Original Article

# Association of Physical Activity with Lipid Profile in Healthy Subjects: A Cross Sectional Study in Tertiary Care Hospital from Central Rural India

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## Abstract

**Context:** Physical activity is an important factor for healthy aging, and lack of it has been associated with chronic noncommunicable diseases (NCDs). Research in sedentary behavior has indicated that it is an independent risk factor of morbidity and mortality, separate from lack of physical activity. **Methods:** This cross-sectional study was conducted in the department of medicine in a tertiary care hospital on apparently healthy relatives of patients without chronic NCDs. Metabolic equivalents of tasks (METs) were calculated by the global physical activity questionnaire (GPAQ). **Statistical Analysis:** We correlated the various parameters [age, sex, body mass index (BMI), waist-hip ratio (WHR), and lipid panel with METs] by Pearson correlation coefficient. **Observations and Results:** Total of 750 patients with a mean age of 42.55 ± 10.93 years were included, and 389 (51.9%) were male in the present study. In our study, a strong negative correlation was found between physical activity and BMI, moderate negative correlation between physical activity with triglycerides (TG), total cholesterol (TC), and WHR. There was a high degree of positive correlation between sedentary lifestyle (SLS) duration with BMI and TC. A moderate degree positive correlation was found between SLS duration and WHR, TG, and low-density lipoproteins (LDL). **Conclusion:** The clinician should be aware of various obesity indices, and it was found that lipid profile is inversely correlated with physical activity and directly correlated with SLS in healthy individuals. Lifestyle changes and exercise may reduce obesity and lipid disorders and thereby reduce further development of complications in those patients.

**Keywords:** Global physical activity questionnaire, lipid profile, noncommunicable diseases, physical activity, sedentary lifestyle

## Introduction

Noncommunicable diseases, also known as chronic diseases, do not spread from person to person, tend to be of long duration, and are the result of a combination of genetic, physiological, environmental, and behavioral factors. The major noncommunicable diseases (NCDs) are one of the major health challenges of the twenty-first century and are linked to four leading behavioral risk factors: tobacco, alcohol, physical inactivity, and unhealthy diet.[1-3] These behaviors lead to metabolic/physiological changes: raised blood pressure and weight, deranged blood glucose, and blood lipids.[4,5] Observational and experimental studies have shown that physical activity favorably impacts health outcomes and the development of chronic NCDs in a graded relationship.[6-10] Regular exercise reduces the risk of cardiovascular diseases (CVD) and[3,11] all-cause and disease-specific mortality.[12-14] There are controversies about which physical activity characteristic would be more important to improve lipid profile: exercise intensity, frequency,[15,16] duration, or a combination of frequency and intensity.[7] The present study is aimed at estimating the association of physical activity with the lipid profile of healthy patients attending a tertiary care hospital in central rural India.

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## Subjects and Methods

### Ethics

The study was approved by the ethics committee of Mahatma Gandhi Institute of Medical Sciences (IRB00003623) of The Mahatma Gandhi Institute of Medical Sciences (MGIMS), Sevagram, Wardha, Maharashtra on 09/07/2017. We obtained a written informed consent from all study subjects before enrolling them in the study.

### Study design and setting

This cross-sectional, analytical, hospital-based study was conducted in the department of Medicine at the MGIMS, Sevagram which is a 1000-bedded teaching tertiary care hospital located in central India. The study was carried out from 1st December 2017 to 30th November 2019. All participants were included in the study with the following inclusion and exclusion criteria:

### Inclusion criteria

- Age group >18 years (Both sexes),
- All apparently healthy relatives of patients without chronic NCDs presenting to the, medicine outpatient and inpatient department and willing to participate in the study.

### Exclusion criteria

- Cardiac diseases like hypertension, ischemic heart disease, and heart failure,
- Any endocrine disorders [diabetes mellitus (DM), thyroid disorders, and Addison's disease],
- Chronic kidney disease,
- Chronic liver failure,
- Patients on cholesterol-lowering drugs [Hydroxymethylglutaryl-CoA (HMG Co-A) reductase inhibitors, bile acid sequestrants, nicotinic acid, and fibric acid],
- Patients on antiplatelet drugs (Aspirin, Dipyridamole, Clopidogrel, Prasugrel, Ticagrelor, Abciximab, and Tirofiban).

