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Comparison of Cognition and Aerobic Capacity in Hypertensive and Age Matched Non-Hypertensive Middle Age Males: An Observational Study

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ABSTRACT

Objective: The study aimed to compare cognition and aerobic capacity in hypertensive and non hypertensive middle aged males and find correlation between aerobic capacity and cognition in both group, to assess the relationship of cognition with age, years of hypertension, years of diabetes mellitus (DM), aerobic capacity among individual with hypertension.

Design and method: An observational analytical study was conducted at community societies in Ahmedabad using purposive sampling. According to inclusion criteria 54 (27 in each group) middle age males were included in the study. Participants were divided into two groups -hypertensive group and non-hypertensive group. Each individual performed 6 minute walk test (6 MWT) to assess the aerobic capacity and Montreal cognitive assessment (MOCA) was taken to assess the cognition.

Results: Statistically significant difference between both groups in 6MWT ($U=208$, $p<0.01$). No significant difference between both groups in MOCA ($U=295$, $p>0.05$). Moderate positive correlation between aerobic capacity and cognition in hypertensive group($r=0.538$, $p<0.005$) and no correlation in non- hypertensive group($r=0.059$, $p>0.05$) was seen. Association between cognition with age ($B=0.423$, $p=0.007$), hypertension year ($B=0.598$, $p=0.299$), DM year ($B=0.322$, $p=0.543$) and aerobic capacity ($B=0.491$, $p=0.003$) in individual with hypertension.

Conclusion: The findings suggest that lower aerobic capacity and no difference in scores of cognition in hypertensive compared to non hypertensive middle aged males is seen. Correlation between aerobic capacity and cognition in hypertensive group was seen. Cognition is ascending way highly associated with hypertension year, aerobic capacity, age and DM year so. In later cognition is affected in hypertensive group.

Keywords: Aerobic capacity, Cognition, Hypertension

INTRODUCTION

Hypertension is called a "silent killer". Hypertension or elevated blood pressure is a serious medical condition that significantly increases the risks of heart, brain, kidney and other diseases. Most people with hypertension are unaware of the problem because it may have no warning signs or symptoms.

An estimated 1.28 billion adults aged 30-79 years worldwide have hypertension, most (two-thirds) living in low- and middle-income countries. Approximately 1 in 5 adults (21%) with hypertension have it under control. Hypertension is a major cause of premature death worldwide. It is non- communicable diseases is to reduce the prevalence of hypertension by 33% between 2010 and 2030.[1] Overall, the prevalence of

hypertension was higher in men (34.6%) than in women (30.8%).[2]

The aerobic capacity is defined as the maximum amount of oxygen that a subject can use per unit of time and body weight.[3] Multiple systems are involved, including the pulmonary, cardiac, vascular, and musculoskeletal systems. Poor aerobic capacity results in reduced activity levels. Other organ dysfunction, such as decline in pulmonary status and cardiomyopathy, may further contribute to declining levels of aerobic capacity. Aerobic capacity is commonly described by the maximum oxygen consumption, or maximal oxygen uptake. This measurement is an indication of the ability of the cardiovascular system to provide oxygen to working muscles and the ability of those muscles to extract oxygen for energy generation in the form of adenosine triphosphate (ATP).[4] Studies suggest the maximal aerobic capacity (MAC) has been associated with preserved neural tissue or brain maintenance (BM) in healthy older adults, including the hippocampus.[5]

Cognition is a term referring to the mental processes involved in gaining knowledge and comprehension. These cognitive processes include thinking, knowing, remembering, judging, and problem solving.[6] Hypertension accelerates arteriosclerotic changes in the brain predisposing to vascular changes result in a reduced luminal diameter, increased resistance to flow and a decline in perfusion.[7] Such hypo perfusion can produce discrete regions of cerebral infarction and diffuse ischemic changes in the periventricular and deep white matter (leukoaraisosis) causing vascular cognitive impairment.[8] Hypertension causes many pathological changes in the vascular system, and these changes may lead to cognitive dysfunction. A study found that diastolic blood pressure (DBP) increased by 10 mm Hg, the risk of cognitive decline increased by 7%, and when systolic blood pressure (SBP)>160 mm Hg, the cognitive function was significantly reduced.[9] The relationship between hypertension and cognitive dysfunction has been a concern, and the mechanism of hypertension-related cognitive dysfunction remains unclear.[10]

Less research has focused on understanding relation between blood pressure, cognition and aerobic capacity in middle aged males whereas a relation is found in older people. So the present study aimed to compare cognition and aerobic capacity, to find correlation between aerobic capacity and cognition in hypertensive and non-hypertensive group, to assess the relationship of cognition with age, years of hypertension, years of diabetes mellitus, aerobic capacity among individual with hypertension.

