Human Nutrition & Metabolism 38 (2024) 200289

Contents lists available at ScienceDirect

Human Nutrition & Metabolism

journal homepage: www.sciencedirect.com/journal/human-nutrition-and-metabolism

Prevalence of hypertension and its associated risk factors during COVID-19 pandemic in the capital of Bangladesh

Urmila Roy [a,1], Arafat Hassan Razon [b,1], Tanvir Ahmad [a,*], Tabassum Sultana Barsha [a]

[a] Department of Nutrition and Food Technology, Jashore University of Science and Technology, Bangladesh
[b] Department of Food Science and Nutrition, School of Science and Technology, Bangladesh Open University, Gazipur, 1705, Bangladesh

ARTICLE INFO

Keywords:
Hypertension
Prevalence
Lifestyle
Exercise
Diet
Diabetes
COVID-19

ABSTRACT

Background: Hypertension (HTN) has emerged as a significant public health challenge and a leading cause of mortality and morbidity in developing countries like Bangladesh.
Objective: This study aimed to assess the prevalence of hypertension and its associated risk factors among residents of Dhaka, the capital of Bangladesh, during the COVID-19 pandemic.
Methods: A cross-sectional study was conducted using a multistage random sampling technique to select 305 individuals from Khilkhet Thana in Dhaka North City Corporation. Data were collected through direct surveys using a modified version of the WHO STEPS questionnaire and analyzed using SPSS version 22 software.
Findings: The study identified a 34.4 % prevalence of HTN among the participants, with 46.2 % of hypertensive individuals being under 40 years of age. Of the 105 hypertensive individuals, 65 % were newly diagnosed during the study, and 11 previously diagnosed individuals were not on any medication. A significant association ($P < 0.001$) was observed between the prevalence of HTN and inadequate intake of fruits (OR = 3.129, 95 % CI = 1.912–5.122, $\chi2 = 21.328$), insufficient vegetables consumption (OR = 2.199, 95 % CI = 1.356–3.565, $\chi2 = 10.373$), high intake of fatty foods (OR = 2.387, 95 % CI = 1.465–3.890, $\chi2 = 12.454$), and excessive salt consumption (OR = 2.771, 95 % CI = 1.677–4.579, $\chi2 = 16.310$). Additionally, the prevalence of HTN was notably higher among overweight (46.70 %) and at-risk (22.90 %) individuals, based on Body Mass Index (BMI) and waist-to-hip ratio (WHR), respectively. The study also found significant correlations ($P < 0.001$) between HTN and factors such as smoking (OR = 2.824, 95 % CI = 1.601–4.980, $\chi2 = 13.432$), kidney disease (OR = 7.534, 95 % CI = 2.694–21.070, $\chi2 = 19.282$), general stress (OR = 3.692, 95 % CI = 2.179–6.255, $\chi2 = 24.896$), COVID-19 related stress (OR = 3.511, 95 % CI = 2.116–5.826, $\chi2 = 24.712$) and sleeping pattern (OR = 5.798, 95 % CI = 3.404–9.875, $\chi2 = 45.724$).
Conclusions: The high prevalence of HTN, particularly among younger individuals during the COVID-19 pandemic, highlights the urgent need for nationwide surveys, surveillance, and clinical research to accurately depict the true burden of HTN in Bangladesh.

1. Introduction

Hypertension (HTN) is recognized as the major threatening factor not only for mortality but also for morbidity internationally, particularly in Low Middle-Income Countries (LMICs) like Bangladesh, where more than two-thirds of people are affected by HTN. A survey from 2010 reported hypertension was responsible for 9.5 million deaths as well as about 162 million years of life lost. HTN is a vital factor for more than half of the Non-Communicable Diseases (NCDs) such as Cardio Vascular Diseases (CVDs), stroke, and heart failure. These conditions are also accountable for fetal and maternal deaths during pregnancy, dementia, and renal failure. The prevalence of elevated blood pressure is increasing globally and is anticipated to affect more than 500 million people by 2025 [1–3].

Presently, the prevalence of hypertension and CVDs has accelerated drastically in South-East Asia including Bangladesh as an outcome of rapid urbanization, expanded life expectancy, poor diet, and lifestyle changes [4,5]. As a result, Bangladesh is undergoing an epidemiological

* Corresponding author. Department of Nutrition and Food Technology, Jashore University of Science and Technology, Bangladesh.
E-mail addresses: urmiroy1994@gmail.com (U. Roy), arafat.sst@bou.ac.bd (A.H. Razon), fmtanvir@gmail.com, fmtanvir_nft@just.edu.bd (T. Ahmad), tabassum_140929@just.edu.bd (T.S. Barsha).
[1] Urmila Roy and Arafat Hassan Razon are the co-first author of this study.

https://doi.org/10.1016/j.hnm.2024.200289
Received 1 July 2024; Received in revised form 17 August 2024; Accepted 23 August 2024
Available online 27 August 2024

evolution from communicable diseases to non-communicable diseases. Although the universal mortality rate has declined over the past few decades, the number of deaths from NCDs are raising at an emerging rate. Among the NCDs, four major causes of death involving cardiovascular conditions, cancer, habitual respiratory complaint, and diabetes have emerged, with HTN being a major contributor to cardiovascular illnesses [6].

A survey of 2010 conducted in Bangladesh regarding the threatening factors of NCDs estimated that the occurrence of HTN among adults was between 16 and 20 %. Another survey by the Bangladesh Health, Nutrition, and Demographic division reported that the prevalence of HTN among grown-ups was 34 %. Additionally, a meta-analysis of studies carried out between 1995 and 2010 found that the pooled prevalence of HTN was 13.7 %, with a high prevalence of HTN in urban areas compared to rural areas (22.2 % vs 14.3 %, individually) [7–9]. Most of these inquiries have focused on the risk factors and prevalence of HTN but did not present any data about the predictors of HTN. To develop proper strategies and procedures for HTN management, it is crucial to have accurate estimates of these risk factors among the urban population in Bangladesh.

Although several methods and strategies have been developed to handle and prevent HTN, it remains a significant challenge for Bangladesh in enforcing these strategies due to limited resources. Effective actions based on perfect procedures and gradual execution should be embraced by considering the original needs. Interventions focusing on awareness, health promotion, and the reduction of common risk factors are require to prevent HTN through a mixture of population-based approaches and targeted interventions. Collaborative actions through intersectoral, multidisciplinary, and multilevel approaches by the Government, Non-Government Organizations (NGOs), and public organizations should be prioritized to prevent HTN.HTN and its complications are predominantly preventable through simple intervention programs among the vulnerable population for a healthier society [9].

Moreover, researchers have mentioned that mental stress is one of the significant risk factors for hypertension, with several prospective investigations have formerly demonstrated a relationship between mental stress and elevated blood pressure [10–12]. In addition to that, chronic stress has been shown to have significant effects in various domains such as marital status, working environment, and socioeconomic status. While several studies have reported significant associations among these factors and elevated blood pressure, persistent exposure to stress may lead to permanent blood pressure elevation with the development of hypertension [13].