A detailed history including previous morbidity/drug history was taken, and anthropometric measurement and clinical examination were carried out.

### Sample size and sampling technique

The calculated sample size for this study was 750. It was adequate to detect the correlation of 0.26 at 5% alpha error and 10% beta error and design effect of the two.[15] Study participants were recruited through consecutive sampling technique till the desired sample size of 750 was achieved.

### Data collection tools

Baseline characteristics and demographic data were recorded for all the study subjects on a pilot-tested questionnaire. Anthropometric measurements (height, weight, BMI and WHR) were taken as per the standard protocols by a trained professional. The study subjects were instructed to stand erect, wearing light clothing, be barefoot, and weight was recorded in kilograms by the digital display weight scale. The height was measured using a stadiometer in an erect position. A scale was kept flat on the head, hairs pressed, and the reading was recorded. BMI was calculated in all study participants by standard Quetelet Index current weight (kg)/height ($m^2$) method. We categorize the study subjects into normal from 18.5kg/$m^2$ to 18.5–22.9 kg/$m^2$, underweight <18.49 kg/$m^2$, overweight from 23.0 kg/$m^2$ to 24.9, and obese >25.0 kg/$m^2$, respectively, as per the cut-off values provided by the World Health Organization for Asian population.[17]

Waist circumference was measured with a flexible tape placed on a horizontal plane around the abdomen at the level of the iliac crest as seen from the anterior view, at the end of gentle exhaling. Hip circumference was measured as the maximal circumference over the buttocks. The waist hip ratio was then calculated by dividing the waist circumference (cm) by the hip circumference (cm). For statistical analysis, central obesity was defined as WHR >0.9 for males and >0.8 for females.

### Biochemical analysis and definitions

Baseline venous blood samples after a 12-h overnight fast were collected for estimation of biochemical tests from all enrolled study participants. Biochemical analyses were performed using a fully automatic chemistry Beckman Coulter analyzer (AU480), calibrated and quality control before the test. Venous blood samples were transported within 6 h to the central laboratory of the hospital for lipid panel [total cholesterol (TC), high-density lipoprotein (HDL), triglycerides (TG), calculated low-density lipoprotein (LDL), and calculated very-low-density lipoproteins (VLDL)] measurement by standard enzymatic tests. Cut-off normal levels for lipid were decided according to the recent American heart association guidelines. Levels were considered abnormal if TC >200 mg/dL, LDL >130 mg/dL, TG >150 mg/dL, HDL <40 mg/dL, and VLDL >30, respectively.[18]

### Physical activity assessment

Physical activity assessment was performed for all the selected study subjects with the help of global physical activity questionnaire (GPAQ) developed by the World Health Organization for physical activity surveillance. This questionnaire gathers information on physical activity, sedentary behavior in three domains, which include activity at work, travel to and from work, and recreational activities.[19] Grading of physical activity was done by calculating metabolic equivalent task (METs) (ratio of a person's working metabolic rate relative to the resting metabolic rate) to express the intensity of physical activities of all the study subjects. We assigned 4 METs and 8 METs to the time spent in moderate and vigorous activities, respectively. It is estimated that, compared to sitting quietly, a persons caloric consumption is four times as high when being moderately active, and eight times high when being vigorously active. The METs were calculated for each study subject using their GPAQ and categorized into four groups i.e. 0–3000, 3001–6000, 6001–9000, and >9000.

We also asked study subjects questions about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, travelling in the car, bus, train, reading, playing cards, or watching television, but do not include time spent sleeping i.e. SLS duration. SLS duration was calculated and categorized into four groups i.e. 0–120, 121–240, 241–480 and ≥480 min. We correlated METs and SLS groups with different parameters of our study i.e. age, sex, BMI, WHR, lipid panel (TC, TG, HDL, LDL, and VLDL).

### Statistical analysis

Statistical data analysis was done using descriptive and inferential statistics using Chi-square test and one-way analysis of variance (ANOVA), and $P < 0.05$ was considered as the level of significance. Pearson correlation coefficient was used to see the correlation between physical activity and lipid panel. Pearson correlation coefficient is considered to be perfect if the value is near ± 1, as one variable increases, the other variable tends to also increase (if positive) or decrease (if negative). It is said to be a strong, moderate, and low degree correlation if the coefficient value (r) lies between ± 0.50 and ± 1, ±0.30 and ± 0.49, and below ± 0.29, respectively. No correlation was defined when the value was zero. We analyzed the data by SPSS 24.0 version and GraphPad Prism 7.0 version.

