# COMPARATIVE STUDY OF ANKLE BRACHIAL PRESSURE INDEX, LIPID PROFILE AND BLOOD SUGAR IN CYCLE RICKSHAW DRIVERS AND CONTROL SUBJECTS

**Manisha makwana*, Urja dholakia*, M.B.jani***, Pooja dholakia****, Lopa vaidya**, Chirag shah***

*Tutor, **Assistant Professor , Department of Physiology, GCS Medical College, Ahmedabad-380025, ***Professor, Department of Physiology, Baroda Medical College, ****Tutor, Department of Microbiology, Government Medical College, Bhavnagar.

**Abstracts**: **Background**: **T**he ankle brachial pressure index (ABPI) is a non–invasive quantitative measurement for diagnosing Peripheral Arterial Disease (PAD). A high ABPI (>1.2) is associated with increased cardiovascular disease. A low ABPI (<0.5) is associated with impaired lower extremity functioning. **Material & Method**: The present study was conducted on 30 pedal rickshaw drivers (group A) and 30 sedentary healthy control subjects (Group B) of similar age group. ABPI was calculated by measuring Blood Pressure with the help of hand held Doppler Machine. **Result:** ABPI in Group A was found to be 0.98±0.2 and 0.96± 0.01 in right and left side respectively. ABPI in control group was found to be 0.91± 0.007 and 0.89±0.01 in right and left side respectively. The data of both the groups was highly significant (p<0.0001).**Conclusion:** Fasting blood Sugar between two groups was significantly (p<0.0001) lower in group A. LDL, triglyceride and total Cholesterol were significantly lower in Group A (p<0.0006, <0.003 and < 0.004 respectively) compared to Group B. However HDL concentration was significantly higher (p<0.0001) in experimental group. This study suggests the possible protective role of strenuous exercise in controlling cardiovascular disease more specially PAD.

Key words: ABPI, HDL, LDL, FBS, PAD.

**Author for correspondence:** Manisha B. Makwana, Department of Physiology, GCS Medical College, Ahmedabad –380025. E- mail: manisha7216@gmail.com

**Introduction:**

The World Health Organization describes Peripheral Vascular Disease as a cluster of conditions in which atherosclerosis, or narrowing of blood vessels, occurs in the peripheral circulation, particularly in the legs. Despite its associations with increased morbidity and mortality, PAD is significantly under-diagnosed and under-treated in the general population. The ankle-brachial pressure index (ABPI) is the initial test for screening and diagnosing peripheral arterial disease.

The present study has been aimed to explore the relationships between the continuous & strenuous physical activity of cycle rickshaw drivers with health and peripheral arterial disease outcomes by ankle brachial pressure index (ABPI) - a strong predictor of peripheral arterial disease.

The ankle-brachial pressure index (ABPI) is a simple, most reliable, accurate, rapid, inexpensive, non-invasive, quantitative measurement & the initial test for screening and diagnosing peripheral arterial disease.

A high ankle brachial pressure index is associated with increased cardiovascular disease morbidity and lower quality of life because it suggests calcification of arteries. A low ankle brachial pressure index is associated with impaired lower extremity functioning, slower walking velocity, fewer blocks walked per week, lower hip abduction force and lower knee extension force. A high ABPI values have significantly higher odds for congestive heart failure, stroke, foot ulcers and neuropathy.

Exercise or physical activity can be defined as a period of enhanced energy expenditure by skeletal muscles, which is met by many complex adjustments of metabolism, respiration, circulation and temperature regulation.

According to the U.S. Surgeon General's Report on Physical Activity and Health, inactive people are nearly twice as likely to develop heart disease as those who are more active.

Cycling on long run improves vegal tone. Consequently person have low resting HR(50-60/min).

Only aerobic exercise like cycling produces cardiovascular conditioning.

The benefits of regular exercise in stage II occlusive peripheral arterial disease may result from changes in hemorrheology. (PMID: 3499255 [PubMed - indexed for MEDLINE) and high intensity aerobic activity is related to cardio-respiratory endurance. Studies showed interesting result of endurance exercise like cycling on Cholesterol metabolism. Endurance-trained athletes have much higher HDL-C values compared to sedentary populations (Haskell, 1984). The primary reason for the elevation in HDL-C is an increase in lipoprotein lipase activity in response to exercise.

