ORIGINAL ARTICLE

Effect of isotonic exercise (walking) on various physiological parameters in hypertension

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Rationale: Walking is an isotonic aerobic exercise has been associated with reduced blood pressure and other physiological changes in observational o.p.d. studies. Study was conducted to determine the effect of isotonic aerobic exercise (walking) on blood pressure.

Data resource: This study has been carried out in Kayachikitsa O.P.D., S.S. hospital, Faculty of Ayurveda, IMS, BHU.

Study collection: The present work comprised a study of 84 hypertensive cases, which include 55 male, 29 females and 34 hypertensive controls, 50 hypertensive individuals. Among total cases participating in this study, control groups had not performed any exercise. All these cases of Hypertension were registered from Kayachikitsa O.P.D., IMS, BHU, for the duration of Jan 2009 to Jan 2011 and the selection was random irrespective of sex, occupation and socioeconomic deliberation. All the patients belonged to age group of 35 to 65 years. Two follow ups have been assessed during the research work i.e. initially, after one months and three months for all the physiological parameters.

Conclusions: Aerobic isotonic exercise (walking) reduces blood pressure and other physiological changes i.e. Respiratory rate, Pulse rate, Blood sugar level and BMI in hypertensive exercise group (HTNE) and most of the control groups showed increase in physiological changes, this specify that lack of physical activity can cause various diseases. An increase in aerobic physical activity should be considered an important component of lifestyle modification for prevention and treatment of high blood pressure.

Key words: isotonic aerobic exercise, hypertension, Ayurveda

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Physical activity that is designed, planned and repetitive for the use of conditioning any part of the body is known as exercise and it is utilized to improve health, maintain fitness of mind and body (http://medicdictionary.thefreedictionary.com/exercise). Action that requires physical or mental exertion,

especially when performed to develop or maintain fitness is called exercise. Most precisely exercise has been defined as a potential interruption to homeostasis by muscle activity that is either exclusively, or in combination, concentric, eccentric or isometric. Winter and Fowler, (2009) regimented or determined exercise consists of a curriculum that includes twenty to sixty minutes of activity at least three to five days a week. Some examples of this type of activity include walking, running, cycling, or swimming (http://new.diet.com/nutrition-and-wellbeing-a-to-z/exercise). Contraction against a constant load, with approximation of ends of the muscle, is isotonic (same tension) contraction (Ganong, 2005). Isotonic exercises are those where body movements are performed. Two types of isotonic contractions are concentric isotonic where a muscle shortens and produces movement (eg. flexion of elbow) and eccentric contraction where a muscle gradually lengthens while continuing to contract (eg. gradually lowering a weight held in the hand such as weight lifting) (Ghai, 2007). Walking is most simple isotonic exercise for all age groups. Exercise may be classified in one of two main categories: anaerobic and aerobic, depending on where energy is derived from. Hypertension is sustained elevation of systemic arterial pressure (Ghai, 2007).

Selection of cases:

Hypertensive cases were registered from Kayachikitsa, S.S. hospital; O.P.D., IMS, BHU for the duration - Jan 2009 to Jan 2011. The selection was random irrespective of sex, occupation and socioeconomic deliberation. All the patients belonged to the age group of 35 to 65 years. Two follow ups have been completed during the research work i.e. one month and after 3 months.

METHODOLOGY:

In the present study, effect of exercise has been observed in hypertensive people. Isotonic aerobic exercise- walking was prescribed for Hypertensive patients for 3 months (Two follow ups) under physician supervision. 30 minutes walking has been prescribed, before those 5 minutes of warm up and after completion of exercise 5 minutes cool down was an essential part of this procedure. Breathing exercises kapal bhati, anuloma- viloma and deep slow breathing during expiratory and inspiratory phase have been advised for 15 minutes. Our study group was divided as follows:

STUDY GROUPS

Hypertensive groups again divided into 2 groups:

a. Hypertensive control (HTNC)- Who did not performed any exercise

b. Hypertensive Exercise (HTNE) – Who performed exercise

INCLUSION CRITERIA:

(i) High normal, mild and moderate essential hypertension cases without any complication. Blood pressure under high normal range systolic above 129 mm Hg and diastolic above 84

(ii) Individuals aged group 35 years to 65 years.

EXCLUSION CRITERIA:

(i) In all the groups individuals aged below 35 years and above 65 years were excluded.

(ii) Mild / moderate hypertension cases with complications such as cerebro-vasular diseases, coronary artery diseases, renal diseases, cardiac heart failure, cardiomyopathy, and any degree of heart blocks, pre-clampsia /eclampsia.

(iii) Secondary hypertension like Cardiac, renal or hormonal like pheochromocytoma etc.