## Observations and Results

We included 750 study subjects who attended inpatient and outpatient in the department of medicine over a period of 18 months based on the inclusion and exclusion criteria [Figure 1].

We observed that the mean age of the study subjects was 42.55 ± years, more than half were <45 years of age, and 389 (51.9%) were males. The baseline characteristics of the study subjects are summarized in Table 1. Almost 55% of the study subjects were obese, and 23% were overweight as per

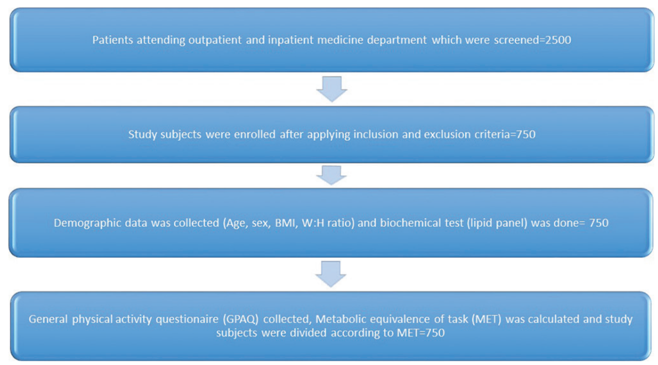


**Figure 1:** Flow chart of study participants

**Table 1: Demographic characteristics distribution of present study**

| Variables | Male *n* (%) | Female *n* (%) | Total *n* (%) |
|---|---|---|---|
| Age | | | |
| 16-30 | 57 (7.6) | 46 (6.1) | 103 (13.7) |
| 31-45 | 157 (20.9) | 188 (25) | 345 (45.9) |
| 46-60 | 154 (20.5) | 108 (14.4) | 262 (34.9) |
| 61-75 | 21 (2.9) | 19 (2.6) | 40 (5.5) |
| Body mass index (kg/m$^2$) | | | |
| Underweight (<18.5) | 1 (0.1) | 2 (0.3) | 3 (0.4) |
| Normal (18.5-22.9) | 83 (11.1) | 64 (8.6) | 147 (19.7) |
| Overweight (23-24.9) | 105 (14) | 68 (9.1) | 173 (23.1) |
| Obese (≥25) | 200 (26.7) | 227 (30.2) | 427 (56.9) |
| Waist: Hip Ratio | | | |
| Normal (<0.9: males, <0.8: females) | 122 (31.4%) | 8 (2.2%) | 389 (51.9) |
| Abnormal (≥0.9: males, ≥0.8: females) | 267 (68.6%) | 353 (97.8%) | 361 (48.1) |
| Lipid panel | | | |
| Abnormal TC (≥200 mg/dL) | 96 (12.8) | 82 (10.9) | 178 (23.7) |
| Abnormal HDL (<40 mg/dL) | 100 (13.3) | 83 (11.06) | 183 (24.4) |
| Abnormal TG (≥150 mg/dL) | 135 (18) | 77 (10.2) | 212 (28.2) |
| Abnormal LDL (≥130 mg/dL) | 69 (9.2) | 58 (7.7) | 127 (16.9) |
| Abnormal VLDL (≥30 mg/dL) | 129 (17.2) | 91 (12.1) | 220 (29.3) |
| Metabolic equivalent of task | | | |
| 0-3000 | 178 (48.6) | 188 (51.4) | 366 (100) |
| 3001-6000 | 174 (53.1) | 154 (46.9) | 328 (100) |
| 6001-9000 | 34 (66.7) | 17 (33.3) | 51 (100) |
| 9001-11000 | 3 (60) | 2 (40) | 5 (100) |
| Sedentary lifestyle duration (min) | | | |
| 0-120 | 5 (41.7) | 7 (58.3) | 12 (100) |
| 121-240 | 221 (52.7) | 198 (47.3) | 419 (100) |
| 241-480 | 160 (60.6) | 156 (49.4) | 316 (100) |
| >480 | 3 (100) | 0 (0) | 3 (100) |

the Asian cut-off for BMI. Among the study subjects, 68.6% males and 97.8% females had abnormal WHR. In our study, maximum study subjects belonged to a group with METs of 0–3000 and SLS duration of 121–240 min.

