

# Effectiveness of Cocoa Powder on Selected Biophysiological Parameters of Hypertension

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## ABSTRACT

**Background:** Hypertension is a life-threatening disease which involves not only the elevation of blood pressure but also the silent evolution of certain biophysiological parameters that paves a wide way towards halting the process of cardiovascular disorders in the near future. Cocoa powder, the naturally available food item aids in above said halting process as a single remedy.

**Methods:** Quantitative- true experimental study was conducted among ten hypertensive clients who were under regular treatment by simple random sampling and experimental group clients were provided 5 gram of cocoa powder in the morning every day for 90 days after assessing their selected biophysiological parameters. Pretest and posttest results of the experimental and control group were analysed statistically.

**Results:** There was a significant difference and reduction in all the physiological and biochemical parameters of hypertension between the pretest and posttest scores of experimental group with no significant difference in the control group.

**Conclusion:** In spite of under regular hypertensive treatment, the clients with hypertension is having some elevation of parameters without their knowledge which will finally fit them in some critical cardiovascular issues. Cocoa powder has a wide range of beneficial effects thereby improving the compliance of the hypertensive clients.

**Keywords:** Hypertension, Biophysiological Parameters, Cardiovascular Disorders, Cocoa Powder.

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## INTRODUCTION

Hypertension is such a mind-bending disease that conquers majority of lives in 21<sup>st</sup> century irrespective of caste, creed, sex, religion etc. Sedentary lifestyle, smoking, mental stress, abdominal obesity, potassium deficiency, alcohol intake, pronounced aging, vitamin D deficiency, high salt and fat intake, pregnancy and unusual medical conditions like diabetes are all the pre-guides for the incidence of hypertension [1]. 1.13 billion people worldwide have hypertension and two-thirds are living in low and middle income countries. One of the global targets for noncommunicable diseases project is to reduce the prevalence of hypertension by 25% by 2025 (baseline 2010) as hypertension possess 19% attributed global deaths in the world [2]. Recent estimates suggest that a 2 mm Hg population-wide decrease in systolic blood pressure can lead to prevention of more than 151,000 stroke and 153,000 coronary heart disease deaths in India [3]. It is evident that more than 45% risk is there for the hypertensive clients in their lifetime.

The treatment of hypertension involves anti-hypertensive drugs and the best proven non-pharmacological interventions for the prevention and treatment of the same encompasses weight reduction, healthy diet, reduced intake of dietary sodium, enhanced intake of potassium, increased physical activity and reduction of alcohol intake [4]. As per the new guidelines, basic detection (biological parameters) methods of hypertension includes complete blood count, lipid profile, serum electrolytes, thyroid-stimulating hormone, renal function tests, blood glucose levels and physical parameters like body mass index, waist

circumference and hip-waist ratio to assess the abdominal obesity [5]. These all tests contemplate with hypertension and its comorbidities. Optimal analysis includes urinalysis, electrocardiogram, echocardiogram and other specific metabolic panels [6].

Treating hypertension only reduces cardiovascular risk by 25% but treating increased cholesterol in hypertension clients reduces the residual cardiovascular risk for more than 35% as 61% to 65% of hypertensives are hypercholesterolemic [7]. Hence it is mandatory to treat the hypertensive clients not only for the increased blood pressure but also the increased cholesterol, alterations in serum electrolytes, glucose levels and renal parameters thereby decreasing the complications of heart attack, heart failure and renal failure [8].

Cocoa solids are the mixture of many substances remaining after cocoa butter is extracted from cocoa beans. Chocolate and cocoa derive their health benefits from flavonoids which are the plant pigments capable of acting as antioxidants and has much if epicatechin to counteract some of the cellular damage that can lead to chronic diseases such as cancer and heart diseases (Karin Ried et.al, 2017). [9] Cocoa flavanols does the function of ACE inhibitors by inhibiting the activity of angiotensin converting enzyme thereby enlarges blood vessels, improves vascular function, decreasing blood pressure, decreases peripheral vascular disease, controls nitric oxide synthase production and increases bioavailability of nitric oxide (NO) [10]. Cocoa has flavanols which has antioxidant capacity releases a broad range of vasoactive substances improves the endothelial function (Maria Monagas et.al., 2009) [11], lowers the plasma levels of

cholesterol, sodium retention, potassium excretion and monitors healthy renal parameters thereby reduces the risk of cardiovascular diseases and stroke in the near future (N.Khan et al., 2012) [12].