**Aims:**

- Peripheral arterial disease awareness, detection, and its treatment in primary care.
- To study the effects of weight bearing and carrying physical activity, of cycle rickshaw drivers, on their lipid profile, blood sugar level and ankle brachial pressure index.
- To determine the protective effect of exercise on PAD.

**Objectives:**

- Evaluation of prevalence of a pathological ABPI in people with sedentary life versus physically active.
- Highlight whether exercise have any protective effect on development of PAD by correlating ABPI with Blood Cholesterol, triglyceride and Blood Sugar.

**Material and Methods:**

The present study consisted of Cycle Rickshaw Driver (n=30) and Control (n=30) subjects. Cycle Rickshaw Drivers & Control subjects were taken for the study from the Slums of Bapod, Vadodara from lower socieoeconomical Class. Study has been conducted from 2009 to 2010.

**Criteria for the selection of the subjects:**

All the subjects Cycle Rickshaw Drivers and Control group were from same socioeconomic class between 20 and 45 yrs age. We have excluded subjects with Diabetes, Hypertension or any other major systemic diseases.

Detailed history of subjects of both the groups was taken. History of intermittent claudication and history of pain during walking, standing, cycling, walking uphill (Edinburgh questionnaire) was taken. Examination of peripheral pulses in lower limb was done and legs were examined for any skin changes or presence of ulcer.

**Parameters studied:**

For the current study we have selected certain parameters for statistical analysis as given below.

1. ABPI
2. Fasting Blood Sugar
3. Lipid Profile

a. Total Cholesterol
b. LDL
c. HDL
d. Triglyceride

Ankle Brachial Pressure Index Measurement

Equipments: Handheld Doppler machine (EMCO meditec India, model no. D- 580) 5-10 MHz, Ultrasound gel, Stethoscope, Sphygmomanometer.

**Technique and interpretation**

The ABPI is a noninvasive test performed with a blood pressure cuff and a Doppler ultrasound that magnifies vascular sounds. Individuals are tested in the supine position following a 5-minute rest period. Initially, brachial systolic

blood pressure is recorded by inflating the blood pressure cuff above the elbow. The Doppler probe is coupled to the skin over the brachial artery with ultrasound gel. The probe should be held at a 45-degree angle that opposes the direction of brachial artery blood flow. The cuff is slowly deflated after the brachial artery has been occluded and the pressure at which the pulse sound returns is recorded as a brachial systolic pressure. Systolic pressure is measured in each arm two times and the highest value is used in the ABPI calculation. Following the brachial recording, ankle systolic pressure is recorded by inflating the cuff approximately 5 cm above the ankle's medial malleolus and listening for vascular occlusion with the Doppler probe placed over the posterior tibial or dorsalis pedis arteries (see Figure). The cuff is slowly deflated and the pressure at which the pulse sound reappears is recorded as an ankle systolic pressure. After two posterior tibial or dorsalis pedis measures on each side, the highest systolic value is used in the ABI calculation. The ABI is calculated by dividing ankle systolic pressure by brachial systolic pressure:

$$\text{ABPI} = \frac{\text{Ankle systolic pressure}}{\text{Brachial systolic pressure}}$$

Normally, ankle systolic pressure should be equal or slightly higher than brachial systolic pressure.

**Statistics:**

The data were collected in Microsoft office Excel and analyzed by Mad Cal Instant software. The method for analysis was Paired t – test with significant level set at 0.05.

**Result:**

We have made two groups, Group A Cycle Rickshaw Drivers and Group B is Control subjects.

Group A= Cycle Rickshaw Drivers

Group B= Control subjects

**Table 1: Subjects in different age group**

| | **No of Subjects** | |
|---|---|---|
| **Age group** | **Group A** | **Group B** |
| **20-24** | **4** | **5** |

| | | |
|---|---|---|
| **25-29** | **5** | **4** |
| **30-34** | **7** | **8** |
| **35-39** | **9** | **8** |
| **40-45** | **9** | **8** |

**Table 2: Comparison of systolic blood pressure of study group**

| Parameters | Group A | | | Group B | |
|---|---|---|---|---|---|
| | Mean | | ±SD | Mean | ±SD |
| Systolic BP of Arm | Right | 120.80 | 9.7 | 127.6 | 8.21 |
| | Left | 119.73 | 8.7 | 124.46 | 6.76 |
| Systolic BP of Ankle | Right | 127.86 | 5.7 | 128.66 | 5.39 |
| | Left | 126.60 | 5.3 | 126.13 | 5.22 |
| ABPI | Right | 1.05 | 0.05 | 1.00 | 0.04 |
| | Left | 1.04 | 0.05 | 0.98 | 0.05 |

