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Original research article

COMPARISON OF COGNITIVE FUNCTIONS BETWEEN PREHYPERTENSIVE AND NORMOTENSIVE SUBJECTS

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Abstract

It is from this period that the changes of aging starts being exerted on one's mind, showering a property of neuronal plasticity on the brain, making it vulnerable to certain parameters like BP, level of physical activity, quality of education obtained, diet, presence of co-morbid conditions like atherosclerosis, diabetes mellitus, secondary hypertension, and last, but definitely not the least, the arterial stiffness. This dearth of studies is fulfilled by my study which is a cross-sectional study, comparing normotensives with prehypertensives, belonging to the age-group, 40-60 yrs.In our study there was significantly BP correlated with MMSE (Mini Mental Status Examination) (P=0.001*) and whereas CDT (Clock Drawing Test), TMT-A and TMT-B were not significantly correlated with blood pressure. It shows comparison between cognitive function and blood pressure. In our study there was BP significantly correlated with MMSE (P=0.001*) and whereas CDT, TMT-A and TMT-B were not significantly correlated with blood pressure.

Keywords:Cognitive functions, prehypertensive, normotensive subjects, MMSE (Mini Mental Status Examination), CDT (Clock Drawing Test), TMT (Trail Making Test), CF(cognitive function).

Introduction

CF is an important higher function required for leading a quality life, without any hindrances in the form of impaired computational ability or impaired memory or reasoning or decreased executive or visuo-spatial ability and the list goes on. It is a dynamic higher function which undergoes changes since its inception depending on the

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various factors like nurturing by the parents, level of education, memory capacity of the individual, executive function of the individual, which is by virtue of the genetic make-up, which makes up the inherent feature of the individual, giving him a unique feature. So, therefore by the time an individual comes to middle-age group, every individual has his own capacity of CF, developed due to nature and further modified due to nurture brought about by the environmental influences on his mind[1].

It is from this period that the changes of aging starts being exerted on one's mind, showering a property of neuronal plasticity on the brain, making it vulnerable to certain parameters like BP, level of physical activity, quality of education obtained, diet, presence of co-morbid conditions like atherosclerosis, diabetes mellitus, secondary hypertension, and last, but definitely not the least, the arterial stiffness[2].

Therefore, my study aims at studying the effect of factors such as BP and arterial stiffness on level of CF in the middle-aged individuals (40-60 yrs.) in between two groups, namely normotensives and prehypertensives. There are many studies enlightening the effect of BP on CF of individuals belonging to the age category (>60 yrs.), i.e. the elderly, findings being contradictory to each other. Some studies favour the observation that increased BP for a prolonged period of time, can affect the entire trajectory of ageing-associated CF and accelerate the same, making the patient ending up in dementia. On contrary, some studies favour the observation that isolated systolic hypertension showed improvement of CF in elderly, especially above 80 yrs. of age, basically due to improved blood flow to the areas of brain determining the CF[3].Some other studies showed no effect of increased SBP or increased DBP on the CF, especially in the elderly. Amidst this uncertainty of the exact BP level, at which there can be shown a significant improvement of CF has not been known, specially proven by RCTs. However, many of these studies aimed at studying hypertensive individuals and its relationship with CF, in both treated and untreated subjects, especially the elderly, causing a deficit in studies which could pass a probe on the effect of a special category of BP, calledprehypertension, a precursor stage, before HTN, especially in the middle-aged individuals. This dearth of studies is fulfilled by my study which is a cross-sectional study, comparing normotensives with prehypertensives, belonging to the age-group, 40-60 yrs. [4].

Methodology

The study was approved by Ethical Committee. Conducted in the Department of Physiology, BLDEU'S Shri B M Patil medical college.

Study design

The study design was cross sectional study.

Source of Data

Group-P: Subjectswith Prehypertensives (SBP between 120-139 mmHg and DBP between 80-89 mmHg),Group will consist of(N=45) age-matched prehypertensive subjects belonging to the age group 40-60 yrs.