In this perspective, the present study had been undertaken with the aim of reducing all biophysiological parameters of hypertension by the single remedy of the consumption of cocoa powder. This intake decreases the cost of medical expenses pertaining to hypertension and its comorbid disease conditions thereby increases the health compliance of hypertensive clients. The rural population especially are refrained from spending much to overrule hypertension and its unknown elevated parameters and they will be aware of their own arising complications only after its sudden burst in some parts of their life. Cocoa plays a significant beneficial role in maintaining the hypertensive parameters in the safe mode so that the people will lead a better quality of healthy life.

### MATERIALS AND METHODS

The research was commenced after the approval of the Institutional Ethics Committee (IEC) of Saveetha Medical College Hospital (Ref No 004/09/2019/IEC/SMCH). The research trial was registered in clinical registry of India (CTRI/2020/01/022772). Quantitative research approach was implemented with true experimental research design. Random sampling method was used to select hypertensive client samples with five in experimental and five in control group. Sample size was estimated by Sigmaplot 13 (systat software, Inc).

Inclusion criteria for the research study included the hypertensive clients who had stage I hypertension (systolic 130-139 mm Hg and diastolic 80-89 mm Hg), stage II hypertension (systolic 140-179 mm Hg and diastolic 90-119 mm Hg), who were between the age group of 30 and 70 years, were of both genders, were under regular treatment, elevated cholesterol levels and could understand Tamil and English. The hypertensive clients who were pregnant, in lactation period, having other major cardiovascular complications, not willing to undertake the intervention and not available at the time of data collection were excluded from the research study. Data collection tool consisted of demographic variables and observational schedule of selected biophysiological parameters of hypertension. Demographic variables comprised of age in years, gender, education, occupation, monthly income, religion, marital status, type of family, dietary habits, intake of fruits and vegetables daily, duration of hypertension, regular treatment, family history of hypertension, habit of tobacco chewing, habit of smoking, habit of alcohol intake, abdominal obesity, amount of salt intake per day, history of daily physical activity and history of stressful lifestyle.

Observation schedule encompassed physiological parameters (body mass index, waist circumference, hip-waist ratio, blood pressure) and biochemical parameters (random blood sugar, total cholesterol, high density lipoprotein, low density lipoprotein, triglycerides, serum sodium, serum potassium, serum chloride, serum urea, serum creatinine and serum uric acid). The study was conducted for a period of three months. Written consent

was obtained from each participant and their privacy, confidentiality were assured. The cocoa powder was given as 5 gram per day in the morning before food for ninety days after the pretest serological tests. On 91<sup>st</sup> day posttest was conducted for the participants and the findings of the participants were recorded in the coding sheet. The final analysis was done by descriptive and inferential statistics.

### RESULTS

Demographic variables in categorical/dichotomous were given in frequencies with their percentages. Biophysiological parameters score were given in mean and standard deviation. Quantitative data difference between experiment and control was analysed using non parametric Mann Whitney U-test. Quantitative data difference between pretest and posttest was calculated using student non-parametric Wilcoxon signed rank test.

Association between Bio-physiological parameters score with demographic variables were analysed using non-parametric kruskal wallis test and mann whitney test. A p-value of  $\leq 0.05$  was considered statistically significant, and two-tailed tests were used for significance testing. Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS, version 16) software.

