Original Article

Physical Activity, Indices of Obesity and Mean Arterial Blood Pressure: Does Place of Living Matters? Rural vs Urban

Physiology Section

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ABSTRACT

Introduction: Physical inactivity is a risk factor for many diseases and conditions. Adequate physical activity is considered as a key factor in the fight against the obesity epidemic. Looking at the technology based lifestyle which is increasingly becoming more popular in this era; percentage of obesity is increasing every year. Even an increase in blood pressure is observed because of: stressors associated with cultural change and health behaviour changes (diet, physical activity, etc.). If no effective strategies or programs are established to fight and control the risk factors including obesity, diabetes, hypertension, dyslipidemia; the obesity related non-communicable diseases will be prevalent in the near future and will elevate the socio-economic burden dramatically. In this era of epidemic diabetes and obesity, studying the joint influences of body mass index and physical activity becomes increasingly important because these reflect actual combined exposures.

Aims and Objectives: To assess different levels of physical activity in the general population; To measure BMI, Waist Circumference (indices of obesity) and mean arterial pressure; To study the inter-relationship between physical activities, indices of obesity (BMI, WC) and mean arterial pressure in urban and rural population.

Materials and Methods: The present study was conducted on a total of 520 subjects randomly selected from general population of district Amritsar in Punjab in the age group of 20-50 years, divided into urban (130 men and 130 women) and rural (130 men and 130 women) population. After measuring the weight and height, body mass index (BMI) was calculated. Waist circumference was taken separately. Mean arterial blood pressure was derived from diastolic blood pressure and pulse pressure. Physical activity levels were assessed by general physical activity questionnaire.

Results: A significant decline in waist circumference (WC), body mass index (BMI) and mean arterial pressure was observed in physically active population as compared to the sedentary life style population.

Conclusion: Physical activity is the best road to good health. Urgent measures should be taken to inculcate the habit of exercising in all age groups.

Key Words: Physical activity, Body Mass Index, Waist Circumference, Mean Arterial Pressure

INTRODUCTION

Regular physical activity, fitness and exercise are critically important for the health and well-being of people of all ages. Regular physical activity helps to maintain a healthy weight, reduces the risk of developing obesity, diabetes mellitus, high blood pressure and heart diseases. Weight gain results from a combination of excess calorie consumption and inadequate physical activity [1]. Obesity is often expressed in terms of body mass index (BMI). Blood pressure means the force exerted by the blood against any unit area of the vessel wall [2]. It is expressed as systolic pressure/ diastolic pressure in millimeters of mercury (mm Hg). It is a complex health problem. The higher the blood pressure in the community, the higher is the prevalence of cardio-vascular diseases, strokes and renal diseases. It is a 'silent killer' [3]. Randomized controlled trials have shown that exercise training 3-5 times per week with 30-60 minutes per session at a moderate intensity level can result in a net reduction of systolic and diastolic blood pressure of 3.4 and 2.4 mm Hg respectively [4]. Sedentary life style and obesity are important life style related public health problems in the world [5]. Obesity is just the tip of iceberg as a risk factor of a cluster of cardiovascular diseases.

Punjab is an economically advanced and physically robust state of India. The socio-economic development with urbanisation has created changes in dietary intake, food consumption patterns and physical activity levels. They all have contributed to the problem of increasing obesity and hypertension in Punjabi population. We intended to explore the interrelationship between levels of physical activity, indices of obesity, mean arterial blood pressure, and what role does area of living play.

MATERIALS AND METHODS

A total of 520 subjects in the age group of 20-50 years divided into urban (130 men and 130 women) and rural (130 men and 130 women) were randomly enrolled from general population of district Amritsar in Punjab for this study.