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Group-N: Subjectswith Normotensives, (SBP <120 and DBP <80 mmHg) Group will consist (N=45) age-matched normotensive subjects belonging to the age group 40-60 yrs

Sample size

The present study included a total sample size of 90.

Inclusion criteria

1. Belonging to age group 40-60 years.
2. Persons who give informed written consent for participation in study.
3. Normotensive.
4. Prehypertensives.

Exclusion criteria

1. Patient refusal.
2. Patients with secondary hypertension.
3. Diabetes Mellitus.
4. Stroke.
5. Dementia.
6. Head injury/ Patients with any Trauma.
7. CHD-congenital heart disease.
8. CAD-coronary artery disease.
9. VHD-valvular heart disease.
10. Cardiac arrhythmias.
11. Patients with PVD-Peripheral vascular disease.
12. Patients on any psychiatric medication.
13. Patients with any Kidney disorders.
14. Patients with any Liver disease.
15. Patients onmedications - antihypertensive, anticoagulants.

Results

Table 1: Correlation between cognitive functions and Blood Pressure (N=90)

Variables	SBP		DBP	
	R value	P value	R value	P value
MMSE	0.370	0.0.001*	-0.182	0.086NS
CDT	-0.135	0.0.204	-0.190	0.073NS
Trail Making Test A	-0.163	0.124	-0.062	0.073NS
Trail Making Test B	-0.110	0.124	-0.062	0.073NS
WMS	-0.309	0.003*	-0.218	0.042*

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Table 1 shows correlation between cognitive function and blood pressure. SBP was significantly correlated with MMSE (P=0.0.001*) and WMS (P=0.003*), whereas CDT, TMT-A and TMT-B were not significantly correlated with blood pressure.
DBP was weakly correlated with MMSE but it was not statistically significant (P=0.086), while WMS was significantly correlated with DBP (P=0.042*). There was no significant relationship between CDT, TMT-A and TMT-B and diastolic blood pressure.

Table 2: Correlation between cognitive functions and arterial stiffness (N=90)

Variables	baPWV	
	R value	P value
MMSE	0.007	0.948 NS
CDT	-0.034	0.948 NS
Trial Making Test A	-0.011	0.917 NS
Trial Making Test B	-0.032	0.764 NS
WMS	-0.011	0.916 NS

Table 2 shows correlation between cognitive functions: MMSE (P=0.948), CDT (P=0.948), TMT-A (P=0.917), TMT-B (P=0.764), WMS (P=0.948). And Arterial Stiffness- baPWV.
There was not significant correlation between cognitive function (all domains) andarterial stiffness (P=0.948).

Table 3: Correlation between cognitive function - MMSE and Blood Pressure (SBP, DBP) and Arterial Stiffness

Correlation between MMSE and	Correlation coefficient (r)	Significant value	Remark
SBP	r=0.370	P=0.001*	Moderate positive correlation and it issignificant
DBP	r=-0.182	P=0.086NS	MildNegativecorrelation and it is not significant
Right baPWVC	r=0.007	P=0.948 NS	No correlation

Table 3 shows correlation between cognitive function- MMSE with blood pressure and arterial stiffness.
SBP was significantly correlated with MMSE (P=0.001*)
DBP was weakly correlated with MMSE but it was not statistically significant (P=0.086).

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There was not significant correlation between cognitive function- MMSE and arterial stiffness (P =0.948).