With related to the collected demographic profile of ten hypertensive clients, the majority wise percentage were explained likewise. Among the five experimental group clients, 60% were in the age group of 41-50 years, 60% were females, 70% did their post-graduation, 80% were working in private sectors, all were mixed dietary patterned persons, were under regular treatment, had abdominal obesity and taking 5 g and more of salt per day with 60% in stressful lifestyle. Among the five control group clients, 60% were in the age group of 41-50 years, 70% did their post graduation, all were working in private sectors, all were mixed dietary patterned persons, were under regular treatment, had abdominal obesity and 40 % were taking 5 g and 70% in stressful lifestyle.

Table 1: Demographic variables of the study participants

Demographic variables		Group			
		Experiment (n=10)		Control (n=10)	
		n	%	n	%
Age in years	31-40 years	2	20.00%	2	20.00%
	41-50 years	6	60.00%	6	60.00%
	51-60 years	1	10.00%	1	10.00%
	61-70 years	1	10.00%	1	10.00%
Gender	Male	4	40.00%	4	40.00%
	Female	6	60.00%	6	60.00%
Education	Postgraduate	7	70.00%	7	70.00%
	Undergraduate	2	20.00%	2	20.00%
	Higher secondary	1	10.00%	1	10.00%
	Primary education	0	0.00%	0	0.00%
	Illiterate	0	0.00%	0	0.00%
Occupation	Government sector	0	0.00%	0	0.00%
	Private sector	8	80.00%	10	100.00%
	Self-employed	0	0.00%	0	0.00%
	Retired	1	10.00%	0	0.00%
	Homemaker	1	10.00%	0	0.00%
	Others	0	0.00%	0	0.00%
Monthly income	Below Rs.5000	2	20.00%	0	0.00%
	Rs.5001-10000	0	0.00%	4	40.00%
	Rs.10001-15000	5	50.00%	5	50.00%
	Above Rs.15001	3	30.00%	1	10.00%
Religion	Hindu	4	40.00%	5	50.00%
	Muslim	1	10.00%	1	10.00%
	Christian	5	50.00%	4	40.00%
	Others	0	0.00%	0	0.00%
Marital status	Married	9	90.00%	10	100.00%
	Unmarried	1	10.00%	0	0.00%
	Separated	0	0.00%	0	0.00%
	Divorced	0	0.00%	0	0.00%
Type of family	Nuclear family	8	80.00%	8	80.00%
	Joint family	2	20.00%	2	20.00%
Dietary habits	Vegetarian	0	0.00%	0	0.00%
	Mixed	10	100.00%	10	100.00%
Intake of fruits and vegetables daily	Yes	5	50.00%	4	40.00%
	No	5	50.00%	6	60.00%

Table 2: Personal information of the hypertensive participants of the study

Personal variables		Group			
		Experiment (n=10)		Control (n=10)	
		n	%	n	%
Duration of hypertension	Less than 5 years	4	40.00%	4	40.00%
	6-10 years	4	40.00%	4	40.00%
	11-15 years	0	0.00%	2	20.00%
	More than 15 years	2	20.00%	0	0.00%
Regular treatment	Yes	10	100.00%	10	100.00%
	No	0	0.00%	0	0.00%
Family history of hypertension	Yes	5	50.00%	6	60.00%
	No	5	50.00%	4	40.00%
Habit of smoking	Yes	0	0.00%	3	30.00%
	No	10	100.00%	7	70.00%
Habit of alcohol intake	Yes	0	0.00%	3	30.00%
	No	10	100.00%	7	70.00%
Habit of chewing tobacco	Yes	0	0.00%	1	10.00%
	No	10	100.00%	9	90.00%
Abdominal obesity	Yes	10	100.00%	10	100.00%
	No	0	0.00%	0	0.00%

Amount of salt intake per day	Less than 5 g	0	0.00%	3	30.00%
	Absolute 5 g	5	50.00%	4	40.00%
	More than 5 g	5	50.00%	3	30.00%
History of daily physical activity	Light	8	80.00%	8	80.00%
	Moderate	2	20.00%	2	20.00%
	Vigorous	0	0.00%	0	0.00%
History of stressful lifestyle	Yes	6	60.00%	7	70.00%
	No	4	40.00%	3	30.00%