The MET profile of study subjects is shown in Table 2. In our study, a strong negative correlation between MET and BMI was found with a Pearson correlation coefficient (r) -0.55. Moderate negative correlation was found between MET with TG (r) -0.34, LDL (r) -0.43, TC is (r) -0.54, and WHR (r) -0.35. Low degree negative correlation was found between METs and HDL (r) -0.24, VLDL (r) -0.31, and gender distribution was -0.126. No significant correlation between METs and age [(r) -0.056] was found. Correlation of MET according to SLS duration showed that study subjects having minimum METs (0–3000) had a mean SLS duration of 317 min which was maximum. The lowest mean SLS duration of 227.05 min was of the group with METs of 6001–9000. The sedentary lifestyle duration profile of study subjects is shown in Table 3. There was a strong positive correlation between SLS duration and BMI (r) 0.54 and TC (r) 0.50. Moderate degree positive correlation was found between SLS duration and WHR (r) 0.33, TG (r) 0.36, and LDL (r) 0.42. There was a low degree positive correlation between SLS duration and age (r) 0.066, HDL (r) 0.16, and VLDL (r) 0.29 and low degree negative correlation (r) -0.044 between SLS duration and gender. Correlation of SLS duration according to METs for study subjects having minimum SLS duration i.e. 0–120 min had mean METs value of 1060, which was the lowest mean MET value. The highest mean MET value of 3866.66 was of the group with the lowest SLS duration [Table 3].

## Discussion

We included 750 study subjects and assessed the association of physical activity with all five parameters of the lipid panel. In this cross-sectional, hospital-based study of Indian adults, 48.8% of the study subjects belonged to the category with minimum METs group i.e. 0–3000, and only five study subjects had their MET 9001–11,000. Similar results were reported by previous studies using different questionnaires and categories of physical activity [Table 2].[20-22] In our study, physical activity was inversely associated with BMI, WHR, TC, TG, LDL, and VLDL. We observed a linear significant correlation between physical activity and HDL. A similar inverse correlation of physical activity and mean TG,[20-22] mean TC,[20,21] mean LDL cholesterol,[21,22] and mean non-HDL (LDL + VLDL) cholesterol levels[20] were observed by previous studies. Various observational studies suggest that regular exercise favorably impacts health outcomes and reduces the risk of all-cause and disease-specific mortality for most individuals.[12,23-25] Comparison of the present study with previous studies regarding demographical distribution, baseline characteristic, and physical activity with lipid profile of study subjects are shown in Table 4 and Table 5.[20-22] We observed a linear relationship between SLS duration and BMI, WHR, and parameters of the lipid panel. This inverse relationship of SLS duration and HDL cholesterol was also consistent with observations of the Luxembourg study [Table 6].[21] The data from the Framingham Heart Study show that moderate and high, compared with low, physical activity levels increase life expectancy.[26] The improvement in survival with exercise was equivalent and additive to other lifestyle measures such as smoking cessation, control of hypertension, and avoidance of

