.001
	Primary to high school	148	117 (79.1)		25 (16.9)	60 (40.5)	63 (42.6)		8 (5.4)	91 (61.5)	49 (33.1)	
	SSC or above	59	38 (64.4)		0	14 (23.7)	45 (76.3)		2 (3.4)	22 (37.3)	35 (59.3)	
SES *	Poor	92	74 (80.4)	0.65	24 (26.1)	39 (42.4)	29 (31.5)	0.003	3 (3.3)	64 (69.6)	25 (27.2)	0.22
	Middle class	214	166 (77.6)		30 (14)	85 (39.7)	99 (46.3)		13 (6.1)	117 (54.7)	84 (39.3)	
Occupation *	Farmer	66	54 (81.8)	0.24	22 (33.3)	22 (33.3)	22 (33.3)	0.001	3 (4.5)	42 (63.6)	21 (31.8)	0.03
	Housewife	146	116 (79.5)		25 (17.1)	61 (41.8)	60 (41.1)		8 (5.5)	94 (64.4)	44 (30.1)	
	Employed	53	39 (73.6)		5 (9.4)	23 (43.4)	25 (47.2)		1 (1.9)	26 (49.1)	26 (49.1)	
	Business	24	19 (79.2)		1 (4.2)	11 (45.8)	12 (50.0)		2 (8.3)	9 (37.5)	13 (54.2)	
Diabetes status *	No diabetes	217	170 (78.3)	0.48	39 (18)	95 (43.8)	83 (38.2)	0.02	10 (4.6)	131 (60.4)	76 (35)	0.62
	Diabetes	41	30 (73.2)		3 (7.3)	12 (29.3)	26 (63.4)		2 (4.9)	21 (51.2)	18 (43.9)	

* Indicates some missing cases; for example, information for one participants' SES was missing.

Table 3. Fruit consumption habits, and knowledge and attitudes towards fruits consumption and their associated factors.

		Are Fruits and Vegetables Good for Health, n (%)				**Do You Feel Unhappy If More Carb Is Eaten, n (%)**				**Habits of Eating Fruit, Times per Week, n (%)**			
		Not at All	**A Little**	**A Lot**	***p*-Value**	**Never**	**Sometime**	**Often**	***p*-Value**	**Max. 1–2**	**Eat Irregularly**	**Almost not**	***p*-Value**
Sex	Total	8 (2.6)	153 (49.8)	146 (47.6)		108 (35.2)	135 (44.0)	63 (20.5)		46 (15.0)	254 (82.7)	7 (2.3)	
	Female	5 (3.2)	85 (55.2)	64 (41.6)	0.04	58 (37.9)	65 (42.5)	30 (19.6)	0.39	15 (9.7)	134 (87.0)	5 (3.2)	0.004
	Male	3 (2)	68 (44.4)	82 (53.6)		50 (32.7)	70 (45.8)	33 (21.6)		31 (20.3)	120 (78.4)	2 (1.3)	
Age in years	30–40	0 (0)	16 (34.8)	30 (65.2)	0.02	13 (28.3)	28 (60.9)	5 (10.9)	0.68	12 (26.1)	33 (71.7)	1 (2.2)	0.03
	40–59	5 (3.1)	83 (51.9)	72 (45)		55 (34.6)	66 (41.5)	38 (23.9)		23 (14.4)	133 (83.1)	4 (2.5)	
	≥60 years	3 (3)	54 (53.5)	44 (43.6)		40 (39.6)	41 (40.6)	20 (19.8)		11 (10.9)	88 (87.1)	2 (2)	
Level of Education	No education	6 (6.1)	62 (62.6)	31 (31.3)	<0.001	39 (39.8)	38 (38.8)	21 (21.4)	0.58	9 (9.1)	89 (89.9)	1 (1)	0.001
	Primary to high school	2 (1.4)	71 (48)	75 (50.7)		49 (33.1)	71 (48.0)	28 (18.9)		17 (11.5)	126 (85.1)	5 (3.4)	
	SSC or above	0 (0)	19 (32.2)	40 (67.8)		20 (33.9)	26 (44.1)	13 (22)		20 (33.9)	38 (64.4)	1 (1.7)	
SES *	Poor	6 (6.5)	55 (59.8)	31 (33.7)	<0.001	29 (31.5)	45 (48.9)	18 (19.6)	0.67	13 (14.1)	76 (82.6)	3 (3.3)	0.35
	Middle class	2 (0.9)	97 (45.3)	115 (53.7)		79 (37.1)	89 (41.8)	45 (21.1)		33 (15.4)	177 (82.7)	4 (1.9)	
Occupation *	Farmer	1 (1.5)	36 (54.5)	29 (43.9)	0.04	27 (40.9)	26 (39.4)	13 (19.7)	0.03	11 (16.7)	53 (80.3)	2 (3)	0.10
	Housewife	5 (3.4)	80 (54.8)	61 (41.8)		57 (39.3)	58 (40)	30 (20.7)		15 (10.3)	126 (86.3)	5 (3.4)	
	Service	1 (1.9)	21 (39.6)	31 (58.5)		13 (24.5)	29 (54.7)	11 (20.8)		9 (17.0)	44 (83.0)	0	
	Business	0 (0)	10 (41.7)	14 (58.3)		4 (16.7)	14 (58.3)	6 (25)		6 (25.0)	18 (75.0)	0	
Diabetes * status	No diabetes	6 (2.8)	111 (51.2)	100 (46.1)	0.70	81 (37.5)	96 (44.4)	39 (18.1)	0.35	34 (15.7)	179 (82.5)	4 (1.8)	0.34
	Diabetes unknown	0 (0)	19 (46.3)	22 (53.7)		9 (22.0)	18 (43.9)	14 (34.1)		4 (9.8)	36 (87.8)	1 (2.4)	