Table 3: Comparison of pretest physiological parameters of the experiment and control group

Physical parameters	Group				Mean Difference	Mann Whitney u-test
	Experiment (n=10)		Control (n=10)			
	Mean	SD	Mean	SD		
Height(cm)	159.00	7.62	162.70	7.01	3.70	z=1.21 p=0.22(NS)
Weight(kg)	76.10	8.28	77.10	9.59	1.00	z=0.64 p=0.52(NS)
Body Mass Index	30.53	3.18	29.11	2.48	-1.42	z=1.10 p=0.29(NS)
Waist circumference (cm)	101.80	4.85	102.30	5.23	0.50	z=0.11 p=0.91(NS)
Hip-waist ratio (m)	1.04	.06	1.04	.04	0.00	z=0.38 p=0.70(NS)

Table 4: Comparison of pretest biochemical parameters of the experiment and control group

Biochemical parameters	Group				Mean Difference	Mann Whitney u-test
	Experiment(n=10)		Control(n=10)			
	Mean	SD	Mean	SD		
Systolic Blood Pressure(mmHg)	144.00	8.43	144.00	10.75	0.00	z=0.08 p=0.94(NS)
Diastolic Blood Pressure(mmHg)	100.00	10.54	103.00	6.75	3.00	z=0.92 p=0.36(NS)
Random Blood Sugar(mmHg)	154.20	46.93	138.80	41.18	-15.40	z=0.68 p=0.49(NS)
Total cholesterol(mg/dl)	279.90	12.31	263.90	22.69	-16.00	z=1.74 p=0.08(NS)
Low density lipoprotein(mg/dl)	170.50	16.51	164.50	20.21	-6.00	z=0.68 p=0.49(NS)
High density lipoprotein(mg/dl)	43.10	16.86	46.90	19.36	3.80	z=0.42 p=0.68(NS)
Triglycerides(mg/dl)	204.50	30.61	184.50	41.57	-20.00	z=1.93 p=0.06(NS)
Serum sodium(meg/l)	146.00	4.71	143.30	7.45	-2.70	z=1.77 p=0.07(NS)
Serum potassium(meg/l)	4.54	.72	4.58	.79	0.04	z=0.56 p=0.57(NS)
Serum chloride(meg/l)	106.60	8.86	106.70	7.54	0.10	z=0.15 p=0.87(NS)
Serum urea(mg/dl)	38.30	4.76	38.00	6.20	-0.30	z=1.81 p=0.07(NS)
Serum creatinine(mg/dl)	1.35	.31	1.30	.27	-0.05	z=1.60 p=0.11(NS)
Serum uric acid(mg/dl)	5.31	.38	5.25	.84	-0.06	z=1.90 p=0.06(NS)

Table 3 and 4 signifies the pretest physiological and biochemical parameters of hypertension of the experiment and control group which has the z score value of non-significant p values.

Table 5: Comparison of pretest and posttest physiological parameters among experiment group

S.No	Physical parameters	Group				Mean Difference	Wilcoxon signed- rank test
		Pre-test		Post-test			
		Mean	SD	Mean	SD		
1	Height(cm)	159.00	7.62	159.00	7.62	0.00	z=0.00 p=1.00(NS)
2	Weight(kg)	76.10	8.28	71.20	8.18	-4.90	z=2.84 p=0.01**(S)
3	Body Mass Index	30.53	3.18	28.24	2.83	-2.29	z=2.80 p=0.01**(S)
4	Waist circumference (cm)	101.80	4.85	98.00	4.00	-3.80	z=2.81 p=0.01**(S)
5	Hip-waist ratio (m)	1.04	.06	.91	.07	-0.13	z=2.68 p=0.01**(S)

Table 6: Comparison of pretest and posttest biochemical parameters among experiment group

