# IMPACT OF PHYSICAL ACTIVITY ON LIPID DISORDERS IN PREHYPERTENSIVE POPULATION

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**Abstract:**

**Background:** Elevated blood pressure and dyslipidemia are risk factors for cardiovascular disease, which is one of the most common noncommunicable diseases (NCD) and is responsible for 41 million deaths (71%) each year. Physical activity (PA) is believed to be a key factor in the prevention and management of hypertension as it reduces the risk of dyslipidemia and the consequences of prehypertension.

**Objective:** This study aimed to determine the effects of physical activity on lipid levels in individuals with prehypertension and examine the association between physical activity and the Framingham risk score (FRS).

**Method:** Individuals of different ages (25–40 years), gender, socioeconomic class, and professions were randomly selected from the general population. After assessing the IPAQ and monitoring BMI and BP (for three consecutive days) in 140 volunteers, a total of 80 prehypertensive subjects were identified. The lipid profiles were measured using a commercial diagnostic kit.

**Results:** The study population was divided into three groups based on IPAQ score: low PA (n = 38, 48%), moderate PA (n = 28, 35%), and high PA (n = 14, 18%). Overweight and obese prehypertensive individuals accounted for 71% (n=64) and 6% (n=5) of the population, respectively. PA, BMI, blood pressure, and cholesterol levels were significantly associated in the bivariate analysis (p0.005, p0.001). It has been demonstrated that a lack of PA elevates BP, TC, LDL, and TG. Participants with dyslipidemia and high blood pressure were more likely to develop heart disease based on their FRS scores.

**Conclusion:** According to this study, increased PA lowered the risk of prehypertension developing into hypertension. Regular PA (moderate to vigorous) also improves cardiovascular health by reducing BP and cholesterol levels, as well as promoting positive physiological changes, such as stimulating the heart arteries to expand more easily and boosting metabolic responses.

**Keywords:** Physical activity, CVD, FRS, Dyslipidemia, Prehypertension, IPAQ.

## 1. Introduction:

Non-communicable diseases are chronic conditions with a lifetime duration that cannot be transmitted from one individual to another and are the main cause of death worldwide [1]. Over 80% of NCDs are cancer, diabetes, cardiovascular diseases, and chronic respiratory diseases, which continue to increase in all age groups [2, 3]. Different physical and mental problems that can occur alone or in combination with other illnesses comprise the remaining 20% of NCDs [4]. CVD accounts for the majority of NCD mortality (17.9 million per year), followed by cancer (9.3 million), diabetes (4.1 million), and lung disorders (4.1 million) [5].

Cardiovascular disease (CVD) is one of the leading causes of death and morbidity and poses a danger to life. Unmanaged potential factors, such as high blood pressure and dyslipidemia, could increase mortality and morbidity in areas with higher CVD prevalence [6]. Hypertension is one of the leading causes of cardiovascular disease and death worldwide [7]. Worldwide, the prevalence of hypertension is increasing, and a large percentage of people with prehypertension continue to develop hypertension owing to the increased prevalence of unhealthy habits, including inactivity and aging of the population (PA) [8]. Prehypertension is defined as systolic blood pressure between 120 and 139 mmHg and/or diastolic blood pressure between 80 and 89 mmHg [9]. Pre-hypertension and hypertension rates have increased globally in recent years. Prehypertensive patients have a greater chance of developing hypertension than those with normal blood pressure. Prehypertension increases the risk of CVD and develops into clinical hypertension at a prevalence of 19% over four years [10]. Studies have shown that the high-risk Systemic Coronary Risk Estimation (SCORE) and Framingham Risk Score (FRS) are available to evaluate the risk of fatal and non-fatal CVD hazards among persons who appear to be in good health [11].

Dyslipidemia, also known as lipid irregularities, is typically characterized by increased levels of total cholesterol (T-Chol), triglycerides (TG), low HDL-C, and small dense LDL particles [12]. Dyslipidemia, a key predictor of cardiovascular disease, damages the endothelium, and the reduction in physiological vasomotor activity resulting from endothelial damage may induce high blood pressure (BP) [13]. As a result, variables such as dyslipidemia that promote endothelial dysfunction may contribute to hypertension. Furthermore, lipid profile regulation, BMI, and blood pressure are all interrelated [14].