Complete information regarding general bio-data i.e. age, gender, socio-economic status, habits, diet history, history of present illness, past history, family history along with assessment of physical activity, measurement of obesity indices and mean arterial pressure was recorded on the Performa evolved and pre-tested for the study. Materials used were:

1. Weighing machine for weight measurement (in Kg);

2. Anthropometric rod for measurement of height (in cm);
3. Measuring tape for measuring waist circumference (measurement was taken midway between the inferior margin of the last rib and the crest of ileum in a horizontal plane. Circumference was measured to the nearest 0.1 cm.);
4. Sphygmomanometer (BP apparatus) for recording blood pressure.

All the instruments were calibrated and verified before use. A general practice physical activity questionnaire was used to provide a simple four-level physical activity index (PAI) [6] reflecting an individual's current physical activity and were categorized into:-

1. General Practice Physical Activity Questionnaire

Date .....

Name .....

Please tell us the type and amount of physical activity involved in your work

(Please mark one box only)

a	I am not in employment (e.g. retired, retired for health reasons, unemployed, fulltime carer etc.)	
b	I spend most of my time at work sitting (such as in an office)	
c	I spend most of my time at work standing or walking. However, my work does not require much intense physical effort (e.g. shop assistant, hairdresser, security guard, childminder, etc.)	
d	My work involves definite physical effort including handling of heavy objects and use of tools (e.g. plumber, electrician, carpenter, cleaner, hospital nurse, gardener, postal delivery workers etc.)	
e	My work involves vigorous physical activity including handling of very heavy objects (e.g. scaffolder, construction worker, refuse collector, etc.)	

2. During the last week ,how many hours did you spend on each of the following activities?

Please answer whether you are in employment or not

Please mark one box only on each row:

		None	Some but less than 1 hour	1 hour but less than 3 hours	3 hours or more
a	Physical exercise such as swimming, jogging, aerobics, football, tennis, gym workout etc.				
b	Cycling, including cycling to work and during leisure time				
c	Walking, including walking to work, shopping, for pleasure etc.				
d	Housework/ Childcare				
e	Gardening/DIY				

3. How would you describe your usual walking pace? Please mark one box only.

Slow pace (i.e. less than 3 mph)		Steady average pace	
Brisk pace		Fast pace (i.e. over 4mph)	

4. Summary of physical activity index (PAI):

	Occupation			
Physical exercise and / or cycling (hr/wk)	**Sedentary**	**Standing**	**Physical**	**Heavy manual**
0	Inactive	Moderately inactive	Moderately active	Active
Some but < 1	Moderately inactive	Moderately active	Active	Active
1-2.9	Moderately active	Active	Active	Active
≥3	Active	Active	Active	Active

5. Patient can be classified into four categories as:-

Inactive: Sedentary job and no physical exercise or cycling.

Moderately inactive: Sedentary job and some but <1 hour physical exercise and/or cycling per week OR
Standing job and no physical exercise or cycling

Moderately active: Sedentary job and 1-2.9 hours physical exercise and/or cycling per week OR
Standing job and some but < 1 hour physical exercise and /or cycling per week OR
Physical job and no physical exercise or cycling

Active: Sedentary job and ≥ 3 hours physical exercise and/or cycling per week OR
Standing job and 1-2.9 hours physical exercise and/or cycling per week OR
Physical job and some but <1 hour physical exercise and/or cycling per week OR
Heavy manual job

Group A: - Inactive
Group B: - Moderately Inactive
Group C: - Moderately Active
Group D: - Active

The subjects in the four groups were further divided into four sub-groups as rural males, urban males, rural females and urban females.

Body Mass Index (BMI):- After estimation of height and weight, BMI was calculated as

$$\text{BMI (In kg/m}^2\text{)} = \frac{\text{Weight in Kilogram (Kg)}}{\text{Height in meter square (m)}^2}$$

Waist circumference ≥ 90 cm for men and ≥ 80 cm for women was considered obese [7].

Blood pressure was measured by auscultatory method after applying the palpatory method. Mean Arterial Pressure (MAP) = Diastolic Blood Pressure + 1/3rd PP.

Statistical analysis was done for all the parameters, 'p' and 't' values were determined, p<0.05 was considered as significant. Anova tests were applied for 'p' values detection between the groups. Post-hoc tests were applied for 'p' values between the sub-groups for multiple comparisons.