**Table 2: Metabolic equivalent of task (MET) profile of study subjects**

| | Metabolic equivalent of task | | | | | |
|---|---|---|---|---|---|---|
| | 0-3000 (*n*=366) | 3001-6000 (*n*=328) | 6001-9000 (*n*=51) | >9000 (*n*=5) | *P* | *r* |
| Age (Mean±SD) (95% CI) | 43.59±11.38 (42.41-44.76) | 41.83±10.57 (40.68-42.98) | 39.70±8.69 (37.26-42.15) | 42.60±14.63 (24.42-60.77) | 0.070 | -0.056 |
| Male | 178 (48.6) | 174 (53.1) | 34 (66.7) | 3 (60) | 0.097 | -0.126 |
| Female | 188 (51.4) | 154 (46.9) | 17 (33.3) | 2 (40) | | |
| BMI (Mean±SD) (95% CI) | 27.70±3.07 (27.38-28.01) | 24.56±2.85 (24.25-24.87) | 23.45±2.10 (22.86-24.04) | 22.61±1.36 (20.91-24.30) | 0.0001 | -0.55 |
| W: H Ratio (Mean±SD) (95% CI) | 0.93±0.04 (0.92-0.93) | 0.89±0.04 (0.89-0.90) | 0.88±0.04 (0.87-0.89) | 0.90±0.02 (0.87-0.93) | 0.0001 | -0.35 |
| Total cholesterol (Mean±SD) (95% CI) | 192.70±36.36 (188.96-196.44) | 159.50±31.60 (156.04-162.93) | 142.58±26.57 (135.11-150.06) | 137.40±12.64 (121.70-153.09) | 0.0001 | -0.54 |
| HDL (Mean±SD) (95% CI) | 50.71±15.54 (49.11-52.31) | 46.50±11.85 (45.22-47.79) | 41.47±11.62 (38.20-44.74) | 44.60±14.79 (26.23-62.96) | 0.0001 | -0.24 |
| Triglyceride (Mean±SD) (95% CI) | 151.51±71.70 (144.14-158.88) | 110.41±41.41 (105.91-114.91) | 100.50±46.37 (87.46-113.55) | 103.20±27.36 (69.22-137.17) | 0.0001 | -0.34 |
| LDL (Mean±SD) (95% CI) | 113.13±35.88 (109.44-116.82) | 90.50±26.93 (87.58-93.43) | 81.03±20.31 (75.32-86.75) | 72.00±11.00 (58.34-85.65) | 0.0001 | -0.43 |
| VLDL (Mean±SD) (95% CI) | 31.13±17.09 (29.37-32.89) | 22.35±10.00 (21.27-23.44) | 19.86±9.20 (17.27-22.45) | 20.20±5.40 (13.49-26.90) | 0.0001 | -0.31 |
| SLS (Mean±SD) (95% CI) | 317.37±92.48 (307.87-326.88) | 238.62±69.36 (231.09-246.16) | 227.05±54.08 (211.84-242.27) | 240.00±42.42 (187.32-292.67) | 0.0001 | - |

**Table 3: Sedentary lifestyle (SLS) duration profile of study subjects**

| | Sedentary lifestyle duration (minutes) | | | | | |
|---|---|---|---|---|---|---|
| | **0-120 (*n*=12)** | **121-240 (*n*=419)** | **241-480 (*n*=316)** | **481-600 (*n*=3)** | ***P*** | ***r*** |
| Age (Mean±SD) (95% CI) | 43.41±9.11 (37.62-49.21) | 42.04±9.80 (41.10-42.98) | 43.22±12.33 (41.86-44.59) | 39.33±10.40 (13.47-65.18) | 0.48 | 0.066 |
| Male | 5 (41.67) | 221 (52.74) | 160 (50.63) | 3 (100) | 0.48 | 0.066 |
| Female | 7 (58.33) | 198 (47.26) | 156 (49.37) | 0 (0) | | |
| BMI (Mean±SD) (95% CI) | 21.89±1.50 (20.93-22.84) | 24.60±2.68 (24.34-24.86) | 27.99±3.13 (27.64-28.34) | 29.35±2.71 (22.60-36.09) | 0.0001 | 0.54 |
| W: H Ratio (Mean±SD) (95% CI) | 0.86±0.03 (0.849-0.888) | 0.90±0.04 (0.896-0.904) | 0.92±0.05 (0.923-0.935) | 0.98±0.05 (0.842-1.129) | 0.0001 | 0.33 |
| Total cholesterol (Mean±SD) (95% CI) | 136.41±26.83 (119.36-153.46) | 159.76±29.05 (156.97-162.55) | 194.64±39.33 (190.29-199.00) | 239.66±28.02 (170.05-309.28) | 0.0001 | 0.50 |
| HDL (Mean±SD) (95% CI) | 44.25±12.63 (36.22-52.27) | 46.22±11.92 (45.08-47.37) | 51.03±16.10 (49.24-52.81) | 42.66±7.23 (24.69-60.63) | 0.0001 | 0.16 |
| Triglyceride (Mean±SD) (95% CI) | 108.75±23.68 (93.70-123.79) | 114.08±50.47 (109.23-118.93) | 150.46±70.10 (142.70-158.22) | 221.00±37.72 (127.29-314.70) | 0.0001 | 0.36 |
| LDL (Mean±SD) (95% CI) | 76.83±76.83 (55.48-98.18) | 90.87±27.87 (88.19-93.55) | 114.33±35.24 (110.43-118.23) | 152.33±17.89 (107.87-196.79) | 0.0001 | 0.42 |
| VLDL (Mean±SD) (95% CI) | 23.33±6.94 (18.92-27.74) | 23.42±13.51 (22.12-24.72) | 30.43±15.20 (28.74-32.11) | 43.66±7.76 (24.37-62.96) | 0.0001 | 0.29 |
| MET (Mean±SD) (95% CI) | 3866.66±1439.52 (2952.03-4781.29) | 4040.63±1727.84 (3874.71-4206.56) | 2427.59±1466.02 (2265.33-2589.85) | 1060.00±295.97 (324.04-1795.23) | 0.0001 | - |