The influence of different physical activity treatments has been suggested in the literature as a way to reduce the risk of developing prehypertension and its effects [15]. According to estimates from the WHO, almost two million individuals pass away each year as a result of physical inactivity. Since people between the ages of 25 and 40 years are the most productive, it is important to look at modifiable variables that might be connected to persons in this age group with elevated blood pressure. Physical inactivity is one such potential factor that has been related to higher blood pressure and CVDs in adults as opposed to regular exercise's ability to decrease blood pressure and weight in adults [10]. The International Physical Activity Questionnaire is an important tool for measuring PA in adults. The term "metabolic equivalent of the task" (MET) describes the number of calories or energy expended during physical activity. In MET hours per day and week, the total amount of physical activity can be calculated [16]. Regular exercise lowers the risk of premature mortality owing to CVD. In addition, it aids in weight reduction while lowering blood pressure, preventing diabetes, and reducing other CVD risk factors [8, 17].

People who are less physically fit or lead sedentary lifestyles are 30–50% more likely than active people to have high blood pressure. A considerable CVD risk is posed by physical inactivity [18]. There are limited data from low- and middle-income nations accessible at this time because the majority of such studies have been carried out in Western nations. The current study aimed to evaluate the relationship between PA, dyslipidemia, and FRS in Pakistan, as well as the effects of PA on prehypertensive participants aged 25–40 years.

## 2. Methodology:

This study included 80 prehypertensive participants from a pool of > 140 volunteers. A cross-sectional design was used in this study. This study was conducted in Lahore, Pakistan. This research comprised participants of both sexes aged between 25 and 40 years from Lahore. Only individuals with prehypertension were included in this study after evaluation using the IPAQ and BP. We excluded participants who were taking any medications, a second type of hypertension, the presence of current TB, cardiovascular illness, malignant tumors, renal, liver, thyroid, or other infectious disorders in the past, and smoking. After obtaining the demographic data, filling questionnaires (IPAQ), and measurement of blood pressure for three consecutive days, prehypertensive individuals were selected, and prehypertensive participants were enrolled in this study. Participants were informed about the study method before measuring their blood pressure and completing the questionnaires. Demographic information was gathered using a specifically created research questionnaire. Demographic factors including age, sex, race, marital status, education, and occupation were all included.

### 2.1 Measurements:

#### 2.1.1 BMI and BP:

The weight and height of the subjects were used to compute their BMI. The participants were weighed without shoes. Seca Gmbh electronic scales from Hamburg, Germany set up on a flat surface to measure weight. Standardized and calibrated mercury sphygmomanometers were used to measure the blood pressure while the patient was sitting. Three days in a row, blood pressure was measured and averaged.

#### 2.1.2 Physical Activity

The short form of the IPAQ was used to evaluate PA, which covers a variety of domains, including work-related, transport-related, home-related, and sports- and leisure-related physical activity. Metabolic-equivalent-of-task (MET) minutes per week were used to represent the energy expenditure of all vigorous and moderate PA as well as walking. Different kinds of IPAQ data activities were analyzed using the MET values listed below: Walking equals 3.3 METs, moderate activity equals 4.0 METs, and vigorous activity equals 8.0 Mets. min/week for each domain was multiplied by the MET values to convert them into Metabolic Equivalent Task (MET)/min/week. The overall PA score was obtained by adding domain-specific values. Low, moderate, and high PA levels of physical activity were classified using the IPAQ scoring technique. Physical inactivity, or failure to exercise enough, was defined as the exercise of less than 600 MET min per week. For simplicity, we used the IPAQ acronym and transformed it into Google form.

#### 2.1.3 Estimation of Lipid profile

After an overnight fast of 8 h, 5 mL of venous blood was collected from each patient and controlled using a plastic syringe fitted with a sterile stainless-steel needle and placed in a vacutainer. The serum was drawn into glass or plastic tubes with or without gel barriers using standard venipuncture procedures. Furthermore, before centrifugation, full clot formation was achieved. The serum was separated from the blood by centrifugation at 4000 rpm for approximately 5 min. Therefore, as soon as the collection process was complete, serum was removed from the gel or RBCs. The serum was pipetted and used for several biochemical tests. The clotting process may take longer to complete in certain samples than in others, particularly in patients on thrombolytic or anticoagulant medication. After the serum was collected, it was aliquoted into an Eppendorf tube and immediately examined.

A commercial diagnostic kit for the detection of lipid profiles was developed by BIO ACTIVE DIAGNOSTIC SYSTEMS JTC Germany, which is based on industry-standard processes based on enzymatic and colorimetric methods utilizing cholesterol esterase and cholesterol oxidase, and spectrophotometry was used. Implemented kit procedure to get desired results. Each stage was conducted in a UMT life sciences lab to avoid any potential influence of the test findings. The UMT laboratory served as the site.

