ASSOCIATION OF HYPERTENSION AND RELATED FACTORS WITH COGNITIVE PERFORMANCE IN AN ELDERLY POPULATION

IA Oishee[1], S Tanira[2], T Shahrin[3], N Jahan[4], SS Tamal[1], MA Moni[1]

[1]*National Institute of Preventive & Social Medicine (NIPSOM), Dhaka, Bangladesh*

[2]*School of Rehabilitation Therapy, Faculty of Health Sciences, Queen's University, Kingston, ON, Canada*

[3]*Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh*

[4]*Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh*

ABSTRACT

This cross-sectional, analytical study to see the association of hypertension and its related factors with the cognitive performance of elderly people in an urban setting in Dhaka, Bangladesh, was conducted between January and December of 2016. A convenient sampling technique was adopted. A total of 189 elderly people (118 male and 71 female) were included in the study. A semi-structured questionnaire was first developed in English and then translated into Bangla. The questionnaire contained questions related to socio-demographic characteristics of the participants and their cognitive functions, as determined by using Mini Mental state Examination (MMSE), hypertension-related information including its medication, any comorbidities, e.g., diabetes mellitus, and family history. Socio-demographic data were analyzed with descriptive statistics. Chi-square test was applied to assess association of qualitative data. The age of the respondents ranged from 60 to 90 years. The mean age was 67.8 ± 6.26 years. Higher proportion of male (37.3%) and female participants (36.6%) were in 60-64 years age group, while the lower proportion in ≥ 75 years age group (male 12.7% and female 14.1%). Strong associations were observed between hypertension and cognitive performance as well as between intake of prescribed anti-hypertensive drugs and cognitive performance ($p < 0.001$). However, no association was found between diabetes mellitus and cognitive performance ($p > 0.05$). Among different anti-hypertensive drugs users, only patients having calcium channel blockers showed association with their cognitive performance ($p < 0.05$). We also observed association between family history of hypertension and cognitive performance ($p < 0.05$). However, no relationship of cognitive performance of the elderly people were found with their family history of diabetes mellitus, cerebrovascular stroke and ischemic heart disease ($p > 0.05$).

Key words: Hypertension, Diabetes mellitus, Antihypertensive drugs, Family history, Cognitive function, Elderly people

Introduction

The growth of the elderly population is a worldwide phenomenon with direct consequences on public health systems. In the 21st century, the ageing population and their health have become a growing health and social care concern all over the world[1,2]. The number of people aged 65 or

older is projected to grow from an estimated 524 million in 2010 to nearly 1.5 billion in 2050, with most of the increase in developing countries[3]. Bangladesh is one of the twenty countries in the world with the largest elderly populations; in 2015, it had more than 11 million elderly people, which is projected to increase to about 21.5 million and 43.5 million by 2030 and 2050 respectively[4]. The increasing elderly population will have an impact on our healthcare system by creating burdens of age-related multiple health complications, disability and death[5,6].

Ageing commonly brings physiologic decline as well as disease state[7]. In elderly population, hypertension is an important risk factor for several morbidities and mortality. It is considered as a significant and often asymptomatic chronic disease, which requires optimal control and persistent adherence to prescribed medication to combat further complications[8]. The relation of hypertension with cognitive function and performance in elderly population have been receiving much attention from epidemiological and clinical research for decades[9-12]. The prevalence of both hypertension and cognition declining disorders like dementia and Alzheimer's disease increase with advancing age[10,11]. Besides, hypertension itself is an important risk factor for vascular dementia and Alzheimer's disease[12]. The brain is a major target of end-organ damage in hypertension, and alterations affecting the cerebral vasculature may lead to vascular insufficiency and neuronal dysfunction as adequate cerebral blood flow responses are needed for memory (and other cognitive) functions[10,12]. Apart from that neurochemical transmission within the brain, basic cellular functions are also affected by hypertension[10]. Thus, a variety of neurophysiological characteristics of hypertensive elderlies could explain their cognitive difficulties.

The relation of hypertension to cognitive function is frequently studied by comparing the cognitive performance of people with normal blood pressure (or normotensives) with that of hypertensive individuals at one point in time. Some of the commonly assessed cognitive functions include attention, learning and memory, executive functions (i.e., self-regulatory behaviors such as planning and organization, mental flexibility, and response inhibition), visuospatial skills, psychomotor abilities, perceptual skills, and language abilities[10].

Considering the impacts of hypertension and its related factors on cognitive alterations in elderly population and given the growing need for such investigations from the epidemiological perspective, the present study was proposed to find out the association of hypertension and its related factors with cognitive impairment in elderly individuals in our country.