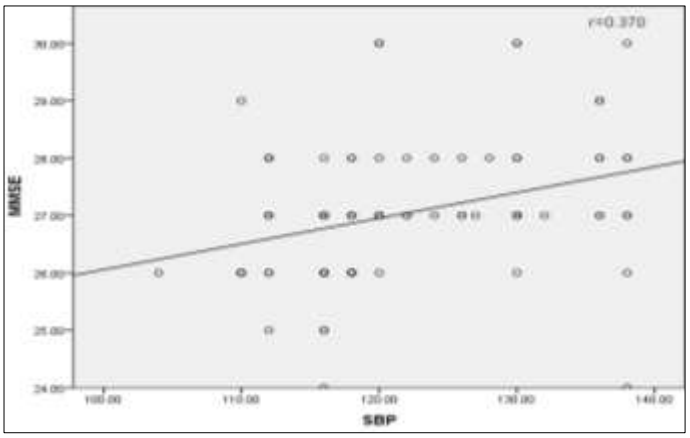

Fig 1: Correlation between cognitive function - MMSE and SBP

It shows SBP was significantly correlated with MMSE (P=0.001*).

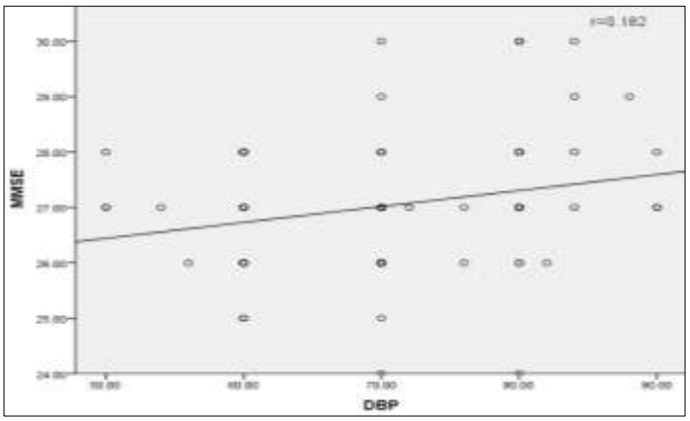

Fig 2: Correlation between cognitive function - MMSE and DBP

It showsDBP was weakly correlated with MMSE and it is not statistically significant (P=0.086).

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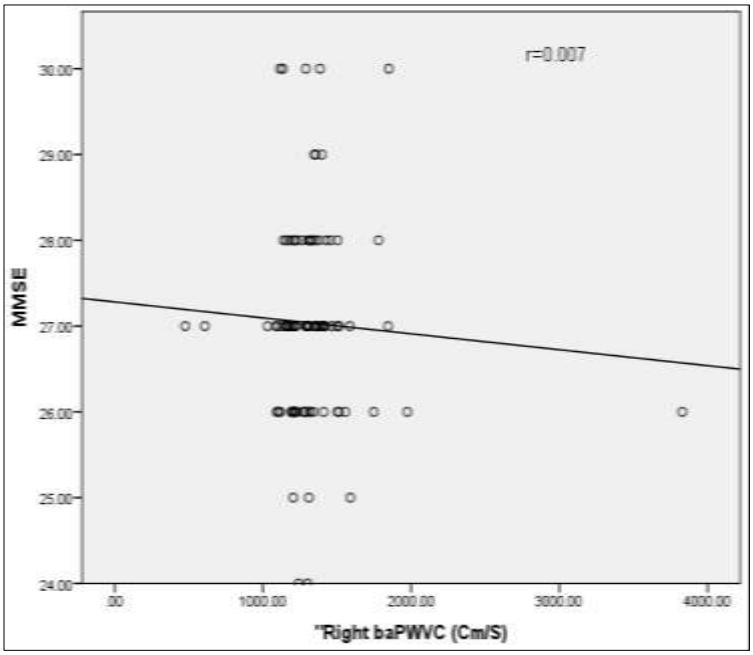

Fig 3: Correlation between cognitive function - MMSE and Arterial Stiffness-Right ba PWVC

It shows there was not significant correlation between cognitive function- MMSE and arterial stiffness Right ba PWVC (Cm/S) (P =0.948).

Table 4: Correlation between cognitive function- CDT and Blood Pressure (SBP, DBP) and Arterial Stiffness

Correlation between CDT and	Correlation coefficient (r)	Significant value	Remark
SBP	r=-0.135	P=0.204	Mild Negative correlation and it is not significant
DBP	r=-0.190	P=0.073NS	MildNegativecorrelation and it is not significant
Right baPWVC	r=-0.034	P=0.948 NS	Negligible negative correlation, it is not significant.