#### 2.1.4 Framingham Risk Score:

Following computations, a formula was used to derive the Framingham Risk Score (FRS), which is the method used to determine a person's 10-year CV risk. When calculating the risk of heart disease, the FRS calculator accounts for variables such as age, ethnicity, total cholesterol, HDL, systolic blood pressure, and smoking. So, to do this, we utilized an Omni calculator.

### 2.2 Data Analysis:

Statistical analysis was performed using SPSS (16.0 version), a statistical tool, and Microsoft Excel. Simple descriptive statistics and the chi-square test were used to reflect the sociodemographic characteristics of the study population. Using Pearson's correlation and Spearman's correlation analysis, it was possible to determine the correlation between the various components.

This study was approved by the University of Management and Technology's research and ethics committee, and informed consent was obtained from the study participants after a summary of the topic. Furthermore, the participants were able to leave the study at any moment without disclosing any information.

## 3 RESULTS

A total of 140 individuals between the ages of 25 and 40 years were contacted; there were equal numbers of men and women (50/50). Prehypertensive individuals were chosen and participated in this study after completing questionnaires, collecting demographic information, and testing blood pressure for three days in a row. Therefore, 80 people aged between 25 and 40 years were included in the current study. Table 1 shows the baseline characteristics of participants.

The gender-specific distribution revealed that there were more prehypertensive men (70%; n=56) than women (30%; n=24). The age distribution had a mean of 30.14 ± 4.86, 28.71 ± 3.70, and 28.74 ± 3.57 in low, moderate, and highly physically active participants respectively. This study found that the participants' average BMI was (24.16 kg/m2 with a standard deviation of 2.4475).

The mean systolic blood pressure in participants with low physical activity was 124.89 ± 3.14. And the mean diastolic blood pressure mean was 84.52 ± 2.98. All the means and standard deviations for low, moderate, and high physical activity are shown in Table 2.

Overweight individuals were more likely to have dyslipidemia and hypertension than those with normal physical activity. People with a high BMI were more likely to have significantly higher blood pressure than those with a normal BMI. Regression analysis revealed that obesity and overweight were significant risk factors for prehypertension in the current investigation.

In table 3 PA showed an inverse relationship with all parameters and was positively significant ($p<0.005$ and $P<0.001$, respectively). High physical activity indicated normal BP, cholesterol level, and BMI in all age categories. This study revealed that the maximum number of participants was inactive, and only 17% of the participants were active. The other calculation method for PA is the MET minutes/week. Accordingly, the maximum number of participants was in the category of inactive or low physical activity due to their sedentary lifestyle. However, only a few of the participants were physically active.

Statistical analysis showed a significant relationship ($p=0.000$ and $p<0.001$, respectively) between all parameters. Physically inactive participants had a high BMI. MET min showed a significant correlation with blood pressure and blood lipid levels, which indicates that high PA can overcome or decrease the risk of hypertension and dyslipidemia are shown in table 3.

However, the proportion of prehypertension is larger in the age range of 30–40 years compared to individuals in the age group of 25–30 years, who have a three times higher chance of having prehypertension. Males made up more of the prehypertensive population than females, with a percentage of 58.5 percent. In addition, BMI and physical activity were significantly associated with cholesterol levels and blood pressure. Cholesterol is a major contributor to prehypertension progression. In this analysis, 10% of participants had normal or desirable cholesterol levels, 70%were suspects, and 20% had high cholesterol levels. The mean value of cholesterol was 221.95 with 21.925 standard deviations. This study indicated that an increase in BMI is associated with higher total cholesterol levels. This prehypertensive participant had a high BMI, high cholesterol level, low HDL level, and high LDL and TG levels.

Table 4 shows the relationship between the different categories of physical activity. The physical activity showed an inverse relationship with TC, LDL, TG, and FRS, and a direct relationship with HDL. This shows that when PA increases, HDL levels also increase, leading to a decrease in the risk of CVD. The 10-year CVD risk of an individual was calculated using the Framingham Risk Score, which is sex-specific. The Framingham Risk Score was first developed using data from the Framingham Heart Study to determine the 10-year risk of developing coronary heart disease. Participants with high blood pressure and low physical activity were more likely to have heart disease. BMI and HDL levels were connected. A significant relationship was found between PA and other parameters.

