Relationship Between Body Mass Index, Cardiovascular Fitness and Physical Activity Among Computer Professionals of Three India Cities

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ABSTRACT

Cardiorespiratory fitness and physical activity are crucial health indicators that contribute to an individual's optimal physical performance. Research evidences show that relationship between body mass index, cardiovascular fitness, and physical activity has not been much researched and therefore the objective of this study was to examine the correlation between physical fitness, cardiovascular fitness, and body mass index among computer professionals. The cross-sectional study was done on 152 computer software professionals drawn from three Indian cities (Chandigarh, Panchkula and Mohali). Inclusion criteria included computer professionals between 21- 45 years working on computer for more than 8 hours per day having work experience of more than 1 year and working in company for more than 6 months. Different parameters for physical examination including blood pressure, weight and height measurements and body mass index for each subject was evaluated. Similarly, Physical activity level (in MET) was calculated using International physical activity questionnaire (IPAQ) and likewise cardiovascular fitness was evaluated by performing YMCA step test. The participants were classified into three BMI groups and association between body mass index, cardiorespiratory fitness and physical activity was determined using Pearson correlations at a significance level of $p \leq 0.05$. The study showed a significant negative correlation is seen between the body mass index and YMCA score among computer professionals suggesting that as compared to their normal-weight counterparts, overweight and obese computer professionals exhibited diminished muscular strength and physical activity along with cardiorespiratory fitness. Thus, It is imperative to develop interventions that specifically target these critical elements of physical fitness among such professionals.

KEY WORDS: RELATIONSHIP; INDEX; CARDIOVASCULAR; FITNESS; PHYSICAL COMPUTER; PROFESSIONALS.

INTRODUCTION

India is one of the leading country in the world with its IT industry been a major service sector since last two decades (Pandey et al.,2020; Shobha, Shibi and Shireen, 2016) According to NAASCOM, India's tech industry is estimated to touch $245 billion in the financial year 2023 and has been one of the major recruiter for the computer software professionals(Economic Times Report,2023). However, large working hours, sedentary and poor lifestyle among the computer professionals has also ushered a new set of occupational health problem where erractic working hours, deadlines compliance associated with prolong computer usage have been correlated with overweight and obesity(Genin et al.,2018).

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Globally the prevalence rate of overweight and obesity has been increased two fold since 1980 to the point where now one third of world's population can be categorized as obese. The prevalence of obesity in India is increasing with urban sectors having more prevalence than rural and females been more affected than their male counterparts (Saha et al, 2023). According to a systematic review of obesity in India, greater than 135 million people are affected with obesity. In comparison to rural areas, urban areas with high socioeconomic status are found to have higher prevalence(Verma et al.,2021; Ahirwar and Mondal.,2019). On determining the type of obesity, it was found that the prevalence of abdominal obesity is higher in India than the generalized obesity and again, urban areas have much higher prevalence than rural areas (Gupta et al., 2023).

Research studies also show that technological advancements have reduced physical activity, physical strain and energy expenditure, resulting in jobs that are more sedentary. As

many individuals spend a great deal of their waking hours in the workplace, so reducing sitting at work may need to be given special attention (Shrestha et al.,2016).Cardiovascular fitness of citizens of a country is a vital prerequisite to a country's realization of its full potentials. Technological developments and modern day commodities have navigated most people into sedentary life style leading to chronic diseases like hypertension, heart disease, diabetes mellitus, metabolic syndrome, chronic low backache& obesity, (Shrestha et al., 2016;Paterson et al.,2020).

Another study reported that adults with high leisure time internet and computer use were more likely to be overweight or obese as compared to participants who did not use the internet or computer. Previous studies reported that there is a significant negative correlation between obesity and VO2 max which indicated striking effect of increasing body fat on cardio-respiratory fitness (Paterson et al.,2020; Loh et al.,2020). Various studies showed effect of BMI on work related musculoskeletal discomfort but the relationship of BMI with physical activity level and cardiorespiratory fitness has not been extensively investigated (Bonney et.,2018; Patkar et al.,2022). So this study was designed to examine the relationship of BMI with cardiovascular and physical fitness in computer professionals.

MATERIAL AND METHODS

The cross-sectional study design included 152 IT professionals from IT companies in three cities of India (Chandigarh, Panchkula and Mohali). The inclusion criteria comprised of Computer professionals of age group 20 - 45 years and working on computer for more than 8 hours per day. Males were included with work experience of more than 1 year and working in company for more than 6 months. The exclusion criteria included History of diagnosed case of acute or chronic respiratory disorder, paralysis, major surgery, neurophysiological disorder, or on any regular medicine. Apart from that Software Professionals who were smokers and had night shifts were also not included in the study.