**Table :3**

| **ABPI Value** | **Interpretation** | **Action** |
|---|---|---|
| above 1.2 | Abnormal<br>Vessel hardening from PVD | Refer routinely |
| 1 -1.2 | Normal range | None |
| 0.9-1 | Acceptable | |
| 0.8-0.9 | Some arterial disease | Manage Risk factors |
| 0.5-0.8 | Moderate arterial disease | Routine specialist referral |
| under 0.5 | Severe arterial disease | Urgent specialist referral |

**Table 4: Comparison of Fasting Blood Sugar**

| Parameter | Group A | Group B |
|---|---|---|
| Fasting Blood Sugar(mg/dl) | Mean SD | Mean SD |
| | 90.20 4.89 | 102.73 4.42 |

Table 5: Comparison of Lipid profile.

| Parameters | Group A | | Group B | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| HDL | 53.6 | 4.12 | 45 | 5.02 |
| LDL | 109.86 | 21.36 | 130.40 | 22.53 |
| Triglyceride | 124.53 | 26.04 | 152.56 | 43.02 |
| Total Cholesterol | 190.73 | 19.63 | 217 | 33.04 |

**Discussion:**

In comparison of ABPI in both the groups as shown in Table 3 it confirms significant positive effect of cycling. The difference between the Group A and Group B was statistically very significant by p value of 0.001. This finding is also supported by the studies done by **Kingwell, Bronwyn A. at al(***Am. J. Physiol.* 273 (*Heart Circ. Physiol.* 42) H2186–H2191, 1997) and **Gardner AW, Sieminski DJ, Montgomery PS.** Physical activity is related to ankle/brachial index in subjects without peripheral arterial occlusive disease.

Comparing random blood sugar between the groups also shown the difference that is very significant statistically by p value <0.0001 though the values in both the groups were in normal limit but it clearly denotes trait toward development of Type II diabetes in group B and this finding signifies positive effect of cycling on glucose metabolism and also supported by study done by ***Rauramaa R. Relationship of physical activity, glucose tolerance, and weight management.***

Aerobic exercise like cycling improves insulin sensitivity and having protective effect from Type 2 diabetes that is one of the major cause of PAD supported by the study conducted by Nancy et al.(2002) also favoured the role of diabetes as risk factor for development of PAD.

In our study comparison of HDL between the groups revealed positive results toward group A as the difference between the groups was statistically very significant by p value of <0.0001. Comparison of triglyceride and total cholesterol yields p value of 0.003 and 0.0004 respectively. This result also signifies positive effect of cycling on lipid profile. High HDL and low triglyceride is considered as protective against atherosclerosis and so PAD. Our study also strongly correlated with the study done by **TRAN, ZUNG VU, WELTMAN (**Journal: Medicine and Science in Sports and Exercise - MED SCI SPORT EXERCISE , vol. 15, no. 5, 1983 ) and such type of similar study was also conducted by **JK Huttunen, E Lansimies, E Voutilainen** (*Circulation* 1979, 60:1220-1229) Another study conducted by **Scott L. Charland et al** showed that out of 2568 patients with peripheral arterial disease 37% had isolated high LDL and 42% had high triglyceride. 5% of men had low HDL (<40 mg/dl) and 41% of women had low HDL (< 50 mg/dl).

**Conclusion:**

- In Cycle Rickshaw Driver we found encouraging results regarding prevention against development of PAD like good ABPI and Lipid profile.
- Lipid profile parameters like HDL was significantly higher and LDL, Triglyceride were significantly lower in Cycle Rickshaw Driver than Control subjects, indicates strong positive effect of cycling (exercise) on improvement of lipid profile.
- In Cycle Rickshaw driver Fasting blood sugar as very well controlled while in Control subjects it was near borderline value concludes that cycling (exercise) is having strong beneficial effect on future development of DM, a known risk factor for development of PAD.
- Measurement of ABPI appears to be important in diagnosing PAD in symptomatic as well as asymptomatic subjects.

**Recommendation:**

ABPI <1 should be consider as borderline state for development on PAD and they should be encouraged for aerobic exercise like cycling, quit smoking, nutritious food and for routine check-up of ABPI.