* Indicates some missing cases; for example, information for one participants' SES was missing.

Table 4. Associations of sociodemographic, occupation, and diabetes status with no raw salt consumption and fruit intake maximum 1–2 serves in a week using logistic regression from a cluster RCT in a rural area in Bangladesh.

			No Raw Salt Consumption		Max. 1–2 Serve per Week	
		No at Risk	**n (%)**	**AOR (95% CI) +**	**n (%)**	**AOR (95% CI) +**
Sex	Total	307	66 (21.5)		46 (15.0)	
	Male (Ref.)	153	35 (22.9)		31 (20.3)	
	Female	154	31 (20.1)	0.81 (0.43, 1.54)	15 (9.7)	0.51 (0.24, 1.09)
Age (years)	30–40 (Ref.)	46	11 (23.9)		12 (26.1)	
	40–59	160	31 (19.4)	1.05 (0.46, 2.44)	23 (14.4)	0.73 (0.30, 1.81)
	≥60 years	101	24 (23.8)	1.48 (0.59, 3.72)	11 (10.9)	0.42 (0.15, 1.20)
Level of education	No education (Ref.)	99	14 (14.1)		9 (9.1)	
	Primary to high school	148	31 (20.9)	1.86 (0.90, 3.84)	17 (11.5)	1.19 (0.49, 2.91)
	SSC or above	59	21 (35.6)	4.27 (1.69, 10.8)	20 (33.9)	4.41 (1.55, 12.5)
SES *	Poor (Ref.)	92	18 (19.6)		13 (14.1)	
	Middle class	214	48 (22.4)	0.94 (0.49, 1.77)	33 (15.4)	0.71 (0.33, 1.54)
Occupation *	Farmer (Ref.)	66	12 (18.2)		11 (16.7)	
	Housewife	146	30 (20.5)	1.71 (0.15, 19.1)	15 (10.3)	0.89 (0.26, 2.54)
	Employed	53	14 (26.4)	1.21 (0.44, 3.30)	9 (17.0)	1.01 (0.30, 3.68)
	Business	24	5 (20.8)	0.96 (0.28, 3.34)	6 (25.0)	1.06 (0.31, 3.72)
Diabetes status *	No diabetes (Ref.)	217	47 (21.7)		34 (15.7)	
	Diabetes	41	11 (26.8)	1.07 (0.47, 2.43)	4 (9.8)	0.41 (0.12, 1.33)

+ Adjusted Odds ratio (AOR) (95% confidence interval (CI))- adjusted for the covariates in the model; * Indicates some missing cases; for example, information for one participants' SES was missing.

The association of salt consumption with blood pressure was not significant. The mean (95% confidence interval) of SBP was 149.0 (144.8, 153.2) and DBP 89.3 (87.3, 91.4) for people who did not consume raw salt, compared to 148.8 (146.4, 151.2) and 90.0 (88.7, 91.3) for people who consumed raw salt. Fruit consumption was also not associated with SBP or DBP (Table 5).

Table 5. Systolic and diastolic blood pressure by raw salt and fruit consumptions.

		Systolic Blood Pressure		Diastolic Blood Pressure	
	No at Risk	**Mean (95% CI)**		**Mean (95% CI)**	
			***p*-Value**		***p*-Value**
Total	307	148.9 (146.8, 150.9)		89.9 (88.8, 90.9)	
No raw Salt consumption	66	149 (144.8, 153.2)	0.94	89.3 (87.3, 91.4)	0.62
Regular salt consumption	241	148.8 (146.4, 151.2)		90.0 (88.7, 91.3)	
Fruit consumption maximum 1–2 times per week	46	146.8 (142.4, 151.3)		89.5 (87.3, 91.6)	
Fruit consumption irregularly	254	149.2 (146.9, 151.6)	0.73	89.9 (88.6, 91.1)	0.86
Almost no fruit consumption	7	148.8 (129.5, 168.1)		91.6 (80.3, 103)	

6. Discussion

6.1. Main Finding of This Study

Our study found that raw salt consumption was high amongst rural residents in Bangladesh, and most of the participants intended to reduce raw salt consumption. This study also found that only 15% of participants reported eating 1–2 servings of fruit on a weekly basis. The proportion of people who did not consume raw salt, and had 1–2 servings of fruit consumption per week were significantly higher in people with an SSC or higher education, compared to people with no education. In our study, raw salt consumption and fruit intake were not associated with blood pressure.