Furthermore, the world had gone through a pandemic season and this pandemic-related stress may have contributory factors behind the increasing trend of HTN. This epidemic season was a result of a transmissible illness known as COVID-19 which was caused by rigorous acute respiratory pattern of coronavirus SARS-CoV-2 and it was first identified in Wuhan, Hubei Province, China on December 31, 2019 [14]. Various reports have been published till now regarding COVID-19 where one report established hypertension (30 %) as one of the most frequent co-morbidities of COVID-19 and similarly another study in china also mentioned hypertension (27 %) as one of the most familiar co-morbidities of COVID-19 [15,16]. As this study was conducted during the wave of COVID-19 that's why through this experiment the researchers just tried to take a snapshot regarding the prevalence of hypertensive state among the study population who had COVID-19-induced stress. In addition to that, the crucial limelight of this study was to discover the prevalence and associated risk factors of HTN in an urban area of Bangladesh, with a particular focus on the impact of pandemic related stress on HTN.

2. Materials and methods

2.1. Study design and area

A multi-stage random sampling technique was used in this study to identify a representative sample of residents from the Dhaka city.

Selection of City Districts: Dhaka is the capital of Bangladesh and people of different regions of Bangladesh are usually migrated to Dhaka in search of livelihood. That was the reason that Dhaka was selected as a study area for this study to get the probable representative population of Bangladesh. Dhaka City Corporation mainly consists of two metropolises such as Dhaka North City Corporation [DNCC] and Dhaka South City Corporation [DSCC] and in the first stage of this study; DNCC was selected randomly to conduct this study. DNCC consists of 54 wards and out of these wards ward no 17 (Khilkhet Thana) was chosen randomly for this study, and after that we conducted this study from May 2020 to October 2020 in the Khilkhet area of Dhaka city (Fig. 1).

Selection of Households and Participants: Khilkhet Thana has a comprehensive region of 15.88 square kilometers (6.13 sq mi). The river Turag (across which lies Rupganj Upazila of Narayanganj District) is situated on the east side of this thana. Khilkhet Thana has composed of approximately 31,141 households which comprised of a population of 130,053 and majority of this people are usually lived in urban areas. All holdings along with their holding numbers within this ward were identified through the use of a detailed area map which was collected from the City Corporation office. The holding numbers were used to select the appropriate households for this study and from these holding numbers, 305 holding numbers were picked up randomly for that study. From each holding, one eligible individual was chosen. In the case of an apartment facility with numerous houses, one house was chosen haphazardly. Only eligible individuals were interviewed throughout the survey and in the case of households with several eligible participants, one individual was selected randomly who had no objection to participating. If no eligible participants were found on the chosen home or participators declined to participate in the study then another individual was opted haphazardly from the same apartment facility or from the following holding number.

2.2. Study population and inclusion criteria

This cross-sectional study involved 305 individuals aged 18–65 years from the chosen study region who gave concurrence for participation. Individuals who were unfit to give a response due to serious physical or internal sickness and with whom anthropometric measurements could not be carried out were eliminated from the study. Any people who were unwilling to provide data and females who were pregnant were eliminated from this study.

2.3. Sample size calculation

The sample size of this study was calculated through equation (1) which is given below [17];

$$N = Z^2pq/d^2 \quad (1)$$

Here, $Z = 1.96$, $p = 0.5$, $q = 0.5$ and $d = 0.05$. The sample size was approximately 384 according to this equation (1) however only 305 samples were collected for this study because of time limitations and lack of funding. Due to the coronavirus circumstances, it was hard for us to survey within the locality and as a result of that we failed to reach the standard level of sample size.

2.4. Study tools and supporting materials

For data collection, a modified version of the STEPS questionnaire (developed by WHO) was utilized in this study [18,19]. The

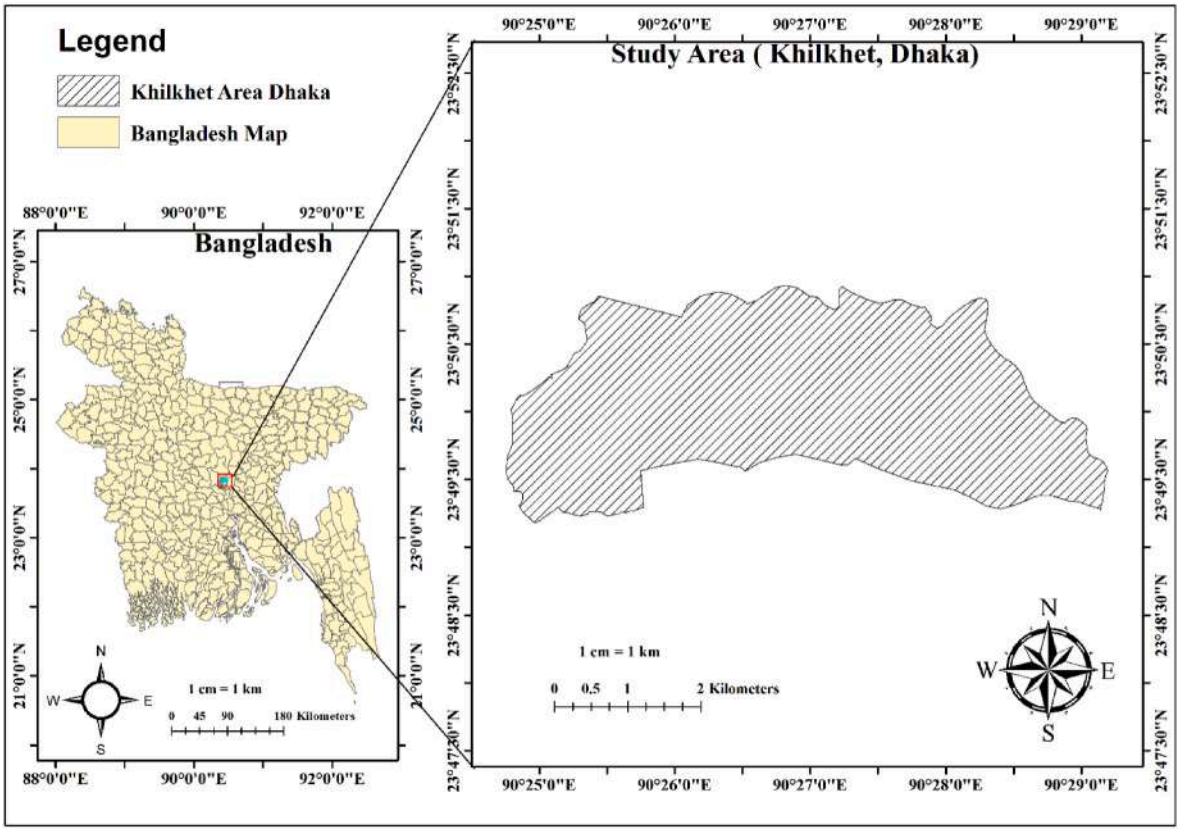

Fig. 1. Geographical representation of the study area.

questionnaire possessed four segments as socio-demographic section, behavioral risk factors section, physical measurements section, and metabolic risk factors section. The developed questionnaire contained personal information (name, sex, age), socio-demographic information (religion, family member, monthly income), anthropometric information (height, weight, BMI (Body Mass Index), waist circumference), clinical information, awareness-based information, and a food frequency questionnaire form. After finalizing the questionnaire, it was pre-tested to find out any difficulty in the questionnaire for ensuring its efficiency as a tool to collect information that was necessary to solve the research problem. The questionnaire was also converted to the native language (Bengali) so that the responders could understand the questionnaire smoothly [7,20].