MATERIALS & METHODS

An observational analytical study was conducted at Physiotherapy department of SBB College of Physiotherapy, SVP Hospital and housing societies of Ahmedabad, Gujarat, India using purposive sampling. Total 108 individuals were screened, out of which 35 individuals did not match the inclusion criteria and 19 were not willing to participate in the study. So 54 (27 in each group) middle age males were included in the study. Sample size calculation was based on a pilot study. Males 40 to 65 years old, diagnosed with hypertension ≥2 years and on medication (hypertensive group) and undiagnosed of hypertension (non-hypertensive group) were included. People with uncontrolled/ malignant or secondary hypertension, severe cardiovascular condition (heart failure, CHD, DVT etc.), cardio respiratory conditions (COPD, asthma, congestive cardiac failure etc.), musculoskeletal disorders (ankylosing spondylitis, severe osteoarthritis, rheumatoid arthritis etc.) and neurological disorders (stroke, Parkinson and multiple sclerosis etc.) - due to which 6 minute walk test (6 MWT) cannot be performed, recent traumatic conditions of lower limb, any type of recent surgery of lower limb and abdomen (last 3 months), malignancy were excluded.

The study was conducted according to the ethical principles of the Declaration of

Helsinki and there was no risk to the participant. Individuals were explained about the study. Written, informed consent was obtained. Participants were divided into two groups -hypertensive group and non-hypertensive group. Assessment was done according to the performa. Each individual performed 6 MWT [11]to assess the aerobic capacity. This is moderate to high-intensity test in middle-aged is valid for assessing maximal aerobic capacity.[12] Subject should rest for approximately 10 minutes before starting the test. Measure the baseline heart rate and oxygen saturation, baseline dyspnea by using the Borg scale. Set the lap counter and timer. Provide the patient with detailed instructions on how to proceed during the test. The patient is then positioned at the starting line and allowed to walk unassisted once the test begins. As each minute passes, the patient should be informed of the time left to complete the test and encouraged to continue. At the end of the test, record the Borg dyspnea, check heart rate and oxygen saturation, the number of laps from the counter or marks on the worksheet, and total distance walked.[13] and Montreal cognitive assessment (MOCA)[14] was taken to assess the cognition. The MoCA consists of 12 items: alternating trail making (0–1 point), figure copy (0–1 point), clock drawing (0–3 points), animal naming (0–3 points), digit span (0–2 points), sustained attention (0–1 point), serial subtraction (0–3 points), sentence repetition (0–2 points), verbal fluency (0–1 point), abstract reasoning (0–2 points), memory (delayed recall, 0–5 points) and orientation (0–6 points). All items add up to MoCA, with a maximum of 30 points, where a higher score represents better cognitive functioning. [15]

STATISTICAL ANALYSIS

Analysis was done by using SPSS version 20.0 and Microsoft Excel 2007. In this study, two outcome measures were taken, one is aerobic capacity which is quantitative in nature, measured by 6MWT and other one is measure of cognition, measured by MOCA scale, which is qualitative in nature. Data of the 6MWT was screened for normality using the Shapiro-Wilk test, and it was found non-normally distributed. Non-parametric test, Mann-Whitney U test was applied to check between group comparisons for both the outcome measures. Spearman's correlation test was applied to find correlation between aerobic capacity and cognition. Association of cognition (dependent variable) with age, hypertension years, diabetes mellitus years and aerobic capacity in individuals with hypertension were assessed with linear regression analyses. Level of significance was kept at 5% ($p<0.05$).