Table 4 shows correlation between Cognitive Function- CDT with Blood Pressure and arterial stiffness.
CDT not significantly correlated with Systolic blood pressure SBP (P=0.204).
CDT not significantly correlated with Diastolic blood pressure DBP (P=0.073).
There was not significant correlation between cognitive function CDT and arterial stiffness (P =0.948).

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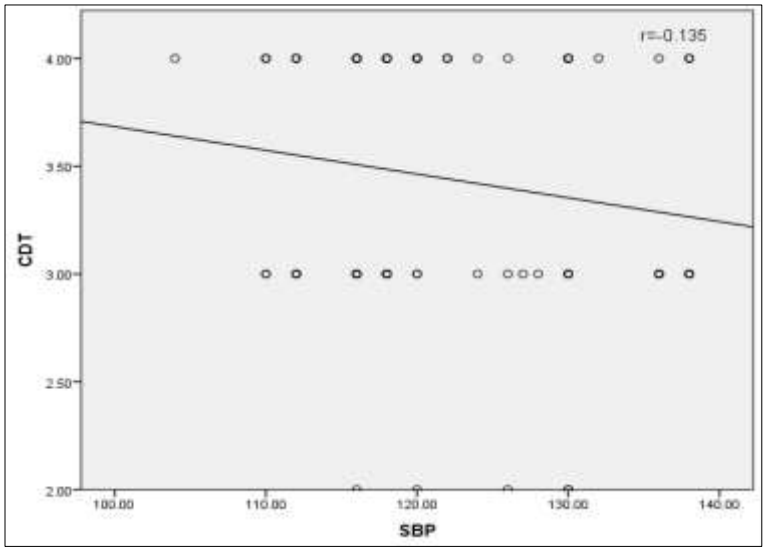

Fig 4: Correlation between cognitive function - CDT and SBP

It shows CDT not significantly correlated with Systolic blood pressure SBP (P=0.204).

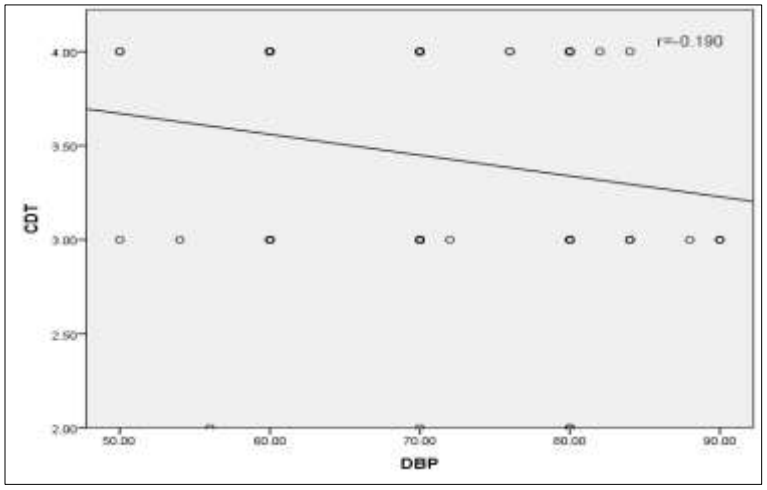

Fig 5: Correlation between cognitive function - CDT and DBP

It shows CDT not significantly correlated with Diastolic blood pressure DBP (P=0.073).