Every subject was asked a question regarding a diet limited to salt; those who said no were considered to have a diet with high salt content, while those who said yes were considered to have a reduced salt consumption [21]. Data related to alcohol consumption, smoking, physical activity, and stress in relation to COVID-19 were also recorded. Psychological stress was measured by asking two questions to the respondents and among them, one was related to COVID-19 stress (fear of infection, the uncertainty of future, food insecurity, protection of family members from infection, future of children's education, etc.) where other belonged to general day to day stress (financial stress, occupational stress, marital stress, etc.). For the above two questions, participants had two response options regarding the categories of stress such as the presence of stress and absence of stress. Individuals who smoke and consume alcohol on a daily basis were classified as current smokers and drinkers, whereas individuals who had previously quit smoking and drinking or had never done so were considered non-smokers and non-drinkers. In addition, the questionnaire asked about family history, awareness of hypertension, and changes in lifestyle related to hypertension.

2.5. Dependent variable

To carry on this study, hypertension was accounted as the dependent variable. In this study participators who possessed systolic blood pressure, $\geq$140 mm of Hg, and/or diastolic blood pressure $\geq$90 mm of Hg, and/or participators with previously diagnosed hypertension were counted as hypertensive.

2.6. Independent variable

In this research, socio-demographic (age, sex, religion, marital status, etc), metabolic (overweight or obesity), and behavioral (salt consumption, tobacco consumption, etc) factors were considered as independent variables.

2.7. Data collection

A direct survey technique PAPI (Paper and Pen Personal Interview) was applied to administrate this study. Appropriate privacy was maintained during the measurements of height, weight, and blood pressure. Moreover, the physical measurements of females were taken only by a female interviewer on the other hand the physical measurements of males were taken only by a male interviewer.

Blood Pressure Measurement: Blood pressure was measured using the Omron HEM 7120 mechanical digital blood pressure machine following the guidelines outlined in Ref. [22]. Participants were seated comfortably, with the arm supported at heart level and measurements were taken after a 15-min rest period. Multiple readings were obtained, and the average value was recorded to ensure accuracy. However, for freshly diagnosed hypertensive responders the interviewers took another additional measurement of blood pressure on the following day at the same time to verify their hypertensive state.

Height Measurement: Hight was measured using a stadiometer

(Cranlea Ltd, Birmingham, UK), as described in the standard anthropometric procedures [22]. Participants stood barefoot with their heels together and the average of the two closest measures was used.

Weight Measurement: Weight was measured using a calibrated digital weight scale (Soehnle; CMS, London, UK) according to the protocol detailed in Ref. [22]. Participants were weighed without shoes and in light clothing. To compute the weight of the participators the average of the two closest measures was utilized.

Waist to Hip Ratio (WHR) and Body Mass Index (BMI) Calculation: Standardized techniques were applied to measure the abdominal circumferences of the study participants [23]. An inelastic plastic tape was utilized for these measures and each measure was taken twice for each participator where a third measurement was also taken if the disparity between the initial two measures surpassed 0.1 cm. The average of the two closest measures was employed in this study to calculate the proportion of waist to hip circumference. In this study, the BMI and WHR of the responders were measured according to Asian standards of cut-off points [24,25]. The following equation (2) was used to calculate the BMI for each participant.

$$\text{BMI} = \text{Weight (Kg)} / \text{Height}^2\ (\text{m}^2) \quad (2)$$

Physical Activity and Dietary Assessment: Physical activity was measured in three classifications. Individual's physical activity was counted as "Recommended" = at least 150 min per week of moderate exercise or 75 min per week of dynamic exercise (or a mixture of moderate and dynamic exertion); "Low" <, 150 min per week of moderate or, 75 min dynamic exertion and "No physical activity" according to American Heart Association recommendations for physical exertion in grown-ups. Individualities who consumed smaller than 5 servings (2.5 cups) of vegetables per day were accounted as low vegetable consumers and those who consumed smaller than 4 servings (2 cups) of fruits per day were considered as low fruit consumers [18].

2.8. Data quality control and statistical analysis

We used a multistage random sampling technique to minimize selection bias, and training was provided to interviewers to avoid information bias. The supervisor of this study always monitored the data collection process in the field level and provided regular feedback. Each morning, devices like the blood pressure machine, height scale, and weight scale were calibrated before use. Completed questionnaires were checked regularly for any error and necessary editing and coding were done before data entry. Data entry and analysis were conducted using SPSS version 22, with an analysis plan aligned with the studies objectives. Appropriate parametric and nonparametric analyses were performed with categorical variables analyzed using probability distribution, and Chi-square tests. Odds ratios and confidence intervals were calculated where applicable, and P values below 0.05 were considered statistically significant.

2.9. Precautions for COVID-19

During the field survey, all interviewers tried their best to maintain proper safety measures to avoid infection by the coronavirus. All the time during the survey they maintained a proper social distance with a mask putted on their face and gloves on their hands. The interviewers also sanitized their hands with a sanitizer before each anthropometric measurement. All the participants were also asked to wear a mask during the data collection and assessment period. Hand sanitization of each participant was confirmed by the interviewers before each measurement. During the anthropometric measurements of the participants, a proper distance was not possible to maintain but during data collection minimum 3 feet distance was maintained.

2.10. Ethical consideration

The Ethical Review Committee, Faculty of Biological Science and Technology, Jashore University of Science and Technology, Bangladesh approved the study, following all the International Rules for Research Ethics. To conduct the interview as well as essential physical measurements, informed written consent was collected from each participant. Also, before collecting data a brief interpretation was given to each participator regarding the study goals, their voluntary character of participation, and their rights to fall back from the survey at any moment during the interview. All information given by the study participants was reserved under strict confidentiality. To maintain the anonymity of the study participants a unique ID was given to each completed questionnaire. In addition to that, each participator was fed with the right to pull out them from the study at any moment they wish without any disadvantage. Furthermore, no financial incentive or compensation was given to the respondents. Participants with high blood pressure were advised to seek medical attention.

3. Results

It was observed from this study that 35 % of respondents with hypertension were aware of their hypertensive status and among them, 70 % of participants took medication for the treatment of hypertension. However, 65 % of them had uncontrolled hypertension, while only 35 % of them had controlled hypertension (Fig. 2).

Here, Total hypertensive subjects = newly identified hypertensive (68) + pre-diagnosed hypertensive (37) = 105.

Table 1 indicates the socio-demographic characteristics of the study participants. A total of 305 individuals were interviewed for the study, where the overall prevalence of HTN among the respondents was 34.4 %. The prevalence of HTN was highest (64 %) among people aged 40–59 years. Additionally, 114 respondents (37.4 %) had a monthly income between 15,000 and 22000 taka, 140 (45.9 %) had an educational level

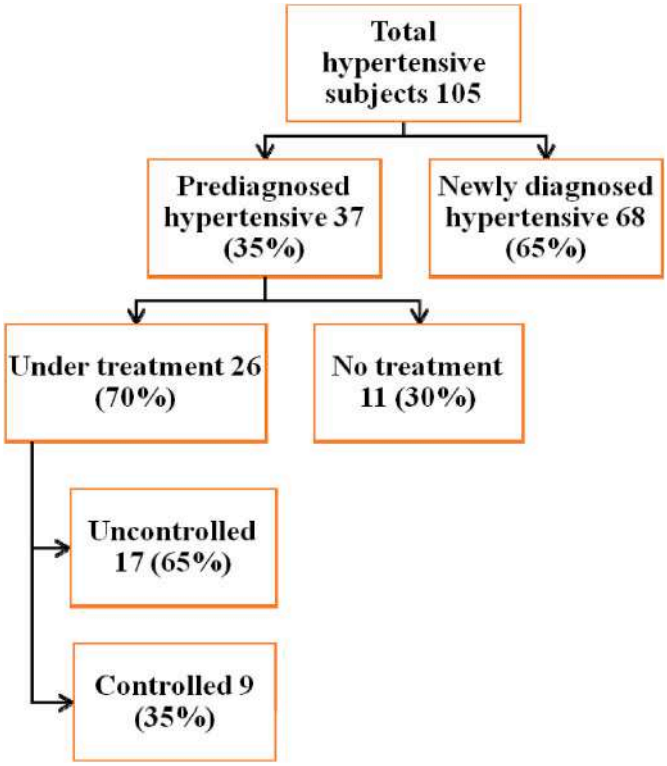

Fig. 2. Overall scenario of the prevalence and characteristics of hypertensive respondents.