Before the commencement of the study, a formal approval for the study was taken from the Research and Ethics Committee and willing subjects were asked to give informed consent for the study. The physical examination {blood pressure, weight and height measurements and body mass index of each subject was documented. (Physical activity level (in MET) was calculated using International physical activity questionnaire (IPAQ).Subjects performed YMCA step test according to described protocol (YMCA Testing Report, 2000).

The procedure to perform YMCA bench step test was as follows where Metrone was set to 96 beats per minute and subject was asked to face the step. Stopwatch was started as the subject start to step on the step following the metronome beat following a cadence of up, up, down, down. This was continued for three minutes. After three minutes subject was asked to stop and immediately, sit on the step or stool and perform the manual pulse reading and count the number of beats for an entire 60 seconds. Pulse rate was taken from the radial pulse and recorded for 60 seconds and compared with the YMCA 3 Minute Step Test scoring.

Statistical Analysis: Statistical software package called IBM SPSS statistics (version 22.0) was utilized for analysis of data. Values are reported as Mean ± Standard deviation. The findings of BMI, IPAQ and YMCA bench step test were correlated statistically. Spearman's correlation was used to see the correlation of different variables. Level of significance is 95% so $p \leq 0.05$ is considered a significant result and p value< 0.01 is considered highly significant result.

Table 1. Demographic profile of the participants

Characteristics	Mean ± S.D
Total number of subjects (n)	152
Age (year)	24.08 ± 2.113
Height (meter)	1.736 ± 0.061
BMI (kg/m^2)	23.162 ± 2.744
SBP (mm Hg)	126.769 ± 5.479
DBP (mm Hg)	86.961 ± 6.415

Table 2: Distribution of subjects on the basis of BMI (in percentage)

BMI categories	Percentage of subjects
Normal	84.61%
Overweight	13.46%
Obese	1.92%

Table 3: Evaluation of PHR (post exercise), YMCA score and IPAQ BMI= Body Mass Index, PHR= Peak Heart Rate, YMCA= Young Men's Christian Association, MET= Metabolic equivalent of task, IPAQ= International Physical Activity Questionnaire

Variables	Mean ± S.D
PHR (post exercise) (bpm)	113.67 ± 16.674
YMCA score	1.88 ± 1.078
IPAQ (MET.min/week)	1033.423 ± 890.003

Table 4. Distribution of subjects having low, moderate and high physical activity as calculated from IPAQ

Physical Activity	Percentage of subjects
Low	48.07%
Moderate	48.07%
High	3.84%

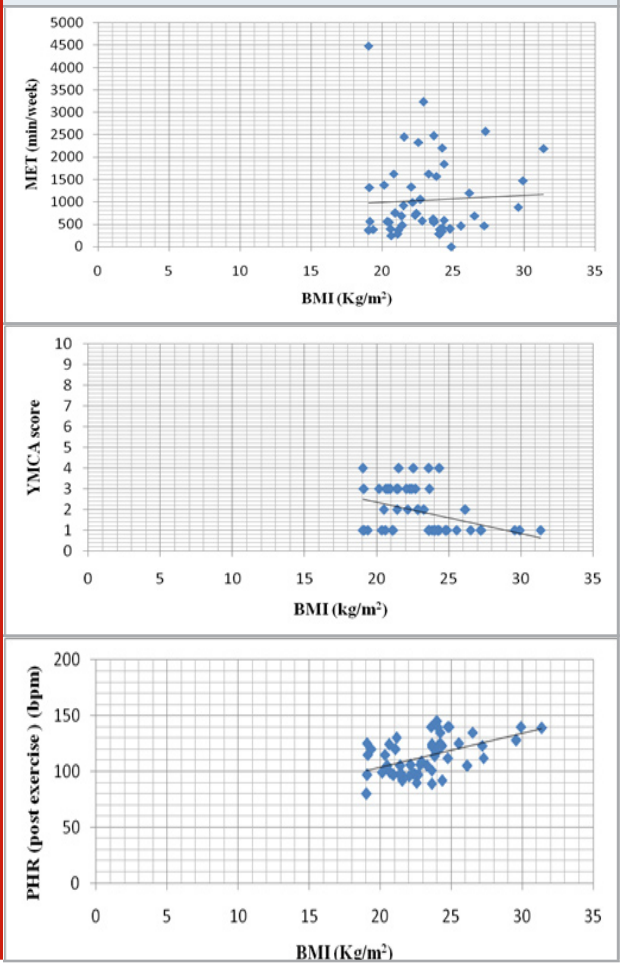
Table 5. Correlation of BMI with MET, YMCA and PHR