**Table 4: Comparison of present study with previous studies regarding demographical distribution of study subjects**

| Parameters/study name | Present Study (2019) | ELSA-Brasil study (2016)[22] | Crichton *et al*. (2015)[21] | Marrugat *et al*. (1996)[20] |
|---|---|---|---|---|
| Type of study | Cross-sectional | Cross-sectional | | |
| Number of participants | 750 | 12,688 | 1331 | 537 |
| Number of Men (%) | 389 (51.9%) | 5731 (54.8%) | 646 (48.5%) | 537 (100%) |
| Age group (range years) (Mean) | 16-75 (42.55) | 35-69 (55.5) | 18 to 69 (44.4) | 20-80 (40.82) |
| BMI (Mean±SD) | 26±3.35 | 26.8±4.8 | - | 24.99±3.08 |
| Waist Hip Ratio (Mean±SD) | 0.91±0.04 | 0.89±0.09 | - | - |
| Questionnaire used | General physical activity questionnaire | International physical Activity Questionnaire | International physical Activity Questionnaire | Minnesota Leisure Time Physical Activity Questionnaire |
| Association assessed | Physical activity its duration, sedentary lifestyle its duration and serum lipids (TC, HDL, LDL, TG, and VLDL) | Physical activity its duration with HDL, LDL, and TG | Physical activity, sedentary behavior time and lipid levels (TC, HDL, LDL, and TG) as cardiovascular risk factors | Amount and intensity of physical activity, physical fitness, and serum lipids (TC, HDL, LDL, and TG) |
| Categories of physical activity | 0-3000 METs<br>3001-6000 METs<br>6001-9000 METs<br>9001-11000 METs | Insufficient, Moderate Vigorous | Sedentary, Low, Medium High | Active<br>Very active |

obesity.[27] Physical activity is assumed to increase the activity of lipase lipoprotein and lecithin cholesterol acyl-transferase and to reduce the activity of hepatic lipase and cholesterol esterified transfer protein, components of reverse cholesterol transport.[28,29]

This study presents several strong points and has some novel findings. Our study has considered all parameters of the lipid panel along with demographic parameters like age, sex, BMI, and WHR using a standardized protocol and an adequate sample size in a rural setting. The cross-sectional design of the present study precludes any conclusion regarding causality between physical activity, sedentary lifestyle, and lipid panel. The results of our study cannot be extrapolated to the whole Indian subcontinent as it was conducted in a rural setting.

We used the long GPAQ questionnaire which has limitations and lowers accuracy than physical activity measurement by use of objective devices and is subject to response bias and recall bias. However, a self-reported questionnaire remains the low-cost, feasible way for the global surveillance of physical activity and intensity.

This study has implications beyond the correlation of physical activity and lipid profile obesity, in healthy individuals. First, the results of the present study do sensitize us to the point that

**Table 5: Comparison of present study with previous studies regarding distribution of study subjects according to physical activity and lipid profile**