Table 1
Characteristics of the respondents **(N=305)**.

Characteristics	Frequency	Percentage (%)	Prevalence of HTN		χ2	P-value
			Yes (%)	No (%)		
Age groups (in years)						
18–39	141	46.2	15 (10.6 %)	126 (89.4 %)	81.249	0.000
40–59	119	39.0	76 (63.9 %)	43 (36.1 %)		
60–65	45	14.8	14 (31.1 %)	31 (68.9 %)		
Total	305	100	105 (34.4 %)	200 (65.6 %)		
Gender						
Male	159	52.1	52 (32.7 %)	107 (67.3 %)	0.436	0.509
Female	146	47.9	53 (36.3 %)	93 (63.7 %)		
Total	305	100	105 (34.4 %)	200 (65.6 %)		
Marital status						
Married	169	55.4	76 (45.0 %)	93 (55.0 %)	18.666	0.000
Unmarried	136	44.6	29 (21.3 %)	107 (78.7 %)		
Total	305	100	105 (34.4 %)	200 (65.6 %)		
Monthly income						
<7000	14	4.6	4 (28.6 %)	10 (71.4 %)	12.136	0.016
7000–14000	55	18	22 (40.0 %)	33 (60.0 %)		
15,000–22000	114	37.4	28 (24.6 %)	86 (75.4 %)		
23,000–30000	75	24.6	36 (48.0 %)	39 (52.0 %)		
>30,000	47	15.4	15 (31.9 %)	32 (68.1 %)		
Total	305	100	105 (34.4 %)	200 (65.6 %)		
Educational status						
Illiterate	19	6.2	11 (57.9 %)	8 (42.1 %)	8.964	0.020
Primary1-5	36	11.8	16 (44.4 %)	20 (55.6 %)		
Secondary 6-10	110	36.1	39 (35.5 %)	71 (64.5 %)		
Higher secondary or above	140	45.9	39 (27.9 %)	101 (72.1 %)		
Total	305	100	105 (34.4 %)	200 (65.6 %)		
Occupation						
Service	127	41.6	34 (26.8 %)	93 (73.2 %)	28.862	0.000
Business	44	14.4	13 (29.5 %)	31 (70.5 %)		
Housewife	83	27.2	48 (57.8 %)	35 (42.2 %)		
Others	51	16.7	10 (19.6 %)	41 (80.4 %)		
Total	305	100	105 (34.4 %)	200 (65.6 %)		

*CI = Confidence Interval, $\chi 2$ = Chi Square, $P < 0.05$ = Significant.

of higher secondary or above, and only 19 respondents (6.2 %) had no academic qualification. In terms of occupation, 83 respondents (27.2 %) were housewives, and most of the respondents were married (169; 55.4 %).

Table 2 reports the effect of dietary habits on the prevalence of HTN. It was found that low fruit consumption (OR = 3.129; 95 % CI = 1.912–5.122, $\chi 2$ = 21.328) and low vegetable consumption (OR = 2.199; 95 % CI = 1.356–3.565, $\chi 2$ = 10.373) were significantly ($P < 0.001$) associated with HTN. On the other hand, a significant ($P = 0.000$) association of extra salt intake (OR = 2.771; 95 % CI = 1.677–4.579, $\chi 2$ = 16.310) with HTN was also noticed among the study population.

Table 3 illustrates the associated risk factors of HTN. Marital status, smoking, diabetes, kidney disease, family history of HTN, general stress, stress-related to COVID-19, and sleeping patterns were significantly associated with HTN ($P < 0.001$). In addition, respondents with diabetes (OR = 6.393, 95 % CI = 3.527–11.588, $\chi 2 = 42.513$) and kidney disease (OR = 7.534, 95 % CI = 2.694–21.070, $\chi 2 = 19.282$) had approximately 69 % and 78 % prevalence of active HTN, respectively.

Fig. 3 illustrates the prevalence of HTN based on BMI and WHR. Overweight respondents had a higher prevalence of HTN, with approximately 47 % having active HTN. However, respondents with normal BMI had a lower prevalence of HTN compared to underweight, overweight, pre-obese, and obese groups. Moreover, almost 75 % of respondents with normal BMI had no HTN. According to WHR, people

Table 2
Effects of dietary habit on the prevalence of HTN.

Variables	Prevalence of HTN		Total	p-value	OR	95 % CI	χ2
	Yes (%)	No (%)					
Low fruit consumption							
Yes	68 (47.9 %)	74 (52.1 %)	142	0.000	3.129	1.912–5.122	21.328
No	37 (22.7 %)	126 (77.3 %)	163				
Low vegetable consumption							
Yes	65 (43.3 %)	85 (56.7 %)	150	0.002	2.199	1.356–3.565	10.373
No	40 (25.8 %)	115 (74.2 %)	155				
Fatty food preference							
Yes	68 (43.9 %)	87 (56.1 %)	155	0.000	2.387	1.465–3.890	12.454
No	37 (24.7 %)	113 (75.3 %)	150				
Extra salt intake							
Yes	49 (50.5 %)	48 (49.5 %)	97	0.000	2.771	1.677–4.579	16.310
No	56 (26.9 %)	152 (73.1 %)	208				
Alcohol consumption							
Yes	16 (66.7 %)	8 (33.3 %)	24	0.001	4.315	1.780–10.456	11.995
No	89 (31.7 %)	192 (68.3 %)	281				

*OR= Odd Ratio, CI = Confidence Interval, $\chi 2$ = Chi Square, $P < 0.05$ = Significant.

Table 3
Hypertension and its associated risk factors.

Variables	Prevalence of HTN		Total	p-value	OR	95 % CI	χ2
	Yes (%)	No (%)					
Marital status							
Married	76 (45.0 %)	93 (55.0 %)	169	0.000	3.015	1.810–5.022	18.666
Unmarried	29 (21.3 %)	107 (78.7 %)	136				
Smoking							
Yes	34 (54.0 %)	29 (46.0 %)	63	0.001	2.824	1.601–4.980	13.432
No	71 (29.3 %)	171 (70.7 %)	242				
Have diabetes							
Yes	45 (68.2 %)	21 (31.8 %)	66	0.000	6.393	3.527–11.588	42.513
No	60 (25.1 %)	179 (74.9 %)	239				
Have kidney disease							
Yes	17 (77.3 %)	5 (22.7 %)	22	0.000	7.534	2.694–21.070	19.282
No	88 (31.1 %)	195 (68.9 %)	283				
Family history of HTN							
Yes	72 (43.9 %)	92 (56.1 %)	164	0.000	2.561	1.558–4.210	14.112
No	33 (23.4 %)	108 (76.6 %)	141				
General stress							
Yes	47 (56.6 %)	36 (43.4 %)	83	0.000	3.692	2.179–6.255	24.896
No	58 (26.1 %)	164 (73.9 %)	222				
Stress due to COVID-19							
Yes	53 (54.1 %)	45 (45.9 %)	98	0.000	3.511	2.116–5.826	24.712
No	52 (25.1 %)	155 (74.9 %)	207				
Sleeping pattern							
<8 h	57 (62.6 %)	34 (37.4 %)	91	0.000	5.798	3.404–9.875	45.724
≥8 h	48 (22.4 %)	166 (77.6 %)	214				

*OR= Odd Ratio, CI = Confidence Interval, χ2 = Chi Square, P < 0.05 = Significant.