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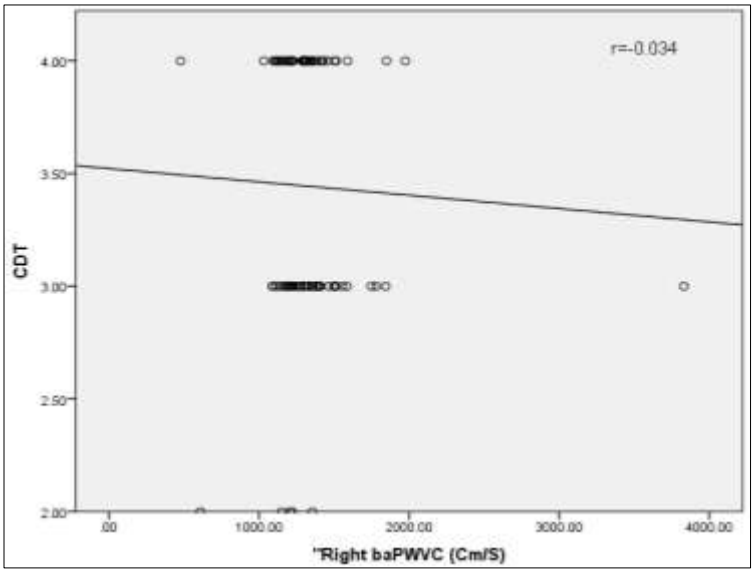

Fig 6: Correlation between cognitive function- CDT and Arterial Stiffness

It shows there was not significant correlation between cognitive function CDT and arterial stiffness (P =0.948).

Table 5: Correlation between cognitive function - Trail Making Test A and Blood Pressure (SBP, DBP) and Arterial Stiffness

Correlation between Trail Making Test A and	**Correlation coefficient (r)**	**Significant value**	**Remark**
SBP	r=-0.163	P=0.124	Mild Negative correlation and it is not significant
DBP	r=-0.087	P=0.416NS	NegligibleNegativecorrelation and it is not significant
Right baPWVC	r=-0.011	P=0.917 NS	Negligible negative correlation, it is not significant.

Table 5 shows correlation between cognitive function- Trail Making Tests A with blood pressure. And arterial stiffness.

Trail Making Test A is not significantly correlated with Systolic blood pressure -SBP (P=0.124)

Trail Making Test A is not significantly correlated with Diastolic blood pressure- DBP (P=0.416).

There was not significant correlation between cognitive function Trail Making Test A and arterial stiffness (P=0.917).

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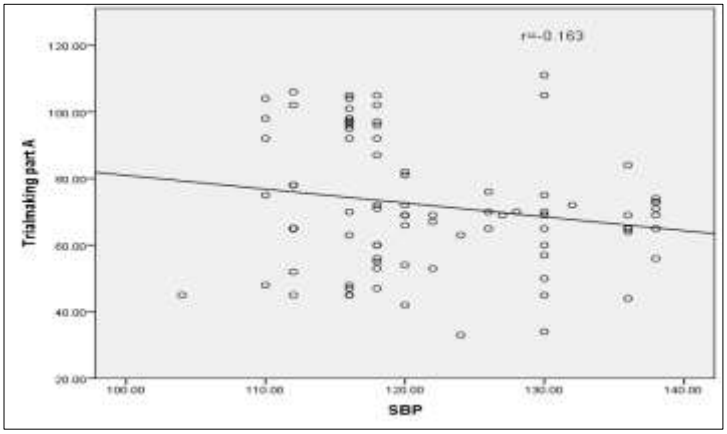

Fig 7: Correlation between cognitive function - Trail Making Test A and SBP

Itshows Trail Making Test A is not significantly correlated with blood pressure SBP (P=0.124).