| Metabolic equivalent of task (MET) | Number of study subjects *n* (%) | Cholesterol (Mean±SD) | Triglyceride (Mean±SD) | HDL (Mean±SD) | LDL (Mean±SD) | VLDL (Mean±SD) |
|---|---|---|---|---|---|---|
| Present study (METs) (*n*=750) | | | | | | |
| 0-3000 | 366 (48.8) | 192.7±36.36 | 151.51±71.70 | 50.1±15.54 | 113.13±35.88 | 31.13±17.09 |
| 3001-6000 | 328 (43.8) | 159.50±31.60 | 110.41±41.41 | 46.50±11.85 | 90.50±26.93 | 22.35±10.00 |
| 6001-9000 | 51 (6.8) | 142.58±26.57 | 100.50±46.37 | 41.47±11.62 | 81.03±20.31 | 19.36±9.20 |
| >9000 | 5 (0.06) | 137.40±12.64 | 103.20±27.36 | 44.60±14.79 | 72±11.00 | 20.20±5.40 |
| ELSA-Brasil study (Physical activity intensity) (*n*=12,688)[22] | | | | | | |
| Insufficient | 9910 (78.1) | - | - | - | - | - |
| Moderate | 1624 (12.8) | - | - | - | - | - |
| Vigorous | 1154 (9.1) | - | - | - | - | - |
| Crichton *et al*. (physical activity status) (*n*=1331)[21] | | | | | | |
| Sedentary | 150 (11.3) | | | | | |
| Low | 393 (29.5) | 201.1±40.7 | 120.8±115.7 | 62.7±18.4 | 122.1±35.4 | - |
| Medium | 394 (29.6) | 201.9±42.2 | 109.5±92.6 | 63.5±16.9 | 123.4±35.3 | - |
| High | 394 (29.6) | 199.4±37.7 | 109.3±73.2 | 60.2±15.1 | 124.1±32.9 | - |
| Marrugat *et al*. (*n*=537)[20] | | | | | | |
| Active | 285 (53) | 216±41.67 | 124±78.34 | 45±11.48 | 171±42.89 | - |
| Very active | 252 (47) | 201±35.97 | 85±40.45 | 53±12.41 | 148±38.20 | - |

**Table 6: Comparison of present study with previous studies regarding distribution of study subjects according to sedentary lifestyle duration and lipid profile**

| Sedentary lifestyle duration (min/day) | Study subjects Number (%) | Cholesterol (Mean±SD) | Triglyceride (Mean±SD) | HDL (Mean±SD) | LDL (Mean±SD) | VLDL (Mean±SD) |
|---|---|---|---|---|---|---|
| Present study sedentary lifestyle duration (Min) (*n*=750) | | | | | | |
| 0-120 | 12 (1.6) | 136.41±26.83 | 108.75±23.68 | 44.25±12.63 | 76.83±33.60 | 23.33±6.94 |
| 121-240 | 419 (55.9) | 159.76±29.05 | 114.08±50.47 | 46.22±11.92 | 90.87±27.87 | 23.42±13.51 |
| 241-480 | 316 (42.1) | 194.64±39.33 | 150.46±70.10 | 51.03±16.10 | 114.33±35.24 | 30.43±15.20 |
| >480 | 3 (0.4) | 239.66±28.02 | 221.00±37.72 | 42.66±7.23 | 152.33±17.89 | 43.66±7.76 |
| Crichton *et al*. (leisure time in min/day) (*n*=150)[21] | | | | | | |
| ≤60 | 21 (13.9) | 199.5±2.9 | 102.8±6.5 | 63.8±1.1 | 121.3±2.5 | - |
| 61-240 | 73 (48.7) | 200.6±1.5 | 112.9±3.4 | 61.7±0.59 | 123.6±1.31 | - |
| ≥240 | 56 (37.3) | 203.8±1.8 | 121.4±3.9 | 60.4±0.69 | 126.2±1.5 | - |

advocating an increase in physical activity may prevent obesity and its complications. Second, screening and early treatment for dyslipidemia in the high risk group (individuals with SLS) will reduce the burden of lipid disorders and their complications, mortality, and will also reduce out-of-pocket expenditure of the family. Third, it may have implications for policy and research initiatives regarding screening and detection as undetected obesity and dyslipidemia can be complicated by various NCDs such as, DM, metabolic syndrome, CVD, hypertension, and stroke. Future community-based follow-up studies should explore associations between a different sedentary lifestyle and varying levels of physical activity intensity with lipid profile and their impact on cardio-metabolic risk factors and development of other NCDs.

## Conclusion

In conclusion, body mass index, waist-hip ratio, total cholesterol, triglyceride, low-density lipoproteins, and very low-density lipoproteins are inversely correlated with physical activity and directly correlated with sedentary lifestyle in healthy individuals. sLifestyle changes and exercise may reduce obesity and lipid disorders and thereby reduce further development of complications.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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