RESULTS

The data revealed that:

- Out of the total population (i.e.520 subjects), 49.2% were active [includes moderately active (Group-C) and active population (Group-D)] and 50.7% were inactive [included moderately inactive (Group-B and inactive population (Group-A)] [Table/Fig-1].
- The anthropometric variables such as waist circumference (WC) showed a significant decrease in their mean values in all the four sub-groups of rural males (RM), urban males (UM), rural females (RF) and urban females (UF) with increase in the physical activity [Table/Fig-3, 4].
- The derived anthropometric variables such as body mass index (BMI) which is an indicator of obesity also showed

Physical Activity	Frequency	Percentage
A.Inactive	152	29.2
B.Moderately Inactive	112	21.5
C.Moderately Active	72	13.8
D.Active	184	35.4

[Table/Fig-1]: Percentage distribution of physical activity in the total population

	A. Inactive	B. Moderately Inactive	C. Moderately Active	D. Active	Total
Rural Males (RM)	11	16	2	101	130
Urban Males (UM)	22	51	16	41	130
Rural Females (RF)	65	18	34	13	130
Urban Females (UF)	55	27	20	28	130

[Table/Fig-2]: Distribution of activity in various groups

	A. Inactive		B. Mod. Inactive		C. Mod. Active		D. Active		
Waist-Circumference	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	p value
Rural Males (RM)	11	101.55±8.61	16	99.94±12.66	2	90.00±2.83	101	86.87 ±12.20	0.000
Urban Males (UM)	22	95.84±11.11	51	91.47±10.96	16	90.28±9.96	41	88.85±10.70	0.110
Rural Females (RF)	65	85.98±13.35	18	83.56±8.68	34	81.62±10.16	13	77.23±6.25	0.050
Urban Females (UF)	55	86.38±15.50	27	84.96±8.33	20	82.80±12.84	28	77.88±8.72	0.035

[Table/Fig-3] Comparison of waist circumference (WC) with physical activity levels in various subgroups

	B vs A	C vs A	D vs A	C vs B	D Vs B	D Vs C
Rural Males (RM)	0.986	0.593	0.001	0.686	0.000	0.983
Urban Males (UM)	0.389	0.401	0.073	0.981	0.656	0.970
Rural Females (RF)	0.856	0.278	0.063	0.938	0.431	0.645
Urban Females (UF)	0.963	0.696	0.022	0.937	0.163	0.541

[Table/Fig-4]: Inter-group comparison of waist circumference (WC) statistical consideration ('p' value)

	A. Inactive		B. Mod. Inactive		C. Mod. Active		D. Active		
BMI	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	p value
Rural Males (RM)	11	28.75±4.26	16	27.80±2.57	2	26.95±1.03	101	24.61±4.66	0.003
Urban Males (UM)	22	27.21±4.56	51	26.73±4.52	16	25.63±3.79	41	23.38±3.11	0.000
Rural Females (RF)	65	29.31±4.26	18	28.10±4.13	34	26.01±4.60	13	25.17±1.78	0.000
Urban Females (UF)	55	27.60±7.77	27	27.34±2.99	20	25.70±4.99	28	23.96±2.24	0.040

[Table/Fig-5]: Comparison of body mass index (BMI) with physical activity levels in various subgroups

	B vs A	C vs A	D vs A	C vs B	D Vs B	D Vs C
Rural Males (RM)	0.947	0.951	0.019	0.994	0.040	0.879
Urban Males (UM)	0.967	0.635	0.003	0.777	0.001	0.237
Rural Females (RF)	0.691	0.002	0.007	0.325	0.222	0.923
Urban Females (UF)	0.998	0.581	0.034	0.761	0.128	0.724

[Table/Fig-6]: Inter-group comparison of body mass index (BMI) statistical consideration ('p' value)