RESULT

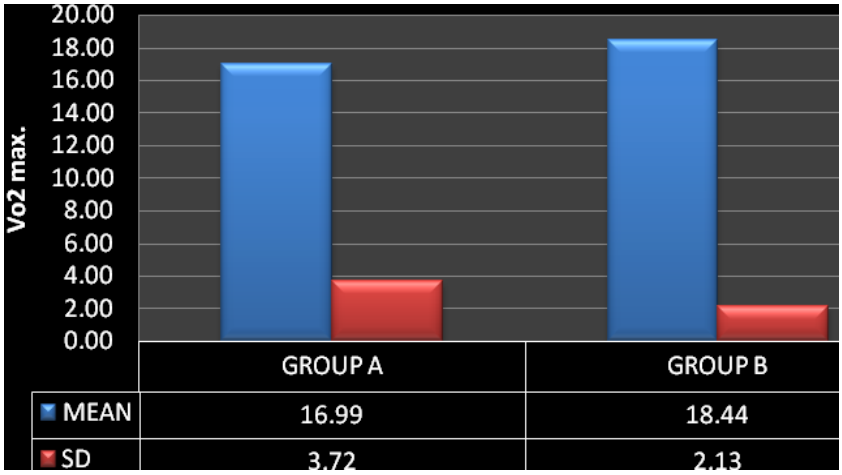
Out of 54 participants, each group had 27 individuals which were selected according to the inclusion and exclusion criteria. Table 1 shows baseline characteristics in present study.

Table 1: Baseline characteristics

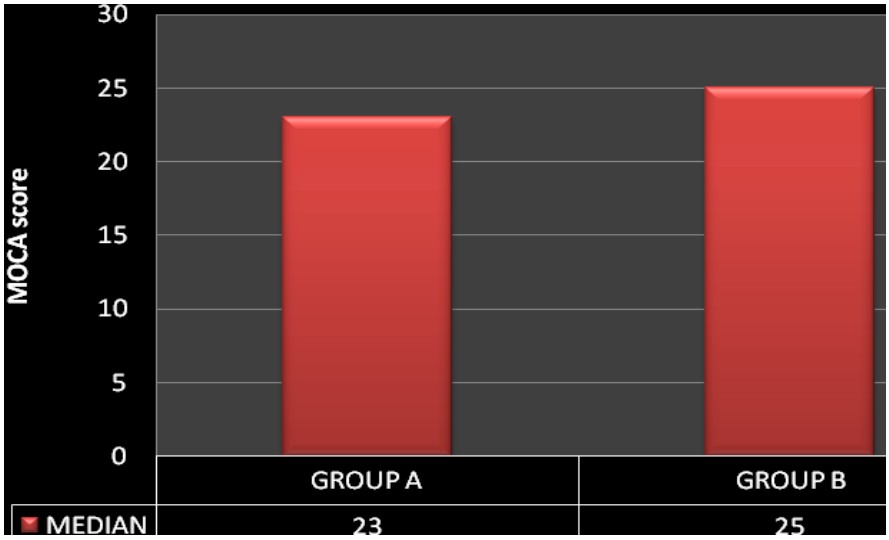
Variables	Hypertensive group	Non-hypertensive group	P value
Age (in years)	56.37± 4.05	51.07± 6.78	0.006
BMI (kg/m^2)	27.56±4.31	26.42±4.05	0.397
Occupation - Job - Businessman - Retired	30% 59% 11%	63% 30% 7%	
Smoker&/alcohol consumption	67%	56%	
Exercise status	74%	63%	0.916
Total duration of HTN	8 ± 5.64 years.	-	
DM	48%	12%	
Other medical conditions	39%	22%	

Graph 1 shows statistically significant difference between groups for 6MWT ($U=208$, $p<0.01$). Graph 2 shows difference in scores of MOCA was not found to be statistically significant between both the groups ($U= 295$, $p> 0.05$). Graph 3 shows moderate positive correlation between cognition and aerobic capacity in middle

aged male (r = 0.309, p < 0.05). Graph 4 shows strong positive correlation between cognition and aerobic capacity in hypertensive middle aged male (r =0.481, p < 0.01). Graph 5 shows no correlation between cognition and aerobic capacity in non-hypertensive middle age male (r =0.059, p > 0.05). Association between cognition with age, hypertension years, diabetes mellitus years and aerobic capacity in individual with hypertension (n=27) is shown in table 2.



Graph 1: VO2 max (ml/kg/min) in both groups



Graph 2: MOCA score in both groups

Table 2: Association between cognition with age, hypertension years, diabetes mellitus years and aerobic capacity in individuals with hypertension

Variable	B (95%CI)	P value
Age	0.423(0.130-0.716)	0.007
Hypertension Year	0.598(-0.567-1.763)	0.299
Diabetes mellitus year	0.322(-0.760-1.404)	0.543
Aerobic capacity	0.491(0.184-.0798)	0.003

Dependent variable: Cognition

Where B - unstandardized regression coefficient; CI - confidence interval.