**Table 1:** Baseline Characteristics of all Participants

| Characteristics | Number of participants | Percentage of participants |
|---|---|---|
| **Age (years)** | | |
| **25-30** | 42 | 52.5% |
| **31-35** | 26 | 32.5% |
| **36-40** | 12 | 15% |
| **Gender** | | |
| **Male** | 56 | 70% |
| **Female** | 24 | 30% |
| **Marital Status** | | |
| **Married** | 38 | 47.5% |
| **Unmarried** | 42 | 52.5% |
| **Physical Activity** | | |
| **High** | 14 | 17.5 |
| **Moderate** | 28 | 35 |
| **Low** | 38 | 47.5 |

**Table 2:** All parameters according to Physical activity.

| Variable | Low Physically Active (n= 44) Mean ± SD | Moderately Physically Active (n= 17) Mean ± SD | Highly Physically Active (n= 19) Mean ± SD | P value |
|---|---|---|---|---|
| **Age (years)** | 30.14 ± 4.86 | 28.71 ± 3.70 | 28.74 ± 3.57 | 0.359 |
| **BMI (kg/m$^2$)** | 24.59 ± 2.70 | 23.74 ± 1.96 | 23.55 ± 2.07 | 0.217 |
| **Systolic BP (mm Hg)** | 124.89 ± 3.14 | 124.12 ± 3.27 | 125.74 ± 2.25 | 0.272 |
| **Diastolic BP (mm Hg)** | 84.52 ± 2.98 | 83.41 ± 2.39 | 84.89 ± 2.56 | 0.248 |
| **TC (mg/dl)** | 231.75 ± 16.60 | 212.12 ± 21.11 | 208.05 ± 22.91 | 0.000 |
| **HDL (mg/dl)** | 46.52 ± 12.19 | 46.88 ± 9.38 | 50.58 ± 11.26 | 0.423 |
| **LDL (mg/dl)** | 144.68 ± 14.24 | 134.05 ± 9.64 | 130.57 ± 15.02 | 0.000 |
| **TG (mg/dl)** | 318.55 ± 76.55 | 226.18 ± 31.62 | 236.74 ± 78.99 | 0.000 |
| **FRS ( % )** | 2.18 ± 0.86 | 1.35 ± 0.48 | 1.31 ± 0.87 | 0.000 |
| | | | | |

**Table 3:** Correlation of Physical Activity (METS) with Metabolic Parameters

| Groups | Age | BMI | TC Level | HDL Level | LDL Level | TG Level | PA | BP | FRS |
|---|---|---|---|---|---|---|---|---|---|
| **Age Group** | 1 | .055 | .231* | -.123 | .238* | .201 | -.185 | .280* | .399** |
| **BMI Groups** | .055 | 1 | .469** | -.293** | .318** | .446** | -.243** | .270* | .476** |
| **TC Level** | .231* | .469** | 1 | -.302** | .614** | .909** | -.445** | .389** | .822** |
| **HDL Level** | -.123 | -.293** | -.302** | 1 | -.340** | -.283* | .187 | -.219 | -.466** |
| **LDL level** | .238* | .318** | .614** | -.340** | 1 | .632** | -.469** | .386** | .644** |
| **TG level** | .201 | .446** | .909** | -.283* | .632** | 1 | -.493** | .377** | .780** |
| **Physical Activity** | -.185 | -.243* | -.445** | .187 | -.469** | -.493** | 1 | -.538** | -.442** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Blood pressure** | .280* | .270* | .389** | -.219 | .386** | .377** | -.538** | 1 | .477** |
| **FRS** | .399** | .476** | .822** | -.466** | .644** | .780** | -.442** | .477** | 1 |

**Table 4:** Difference in variable according to PA:

| Variable | Low vs Moderate (Mean Difference) | Low vs High (Mean Difference) | Moderate vs High (Mean Difference) |
|---|---|---|---|
| TC | 19.63* ± 5.48 | 23.69* ± 5.27 | 4.06 ± 6.41 |
| LDL | 10.62* ± 3.88 | 14.10* ± 3.73 | 3.47 ± 4.54 |
| HDL | -0.36 ± 3.26 | -4.05 ± 3.14 | -3.69 ± 3.82 |
| TG | 92.36* ± 19.05 | 81.80* ± 18.31 | -10.56 ± 22.27 |
| FRS | 0.83* ± 0.22 | 0.87* ± 0.22 | 0.04 ± 0.26 |

*p value < 0.05

## 4 DISCUSSION

Prehypertension is the initial stage of hypertension, and it occurs in several forms. People with prehypertensive symptoms typically develop hypertension due to a wide range of risk factors, including CVDs and several other NCDs. Pakistan is a nation where the population is rapidly growing. Prehypertension and hypertension risk factors are increasing among Pakistanis as a result of the rising population, due to a sedentary lifestyle and decreasing PA [11].PA reduces BP, bad cholesterol, and CVDs as a kind of treatment. Poor dietary habits and physical inactivity, by estimates from the WHO, cause over two million CVD-related deaths annually. We aimed to assess the effect of physical exercise on blood lipid levels by estimating the prevalence of hypertension, which may be avoided or reduced if sedentary people become active. We also believe that PA lowers the likelihood of developing hypertension [19]. The prevalence of high blood pressure in Pakistan has been documented in two epidemiological studies. The National Health Survey from 1990 to 1994 was the basis for the first research study, which reported a hypertension rate of 19.1% [20]. The prevalence of hypertension is likely to increase over time.