	A. Inactive		B. Mod. Inactive		C. Mod. Active		D. Active		
Mean Arterial Pressure	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	p value
Rural Males (RM)	11	109.39±5.23	16	106.37±9.95	2	101.00±8.01	101	102.17±9.33	0.044
Urban Males (UM)	22	109.39±7.90	51	107.75±11.24	16	104.70±8.27	41	103.12±14.50	0.034
Rural Females (RF)	65	109.60±7.76	18	102.77±10.55	34	100.92±13.98	13	99.07±8.96	0.000
Urban Females (UF)	55	110.02±13.54	27	104.54±11.78	20	102.76±10.07	28	100.83±9.60	0.005

[Table/Fig-7]: Comparison of mean arterial pressure (MAP) with physical activity levels in various subgroups

	B vs A	C vs A	D vs A	C vs B	D Vs B	D Vs C
Rural Males (RM)	0.834	0.632	0.067	0.862	0.324	0.998
Urban Males (UM)	0.946	0.612	0.180	0.798	0.235	0.967
Rural Females (RF)	0.064	0.001	0.005	0.925	0.753	0.945
Urban Females (UF)	0.211	0.097	0.006	0.958	0.658	0.945

[Table/Fig-8]: Inter-group comparison of mean arterial pressure (MAP)-statistical consideration ('p' value)

	A (Inactive)			B (Moderately inactive)			C (Moderately Active)			D (Active)		
	RRF (65)	UUF (55)	Intergroup (P value)	RRF (18)	UUF (27)	Intergroup (P value)	RRF (34)	UUF (20)	Intergroup (P value)	RRF (13)	UUF (28)	Intergroup (P value)
WC	885.98 ± 13.35	86.38 ± 15.50	.999	83.56 ± 8.68	84.96 ± 8.33	.970	81.62 ± 10.16	82.80 ± 12.84	.980	77.23 ± 6.25	77.88 ± 8.72	.998
BBMI	29.31 ± 4.26	27.60 ± 7.77	.378	28.10 ± 4.13	27.34 ± 2.99	.924	26.01 ± 4.60	25.70 ± 4.99	.995	25.17 ± 1.78	23.96 ± 2.24	.793
MMAP	109.60 ± 7.76	110.02 ± 13.54	.996	102.77 ± 10.55	104.54 ± 11.78	.953	100.92 ± 13.98	102.76 ± 10.07	.945	99.07 ± 8.96	100.83 ± 9.60	.962

[Table/Fig-9]: Area of living impact on females

	A (Inactive)			B (Moderately inactive)			C (Moderateiy Active)			D (Active)		
	RRM (11)	UUM (22)	Intergroup (P value)	RRM (16)	UUM (51)	Intergroup (P value)	RRM (2)	UUM (16)	Intergroup ((P value)	RRM (101)	UUM (41)	Intergroup ((P value)
WC	101.55 ± 8.61	95.84 ± 11.11	.67	99.94 ± 12.66	91.47 ± 10.96	.125	90.00 ± 2.83	90.28 ± 9.96	11.000	86.87 ± 12.20	88.85 ± 10.70	.769
BBMI	28.75 ± 4.26	27.21± 4.56	.891	27.80 ± 2.52	26.73 ± 4.52	.777	26.95 ± 1.03	25.63 ± 3.79	.980	24.61 ± 4.66	23.38 ± 3.11	.328
MMAP	109.39 ± 5.23	109.39 ± 7.90	1.000	106.37 ± 9.95	107.75 ± 11.24	.973	101.00 ± 8.01	104.70 ± 8.27	.975	102.17 ± 9.33	103.12 ± 14.50	.964

[Table/Fig-10]: Area of living impact on Males

drastic improvement with increased levels of physical activity in both rural and urban population [Table/Fig-5, 6].

- The physiological parameters such as systolic blood pressure (SBP), diastolic blood pressure (DBP), and the derived parameters such as pulse pressure (PP) and mean arterial pressure (MAP) showed significant change with the increasing physical activity. [Table/Fig-7, 8].

DISCUSSION

This study was undertaken in the district of Punjab, India to study the various lifestyle factors and their impact on objective physical parameters.