Diagnostic criteria for hypertension:

The Sixth Report of Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure established following classification:

Classification of blood pressure for adults >18 years old		
Category	**Systolic blood pressure (mmHg)**	**Diastolic blood pressure (mmHg)**
Optimal	<120	<80
Normal	<130	<85
High normal hypertension	130-139	85-89
Hypertension		
Stage 1(mild)	140-159	90-99
Stage 2 (moderate)	160-179	100-109
Stage 3 (severe)	>180	>100
Isolated Systolic hypertension	>140	<90

Parameters:

1. Clinical parameter: Pulse Rate, Blood Pressure, Respiratory Rate.

2. Blood: Blood Sugar

3. Anthropometry: BMI. Body mass index (Quetelet's index): Body mass index is a statistical measure of weight scaled according to height. It was calculated by using following formula.

BMI= Weight (kg)/(Height (m))^2 (WHO 2002), Abdominal and hip circumference.

Assessment criteria

1. History and clinical examination:

A detailed history was taken and physical examination was performed as per proforma prepared by the department of Kriya Sharir.

Statistical analysis:

The data of 84 patients were collected, coded and fed into the computer. Analysis was done by using Statistical Package for Social Sciences (SPSS) Software Version17.0. Data tabulated and appropriate statistical test viz .cross tabulation, frequency, descriptive mean, paired sample t test and unpaired t-test were applied in order to draw meaningful inferences. The statistical methods were adopted to evaluate the significance of changes after the treatment and also in different comparative groups in clinical observation.

OBSERVATIONS AND RESULTS:

The present work comprised a study of 84 cases. Out of these 84 (55 male, 29 females) patients were hypertensive. (This distribution can be seen from Table 1)

Table 1. Incidence of Gender as per group

SEX	Group			
	HTNC	HTNE	Total	%
Male	21	34	55	65.48
Female	13	16	29	34.52
Total	34	50	84	100

Table 2: Effect of exercise on Systolic and Diastolic Blood pressure in Hypertensive patients

Group	SBP(mmHg) (Mean ± S.D)			Intra group t- Test	
				Initial vs F1	F1 vs F2
	Initial	F 1	F2		
HTNC	146.97±15.12	148.84±15.05	151.23±16.78	t= 2.060 p<0.05(S)	t=1.805 p>0.05(NS)
HTNE	143.80 ± 14.25	131.80 ±14.89	124.12 ±14.39	t= 8.269 p< 0.001(HS)	t=6.067 p< 0.001(HS)
Unpaired t – test	I vs II t=0.950 p>0.05(NS)	I vs II t=4.986 p< 0.001(HS)	I vs II t = 7.691 p<0.001(HS)		
Group	DBP(mmHg) (Mean ± S.D)			Intra group comparison Paired t- Test	
				Initial vs F1	F1 vs F2
	Initial	F 1	F2		
HTNC	96.64±9.23	95.81 ± 7.36	94.84±5.18	t=0.852 p>0.05(NS)	t=1.805 p>0.05(NS)
HTNE	91.20± 10.52	87.00±7.91	83.527.12	t= 4.547 p< 0.001(HS)	t=4.480 p< 0.001(HS)
Unpaired t – test	I vs II t=2.365 p<0.02(S)	I vs II t=4.998 p< 0.001(HS)	I vs II t = 7.672 p< 0.001(HS)		

After first and second follow-up a statistically highly significant (p<0.001) improvement in SBP was observed in HTNE and statistically significant (p<0.02) increase were viewed in SBP among HTNC individuals at Initial vs F1. A statistically highly significant (p<0.001) improvement was observed in SBP on intergroup comparison between I, II group during first and second follow-up and significant result. A statistically highly significant (p<0.001) decrease in DBP was observed in HTNE after walking (Isotonic exercise) during first and second follow-up and decrease was also viewed in DBP in HTNC group also but on statistical analysis it was not found significant. Intergroup group comparison depicted statistically highly significant (p<0.001) decrease in DBP between I&II group after first and second follow up and only significant changes was observed at initially between I&II. (This can be visualized from Table 2)

On intra group comparison after first follow – up a statistically highly significant (p<0.001) decrease in Pulse rate was observed in HTNE after walking (Isotonic exercise) and highly significant (p<0.001) decrease was viewed in HTNE F1 vs F2. Intergroup group comparison was statically not significant. After first follow – up statistically highly significant (p<0.001) decrease in respiratory rate was observed in HTNE group after walking (Isotonic exercise) and

statistically significant (p<0.02) decrease was viewed in HTNC while the intergroup comparison was statistically insignificant. (Table 3)

A statistically highly significant (p<0.001) decrease in fasting blood sugar level was observed in HTNE after walking (Isotonic exercise) during Initial vs F1 and statistically significant (p<0.05) decrease was observed in HTNE during F1 vs. F2 follow up. After second follow up in HTNC group FBS was found to be increased and on statistical analysis it was found highly significant (p<0.001).