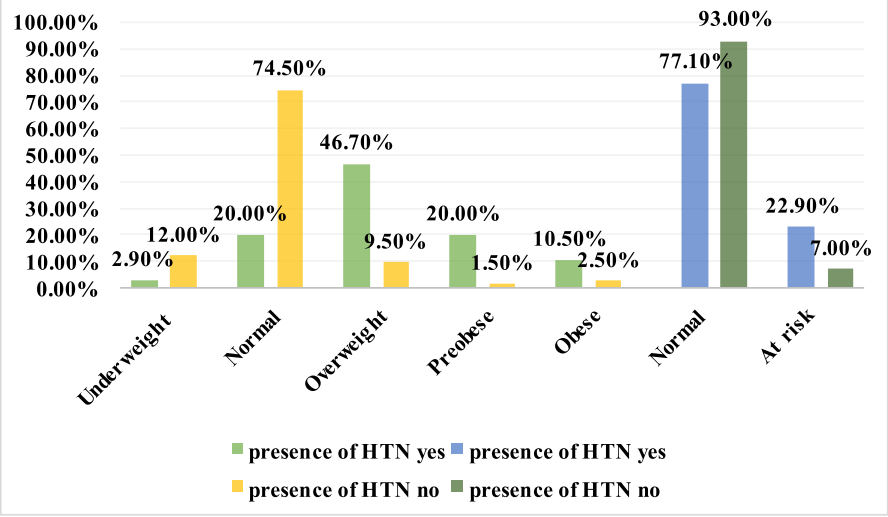

Fig. 3. Impact of BMI and WHR on the prevalence of HTN.

with normal and at-risk WHR had 77.10 % and 22.90 % prevalence of HTN, respectively.

Regarding physical activity, the majority of hypertensive respondents (63.80 %) had low physical activity levels. Additionally, 24.80 % of hypertensive study subjects were non-active (Fig. 4).

4. Discussion

In current years, HTN has become a major chronic non-communicable disease around the world and the absolute numbers of hypertensive patients are increasing gradually in developing countries like Bangladesh. Moreover, this study was administrated to assess the prevalence of HTN as well as its risk factors during the COVID-19 epidemic. The major finding of this study is that HTN is a prevalent and emerging health concern among the urban respondents in Bangladesh, with a significant number of respondents being affected during the COVID-19 pandemic. The study demonstrated the main risk factors of HTN, including unhealthy dietary habits, obesity, lower educational levels and pandemic related stress. These findings highlight the urgent need for targeted public health interventions to mitigate the burden of hypertension in Bangladesh.

It has been assured through this cross-sectional study that besides different non-communicable diseases HTN has turned one of the most common non-communicable diseases among Bangladeshi grown-ups of urban areas. The current study illustrates the frequency of HTN among adults aged 18–65 years in an urban area where the prevalence of HTN was 34.4 % which was marginally advanced in comparison with the former investigations where the frequency of HTN in Bangladesh was ranging from 16 to 34 % [7,8]. Additionally, from the analysis of our research data we noticed an inclined trend in the prevalence of hypertension from 2010 to 2020, where we found an 14 % increment in the prevalence of hypertension among Bangladeshi respondents during the

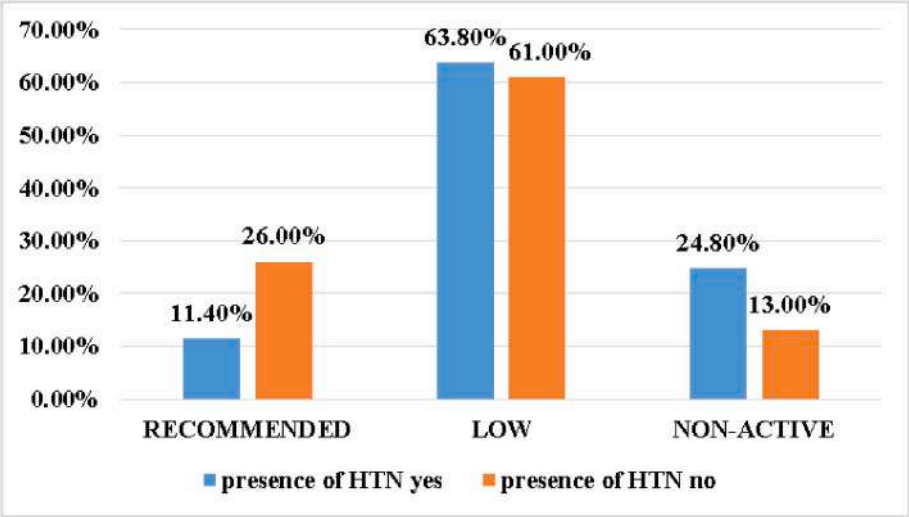

Fig. 4. Impact of physical activity level on the prevalence of HTN.

years of 2010 and 2020 [26–29]. However, these differences are due to distinct study populations, different cut-off marks in determining the level of HTN, and correspondingly different age groups of the study population.

On the other aspect, a study of India identified a high frequency of pre-HTN and HTN in urban regions of Varanasi, which was 41.7 % and 32.96 %, respectively, furthermore that was so high in comparison with prior studies [30]. In addition to that, a study in Pakistan displayed that the prevalence of HTN had been amplifying in urban zones day by day [21].Moreover, some studies have also mentioned that urbanization is the main cause of making people's life sedentary where people utilize most of their time watching television, consuming high-calorie foods, and browsing the internet. In addition to that, these factors are the leading cause of hypertension and cardiovascular diseases now a day's [31–36].

In this study, the frequency of hypertension was significantly lower among respondents who finished their secondary and higher secondary education, while on the different aspect, illiterate respondents were more prone to hypertension. However, prior investigations in developed nations have mentioned an alike trend where hypertension was more usual among less educated people [37].On the different angle, it has been predicted by a study that highly educated people in developing nations may carry out lower physical activity and may eat a high volume of noxious food items which may accelerate their risk of developing a hypertensive state [32]. To control this situation the government of these developing countries should come forward to take significant steps to increase awareness among educated and uneducated individuals regarding the consequences of unhealthy lifestyles and hypertension.

It has been mentioned in this study that with the increasing age of our respondents the frequency of HTN was also amplified. Moreover, from this study, we came to know that respondents who had fallen within the age range 40–59 years had the highest prevalence (63.9 %) of HTN, and female respondents had a slightly greater prevalence of HTN in comparison with male respondents. However, a similar study administrated in the United States of America (USA) mentioned that the prevalence of HTN was raised with age but only 34 % of their hypertensive respondents had fallen within the age range 40–59 years which is not similar to ours in terms of percentage. Their study also mentioned that the prevalence of HTN was high among male grown-ups than female grown-ups which are also dissimilar from ours [38].Another study in Pakistan displayed a meaningful ($P < 0.001$) correlation of age with HTN where they demonstrated that the prevalence of HTN was amplified with the increasing age of their respondents [21].