**References:**


1. Hemorheology Research Laboratory, University of Munich, F.R.G, 1987 Nov;76(5):1110-4. PMID: 3499255 [PubMed - indexed for MEDLINE] .
2. Kingwell, Bronwyn A. at al(*Am. J. Physiol.* 273 (*Heart Circ. Physiol.* 42) H2186–H2191, 1997)
3. Gardner AW, Poehlman ET. Exercise rehabilitation programs for the treatment of claudication pain. JAMA 1995;274:975-80.
4. *Rauramaa R. Relationship of physical activity, glucose tolerance, and weight management. -rev Aled 1984*. PMID:6371777 [PubMed - indexed for MEDLINE] .
5. Medicine & Science in Sports & Exercise: The effects of exercise on blood lipids and lipoproteins: a meta-analysis of studies TRAN, ZUNG VU; WELTMAN, ARTHUR; GLASS, GENE V. and; MOOD, DALE P.
6. Effect of moderate physical exercise on serum lipoproteins. A controlled clinical trial with special reference to serum high-density lipoproteins JK Huttunen, E Lansimies, E Voutilainen, C Ehnholm, E Hietanen, I Penttila *Circulation* 1979, 60:1220-1229
7. Bhasin N, Scott DJA. Ankle Brachial Pressure Index: identifying cardiovascular risk and improving diagnostic accuracy. J R Soc Med 2007;100: 4-5. [PMC free article] [PubMed]
8. Caruana MF, Bradbury AW, Adam DJ (May 2005). "The validity, reliability, reproducibility and extended utility of ankle to brachial pressure index in current

vascular surgical practice". *Eur J Vasc Endovasc Surg.*

9. McDermott MM, Criqui MH, Liu K, Guralnik JM, Greenland P, Martin GJ, Pearce W (December2000). "Lower ankle/brachial index, as calculated by averaging the dorsalis pedis and posterior tibial arterial pressures, and association with leg functioning in peripheral arterial disease". *JJ Vasc Surg.* 32 (6): 1164–71.
10. Angiology. 1997 Oct;48(10):883-91. Physical activity is related to ankle/brachial index in subjects without peripheral arterial occlusive disease. Gardner AW, Sieminski DJ, Montgomery PS.
11. Hiatt WR, Regensteiner JG, Hargarten ME, Wolfel E, Brass EP. Benefit of exercise conditioning for patients with peripheral arterial disease. Circulation 1990;81:602-9.
12. Larsen OA, Lassen NA. Effect of daily muscular exercise in patients with intermittent claudication. Lancet 1966;19:1093-6.
13. Montoye, H. J., Van Huss, W. D., Brewer, W. D., Jones, E. M., OhIson, M. A., Mahoney, E. & Olson, H., 1959. The effects of exercise on blood cholesterol in middle-aged men, Am.J.Clin.Nutrn., 7, 139-145.
14. Gordon T, Castelli WP, Hjortland MC, Kannel WB, Dawber TR: High density lipoprotein as a protective factor against coronary heart disease. The Framingham study. Am J Med 62: 707, 1977
15. Grimby G, Wilhelmsen L, Bjdrntorp P, Saltin B, Tibblin G: Habitual physical activity: aerobic power and blood lipids. In Muscle Metabolism During Exercise, edited by Pernow B, Saltin B. New York, Plenum Press, 1971, pp 467-481.
16. Lehtonen A, Viikari J: Serum triglycerides and cholesterol and serum high-density lipoprotein cholesterol in highly physically active men. Acta Med Scand 204: 111, 1978
17. Holloszy JO, Skinner JS, Toro G, Cureton TK: Effects of a six month program of endurance exercise on the serum lipids of middle-aged men. Am J Cardiol 14: 753, 1964
18. Hennes MM, O'Shaughnessy IM, Kelly TM, et al. (1996) Insulin resistant lipolysis in abdominally obese hypertensive individuals. Hypertension. 28:120-126.
19. Am J Epidemiol. 1992 Feb 15;135(4):331-40. Smoking, lipids, glucose intolerance, and blood pressure as risk factors for peripheral atherosclerosis compared with ischemic heart disease in the Edinburgh Artery Study. Fowkes FG, Housley E et al Department of Public Health Sciences, University of Edinburgh, United Kingdom.
20. Veves A, Akbari CM, Primavera J et al (1998) : Endothelial dysfunction and the expression of endothelial nitric oxide synthetase in diabetic neuropathy, ascular disease, and foot ulceration. Diabetes 47:457–463, Steinberg HO, Baron AD (2002): Vascular function, insulin resistance and fatty acids. Diabetologia 45:623–634.

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