S.No	Bio-chemical parameters	Group				Mean Difference	Mann Whitney u-test
		Pre-test		Post-test			
		Mean	SD	Mean	SD		
6	Systolic Blood Pressure(mmHg)	144.00	10.75	127.00	8.23	-17.00	z=2.92 p=0.01**(S)
7	Diastolic Blood	103.00	6.75	90.00	6.67	-13.00	z=2.23 p=0.03*(S)

8	Pressure(mmHg)							
	Random Blood Sugar(mmHg)	138.80	41.18	134.90	36.73	-3.90	z=2.80 p=0.01** (S)	
9	Total cholesterol(mg/dl)	263.90	22.69	223.40	16.78	-40.50	z=2.80 p=0.01** (S)	
10	Low density lipoprotein(mg/dl)	164.50	20.21	139.20	14.91	-25.30	z=2.81 p=0.01** (S)	
11	High density lipoprotein(mg/dl)	46.90	19.36	51.20	14.70	4.30	z=2.81 p=0.01** (S)	
12	Triglycerides(mg/dl)	184.50	41.57	156.50	17.91	-28.00	z=2.81 p=0.01** (S)	
13	Serum sodium(meg/l)	143.30	7.45	140.00	1.41	-3.30	z=2.55 p=0.01** (S)	
14	Serum potassium(meg/l)	4.58	.79	4.16	.52	-0.42	z=2.32 p=0.03* (S)	
15	Serum chloride(meg/l)	106.70	7.54	101.70	4.40	-5.00	z=2.10 p=0.04* (S)	
16	Serum urea(mg/dl)	38.00	6.20	34.90	3.31	-3.10	z=2.36 p=0.02* (S)	
17	Serum creatinine(mg/dl)	1.30	.27	.94	.16	-0.36	z=2.43 p=0.02* (S)	
18	Serum uric acid(mg/dl)	5.25	.84	4.81	.43	-0.44	z=2.65 p=0.01** (S)	

Table 7: Comparison of pretest and posttest physical parameters among control group

S.No	Physical parameters	Group				Mean Difference	Wilcoxon signed- rank test
		Pre-test		Post-test			
		Mean	SD	Mean	SD		
1	Height(cm)	162.70	7.01	162.70	7.01	0.00	z=0.00 p=1.00(NS)
2	Weight(kg)	77.10	9.59	77.40	8.75	0.30	z=0.68 p=0.49(NS)
3	Body Mass Index	29.11	2.48	29.32	2.24	0.21	z=1.08 p=0.28(NS)
4	Waist circumference (cm)	102.30	5.23	103.50	5.08	1.20	z=1.80 p=0.08(NS)
5	Hip-waist ratio (m)	1.04	.04	1.03	.06	-0.01	z=0.41 p=0.67(NS)

Table 8: Comparison of pretest and posttest bio-chemical parameters among control group

S.No	Bio-chemical parameters	Group				Mean Difference	Mann Whitney u- test
		Pre-test		Post-test			
		Mean	SD	Mean	SD		
6	Systolic Blood Pressure(mmHg)	144.00	8.43	137.00	9.49	-7.00	z=1.73 p=0.08(NS)
7	Diastolic Blood Pressure(mmHg)	100.00	10.54	91.00	11.01	-9.00	z=1.91 p=0.06(NS)
8	Random Blood Sugar(mmHg)	154.20	46.93	144.30	48.64	-9.90	z=1.31 p=0.17(NS)
9	Total cholesterol(mg/dl)	279.90	12.31	263.60	17.28	-16.30	z=0.05 p=0.96(NS)
10	Low density lipoprotein(mg/dl)	170.50	16.51	165.50	14.35	-5.00	z=0.56 p=0.57(NS)
11	High density lipoprotein(mg/dl)	43.10	16.86	43.90	13.66	0.80	z=1.32 p=0.18(NS)
12	Triglycerides(mg/dl)	204.50	30.61	180.60	33.32	-23.90	z=1.86 p=0.07(NS)
13	Serum sodium(meg/l)	146.00	4.71	141.30	4.62	-4.70	z=1.41 p=0.15(NS)
14	Serum potassium(meg/l)	4.54	.72	5.33	2.20	0.79	z=0.88 p=0.37(NS)
15	Serum chloride(meg/l)	106.60	8.86	101.10	6.67	-5.50	z=1.90 p=0.06(NS)
16	Serum urea(mg/dl)	38.30	4.76	42.50	5.60	4.20	z=1.68 p=0.09(NS)
17	Serum creatinine(mg/dl)	1.35	.31	1.26	.42	-0.09	z=0.21 p=0.83(NS)
18	Serum uric acid(mg/dl)	5.31	.38	5.54	1.04	0.23	z=0.81 p=0.41(NS)