Materials and Methods

This cross-sectional, analytical study was conducted in Mirpur area under Dhaka City Corporation, Bangladesh between January and December of 2016. The study population were elderlies over the age of 60 years of both sexes who were present at their homes during data collection.

Elderly persons of 60 years and above having reading and writing abilities, willing to participate in the study and staying at home for more than six months were included in the study. Diagnosed stroke patients, patients with history of head injury or trauma, patients having speech or communication difficulties, severely ill individuals, people with mental health issues, patients diagnosed with brain tumors and reported cardiovascular events were excluded from the study.

A convenient sampling technique was adopted. Based on the inclusion and exclusion criteria, finally 189 elderly people (118 male and 71 female) were included in the study. A semi-structured questionnaire was first developed in English and then translated into Bangla. The questionnaire contained questions related to i) participants' socio-demographic characteristics, ii) determination of cognitive functional status using mini mental state examination (MMSE), iii) hypertension-related information including its medication, iv) any comorbidities, e.g., diabetes mellitus, and v) family history including hypertension, diabetes mellitus, cerebrovascular stroke, and ischemic heart disease.

The mini mental state examination (MMSE) is one of the most commonly used tests worldwide for assessing cognitive function developed by Folstein et al[13] in 1975. The MMSE assesses orientation in time and place, attention, memory, and language and visual construction. The MMSE has a maximum of 30 points where higher scores indicate better cognition. The cut-off levels used in this study were: $\geq 27 =$ no impairment; $21–26 =$ mild; $11–20 =$ moderate; and $\leq 10 =$ severe impairment[14].

After data collection, each questionnaire form was checked to find out any incompleteness or missing data or outliers. Data sheets produced on the computer were double checked to ensure their accuracy and completeness. All statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) software version 23.0. Socio-demographic data were analyzed with descriptive statistics. Chi-square test was applied to assess association of qualitative data. To assess the strength of association, odds ratio (OR) and their corresponding 95% confidence interval (CI)

were calculated. All tests were two tailed and a P value < 0.05 was considered statistically significant. This research was approved by the Institutional Ethical Review Committee of National Institute of Preventive and Social Medicine (NIPSOM), Dhaka, Bangladesh.

Results

In this study there were total 189 respondents. Among them 118(62.43%) were male and 71(37.57%) were female. The age of the respondents ranged from 60 to 90 years. The mean age was 67.8 ± 6.26 years. Higher proportion of study subjects were in the 60-64 years age group (37.3% in male and 36.6% in female). The lowest proportion was in the age group of ≥ 75 years (male 12.7% and female 14.1%). In males 74.6% and 50.7% of females were married while 25.4% of males and 49.3% of females were separated/widow/widower. Most of the male respondents (67.4%) were in graduate and above education group while most female respondents (50.7%) belonged to SSC and below and informal education group. The rest of them were included into HSC education group: 11% and 32.4% respectively in male and female. Most of the respondents (58.20%) (55.08% of male and 61.97% of female) belonged to the extended family and in nuclear family 41.80% (44.1% of male and 38.0% of female). Among the male respondents, 76.3% were retired. Rest of the respondents were service holders (9.3%), businessmen (12.7%) and teachers (1.7%). Female respondents were mostly housewives (97.2%) and only two (2.8%) were teachers (Table I). Among the participants, more than half (52.4%) of the respondents had mild cognitive impairment, 35.4% had normal cognitive function and the rest (12.2%) had moderate cognitive impairment. No severe

cognitive impairment was found (Fig 1). Diagnosed hypertensive elderly participants had three times higher mild cognitive impairment (67.5%) than that of non-hypertensive participants (29.3%) while moderate cognitive impairment (14.9%) was almost two times higher in hypertensive elderlies than that that of its non-hypertensive counterparts (8%). On the other hand, only 17.5% of the hypertensive elderlies had normal cognitive function and 62.7% non-hypertensive individuals had normal cognitive function. A strong association between hypertension and cognitive impairment was observed, which was statistically significant (P < 0.001). However, no association was found between diabetes mellitus and cognitive performance of the elderly participants (p > 0.05). Elderly people who did not take anti-hypertensive drugs had much more normal cognitive function (62.7%) than that of the participants who took hypertensive drugs (17.5%) (3.5 times higher incidence). In contrast, participants who were treated with anti-hypertensive drugs had higher percentage of development of mild cognitive impairment (67.5%) and moderate cognitive impairment (14.9%) than those who did not take anti-hypertensive drugs. Therefore, a strong association was observed between intake of prescribed anti-hypertensive drugs and cognitive performance, which was statistically significant (p < 0.001). Investigating into relationship between different anti-hypertensive drugs and cognitive performance, only patients having calcium channel blockers showed association with their cognitive impairment (p < 0.05). Participants having family history of hypertension had higher incidence of mild cognitive impairment (61.6%) than those who did not have any family history (39%). On the contrary, elderly people with no family history of hypertension had higher