Prehypertension affected 47.05 percent of the study population. The gender breakdown of participants showed that males (n = 56; 70%) and females (n = 24; 30%) made up the majority of the sample. The majority of studies agree with the present study's conclusions that males are more likely than women to have prehypertension. In Delhi, Manipur, and Kerala, three separate Indian states, research was conducted on 360 young people between the ages of 20 and 30 years [21]. Men had a prehypertension incidence rate of approximately 54% compared to women's incidence rate of approximately 10% [22]. This study showed that physical activity reduces blood pressure regardless of intensity, showing that even a quick stroll can lower blood pressure and reduce the risk of CVD [23]. According to certain studies, walking can increase metabolism and reduce blood pressure, particularly systolic blood pressure. Additionally, several studies have shown that because walking is a flexible and affordable intervention, it may be used as a replacement and supplemental strategy for other sports [24].

In the current study, there was a statistically significant tendency for the risk of prehypertension to increase as BMI levels increased. The mean body mass index was 24.168, with a standard deviation of 2.4475. This study showed a stronger relationship between age, BMI, SBP, and DSBP blood pressure, all of which had positive relationships with one another. Age has an impact on blood pressure, as seen by the gradual increase in systolic and diastolic blood pressure values from the youngest to the oldest age group [14]. Age-associated high blood pressure is connected to older research, according to that study [22]. Pre-hypertension is recognized as a possible risk factor for CVD, and the current study demonstrated how it might work together to accelerate the course of MI. In the present study, age, SBP, and DSBP showed a greater association than age and BMI.

According to the World Health Organization, prehypertension is more prevalent in economically underdeveloped countries, where heart diseases cause approximately 80% of mortality [6]. This study found that the primary risk variable for the progression of prehypertension was dyslipidemia. This observation is in line with research results from Bangladesh-based research [15]. Adults with normal, overweight, and obese individuals exhibited different TG, TC, HDL, and LDL levels [13]. Regular physical activity reduces fatty tissues in the human body, which lowers TC, LDL, and TG levels as well as BMI, according to American research examining the impact of PA on body mass index. This is because physical activity changes the amount of food and energy the body uses. As a result, the amount of fatty tissue in the human body decreases, which has a direct impact on the body mass index and cholesterol levels (BMI) [25].

Studies investigating the relationship between lipid profiles and prehypertension and mortality from CVDs and other causes have not consistently produced similar results[9, 26]. The purpose of our study was to examine how a program to promote physical activity affects several outcome indicators in people with prehypertension. Physical activity has a natural ability to enhance human health. Noncommunicable disease risk decreases, and overall well-being increases [27, 28]. Every physical activity improves human health and makes it better, which lowers mortality. This study suggests that a decline in physical activity causes hypertension and diabetes, ultimately resulting in CVD. The results showed that only 6.5 percent of individuals were active, 20% had moderate PA, and 72.5 percent had low PA. The inactive participants were on the edge of developing hypertension and borderline diabetes. In the middle-aged and older prehypertensive group, a previous study also discovered a greater incidence of the development of hypertension with decreased exercise ability [16, 26]. Physical Activity, which has the advantages of being affordable and not interfering with other drugs, is among the most efficient non-drug means of decreasing blood pressure. Without activity, blood pressure measurements are frequently 1.2 mmHg higher in the diastolic and 4 mmHg higher in the systolic [12]. The current study aimed to examine the effects of physical activity on the prognosis of CVD. To offer a theoretical foundation for early intervention, this study attempted to identify the risk variables associated with CVD and prehypertension.

## 5 Conclusion:

Physical exercise keeps individuals healthy and their BMI within normal ranges because it boosts metabolism and burns off extra fatty tissue, which in turn helps to reduce body weight and maintain appropriate BMI levels. This study found that exercise dramatically reduced the risk of developing hypertension, increased HDL levels, decreased blood cholesterol, and altered body metabolism, which lowered the chances of CVD. Our results showed that the overall level of PA among the participants was insufficient, and a strong relationship between PA and hypertension was found. It seems that regulating blood pressure or treating its symptoms is directly affected by the body's lipid levels. We encourage physicians to monitor the PA, lipid profile, and blood pressure of their patients to slow the progression of hypertension and CVD.

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