As shown in [Table/Fig-1], the inactive groups (A and B),comprised of 50.7% of the total population while the active groups (C and D) had a percentage of 49.2% i.e the inactive Vs active groups had an equal proportion of participation in the study.

It was observed that maximum physical activity was seen in males more so in rural males compared to maximum inactivity seen in both rural as well as urban females [Table/Fig-2].

Waist circumference is a convenient measure of abdominal adipose tissue and is unrelated to height, correlates closely with BMI, and is associated with cardiovascular risk factors independent of BMI [8]. It was observed that in all the four sub-groups i.e. rural males (RM), urban males (UM), rural females (RF) and urban females (UF) there is a steady decline in the mean waist circumference (WC) with increasing physical activity levels [Table/Fig-3]. This change was significant for all groups expect urban males [Table/Fig-4].

When comparing the most active to most inactive, statistical significance reached for the rural males and urban females. This difference in the urban females (UF) showed a significant reduction ($p<0.05$) in the waist circumference (WC) with increased physical activity levels. This outcome may have been enhanced, due to the fact that the urban females are more cautious about their figure and hence they adhere to fitness program and diet control in comparison to urban males.

We did not find any significant difference, within the same level of activity group, between rural and urban population. This was true for both males and females [Table/Fig-9 and Table/Fig-10].

The derived anthropometric variables i.e. body mass index (BMI) also showed a steady decline in their mean values from inactivity to activity in all the four sub-groups i.e. rural males (RM), urban males (UM), rural females (RF) and urban females (UF) irrespective of the sex and place of living (rural or urban). These indicators of obesity are similar to the findings of other researchers [4,8,9]. These differences are statistically significant ($p<0.05$ to $p<0.001$) [Table/Fig-5].

The inter-group comparison in the sub-group of rural & urban both males and females show a statistically significant difference in the mean body mass index (BMI) of the most active group (Group-D) in comparison to their respective inactive group (Group-A). [Table/Fig-6].

The data here suggests that females have comparatively higher body mass index (BMI) than males, which is very much consistent with many of the studies done earlier [10,11,12]. How much of this is due to interplay of higher prevalence of short stature among women as whole and more so among rural women.

Here again lack of significant difference in mean body mass index (BMI) of rural subjects in comparison to urban subjects exemplified the importance of activity compared to area of living [Table/Fig-9 and Table/Fig-10]. Others have found varied results

in this respect. Some concor with our finding [13] while others don't [14,15].

The mean arterial pressure (MAP) is on the lower side in the physically active population as compared to the physically inactive subjects as evident from [Table/Fig-7]. These observations are consistent with the findings of other studies [4,14,16,17].

In the category of rural and urban females, active (Group-D) groups have shown a significant decline ($p<0.05$) in the mean arterial pressure as compared to the inactive group (Group-A). In the category of rural males the difference between the MAP of most inactive vs most active group were pronounced, almost reaching statistical significance [Table/Fig-8]. However similar change was not seen among the urban males. Co-morbid conditions and habits like smoking , diabetes etc may have played important role in determining the blood pressure in addition to activity level.

In the inter sub-group comparison of rural males (RM) Vs urban males (UM) and rural females (RF) Vs urban females (UF), the mean arterial pressure (MAP) values did not show any significant difference ($p>0.05$) in all the four groups as decided by level of activity [Table/Fig-9 and Table/Fig-10].

Limitations of the study: Since this study was confined to single geographical area, extrapolation of the results to other areas requires validation by larger studies. Some observations where statistical significance was expected, but not found, may be due to lack of adequate sample size.

CONCLUSION

Inverse relationship between the level of physical activity and indices of obesity (WC,BMI) was found. Same was true for the Mean Arterial Blood pressure. No significant difference was observed between rural & urban population for indices of obesity as well as Mean Arterial Blood Pressure, when a comparison was made between populations with same activity level. We conclude that defining level of physical activity parameter is more important than the area of living (rural/urban).

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