6.2. What Is already Known on This Topic

These findings aligned with other studies on Bangladeshi populations, which found that average individual salt consumption tended to exceed the WHO salt recommendations [6], whilst not meeting fruit and vegetable intake recommendations [55–57].

6.3. What This Study Adds

Our study's findings add to existing findings on the underconsumption of fruit amongst the Bangladeshi population. Low fruit intake could be attributed to lack of availability and high cost, as well as lack of social support for the consumption of fruit [58]. Although a high proportion of participants in the study recognized a positive correlation between salt intake and blood pressure, only one-third of the participants reported that they strongly considered reducing raw salt intake in their diet. Positive perceptions of salt use in cultural foods or the perceived health benefits of salt consumption could explain the non-intention to reduce salt intake [59].

Whilst studies have demonstrated the correlation between level of education and wealth with behavior amongst Bangladeshi people [57], this study further highlights the link between the type of employment, a social determinant of health, with knowledge and health behavior. Furthermore, this study highlights that participants with higher education and socio-economic status were more likely to have knowledge about health and were more likely to consider translating this knowledge into practice, such as reducing raw salt intake among people with a higher education. Applying health knowledge to health behavior depends on various factors, including individual skills and context [60]. In our study, higher education was found to be associated with reduced salt and higher fruit consumptions, which is consistent with previous studies [61–63] Higher education is a critical element in managing health. Behavioral change requires individuals to have the

ability to acquire health information to inform healthy decision-making [64], to translate health information into healthy behavior as a result of understanding [65], to possess skills to apply health knowledge in different contexts [60,66]; and to interact with the healthcare system [67].

Our study did not find an association of raw salt intake and fruit consumption with blood pressure. Some studies in Bangladesh identified three major dietary patterns from food frequency data, including a balanced diet, characterized by rice, some meat, small fish, fruits, and vegetables which was associated with lowering blood pressure, compared to dietary patterns comprised of animal protein, associated with elevated blood pressure [68,69]. These findings suggest the critical role of dietary habits in managing hypertension in a low-income population. Our study did not objectively measure any dietary patterns from similar food frequency data and failed to provide a direct comparison. However, our study reports that people with higher education were associated with a lower level of salt consumption. Higher education was previously reported to be associated with a lower prevalence of hypertension, indicating that this could be a similar mechanism of lowering blood pressure by consuming a healthy diet in rural Bangladesh. At present, Bangladesh has multi-sectorial plans for salt reduction, including food reformulation, discouraging sales of high salt-processed foods in different settings and population education through mass media campaigns [70]. Such population-based salt reduction strategies have already been demonstrated to be cost-effective when implemented in LMICS [71].

Our study has several strengths. Firstly, data was collected face-to-face whilst maintaining social distancing and other health and safety issues, due to the COVID-19 pandemic. Due to the nature of the questions asked, and considering the literacy levels of the participants, our approach ensured inclusiveness of a range of rural residents whilst adhering to local health regulations. The study had an almost equal number of men and women which allowed equal representation of the population in our findings.

6.4. Limitations of This Study

The study has several limitations. The study was conducted in a single location which limits its findings to a localized level rather than generalization to a national level. However, the rural populations in Bangladesh are similar in terms of socio-demographic and education levels [72], and, hence, we believe that our findings provide important insights that can be used to understand other rural Bangladeshi communities. Blood pressure was measured with an automated device, which might yield slightly varied results between participants. However, we checked the accuracy of the readings using a standard analog device from a sub-sample and found the accuracy level was high. Although we studied salt and fruit consumption, we neither studied vegetable consumption nor provided an objective measure of food frequency data, where people usually follow specific patterns of diet rather than an individual diet.

7. Conclusions

The study participants were aware of the detrimental effect of raw salt consumption on blood pressure control and that fruit intake was good for health. However, more than 90% of the participants consumed raw salt and more than 95% consumed fruit irregularly. Those with higher education were more in favor of reducing salt intake and increasing fruit intake for managing blood pressure. Public health campaigns and health education programs incorporating health literacy should be implemented to encourage and empower individuals to reduce raw salt intake and increase fruit intake.

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Data Availability Statement: Data will make available upon request to the corresponding author.

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