Original Article

Acute Effect of Oral Rehydration Salt on Blood Pressure among the Medical Students of a Private Medical College in Dhaka, Bangladesh: Clinical Trial

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Abstract

Introduction: Hypertension is the main cause of global death from cardiovascular events. High intake of salt cause rise of blood pressure is widely accepted. However, intervention studies focused on blood pressure response to acute oral rehydration solution (ORS) loading is deficient. **Objective:** The study aimed to assess the effect of ORS on blood pressure among fourth year medical students of a private medical college in Dhaka city, Bangladesh. **Methods:** An uncontrolled clinical trial was done in Ibn Sina Medical College, Dhaka from July, 2021 to December, 2021. Systolic blood pressure (SBP) of ≥140 mmHg and diastolic blood pressure (DBP) of ≥90 mmHg was considered as hypertension. Blood pressure was measured 30 minutes and 1 hour after of 500 ml ORS administration. Forty-five normotensive medical students included in the study. **Results:** Study findings depicted students after 500 ml ORS administration showed a significant rise in both SBP (Male: from 116 ± 7.07 to 128 ± 9.89; P = 0.000 and female: from 108 ± 6.05 to 118 ± 5.88; P = 0.000) and DBP (Male: from 78 ± 3.54 to 85 ± 5.32; P = 0.000 and female: from 74 ± 2.07 to 78 ± 4.02; P = 0.007) at 1 hour and significantly (P = 0.000) higher rise in male students (Average SBP and DBP rise: 12 and 7 mmHg respectively) than that of female (Average SBP and DBP rise: 10 and 7 mmHg respectively). **Conclusion:** Study result indicated that ORS can be considered as a treatment strategy to increase blood pressure and it is important to avoid acute ORS load in people with hypertension.

Keywords: Hypertension, blood pressure, prevalence, medical students, male, female, oral rehydration salt, intervention, clinical trial.

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Introduction

Hypertension, often known as high blood pressure (BP), which is a silent killer that cause diseases affecting the heart, kidneys, brain, and other organs [1, 2]. About 1.3 billion people are affected according to World Health Organization (WHO) estimates and they greatly increase morbidity and mortality worldwide [3]. The prevalence of hypertension is rising worldwide [4]. Two-thirds of those affected individuals reside in low- and middle-income countries, including Bangladesh. Over the past few years, the prevalence of hypertension in Bangladesh has alarmingly increased [5]. Globally, one in five women and one in four men are affected [6].

Hypertension is a multifactorial disease. One risk factor is salt sensitivity of blood pressure

(SSBP), which occurs when BP varies with changes in salt intake [7]. In normotensive people, this may eventually lead to hypertension [8]. However, normotensive and hypertensive persons' blood pressure responses to changes in sodium and extracellular fluid balance differ [9].

Additionally, only a portion of the mechanisms that may be responsible for the elevated blood pressure associated with a high salt intake are known. Acute salt administration may inhibit plasma renin activity (PRA) [10]. Response of different individuals to the acute salt loading differs. Through a dietary salt intervention trial, a previous study had shown that women, hypertensive individuals, and elderly people had elevated salt sensitivity of BP [11]. Many research results showed that salt immediately affects BP. A 1 mmol/L change in serum sodium translates into approximately 2 mmHg of blood pressure increase [12, 13], and there is evidence that eating foods high in salt (around 1495 mg of sodium) reduces brachial artery flow-mediated dilatation within 30 minutes [14].

However, there was no human subjects-based intervention studies focused on BP response to acute oral rehydration solution (ORS) loading. Previous study depicted that highest proportion of hypertensive medical students (24.8%) were in their final year, followed by those in their fourth year (22.0%) [15]. We hypothesized that there may be variations of BP after acute ORS load in fourth year medical students. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) is used to measure blood pressure. If a patient's SBP is 140 mmHg or higher and DBP is 90 mmHg or higher, considered hypertension according to National Guidelines for Management of Hypertension in Bangladesh16. High BP is considered by measuring BP on at least two separate occasions [16, 17].

This study aimed to (1) assess the acute effect of ORS loading on BP (2) how much changes of blood pressure with the amount of ORS (3) assess the changes in blood pressure in relation to gender differences. The results highlighted that, the significance of ORS supplementation can be considered as a treatment strategy to improve blood pressure and restriction of ORS may be needed in hypertensive patients or tight monitoring of hypertensive patients when they are taking ORS.

Methods

Trial design and trial participants: This was an uncontrolled clinical trial, conducted in the Ibn Sina Medical College, Dhaka, Bangladesh from July, 2021 to December, 2021. For this study, fourth year medical students were selected, and 46 were approached conveniently (based on their presence on the day of data collection). Out of 46 participated students, 1 student found hypertensive; excluded from the intervention and analysis. Finally, 45 students were included in analysis; 17 students were male and 28 students were female.