From the analysis of our findings, we noticed that the prevalence of hypertension had a significant association with smoking, alcohol and low fruit consumption, and stress related to COVID-19. A previous study related to the association of fruits and vegetables consumption with hypertension showed that vegetarian who consumed fruits and vegetables on a daily basis had lower prevalence of HTN than the general people who had the tendency to consume lower amount of fruits and vegetables [39]. On the other hand, it has now been an established fact that high blood pressure has been a significant outcome for the population who usually drink different varieties of alcoholic beverages throughout the world, the situation is more likely to aggregate with the addition of smoking. Additionally, a randomized control trial also proved that one of the potential reversible cause of hypertension is the heavier drinking patterns [40,41]. Another study in India also reported that not only obesity but also high stress is also significantly associated with the development of HTN [42]. So, to reduce the burden of HTN within our community individuals should improve their lifestyle related behaviors in a healthy way.

This study results demonstrate that participants' extra salt intake was significantly ($P = 0.000$) associated with the prevalence of HTN. Also, a study administrated in 2010 displayed that the main reason for 1.65 million cardiac demise around the world was due to extra sodium intake beyond the reference level of 2.0 g per day [43]. However, another study in Bangladesh narrated that the extra salt consumption among the population was deeply associated with the behavior, attitude, and culture regarding the salt intake pattern among the population [44]. So, there is an urgency to make people understand the behavioral concept regarding salt consumption as well as develop culturally applicable materials that may be suitable to raise general awareness regarding the adverse effects of extra salt intake among the population of Bangladesh.

In this study, among the 105 hypertensive respondents, 37 respondents were previously diagnosed as hypertensive and 68 respondents were newly diagnosed as hypertensive. However, among the pre-diagnosed hypertensive respondents, 70 % of them were under treatment of hypertension where 65 % of respondents had uncontrolled hypertension, and 35 % of respondents had controlled hypertension. A recent study in Bangladesh has reported that among their hypertensive respondents approximately 82 % were under medicinal treatment, whereas around 40 % of respondents had uncontrolled hypertension [22]. On the other hand, a similar hypertension-related study in India has reported that approximately 71 % of their hypertensive respondents were under treatment of hypertension, where almost 65 % of them had uncontrolled hypertensive state which is very much in line with our study results [30].

The outcomes of this study also demonstrate that the prevalence of

HTN was more noticeable among respondents with high BMI and WHR. Furthermore, according to this study results HTN was significantly high among overweight, pre-obese, and obese respondents in terms of their BMI. On the other hand, according to the WHR of this study population, a high frequency of HTN among normal WHR was also observed. So, our findings demonstrate that HTN may now also be a major health complication among normal BMI or WHR respondents. These results of our study are very much consistent with a study administrated in Hyderabad, India where HTN was more usual in obese (65 %) than in non-obese (6.3 %) subjects [45]. Some previous studies in Bangladesh also reported similar findings where obesity was a major risk factor for HTN [7].

From the risk factor analysis of HTN, it was observed that married persons of this study were more susceptible to develop HTN than unmarried persons. This finding is comparable to a study administered in Pakistan which mentioned that above half of their respondents were married (55.4 %) and their married persons had a higher risk of developing HTN than unmarried persons ($P = 0.000$) [21]. This may be due to having extra family stress that can lead to rising in blood pressure. In the current study, respondents with diabetes mellitus and kidney disease had a higher prevalence of HTN which is supported by a study conducted in Canada [46].

A positive affiliation between insufficient physical activity and hypertension was narrated in this study which is very much compatible with former studies conducted in Bangladesh and other developing nations [7,47,48]. For cardiovascular conditions, one of the significant adjustable risk factors is insufficient physical activity and it is evident from the STEPS survey 2018 that the current prevalence of inadequate physical activity in Bangladesh is around 30 %. The majority of the Bangladeshis who are conducting decent physical activities are generally doing transport as well as work-related physical activities and they are not very familiar with the recreational physical activities like in developed states [19,49,50]. Stakeholders should come forward to make people educate regarding the necessities of fulfilling decent physical activities to reduce the burden of hypertension in Bangladesh. The authority of Bangladesh can make policies to provide empty spaces in the workplace so that physical activities can be performed by the working people.

In this study, 83 respondents had general stress whereas approximately 57 % ($n = 47$) respondents had an active hypertensive state. So, a majority portion of this study population who had stress due to marital status, occupation, or financial problems were mostly affected with hypertension. A study in China among middle-aged people has reported that the risk of hypertension inclined around 9 % due to psychological stress [51]. Interestingly in this study, we have found that respondents had stress due to COVID-19 and out of 305 respondents of this study 98 respondents had C0VID-19 related stress. Furthermore, we have also observed that out of 98 respondents who had COVID-19 related stress 54.1 % ($n = 53$) of them had a hypertensive state. So, this finding indicates that stress due to COVID-19 may have an impact on the mental state of individualities and it may be one of the most significant risk factors for hypertension nowadays.

In Bangladesh, like other countries around the world community transmission of the coronavirus has continuously occurred since its outbreak however the steps taken by the government to control its transmission, as well as its infectious nature, has created fear among general people which enhance the development of several psychological distresses among the population [52]. As a significant proportion of this study population had COVID-19 stress which may be mediated by this epidemic situation due to several reasons similar as tension or anxiety of getting the infection, breakdown of educational activities as well as the uncertainty of future career, increasing financial problems, raising the crisis of food due to inadequate supply of food products in the local markets, losing jobs and unemployment, tension due to sickness of individuals or their family members or relatives, fear of taking medical treatment in hospital and so on.

However, the majority of these study respondents expressed that their financial crisis, the uncertainty of the future, and the spreading nature of this infection were the major causes behind their psychological disturbance. Moreover, among the respondents of this study 207 participants had no stress due to COVID-19 which maybe because they had no family responsibilities or no issues to stress or they might take this pandemic situation lightly or they might not be properly aware of the difficulties regarding this infectious communicable disease. To sum up, respondents with older age, engaging in less physical activity, eating a low number of fruits and vegetables per day, adding extra salt to food, having high BMI and WHR, having diabetes and kidney disease were independently associated with higher blood pressure levels and an increased risk of HTN. Furthermore, these findings are similar to other studies conducted in Bangladesh, India, Canada, Pakistan, and Iran [7,21,46,53–55].

4.1. Recommendations

Depending on the findings of this study some recommendations can be made to maintain and control the hypertensive status of individuals. People should be conscious about their weight management and a healthy weight should be maintained to control high blood pressure. Moreover, eating a healthy balanced diet can also be effective in the management of high blood pressure. So, plenty of fruits and vegetables should be consumed regularly and total salt intake, as well as processed food consumption, should be reduced to maintain a healthy dietary habit. Regular physical activities (at least 150 min per week) are recommended to maintain healthy blood pressure. Drinking too much alcohol and smoking can lead to high blood pressure, so one should avoid these unhealthy behaviors. Lastly, people should check their blood pressure regularly and should take proper sleep at night as well as people should try to avoid unnecessary stresses to live a healthy life.

4.2. Strengths and limitations

The biggish strength of this study is that, this may be the only study in Bangladesh during the COVID-19 epidemic situation which has succeeded to take complete anthropometric measures as well as blood pressure data from respondents by keeping up proper defensive moves against coronavirus for both study participators and the interviewers. Likewise, to our best knowledge, this will be the precious study in Bangladesh which has successfully administered field surveys as well face-to-face interviews through keeping up decent social distance and other cautions regarding coronavirus infection throughout the study period.