Variables	rs	p- value
BMI-MET	0.046	0.745
BMI-YMCA score	-0.417	0.002
BMI-PHR (post exercise)	0.482	0.000

RESULTS AND DISCUSSION

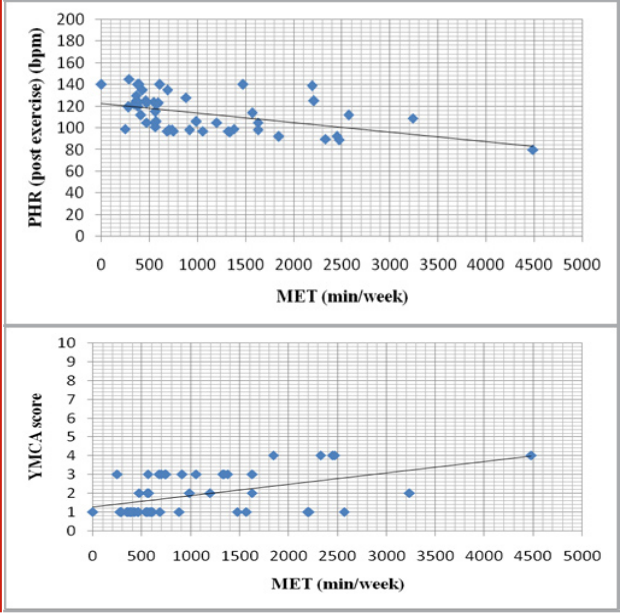
The demographic data of the 152 participants as well as distribution of the subjects on basis of BMI was described in Table 1 and 2 respectively. Similarly the evaluation of the participants based on Cardiovascular fitness and Physical activity was shown in Table 3 and 4 respectively. The correlation between different parameters i.e BMI-MET, BMI with YMCA score and PHR (post exercise) as well as MET with PHR (post exercise) and YMCA score was shown in Table 5. The scatter diagram for the different correlations were explained in Fig. 1.The Fig 1A showed the scatter diagram depicts a negative correlation between BMI and YMCA score.

Figure 1: showing Scatter diagram with Correlation between BMI with MET, YMCA and PHR (post exercise)



This scatter diagram 1B showed a positive correlation between BMI and PHR (post exercise) and likewise scatter diagram 1C showed a positive correlation between BMI and PHR (post exercise). Similarly, in Fig 2 different scatter diagram depicted correlation between MET and different variables such as PHR as well as YMCA score. The Fig 2 A showed a negative correlation between MET and PHR (post exercise) whereas Fig 2B showed scatter diagram having a positive correlation between MET and YMCA score.

Figure 2: showing Scatter diagram with Correlation between MET with PHR (post exercise) as well as YMCA score



Mean age of the subjects is found to be 24.08 and mean BMI of subjects studied is 23.162 (Table 1). Out of total 152 subjects who were measured, 84.61% were of normal BMI, 13.46% was overweight and 1.92 % was obese (Table 2, Fig. 1).Physical activity level of subjects was evaluated using International physical activity Questionnaire. Mean of METs calculated from IPAQ is found to be 1033.42 METs. min/week (Table 3). Out of total 152 subjects, 48.07% were having low level of physical activity, 48.07% had moderate level of physical activity and 3.84% had high level of physical activity according to IPAQ scoring protocol long form (Table 4,Fig. 2).

Cardiovascular fitness was evaluated using a YMCA bench step test and all the participants completed the test without any complications. Mean PHR (post exercise) and mean YMCA score after completing the test is found to be 113.67 and 1.88 respectively (Table 3) .On matching the scores of their performance with YMCA bench step test scoring12, it was found that the scores are between 1 and 2, which fall in the category of “Poor” or “Below Average”. On correlating BMI with METs as calculated using IPAQ, there is weak positive correlation with BMI which was found to be statistically non-significant (Table 5 and Figure 2)

Based on the data from the computer professionals, the Body mass indexes of subjects included were correlated with peak exercise heart rate (post exercise), YMCA score

and Physical activity in METs.On matching the scores of their performance with YMCA bench step test scoring12, it was found that the scores are between 1 and 2, which fall in the category of "Poor" or "Below Average". Similarly, on correlating BMI with METs as calculated using IPAQ, there is weak positive correlation with BMI which was found to be statistically non-significant (Table 5, Fig. 2).