Data collection: The tutorial room was selected to measure blood pressure. Female lecturer took the measurement of female students. An Aneroid Sphygmomanometer machine (ALPK2, No.500-V) was used for measurement. Blood pressure was measured after 10 minutes rest while students were in sitting posture. Students with SBP ≥140 mmHg or DBP ≥90 mmHg were classified as hypertensive16.

Intervention schedule: Pre-intervention phase: Blood pressure was measured before administration of ORS after 10 minutes rest while students were seated.

Intervention phase: Five hundred ml ORS was administered. During the 1-hour study period, no other foods or drinking were permitted.

Post-intervention phase: Blood pressure was

measured after 30 minutes of 500 ml ORS administration and again after 1 hour of 500 ml ORS while the students were seated. The evaluation battery took 2 to 4 minutes for every student. The students were discharged from the study after measurement of blood pressure at 1 hour of 500 ml ORS administration.

Ethical Issues: Thorough briefing regarding the objectives and procedure of the study was done. Students were also informed about the confidential handling of their information and they've right to refuse to participate or withdraw from the study.

Statistical Analysis: Microsoft Excel was used to compile, present, and analyze the data following per-protocol principle. The data was described using means and standard deviations. Paired t-test, unpaired t test were done to compare the blood pressure between before and after ORS administration, and between male and female students respectively. The level of significance was considered to be a p-value < 0.01.

Results

The data from 46 fourth year medical students was collected. Out of these, 17 (38%) were males and 28 (62%) were females. One student (2.2%) found hypertensive (140/100 mm Hg) and excluded from the analysis. Finally, 45 students were included in analysis. Notably, none of the students were on antihypertensive drugs. The mean (± SD) SBP and DBP of male students were 116 (± 7.07) and 78 (± 3.54) mmHg before ORS administration respectively. A noticeable difference was found 30 minutes after ORS which was statistically significant (SBP: 125 ± 6.80; P = 0.000 and DBP: 82 ± 2.09; P = 0.005). Also, significant difference was noted 1 hour after ORS (SBP: 128 ± 9.89; P = 0.000 and DBP: 85 ± 5.32; P = 0.013). This rise had become more significant in both SBP and DBP in comparison to before and 1 hour after ORS (SBP from 116 ± 7.07 to 128 ± 9.89; P = 0.000 and DBP from 78 ± 3.54 to 85 ± 5.32; P = 0.000). In female students, the mean (± standard deviation) SBP and DBP were 108 (6.05) and 74 (2.07) mmHg before ORS administration respectively. A noticeable change was found 30 minutes after ORS which was statistically significant (SBP: 118 ± 5.88; P = 0.000 and DBP: 78 ± 4.02; P = 0.000). A noticeable but not statistically significant difference was noted 1 hour after ORS (SBP: 118 ± 5.88; P = 0.5 and DBP: 78 ± 4.02; P = 0.5). But a significant rise of BP had become evident in both SBP and DBP in comparison to before and 1 hour after ORS (SBP from 108 ± 6.05 to 118 ± 5.88; P = 0.000 and DBP from 74 ± 2.07 to 78 ± 4.02; P = 0.007) [Table I].

Discussion

Hypertension is the main cause of global death from cardiovascular disease, primarily coronary heart disease, and stroke [18]. But unfortunately, there is no research found applying ORS as a treatment strategy involving human subjects to improve blood pressure. Given the link between saline loading and blood pressure [10], and the relationship between oral saline intake and pulse pressure increase [19], the primary purpose of the study is to assess the effect of ORS on blood pressure. Indeed, the importance of this uncontrolled clinical trial was to determine how much increase in blood pressure after ORS administration with the gender differences among the medical students.

It is well known that there is inverse relationship between renin and salt intake [20]. By increasing the concentration of NaCl at the macula densa, an acute sodium treatment could inhibit both renin release and plasma renin activity (PRA) [21] and then produce hypertension. In dietary salt intervention trial a difference was found in response of individuals to the acute salt loading i.e. women had

Table I. Blood Pressure in students before ORS intake, 30 minutes after ORS intake, and 1 hour after ORS intake.

Variables	Before ORS intake (mean ± SD)	30 Minutes after ORS intake (mean ± SD)	1 hour after ORS intake (mean ± SD)	*p* value[x]
SBP of male students (mmHg) (n=17)	116 ± 7.07	125 ± 6.80	1128 ± 9.89	a = 0.000 b = 0.0001 c = 0.000
DBP of male students (mmHg) (n=17)	78 ± 3.54	82 ± 2.09	85 ± 5.32	a = 0.005 b = 0.013 c = 0.000
SBP of female students (mmHg) (n=28)	108 ± 6.05	118 ± 5.88	118 ± 5.88	a = 0.000 b = 0.5 c = 0.000
DBP of female students (mmHg) (n=28)	74 ± 2.07	78 ± 4.02	78 ± 4.02	a = 0.000 b = 0.5 c = 0.007

SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure, n = number of patients, SD = standard deviation, xpaired t-tests, a = compare between before ORS and the 30 minutes after ORS, b = compare between the 30 minutes after ORS and the 1 hour after ORS, c = compare between before ORS and the 1 hour after ORS.