Besides these strengths, this study has some methodological limitations also. The initial and leading limitation of this study is the lack of funding to administrate this study. Another limitation of this study is that this was a cross-sectional study that was administrated in a single area of Dhaka megacity. That's why the outcomes of this study may not be applicable as well as may not be counted standard for other regions of Bangladesh. The reliance on self-reported data for certain variables, such as dietary habits and physical activity, introduces the potential for reporting bias. Additionally, as this is a cross-sectional study, we could not justify any causality of variables.

5. Conclusion

From the findings of this study, it can be concluded that the frequency of HTN is genuinely high among the urban population. Various Risk factors can be mentioned as the contributory element of HTN such as older age, high BMI, low physical activity, family history of HTN, a diet low in fruits and vegetables, the presence of diabetes and kidney disease, and so on. Still, besides these factors, COVID-19 affiliated stress may have a meaningful impact on the frequency of hypertension and for the current epidemic situation; it may be accounted as a risk factor of

HTN. Although age is an un-modifiable factor, interventions should focus on managing modifiable factors such as weight, physical activity, and diet. This is particularly important given the current limitations of Bangladesh's healthcare infrastructure, which lacks sufficient personnel and resources. To combat HTN effectively, there is a need for enhanced public health interventions, including community-based screening programs and improved monitoring systems. Addressing these needs will support early detection and management of HTN, ultimately improving public health outcomes.

Funding

None.

CRediT authorship contribution statement

Urmila Roy: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation. **Arafat Hassan Razon:** Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tanvir Ahmad:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tabassum Sultana Barsha:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors would like to thank all the participants for sharing their time and providing consent as well as information necessary for the successful completion of the study.

References

[1] S.S. Lim, T. Vos, A.D. Flaxman, G. Danaei, K. Shibuya, H. Adair-Rohani, et al., A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010, Lancet 380 (9859) (2012) 2224–2260.

[2] C. Nganou-Gnindjio, B. Hamadou, A. Tankeu, J.P. Essomba, J. Boombhi, L. Mfeukeu Kuaté, et al., Target organ damage in newly diagnosed hypertensive individuals in Yaoundé, sub Saharan Africa, Arch Cardiovasc Dis Suppl 11 (1) (2019 Jan 1) 101–102.

[3] R. Fuentes, N. Ilmaniemi, E. Laurikainen, J. Tuomilehto, A. Nissinen, Hypertension in developing economies: a review of population-based studies carried out from 1980 to 1998, J. Hypertens. 18 (5) (2000) 521–529.

[4] S.K. Das, K. Sanyal, A. Basu, Study of urban community survey in India: growing trend of high prevalence of hypertension in a developing country, Int. J. Med. Sci. 2 (2005).

[5] P. Joshi, S. Islam, P. Pais, S. Reddy, P. Dorairaj, K. Kazmi, et al., Risk factors for early myocardial infarction in South Asians compared with individuals in other countries, J. Am. Med. Assoc. 297 (3) (2007).

[6] S.H. Khan, S.H. Talukder, Nutrition transition in Bangladesh: is the country ready for this double burden, Obes. Rev. 14 (S2) (2013).

[7] S.M.S. Islam, A. Mainuddin, M.S. Islam, M.A. Karim, S.Z. Mou, S. Arefin, et al., Prevalence of risk factors for hypertension: a cross-sectional study in an urban area of Bangladesh, Glob Cardiol Sci Pract 2015 (4) (2015 Sep 20) 43.

[8] N. Saquib, J. Saquib, T. Ahmed, M.A. Khanam, M.R. Cullen, Cardiovascular diseases and Type 2 Diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010, BMC Publ. Health 12 (1) (2012).

[9] T. Biswas, S.M.S. Islam, A. Islam, Prevention of hypertension in Bangladesh: a review, Cardiovasc. J. 7 (2) (2015 Feb 16) 137–144.

[10] A. Steptoe, Psychosocial factors in the development of hypertension, Ann. Med. 32 (5) (2000).

[11] B.A. Greiner, N. Krause, D. Ragland, J.M. Fisher, Occupational stressors and hypertension: a multi-method study using observer-based job analysis and self-reports in urban transit operators, Soc. Sci. Med. 59 (5) (2004 Sep 1) 1081–1094.

[12] A. Steptoe, G. Willemsen, The influence of low job control on ambulatory blood pressure and perceived stress over the working day in men and women from the Whitehall II cohort, J. Hypertens. 22 (5) (2004).

[13] F. Sparrenberger, F.T. Cichelero, A.M. Ascoli, F.P. Fonseca, G. Weiss, O. Berwanger, et al., Does psychosocial stress cause hypertension? A systematic review of observational studies, J. Hum. Hypertens. 23 (2009) 12–19.

[14] N. Zhu, D. Zhang, W. Wang, X. Li, B. Yang, J. Song, et al., A novel coronavirus from patients with pneumonia in China, 2019, N. Engl. J. Med. 382 (8) (2020).

[15] F. Zhou, T. Yu, R. Du, G. Fan, Y. Liu, Z. Liu, et al., Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study, Lancet 395 (10229) (2020 Mar 28) 1054–1062.

[16] C. Wu, X. Chen, Y. Cai, J. Xia, X. Zhou, S. Xu, et al., Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in wuhan, China, JAMA Intern. Med. 180 (7) (2020).

[17] M.M. Haque, A.K.M.M. Uddin, M.A. Naser, M.Z.H. Khan, S.K. Roy, Y. Arafat, Health and nutritional status of aged people, Chattagram Maa-O-Shishu Hosp Med Coll J. 13 (3) (2014 Nov 29) 30–34.

[18] W. Steps, The WHO STEPwise Approach to Chronic Disease Risk Factor Surveillance (STEPS), World Health Organ, 2017, pp. 1–16.

[19] M.M. Zaman, M.R. Bhuiyan, M.N. Karim, Rahman MM. MoniruzZaman, A. W. Akanda, et al., Clustering of non-communicable diseases risk factors in Bangladeshi adults: an analysis of STEPS survey 2013, BMC Publ. Health 15 (1) (2015).

[20] A. Razzaque, L. Nahar, Abu Haider, Mohammad Golam Mustafa, Karar Zunaid Ahsan, Mohammad Shafiqul Islam, M. Yunus, Sociodemographic differentials of selected noncommunicable diseases risk factors among adults in matlab, Bangladesh: findings from a WHO STEPS survey, Asia Pac. J. Publ. Health 23 (2) (2011 Mar) 183–191.

[21] S. Ishtiaq, U. Ilyas, S. Naz, R. Altaf, H. Afzaal, S.A. Muhammad, et al., Assessment of the risk factors of hypertension among adult & elderly group in twin cities of Pakistan, J. Pakistan Med. Assoc. 67 (11) (2017).

[22] M. Hasan, M. Showkat, A. Khan, I. Sutradhar, M.M. Hossain, M. Hossaine, et al., Prevalence and associated factors of hypertension in selected urban and rural areas of Dhaka, Bangladesh: findings from SHASTO baseline survey, BMJ Open 11 (2021) 38975.

[23] Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults–the evidence report, National Institutes of Health. Obes Res. 6 (Suppl 2) (1998 Sep) 51S–209S.

[24] L.O. Llido, R. Mirasol, Comparison of Body Mass Index Based Nutritional Status Using WHO Criteria versus "Asian" Criteria: Report from the Philippines, PhilSPEN Online J Parenter Enter Nutr, 2010.