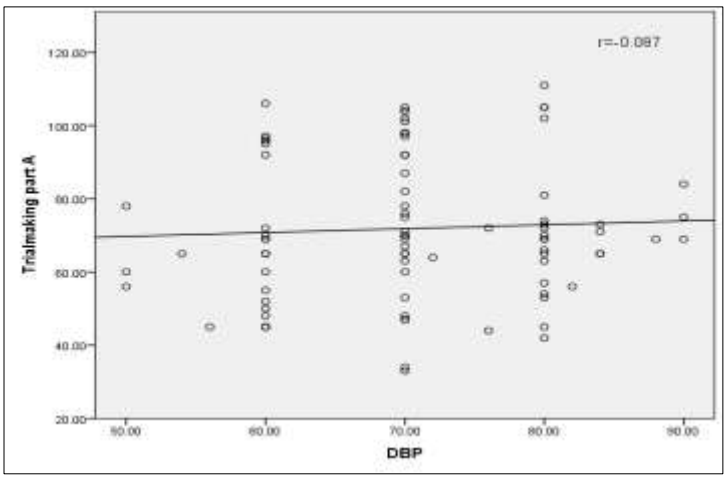

Fig 8: Correlation between cognitive function - Trail Making Test A and DBP

It shows Trail Making Test A is not significantly correlated with Diastolic blood pressure DBP (P=0.416).

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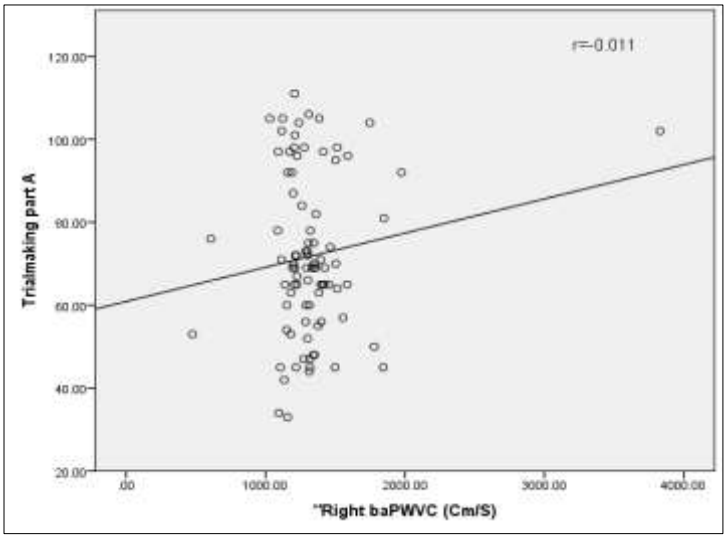

Fig 9: Correlation between cognitive function - Trail Making Test A and Arterial Stiffness

It shows there was not significant correlation between cognitive function Trail Making Test A and arterial stiffness (P=0.917).

Table 6: Comparison of Cognitive Functions between Prehypertensive and Normotensive subjects

Variables	Prehypertensive	Normotensive	Unpaired t test
	Mean ± SD	Mean ± SD	
MMSE	27.51±1.25	26.53±0.97	P=0.001*
CDT	3.38±0.65	3.51±0.55	P=0.382 NS
Trail Making Part A	67.40±15.41	77.16±21.88	P=0.063NS
Trail Making Part B	162.60±50.38	181.42±43.53	P=0.166NS
WMS	22.10±2.16	19.23±2.27	P=0.483 NS

Table 6 shows comparison of Cognitive Functions between Prehypertensive and Normotensive subjects.

In our study there was significantly BP correlated with MMSE (P=0.001*) and whereas CDT, TMT-A and TMT-B were not significantly correlated with blood pressure.

.It shows comparison between cognitive function and blood pressure.

In our study there was BP significantly correlated with MMSE (P=0.001*) and whereas CDT, TMT-A and TMT-B were not significantly correlated with blood pressure.

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Discussion

While studying the effect of prehypertension on the level of CF, one can understand that AS, is also one such parameter which can modulate the level of CF, in a way that, it has an adverse effect on it. The state of stiff arteries makes the free blood flow to the brain very restrictive such that, uniformity of blood flow to the areas of the brain gets affected. Many studies favoured the observation that chronically elevated AS, measured in terms of ba-PWV had an adverse effect on the CF, producing a significant cognitive decline; especially in the elderly; howmuch ever authenticated it may be, lack of RCTs in favour of this observation could not transform the management of Alzheimer's Disease, in terms of prevention of elevation of AS, intervention which can be taken, right from middle-age[5].