DISCUSSION

In present study statistically significant difference ($p < 0.05$) was found VO_2 max in hypertensive and non-hypertensive middle aged males. Similarly, Fagard R et al concluded that in young and middle aged men, elevated blood pressures (BP) and greater age were both associated with reduction of VO_2max.[16] Kraft KA et al concluded that normotensive subjects have higher aerobic capacity with lower aortic stiffness compared to hypertensive individuals.[17] Other studies suggest that the rising BP with age is associated with structural changes in the arteries and especially with large artery stiffness, reduced aerobic fitness, increased CV risk in the elderly.[18] Hypertension accelerates arteriosclerotic changes in the brain predisposing to vascular changes result in a reduced luminal diameter, increased resistance to flow and a decline in perfusion.[19] Such hypo perfusion can produce discrete regions of cerebral infarction and diffuse ischemic changes in the periventricular and deep white matter (leukoaraisosis) causing vascular cognitive impairment.[20] Hypertension causes many pathological changes in the vascular system, and these changes may lead to cognitive dysfunction. A study found that diastolic blood pressure (DBP) increased by 10mm Hg, the risk of cognitive decline increased by 7%, and when systolic blood pressure (SBP)>160mm Hg, the cognitive function was significantly reduced.[21]

In present study statistically not significant difference ($p < 0.05$) was found in MOCA scores between hypertensive and non-hypertensive middle aged males. Hypertension is associated with stiffening of large arteries; this stiffening may also reduce cerebrovascular blood flow. Chronic hypertension exerts profound influence on the structure of cerebral vasculature,[22] which may give rise to cognitive impairments. These findings are similar to studies done by Min Li et al suggest that aging, hypertension and type 2 diabetes mellitus, are the most important contributing factors for the development and progression toward cognitive impairment. The relationship between hypertension and cognitive dysfunction has been a concern, and the mechanism of hypertension-related cognitive dysfunction remains unclear.[23] Kivipelto M et al found that in midlife vascular risk factors like hypertension, diabetes mellitus, hyperlipidemia lead to the development of mild cognitive impairment (MCI) in late life.[24] The study done by, Marijanatadic et al, also supports findings of our study, that hypertension related cognitive dysfunction develops as a result of imbalance in autoregulation of cerebral blood flow and cerebral vascular alterations. They emphasized that, special attention should be given to hypertensive adults in their mid-life to reduce the chances of developing cognitive impairments in later life.[25]

There is moderate positive correlation between cognition and aerobic capacity ($r = 0.309$, $p < 0.05$), strong positive correlation between cognition and aerobic capacity ($r = 0.481$, $p < 0.01$), no correlation between cognition and aerobic capacity in non-hypertensive middle age males ($r = 0.059$, $p > 0.05$). Hwang J et al found that a high capacity for maximal oxygen uptake among healthy, young adults was associated with greater cerebral vasomotor reactivity that high-aerobic fitness may promote cerebrovascular and cognitive functioning abilities.[26] Fiocco AJ et al found that strong associations exist between physical fitness (i.e.VO_2 max), vascular function and cognition, which provides new understanding regarding the mechanisms by which fitness positively impacts cognition with aging. [27] In present study cognition was associated in an ascending way with years of hypertension, aerobic capacity, age and DM years. In later cognition is affected in hypertensive group. Studies suggest that CVD risk factors such as hypertension, diabetes, and hyperlipidemia place individuals at risk not only for stroke and ischemic heart disease, but also for neurocognitive impairment and dementia,

and that the effects of these CVD risk factors on the brain may be additive. Lifestyle behaviors, including physical activity and healthy dietary habits have been shown to improve CVD risk factors and may aid in the prevention of neurocognitive decline. Physically active individuals are less likely to develop dementia and studies have suggested that aerobic exercise may improve neurocognition in healthy adults. Higher CVD risk and greater inflammation have been linked to impaired neurocognition and may mediate the relationship of lifestyle habits and neurocognition.[28] However this was not studied in the present study. It was a limitation of this study that education, occupation, socio-economic status were not evaluated.

CONCLUSION

The findings suggest that lower aerobic capacity and no difference in scores of cognitions in men with hypertension group compared to non hypertensive group middle aged males is seen. Moderate correlation between aerobic capacity and cognition in middle aged males with hypertension and no correlation between aerobic capacity and cognition in non-hypertensive group was seen. Cognition is affected according to duration of hypertension, aerobic capacity of individuals, years of diabetes mellitus, other co-morbidities, and age. So, studies to see the effect of regular aerobic exercise on aerobic capacity, cognition and quality of Life can be done.

Declaration by Authors

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