incidence of normal cognitive function (46.8%) than those who had a family history (27.7%). Hence, we observed association between family history of hypertension and cognitive performance, which was statistically significant (P < 0.05). However, no relationships of cognitive performance of the elderly people were found with their family history of diabetes mellitus, cerebrovascular stroke and ischemic heart disease (p > 0.05) (Table II).

Table I: Sociodemographic characteristics of the elderly participants (N=189)

Characteristics	Male (n=118)	Female (n=71)
	Frequency (%)	Frequency (%)
Sex	118 (62.43)	71 (37.57)
Age group		
60−64 years	44 (37.3)	26 (36.6)
65−69 years	32 (27.1)	18 (25.4)
70−74 years	27 (22.9)	17 (23.9)
≥75 years	15 (12.7)	10 (14.1)
Mean age	67.8±6.26 years	
Marital status		
Married	88 (74.6)	36 (50.7)
Separated/widow/widower	30 (25.4)	35 (49.3)
Educational status		
SSC and below and informal education	29 (24.6)	36 (50.7)
HSC	13 (11)	23 (32.4)
Graduate and above	76 (67.4)	12 (16.9)
Type of family		
Nuclear	53 (44.92)	27 (38.03)
Extended	65 (55.08)	44 (61.97)
Occupation		
Service	11 (9.3)	-
Business	15 (12.7)	-
Teacher	2 (1.7)	2 (2.8)
Retired	90 (76.3)	-
Housewife	-	69 (97.2)

Table II: Association of hypertension and related factors with cognitive performance of the elderly participants (N=189)

Characteristics	Cognitive performance			p values
	Normal cognitive function Frequency (%)	Mild cognitive impairment Frequency (%)	Moderate cognitive impairment Frequency (%)	
Diagnosed cases of hypertension by the physician				
Non hypertensive	47 (62.7)	22 (29.3)	6 (8.0)	<0.001
Hypertensive	20 (17.5)	77 (67.5)	17 (14.9)	
History of diabetes mellitus				
No	44 (35.2)	68 (54.4)	13 (10.4)	
Yes	23 (35.9)	31 (48.4)	10 (15.6)	>0.05
Intake of prescribed anti-hypertensive drug by the physician within 2 weeks				
Not taken	47 (62.7)	22 (29.3)	6 (8.0)	<0.001
Taken	20 (17.5)	77 (67.5)	17 (14.9)	
Anti-hypertensive drugs taken by the respondents who were diagnosed as hypertensive				
Beta-blockers				
No	62 (37.6)	82 (49.7)	21 (12.7)	>0.05
Yes	5 (20.8)	17 (70.8)	2 (8.3)	
Calcium-channel blockers				
No	58 (40.8)	69 (48.6)	15 (10.6)	<0.05
Yes	9 (19.1)	30 (63.8)	8 (17.0)	
Diuretics				
No	66 (35.7)	96 (51.9)	23 (12.4)	>0.05
Yes	01 (25.0)	3 (75.0)	0 (0.0)	
ARB				
No	57 (38.5)	72 (48.6)	19 (12.8)	>0.05
Yes	10 (24.4)	27 (65.9)	4 (9.8)	
ACEI				
No	65 (37.1)	89 (50.9)	21 (12.0)	>0.05
Yes	2 (14.3)	10 (71.4)	2 (14.3)	
Others	67 (35.4)	99 (52.4)	23 (12.2)	>0.05
Family history of hypertension				
No	36 (46.8)	30 (39.0)	11 (14.3)	
Yes	31 (27.7)	69 (61.6)	12 (10.7)	<0.05
Family history of diabetes mellitus				
No	37 (41.6)	42 (47.2)	10 (11.2)	>0.05
Yes	30 (30.0)	57 (57.0)	13 (13.0)	
Family history of cerebrovascular stroke				
No	47 (39.5)	57 (47.9)	15 (12.6)	>0.05
Yes	20 (28.6)	42 (60.0)	8 (11.4)	
Family history of ischemic heart diseases				
No	47 (38.8)	58 (47.9)	16 (13.2)	>0.05
Yes	20 (29.4)	41 (60.3)	7 (10.3)	
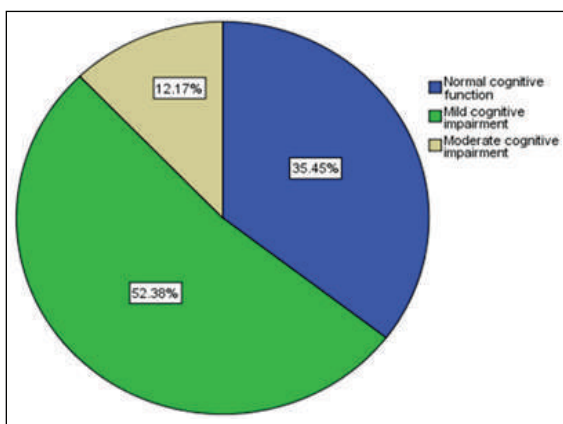
Discussion