The findings of our study are in consistent with previous studies which showed no significant correlation between physical activity and obesity(Patkar and Joshi,2011). Another study also showed a weak negative correlation between IPAQ and BMI(Bonney et al.,2018). The reason behind this could be that the participants of this study were highly educated and aware about the health hazards of sedentary life style. Most of them were engaged in one or the other aerobic exercises. Moreover, the IPAQ questions reflect the physical activity level of past 7 days. However a different questionnaire reflecting the physically activity level of past one month would have modified the results. Furthermore, in yet another study conducted upon adults who engaged in high leisure-time internet and computer use were more likely to be overweight or obese even if they were highly active in their leisure time, as compared to participants who did not use the Internet or computer(Genin et al.,2018).

In the present study a significant negative correlation was observed between the body mass index and YMCA score of computer software professionals (Table 5, Fig 1). This indicates the striking effects of increasing body fat on cardiovascular fitness. This is supported by a previous study where the authors have reported that there is significant negative correlation between obesity and VO2 max(Shetty, Padmanabha and Doddamani, 2013). The reason behind this correlation could be that excessive amount of body fat exerts an unfavorable burden as well as hindering action toward cardiac function particularly during exhaustive exercise and excessive hyperactive body musculature fails to uptake sufficient amount of oxygen due to deposition of proportionately high amount of fat mass(Khona et al.,2017).

In the present study, a highly significant positive correlation was also observed between body mass index and peak heart rate (post exercise), (Table 5,Fig. 1).This was also in consistency with yet another study done where significantly positive correlation between body mass index and heart rate during Treadmill Jogging test was measured. It is known that obese people have increased sympathetic nerve firing rate than normal people. Thus, as heart is required to pump blood through relatively large depot of adipose tissue, Obesity leads to a state of chronic volume overload. Increased stroke volume and preload is related to hypertension and increased heart rate. Obese individuals with hypertension usually have thickening of ventricular wall and greater heart volume and so are more likely to suffer from cardiac failure (Dietrich et al.,2008). Obese subjects showed a significant increase in sympathetic activities of the heart, which showed imbalance in the autonomic neural activities of the heart(Bandyopadhyay and Chatterjee, 2003).

The current study found out significant negative correlation between MET and PHR (post exercise) (Table 6.Fig. 2).This showed that subjects who were physically active had decreased peak heart rate (post exercise).There are dearth of studies who correlated MET and PHR (post exercise). Aso study by Dietrich et al(2008) reported that middle-aged and elderly obese subjects who were regularly physically active had higher heart rate variability than their sedentary peers even after taking into account the effects of sex, age, study site, education, diabetes, hypertension, beta-blocker intake and smoking status. Reason behind is that regular physical exercise has strong beneficial effects on cardiac autonomic nervous function and thus appears to offset the negative effect of obesity on HRV. This study also found positive correlation between MET and YMCA score. This indicates the striking effects of increasing physical activity on improving cardiovascular fitness.

Regular exercise has a favorable effect on many of the established risk factors (sedentary life style, high blood pressure, abnormal values for blood lipids, smoking, and obesity) for cardiovascular disease. For example, exercise promotes weight reduction and can help reduce blood pressure. Exercise can reduce "bad" cholesterol levels in the blood (the low-density lipoprotein [LDL] level), as well as total cholesterol, and can raise the "good" cholesterol (the high-density lipoprotein level [HDL]).The Surgeon General's Report, a joint CDC/ ACSM consensus statement, and a National Institutes of Health report agreed that the benefits mentioned above will generally occur by engaging in at least 30 minutes of modest activity on most, preferably all, days of the week. Modest activity is defined as any activity that is similar in intensity to brisk walking at a rate of about 3 to 4 miles per hour.

These activities can include any other form of occupational or recreational activity that is dynamic in nature and of similar intensity, such as cycling, yard work, and swimming. This amount of exercise equates to approximately five to seven 30-minute sessions per week at an intensity equivalent to 3 to 6 METs (multiples of the resting metabolic rate*), or approximately 600 to 1200 calories expended per week21.Results of this study shows that with the increase of body mass index, post exercise peak heart rate increases suggesting low cardiovascular fitness of the population studied. Physical activity level is positively correlating with YMCA score suggesting that routine physical activity improves cardiovascular fitness in young population.

Limitations of the study and Future scope: The study had certain limitations too. For instance, the sample size was small, the female subjects were not included, Variables such as resting heart rate, heart rate recovery and blood pressure (post exercise) was not included, IPAQ records only activities done beyond 10 minutes, thus activities done less than that duration is not recorded thus it tends to underestimate the physical activity levels.The present study investigated the correlation with a small size so future research with a larger study population including both males and females is required for generalization of the results. The present study did not study variables like resting heart rate, heart rate recovery and blood pressure (post exercise), so

future research may be done to evaluate these variables also. Moreover, similar parameters of the study can be studied after a training protocol.

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