The effectiveness of the cocoa powder in reducing the selected biophysiological parameters of hypertension was ascertained by comparing the pretest and posttest physiological and biological parameters of hypertension among experimental group and control group which showed significant difference ( $p=0.01$ ,  $p=0.02$  and  $p=0.05$ )

portrayed in table 5 and 6 whereas there was no significant difference in the control group between the pretest and posttest values as presented in table 7 and 8.

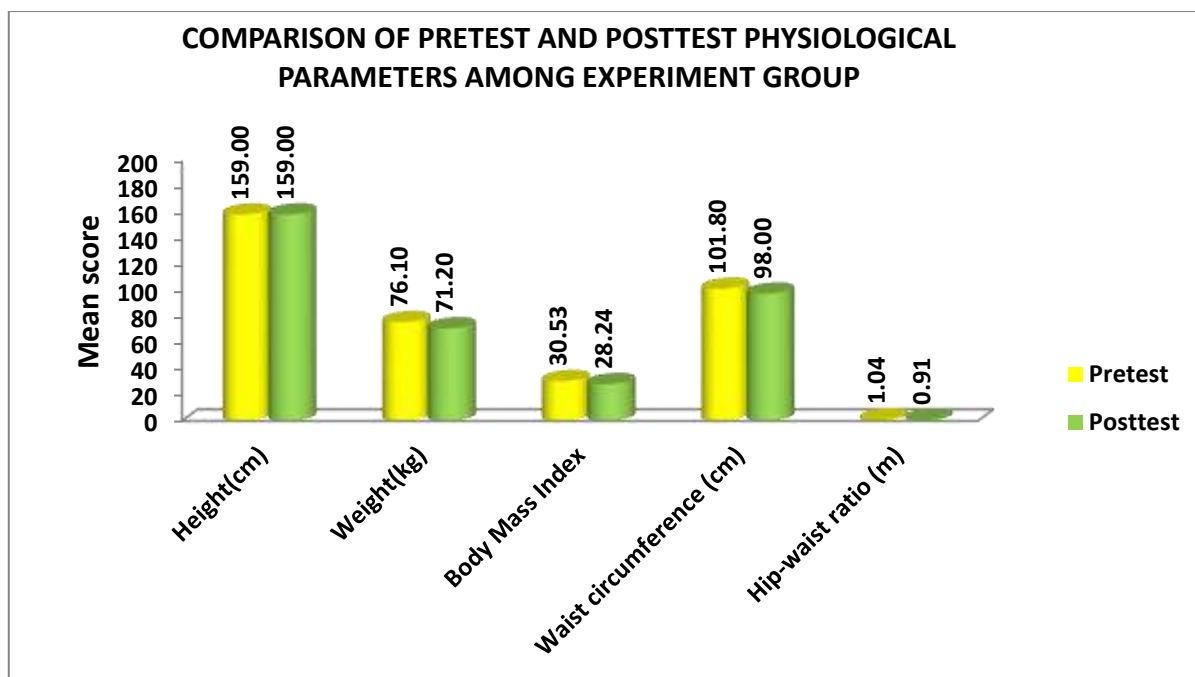


Figure 1: Comparison of pretest and posttest physical parameters among experiment group