In the present study, we investigated the relationship of hypertension and its related factors with cognitive performances of elderly people. Although research works examining the relationship between hypertension and cognitive function have increased over years, the findings have been inconsistent among research reports[15]. Hypertensive elderly people may develop mild to moderate cognitive impairment; a significant association was observed in our study between hypertension and cognitive impairment levels. Most of the epidemiological studies regarding this issue were done in the other parts of the world and some of the researchers reported positive association[15-19] while some found negative association[20-22]. However, the differences in observations may be due to variations in sample size and sampling techniques.

In the present study it was observed that participants who were on anti-hypertensive drugs had higher incidence of mild to moderate cognitive impairment in comparison to those who did not take it. Moreover, among different anti-hypertensive drugs, only calcium channel blockers had significant association with cognitive impairment. However, evidence suggests that anti-hypertensive therapy has a

protective effect on cognitive impairment[23-25]. These differences in observations may be due to the facts that firstly recording of blood pressure at a single visit may diminish the accuracy of the data. Such imprecision in blood pressure measurement would bias the relation between them. Another fact of these variations may be due to different scales used for studying cognitive functions apart from different inclusion criteria.

In this study, the percentage of normal cognitive function was found with a narrow difference between diabetic (35.9%) and non-diabetic (35.2%) participants. However, the difference was not statistically significant. Several previous evidence showed that diabetes acts as a predictor of cognitive impairment among people[26-28]. The fact differs from our study as because in our study data regarding diabetes mellitus was collected only by history taking of the participants, which may produce-recall bias and accurate data could be missed. Similar observation may happen as we collected family history of diabetes mellitus, cerebrovascular stroke and ischemic heart disease of the participants to see how those factors work on their cognitive performance and we found no association. However, we revealed association between family history of hypertension and cognitive performance.

As the study was conducted in a defined area of Dhaka city, the results might not be generalized for the country. Large-scale multicentre studies could be conducted with larger samples and longer duration by following appropriate study design for determining association of hypertension and cognitive function.

Our data suggest an inverse association between hypertension and cognitive function and performance of elderly people. Measures should

be taken for prevention and management of modifiable clinical factors like hypertension to reduce the risks of cognitive impairment in later life. Moreover, due to the association of hypertension and cognitive impairment in the ageing population, early detection and prompt treatment of both the diseases are needed to reduce the individual, social as well as economic burden of the country.

References

1. The Lancet Public Health. Ageing: a 21st century public health challenge? Lancet Public Health 2017; 2(7): e297.

2. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. Lancet. 2009; 374(9696): 1196-1208.

3. National Institute on Aging (NIA). National Institutes of Health (NIH). Global health and aging. 2011. Available at: https://www.nia.nih.gov/sites/default/files/2017-06/global_health_aging.pdf. Accessed March 2017.

4. Bangladesh Bureau of Statistics (BBS). Statistics and Informatics Division, Ministry of Planning, Government of The People's Republic of Bangladesh. Population Projection of Bangladesh-Dynamics and trends 2011-2061. Dhaka, Bangladesh: BBS; 2015.

5. Divo MJ, Martinez CH, Mannino DM. Ageing and the epidemiology of multimorbidity. Eur Respir J 2014; 44(4): 1055-1068.

6. Tanira S, Nurunnabi ASM, Sony SA, Khatun R. Elderly population of Bangladesh: a public health concern. J Health Sci Res Policy 2015; 2(1): 2-7.