On intergroup group comparison illustrated the statistically significant (p<0.05) change in fasting blood sugar between the group I&II group during initial and second follow up. Statistically significant (p<0.05) decrease in post prandial blood sugar level in HTNE after both follow up and in HTNC Statistically significant increase after second follow up after walking (Isotonic exercise). Intergroup group comparison illustrated statistically significant (p<0.02) decrease in post prandial blood sugar in I&II group at second follow up. (This can be visualized from Table 4)

Table 3: Effect of exercise on Pulse Rate and Respiratory Rate in Hypertensive patients

Group	Pulse Rate (per minute) (Mean ± S.D)			Intra group comparison Paired t- Test	
	Initial	**F 1**	**F2**	**Initial vs F1**	**F1 vs F2**
HTNC	80.45 ±6.46	76.06 ±5.25	75.35±4.68	t=3.158 p<0.01(HS)	t=1.076 p>0.05(NS)
HTNE	79.04 ± 7.11	76.52 ±5.95	75.06± 5.95	t= 5.032 p <0.00(HS)	t= 5.032 p<0.001(HS)
Unpaired t – test	I vs II t=0 .898 p>0.05(NS)	I vs II t=3.49 p>0.05(NS)	I vs II t =0.232 p>0.05(NS)		
Group	Respiratory Rate (per minute) (Mean ± S.D)			Intra group comparison Paired t- Test	
	Initial	**F 1**	**F2**	**Initial vs F1**	**F1 vs F2**
HTNC	24.10±4.13	22.90± 4.15	22.45±4.20	t= 2.519 p<0.02(S)	t=0.818 p>0.05(NS)
HTNE	24.46± 3.63	21.76 ±3.16	21.52 ± 2.61	t= 7.814 p< .0001(HS)	t= 0.829 p>0.05(NS)
Unpaired t – test	I vs II t=0.415 p>0.05(NS)	I vs II t=1.39 p>0.05(NS)	I vs II t = 1.231 p>0.05(NS)		

Table 4: Effect of exercise on Fasting and Post prandial Blood Sugar in Hypertensive patients

Group	FBS(mg/dl) (Mean ± S.D)			Intra group comparison Paired t- Test	
	Initial	F 1	F2	Initial vs F1	F1 vs F2
HTNC	98.38±16.11	97. 83±16.11	116.27±37.88	t=1.706 p>0.05 (NS)	t=4.142 p< 0.001 (HS)
HTNE	106.41±19.38	103.98 ±17.76	102.74±18.63	t=5.995 p<0.001(HS)	t=1.280 p< 0.05 (S)
Unpaired t – test	I vs II t= 2.124 p<0.05 (S)	I vs II t=-1.622 p>0.05 (NS)	I vs II t = 2.235 p<0.05(S)		
Group	PP(mg/dl) (Mean ± S.D)			Intra group comparison Paired t - Test	
	Initial	F 1	F2	Initial vs F1	F1 vs F2
HTNC	127.90 ±27.05	123.90±24.96	140.50±35.18	t=1.351 p>0.05(NS)	t=2.573 p<0.02(S)
HTNE	141.74±48.04	135.35± 34.10	123.16±28.23	t=2.222 p<0.05 (S)	t=3.610 p<0.02(S)
Unpaired t – test	I vs II t=1.521 p>0.05(NS	I vs II t=1.664 p>0.05(NS)	I vs II t =2.499 p<0.02(S)		

A statistically highly significant (p<0.001) decrease in Basal metabolic index was observed in HTNE (I&IInd FU) after walking (Isotonic exercise) and increase in HTNC (IInd FU) (Table 5).