[25] Q. Qiao, R. Nyamdorj, The optimal cutoff values and their performance of waist circumference and waist-to-hip ratio for diagnosing type II diabetes, Eur. J. Clin. Nutr. 64 (2010) 23–29.

[26] M. Rahman, M.M. Zaman, J.Y. Islam, J. Chowdhury, H.N. Ahsan, R. Rahman, et al., Prevalence, treatment patterns, and risk factors of hypertension and pre-hypertension among Bangladeshi adults, J. Hum. Hypertens. 32 (5) (2018) 334–348.

[27] M.M. Zaman, M.R. Bhuiyan, MdN. Karim, Rahman MdM. MoniruzZaman, A. W. Akanda, et al., Clustering of non-communicable diseases risk factors in Bangladeshi adults: an analysis of STEPS survey 2013, BMC Publ. Health 15 (1) (2015 Dec) 659.

[28] J.Y. Islam, M.M. Zaman, S.A. Haq, S. Ahmed, Z. Al-Quadir, Epidemiology of hypertension among Bangladeshi adults using the 2017 ACC/AHA hypertension clinical practice guidelines and joint National Committee 7 guidelines, J. Hum. Hypertens. 32 (10) (2018) 668–680.

[29] W.H. Organization, Noncommunicable Diseases Country Profiles 2014, Switz World Health Organ, Geneva, 2014.

[30] S. Singh, R. Shankar, G.P. Singh, Prevalence and Associated Risk Factors of Hypertension: A Cross-Sectional Study in Urban Varanasi, 2017.

[31] K. Atkinson, S. Lowe, S. Moore, Human development, occupational structure and physical inactivity among 47 low and middle income countries, Prev Med Rep 3 (2016 Jun 1) 40–45.

[32] S.L. Martin, G.J. Kirkner, K. Mayo, C.E. Matthews, J.L. Durstine, J.R. Hebert, Urban, rural, and regional variations in physical activity, J. Rural Health 21 (2005).

[33] G. Bishwajit, S. Ide, M.A. Hossain, M.N. Safa, Trade liberalization, urbanization and nutrition transition in asian countries, J Nutr Health Food Sci 2 (1) (2014).

[34] H. Liu, G.J. Walker, The effects of urbanization, motivation, and constraint on Chinese people's leisure-time physical activity, Leisure Sci. 37 (5) (2015) 458–478.

[35] E. Sobngwi, J.C.N. Mbanya, N.C. Unwin, A.P. Kengne, E.M. Minkoulou, L. Fezeu, et al., Physical activity and its relationship with obesity, hypertension and diabetes in urban and rural Cameroon, Int. J. Obes. 26 (7) (2002).

[36] M. Zhao, Y. Konishi, P. Glewwe, Does information on health status lead to a healthier lifestyle? Evidence from China on the effect of hypertension diagnosis on food consumption, J. Health Econ. 32 (2) (2013 Mar 1) 367–385.

[37] L.S.E. Seow, M. Subramaniam, E. Abdin, J.A. Vaingankar, S.A. Chong, Hypertension and its associated risks among Singapore elderly residential population, J Clin Gerontol Geriatr 6 (4) (2015 Dec 1) 125–132.

[38] C.D. Fryar, Y. Ostchega, C.M. Hales, G. Zhang, D. Kruszon-Moran, Hypertension Prevalence and Control Among Adults: United States, 2015-2016, vol. 289, NCHS Data Brief, 2017.

[39] I.L. Rouse, B.K. Armstrong, L.J. Beilin, The relationship of blood pressure to diet and lifestyle in two religious populations, J. Hypertens. 1 (1) (1983) 65–72.

[40] I.B. Puddey, L.J. Beilin, V. Rakic, Alcohol, hypertension and the cardiovascular system: a critical appraisal, Addiction Biol. 2 (2) (1997) 159–170.

[41] I.B. Puddey, L.J. Beilin, R. Vandongen, Regular alcohol use raises blood pressure in treated hypertensive subjects: a randomised controlled trial, Lancet 329 (8534) (1987 Mar 21) 647–651.
[42] S. Bhelkar, S. Despande, S. Mankar, P. Hiwarkar, Association between stress and hypertension among adults more than 30 Years: a case-control study, Natl J Community Med 9 (6) (2018 Jun 30) 430–433.
[43] D. Mozaffarian, S. Fahimi, G.M. Singh, R. Micha, S. Khatibzadeh, R.E. Engell, et al., Global sodium consumption and death from cardiovascular causes, N. Engl. J. Med. 371 (7) (2014).
[44] I. de Brito-Ashurst, L. Perry, T.A.B. Sanders, J.E. Thomas, M.M. Yaqoob, H. Dobbie, Barriers and facilitators of dietary sodium restriction amongst Bangladeshi chronic kidney disease patients, J. Hum. Nutr. Diet. 24 (1) (2011 Feb 1) 86–95.
[45] H. Mahesar, F.D. Khand, G.M. Seehar, Prevalence of hypertension and obesity in Hyderabad, SINDH Univ Res J Sci Ser. 43 (2) (2011) 219–224.
[46] A.A. Leung, T. Bushnik, D. Hennessy, F.A. McAlister, D.G. Manuel, Risk factors for hypertension in Canada, Health Rep. 30 (2) (2019).
[47] R. Khanam, S. Ahmed, S. Rahman, GM Al Kibria, J.R.R. Syed, A.M. Khan, et al., Prevalence and factors associated with hypertension among adults in rural Sylhet district of Bangladesh: a cross-sectional study, BMJ Open 9 (10) (2019).
[48] A.S. Bhadoria, P.K. Kasar, N.A. Toppo, P. Bhadoria, S. Pradhan, V. Kabirpanthi, Prevalence of hypertension and associated cardiovascular risk factors in Central India, J Fam Community Med 29 (2014) 29–38.
[49] P.W. Ku, K.R. Fox, J. McKenna, T.L. Peng, Prevalence of leisure-time physical activity in Taiwanese adults: results of four national surveys, 2000-2004, Prev. Med. 43 (6) (2006).
[50] O.T.H. Trinh, N.D. Nguyen, M.J. Dibley, P. Phongsavan, A.E. Bauman, The prevalence and correlates of physical inactivity among adults in Ho Chi Minh City, BMC Publ. Health 8 (2008).
[51] B. Hu, X. Liu, S. Yin, H. Fan, F. Feng, J. Yuan, Effects of psychological stress on hypertension in middle-aged Chinese: a cross-sectional study, PLoS One 10 (6) (2015).
[52] S.K. Brooks, R.K. Webster, L.E. Smith, L. Woodland, S. Wessely, N. Greenberg, et al., The psychological impact of quarantine and how to reduce it: rapid review of the evidence, Lancet 395 (2020).
[53] J. Kishore, N. Gupta, C. Kohli, N. Kumar, Prevalence of hypertension and determination of its risk factors in rural Delhi, Int. J. Hypertens. 2016 (2016).
[54] M. Eghbali, A. Khosravi, A. Feizi, A. Mansouri, B. Mahaki, N. Sarrafzadegan, Prevalence, awareness, treatment, control, and risk factors of hypertension among adults: a cross-sectional study in Iran, Epidemiol Health 40 (2018).
[55] M. Rahman, M. Mostafa Zaman, J. Yasmine Islam, J. Chowdhury, H. Nazmul Ahsan, R. Rahman, et al., Prevalence, treatment patterns, and risk factors of hypertension and pre-hypertension among Bangladeshi adults, J. Hum. Hypertens. 32 (2018) 334–348.