7. Peters R. Ageing and the brain. Postgrad Med J 2006; 82(964): 84-88.

8. Lionakis N, Mendrinos D, Sanidas E, Favatas G, Georgopoulou M. Hypertension in the elderly. World J Cardiol 2012; 4(5): 135-147.

9. Stewart R. Hypertension and cognitive decline. Br J Psychiatry 1999; 174: 286-287.

10. Waldstein SR. The relation of hypertension to cognitive function. Curr Direct Psychol Sci 2003; 12(1): 9-12.

11. Qiu C, Winblad B, Fratiglioni L. The age-dependent relation of blood pressure to cognitive function and dementia. Lancet Neurol 2005; 4(8): 487-499.

12. Iadecola C, Yaffe K, Biller J, Bratzke LC, Faraci FM, Gorelick PB et al. Impact of hypertension on cognitive function: a scientific statement from the American Heart Association. Hypertension 2016; 68(6): e67-94.

13. Folstein MF, Folstein SE, McHugh PR."Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12(3): 189-198.

14. Folstein MF, Folstein SE, White T, Messer MA. MMSE-2: Mini-Mental State Examination, Second Edition (MMSE-2) User's Manual. Odessa: Psychological Assessment Resources; 2001.

15. Wysocki M, Luo X, Schmeidler J, Dahlman K, Lesser GT, Grossman H et al. Hypertension is associated with cognitive decline in elderly people at high risk for dementia. Am J Geriatr Psychiatry 2012; 20(2): 179-187.

16. Wallace RB, Lemke JH, Morris MC, Goodenberger M, Kohout F, Hinrichs JV. Relationship of free-recall memory to hypertension in the elderly. The Iowa 65+ Rural Health Study. J Chronic Dis 1985; 38(6): 475-481.

17. Tzourio C, Dufouil C, Ducimetière P, Alpérovitch A. Cognitive decline in individuals with high blood pressure: a longitudinal study in the elderly. EVA Study Group. Epidemiology of Vascular Aging. Neurology 1999; 53(9): 1948-1952.

18. Vinyoles E, De la Figuera M, Gonzalez-Segura D. Cognitive function and blood pressure control in hypertensive patients over 60 years of age: COGNIPRES study. Curr Med Res Opin 2008; 24(12): 3331-3339.

19. Wu L, He Y, Jiang B, Liu M, Wang J, Yang S, et al. The association between the prevalence, treatment and control of hypertension and the risk of mild cognitive impairment in an elderly urban population in China. Hypertens Res 2016; 39(5): 367-375.

20. Imarhiagbe F, Ogunrin O, Ogunniyi A. Cognitive performance of hypertensive elderly Nigerians: a case control study. Afr J Med Med Sci 2005; 34(3): 269-273.

21. Huang CQ, Dong BR, Zhang YL, Wu HM, Liu QX, Flaherty JH. Cognitive impairment and hypertension among Chinese nonagenarians and centenarians. Hypertens Res 2009; 32(7): 554-558.

22. Lacruz ME, Tiller D, Kluttig A, Greiser KH, Nuding S, Werdan K et al. Association of late-life changes in blood pressure and cognitive status. J Geriatr Cardiol 2016; 13(1): 37-43.

23. Duron E, Hanon O. Antihypertensive treatments, cognitive decline, and dementia. J Alzheimers Dis 2010; 20(3): 903-914.

24. Rouch L, Cestac P, Hanon O, Cool C, Helmer C, Bouhanick B et al. Antihypertensive drugs, prevention of cognitive decline and dementia: a systematic review of observational studies, randomized controlled trials and meta-analyses, with discussion of potential mechanisms. CNS Drugs 2015; 29(2): 113-130.

25. Tadic M, Cuspidi C, Hering D. Hypertension and cognitive dysfunction in elderly: blood pressure management for this global burden. BMC Cardiovasc Disord 2016; 16(1): 208.

26. Van Exel E, Gussekloo J, Houx P, de Craen AJ, Macfarlane PW, Bootsma-van der Wiel A et al. Atherosclerosis and cognitive impairment are linked in the elderly. The Leiden 85-plus Study. Atherosclerosis 2002; 165(2): 353-359.

27. Cheng G, Huang C, Deng H, Wang H. Diabetes as a risk factor for dementia and mild cognitive impairment: a meta-analysis of longitudinal studies. Intern Med J 2012; 42(5): 484-491.

28. Moheet A, Mangia S, Seaquist ER. Impact of diabetes on cognitive function and brain structure. Ann NY Acad Sci 2015; 1353: 60-71.