DISCUSSION:

There is a significant distribution according to gender in hypertensive patients. Various studies have reported that prevalence of hypertension was more in males than female. (Ofuya, 2007; Costanzo *et al,* 2008) In our study male and female hypertensive cases were 141 (61.3%) and 89 (39.7%) **(Table 1)**. This may be due to high stress, lack of physical activity and low expenditure of energy of male individuals in comparison to female individuals. Among the rural populations, prevalence of hypertension was more in men as compared to women. (Agrawal *et al,* 2008) There is a strong correlation between changing lifestyle factors and increase in hypertension in India. Systolic blood pressure falls due to decreased sympathetic discharge after 30 minutes walk for 3

months. (Table 2) Some previous studies have shown that systolic and diastolic blood pressure decreased after aerobic exercise. (Wheaton, 2002; Sohn, 2007; Gordon, 1997; Ghai, 2007)

Table 5: Effect of exercise on BMI (Basal Metabolic Index) in different in Hypertensive patients

Group	BMI (Kg/m²) (Mean ± S.D.)			Intra group comparison Paired t- Test	
				Initial vs F1	F1 vs F2
HTNC	Initial	F 1	F2		
	25.53 ±3.76	25.06 ±3.80	25.95±3.66	t=0.622 p>0.05(NS)	t=4.548 p <0.001 (HS)
HTNE	26.54± 4.69	25.74± 4.02	24.84± 3.38	t= 3.013 p<0.01 (HS)	t= 3.498 p<0.001 (HS)
Unpaired t – test	I vs II t=0 .891 p>0.05(NS)	I vs II t=0.153 p>0.05(NS)	I vs II t =1.284 p>0.05(NS)		

So our study also confirms the findings of earlier workers .Decrease in diastolic blood pressure after exercise may be caused due to decrease in peripheral resistance by producing vaso-dilatation through accumulation of metabolites like carbon dioxide and hydrogen ion because the diastolic blood pressure is directly affected by peripheral resistance. Pulse is actually heart rate, or the number of times ones heart beats in one minute. Pulse rates vary from person to person. Pulse is lower when individuals are at rest and increases when exercise (because more oxygen-rich blood is needed by the body when an individual exercise). As activity level decreases, vasopressin agents that increase heart rate are decreased in a reverse feedback loop of blood pressure homeostasis. Also, the heart rate partly depends on Starling's law, which indicates that the more volume of blood enters the heart, the more will be pumped out. With a lower blood return after exercise, the heart will respond by beating both more slowly and also with less force per beat other study had shown the decrease sympathetic stress after exercise

interventions causes decrease in pulse rate (Table 3) (Gordon, 1997). In our study control (HTNC) as well as hypertensive (HTNE) group has shown the decrease pulse rate. After first follow – up statistically highly significant (p<0.001) decrease in Respiratory rate was observed in HTNE after walking (Isotonic exercise) and statistically significant (p<0.02) decrease was viewed in HTNC. Some previous study reported the same result (Izdebska *et al.* 2006). Respiratory rate and depth of respiration both decrease immediate after exercise but in our study respiratory rate has been decreased after 3 months of isotonic exercise this may be due to fact that in our study readings were taken after 3 months and not immediate after exercise. **(**Table 3**).** Another cause of this result may be due to fact that the breathing exercise also results in decreased respiratory rate (Jain, 2009)**.**

Blood glucose levels are decreased during periods of exercise. Glucose is lowered by exercise due to increased permeability to glucose in

peripheral tissues. Ronald J. Sigal (2006) reported that fasting blood sugar level decreased after the exercise and it was consistent to our study. After both Follow Up it was also found significant whereas in control groups it was found to be increased. Intergroup group comparison illustrated statistically significant ($p<0.02$) decrease in post Prandial blood sugar in I&II group at second follow up and significant change was Some previous studies also have suggested the same result. Shivananda Nayak (2005), Sheri R. Colberg *et al* (2009) reported that a long duration and low intensity endurance exercise can yield better result than high intensity short duration program (Nayak, 2005, Colberg *et al.* 2009). The exercise session of beyond 30 minutes has additional cardiovascular benefits. The initial exercise program should include moderate duration of 30 minutes (Table 4).

Basal Metabolic Rate (BMR) can be defined as minimum amount of calories required to sustain the body's functions and processes, when the body rests. It is responsible for consumption of about 70% of total calories used up by the body. BMR is regulated by a hormone called as thyroxin. A statistically highly significant ($p<0.001$) decrease in Basal metabolic index was observed in HTNE (I&IInd FU) after walking (Isotonic exercise) and increase in HTNC (IInd FU). But in the control group this change was clinically insignificant because range of BMI was within overweight (Table 5). Marie H. Murphy *et al.* (2007) reported decrease in basal metabolic index after exercise.

CONCLUSION:

Exercise has shown the significant effect on certain vital physiological parameters i.e. Systolic blood pressure, Diastolic blood pressure, Pulse rate and Respiratory rate it means exercise have very strong correlation with these parameters. Systolic and diastolic blood pressure significantly decreases by isotonic exercise. Regular exercise decreases the sympathetic overload all over the body which is curative and preventive for some life threatening diseases. Every body should have awareness for health and avoid sedentary life style. A daily walk enduring 30 minutes significantly reduces the risk of hypertension in men.

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