Now, that we know that both AS and BP can influence CF, especially independently, supported by various above mentioned studies, one has to still find out the mysterious relationship between AS and BP, as to whether their interaction in a positive or negative co-relation way is responsible for augmentation of CF orreduction of performance associated with CF. Therefore my study aimed at seeking the answer to the same question of a probable relationship between BP and AS, as to how it influences the cognitive functioning[6].

According to our study, the CF assessed by MMSE shows a positive correlation with SBP implying that elevated SBP in middle-aged individuals for a prolonged period can show improvement in CF, especially if BP falls in the prehypertensive range. This is further proved by other studies, that with the further treatment with use of antihypertensives, there was no improvement in the CF, implying that sustained elevated BP in the hypertensive range. Hence, BP when present in the prehypertensive range has a positive correlation with CF, which deviates in the hypertensives. This can be explained on the basis of the fact that may be there are no pathological correlates of hypertension, like cerebral ischaemia, cerebral infarction, vascular smooth muscle hyperplasia and atherosclerosis of small and large blood vessels, developing in the prehypertensives range of BP. This only suggests that BP in the prehypertensive range of BP. This only suggests that prehypertensive range of BP only can improve the CF, that too globally, by virtue of improved blood flow, which is not seen in case of hypertension range of BP [7].

The second finding of our study is that DBP shows mild negative correlation with CF assessed by MMSE, that too, which is not statistically significant. This finding suggests that, with increase in DBP, there is decrease in CF. It can be further stressed byvarious studies that increase in DBP, reduces the PP such that the perfusion of the cerebrum gets affected which leads to hypo perfusion, resulting in cognitive decline[8].

Our next finding suggests that CF assessed by CDT, TMT-A & TMT-B has a mild negative correlation with SBP & DBP which is not statistically significant. Hence, we can say that increase in SBP & DBP may lead to decrease in CF, that too to lesser extent, without any significant risk factor level of association. Many studies suggests that BP elevated for significant duration can lead to various pathological consequences like cardiovascular remodeling, specially the increase in the thickness of the large and small blood vessels, leading to impaired blood flowto that area of the brain which is

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associated with the visuo-constructiveabilities, psychomotor speed & executive function.

Our further finding suggests that CF assessed by WMS has moderate negative correlation with SBP& DBP suggesting that with increase in SBP & DBP levels of BP, there is decrease of CF, especially in the domain of associate learning. Some studies suggests that chronically elevated SBP & DBP levels, even in the prehypertensive range can prove to be detrimental, and can increase the risk of dementia in them in late-adult life, especially the domain of associate learning[9].

Our final study suggests that the CF assessed by MMSE, CDT, TMT-A, TMT-B and WMS shows no significant or negligible negative correlation with AS, measured in the form of Rt.ba PWV. Therefore, we can say that then exists no linear correlation between Rt.ba PWV & CF involving various domains such as global CF, visuo-constructive abilities, psychomotor speed and executive function and finally recall and associate-learning. Some studies suggested AS is a parameter which undergoes changes only under the influence of alteration of haemodynamics of the blood vessel wall, especially in case of hypertensives, leading to loss or fragmentation of elastin fibres within the vessel wall and associated with collagen deposition. Since such alteration of vessel wall hemodynamics does not occur within the prehypertensive range, AS does not have any effect on the CF, be it any domain[10].

Conclusion

Therefore, we can conclude thatglobal CF and domains like recall and associate learning can get affected with elevated SBP, especially in the prehypertensive range, in middle-aged individuals, showing a positive correlation. Hence, if interventions in the form of lifestyle modifications like exercise, reduced salt intake, consuminglesser amount of cholesterol-laden foods, can be prevented. Therefore, it' s essential that one's BP in the prehypertensive range should always be kept under control, through lifestyle modifications as mentioned before, so that their becoming hypertensives can be prevented to a large extent.

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