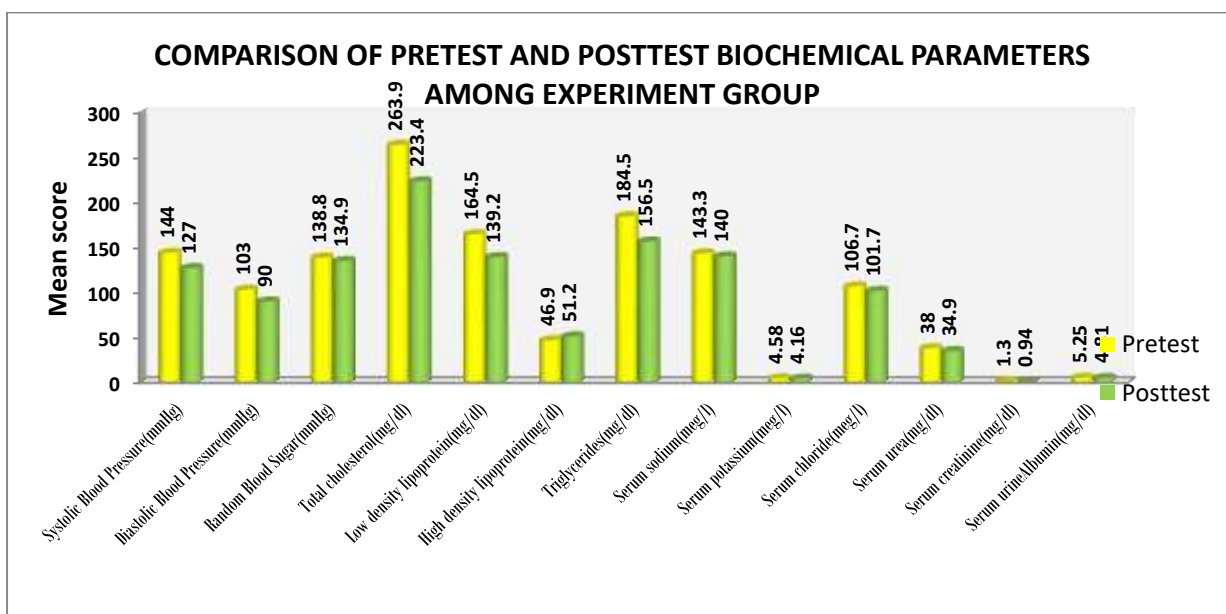


Figure 2: Comparison of pretest and posttest biochemical parameters among experiment group

Figure 1 and 2 depicts the comparison of pretest and posttest biophysiological parameters of hypertension by clearly pointing out the decrease in the values after the intake of cocoa powder.

With related to the association of the pretest scores of experimental group with the selected demographic variables, duration of hypertension, history of stressful lifestyle and amount of salt intake were significantly associated at  $p=0.01$ .

## DISCUSSION

The quantitative study was conducted to assess the effectiveness of cocoa powder on selected biophysiological parameters of hypertension. The primary objective was to

evaluate the effectiveness of cocoa powder in experimental group. The study findings revealed that there was a significant reduction of physiological and biochemical parameters of hypertension between the pretest and posttest scores of experimental group ( $p=0.01$ ) than the control group. As per the second objective the findings revealed the significant difference between the posttest scores of physical and biological parameters of hypertension between the experimental and control group at  $p=0.01, p=0.001, p=0.05$  and  $p=0.02$  significant level which was tested using Mann Whitney U –test. And in the association of the pretest of the experimental group with the selected demographic variables, it was found associated with the duration of



hypertension, stressful lifestyle and amount of salt intake per day by the hypertensive clients.

### CONCLUSION

The research findings revealed that cocoa powder is effective in reducing the selected biophysiological parameters of hypertension which will improve the cardiovascular health of the hypertensive clients in the near future. Cocoa powder is a blessing which can improve their cardiac health along with the healthy diet as the best recipe ingredient.

### FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

### CONFLICTS OF INTEREST

There are no conflicts of interest.

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