Table II. Blood Pressure in male and female students before ORS intake, 30 minutes after ORS intake, and 1 hour after ORS intake.

Variables		Male (17) (mean±SD)	Female (28) (mean±SD)	*p* value[z]
SBP (mmHg)	Before ORS	116 ± 7.07	108 ± 6.05	0.000
	30 Minutes After ORS	125 ± 6.80	113 ± 5.45	0.000
	1 Hour After ORS	128 ± 9.89	118 ± 5.88	0.000
DBP (mmHg)	Before ORS	78 ± 3.54	74 ± 2.07	0.013
	30 Minutes After ORS	82 ± 2.09	77 ± 3.01	0.003
	1 Hour After ORS	85 ± 5.32	78 ± 4.02	0.000

n = number of patients, SD = standard deviation, z = Unpaired t-tests

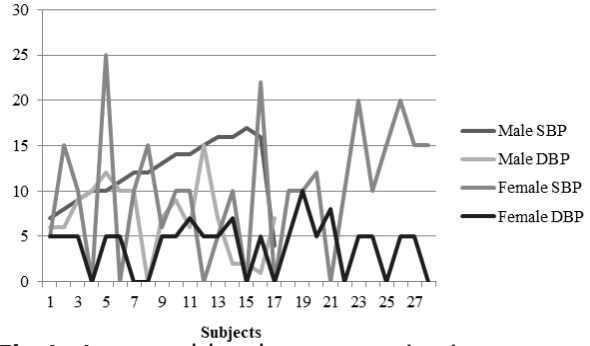


Fig 1: Average blood pressure rise in response to ORS among male and female students.
SBP = systolic blood pressure, DBP = diastolic blood pressure.

increased response to salt on blood pressure [11].

We noted a significant increase in BP after 1 hour of ORS. From this finding it is understood, the increase that was found as a result of administrating ORS was significant after 30 minutes and this increase had become more significant after 1 hour in both male (SBP: P = 0.000 and DBP: P = 0.000) and female (SBP: P = 0.000 and DBP: P = 0.007) students. Similar finding was demonstrated after acute oral loading of 1000 ml of 0.9% saline solution

results with an increase in SBP [10]. A comparative study showed oral rehydration solution supplementation increase in pulse pressure [19]. The trial findings were also consistent with another study within 127 individuals taking 1 g sodium chloride and found about 32% of participants had increases in SBP [22].

Our study's sex difference i.e. male students were more likely to have high BP compared to female students (SBP: P = 0.000 and DBP: P = 0.013) is in line with a Bangladeshi study on trainee doctors, which indicated that male had higher rate of hypertension than female [22, 23]. Also, a significant difference was observed between the male and female students after 30 minutes (SBP: P = 0.000 and DBP: P = 0.003), and this difference become more significant after 1 hour (SBP: P = 0.000 and DBP: P = 0.000).

An average increase in 12 mmHg SBP and 7 mmHg DBP was found which is in line with results of two other studies where notable variation in SBP values when compared to baseline levels were at 3 and 4 hours 6.6 mmHg (4.6-8.6 mmHg) and 6.9 mmHg (4.9-8.9 mmHg) respectively [13] and all subjects experienced a significant increase of 14 mmHg (7–21 mmHg) SBP after taking oral salt (1 g sodium chloride) that was higher than the level of 20 mmHg that is usually considered as clinically significant level [22]. Additionally, following saline loading, another study revealed a significant increase of 8.12 mmHg SBP10. The effect of salt to influence BP may be less explained by its relation to the effects on extracellular volume and cardiac output, but instead its ability to increase serum osmolarity [24].

Finally, the rate of increase in blood pressure after ORS among medical students highlights the urgently focused attention for preventing development of hypertension as they are vulnerable by stress, unhealthy dietary habits, and sedentary behaviors during intense academic periods. The strength is that this is the first intervention study conducted on medical students to focus on the acute effect of ORS intake on the variations of BP. Some scholars claimed that acute salt loading has been linked to negative cardiovascular consequences30. The limitations of the current study are the sample size was much small, absence of placebo-controlled group, randomization was not done, intervention was given by oral saline but the other method including intravenous saline were not included, long term effects of ORS therapy on BP were not assessed.

Conclusion

From the study result it can be concluded that that ORS can be considered as a treatment strategy to increase blood pressure and it is important to avoid acute ORS load in people with hypertension.

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Author Contributions

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Conflict of Interest

The authors declare that there were no commercial or financial relationships that could be raised suspicions of a potential conflict of interest.

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