Short Communication

# Cardiovascular risk is linked to body mass index in first-degree relatives of type 2 diabetics

**Gopal Krushna Pal, Pravati Pal, Jagadeeswaran Indumathy, Balasubramanian Suchitra, Allampalli Sirisha**

*Departments of Physiology, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India*

## Abstract

Although cardiovascular (CV) risks are reported in first-degree relatives (FDR) of type 2 diabetics, the pathophysiological mechanisms contributing to these risks are not known. We investigated the association of CV risks with body mass index (BMI) in these subjects. BMI, basal heart rate (BHR), blood pressure (BP), and rate-pressure product (RPP) were measured and analyzed in age-matched subjects of study group (FDR of type 2 diabetics, $n$ = 58) and control group (subjects with no family history of diabetes, $n$ = 92). BMI, BP, BHR, and RPP were significantly increased ($P$ < 0.0001) in the study group compared to the control group. Sympathovagal imbalance in the study group was due to concomitant sympathetic activation and vagal inhibition. Bivariate logistic regression showed significant prediction (odds ratio: 2.12, confidence interval: 1.120–5.317, $P$ = 0.009) of BMI to increased RPP, the marker of CV risk, in the study group, but not in the control group. CV risk in FDR of type 2 diabetics is linked to BMI.

**Key words:** Body mass index, cardiovascular risk, first-degree relatives of type 2 diabetics, rate-pressure product

***Received:*** 28th June, 2016; ***Revised:*** 20th July, 2016; ***Accepted:*** 02nd August, 2016

## INTRODUCTION

Asian Indian phenotype has been reported to be exceptionally predisposed to develop diabetes due to strong familial aggregation and abrupt change in lifestyle.[1] According to the World Health Organization data, the diabetic population in the world is projected to rise to 366 million in 2030.[2] India is the diabetic capital of the world.[3,4] The cardiovascular disease (CVD) and diabetes in developing countries are quite prevalent in the younger age group and the risk for CVD escalates with the co-occurrence of diabetes.[4] Therefore, early detection and treatment of diabetes and CVD, especially in younger population is among the key health policies worldwide.[5,6] The first-degree relatives (FDR) of diabetics have a higher risk of developing diabetes,[7] and there are reports of increased cardiovascular (CV) risks in this high-risk population.[8,9]

However, the mechanisms of CV risks in this young high-risk population have not been clearly ascertained. The FDR of type 2 diabetes is reported to have a high body mass index (BMI) compared to normal population. Increased rate-pressure product (RPP) has been identified as CV risk.[10] Therefore, in this study, we have assessed the link of BMI to RPP, the marker of CV risk in FDR of type 2 diabetics in this younger age group.

## MATERIALS AND METHODS

This cross-sectional blinded study was conducted after obtaining the approval of Research Council and

**Address for correspondence:** Dr. Gopal Krushna Pal, Department of Physiology, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry - 605 006, India.
E-mail: drgkpal@gmail.com

| Access this article online | |
|---|---|
| Quick Response Code: | Website: www.ijcep.org |
| | DOI: 10.4103/2348-8832.191583 |



**How to cite this article:** Pal GK, Pal P, Indumathy J, Suchitra B, Sirisha A. Cardiovascular risk is linked to body mass index in first-degree relatives of type 2 diabetics. Int J Clin Exp Physiol 2016;3:144-6.

Institutional Ethics Committee, of Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry, India. One hundred and fifty subjects were recruited from undergraduate courses of JIPMER of 2013–2014 batch. Written informed consent was obtained from all the participants before the commencement of the study procedures. They were classified into two groups.

1. Control group ($n$ = 92): Normal healthy subjects without family history of diabetes
2. Study group ($n$ = 58): Normal healthy FDR with family history of type 2 diabetes mellitus.

The subject of the study group (FDR with a history of type 2 diabetics) was defined as the subject having either of the parents or siblings diagnosed to have type 2 diabetes mellitus for at least 1 year and receiving treatment for the same. This was done through questionnaires and interview.

Healthy subjects (subjects without illness) were included in the study. Subjects receiving any medication, subjects with history of diabetes, smoking, hypertension, and hypertensive patients receiving medication were excluded from the study.

Subjects were asked to report to autonomic function testing (AFT) laboratory of Physiology Department at about 9 AM following a light breakfast, without tea or coffee. After obtaining the written informed consent, their age, height, and body weight were recorded, and BMI was calculated. The temperature of AFT laboratory was maintained at 25°C for all the recordings. Omron (SEM-1 Model) automatic BP monitor (Omron Healthcare Co. Ltd, Kyoto, Japan) was used for systolic blood pressure (SBP), diastolic blood pressure (DBP) and basal heart rate (BHR) recordings and mean arterial pressure (MAP) was calculated. RPP was calculated using the formula, RPP = systolic pressure × heart rate × $10^{-2}$.[10]

SPSS version 13 (SPSS Software Inc., Chicago, IL, USA) and GraphPad InStat software (GraphPad Software Inc., San Diego, CA, USA) were used for statistical analysis. All the data were presented as mean ± standard deviation. Normality of data was tested by Kolmogorov–Smirnov test. For parametric data, the level of significance between the groups was tested using the Student's unpaired $t$-test. The prediction of BMI to increased RPP was assessed by bivariate logistic regression. The value of $P < 0.05$ was considered statistically significant.

## RESULTS

There was no significant difference in age between the subjects of control group and study group [Table 1]. The BMI, WHR, BHR, SBP, DBP, MAP, and RPP of study group subjects were significantly more ($P < 0.0001$) compared to that of control group subjects [Table 1]. Bivariate logistic regression [Table 2] showed significant prediction of BMI to RPP in study group (odds ratio [OR]: 2.12, confidence interval (CI): 1.120–5.317, $P$ = 0.009) compared to that of control group (OR: 0.60, CI: 0.445–2.310, $P$ = 1.90).

## DISCUSSION

In the study group, BMI was significantly more compared to that of control group, indicating the presence of obesity in FDR of type 2 diabetics. Obesity has been reported to be more prevalent in individuals with family history of diabetes.[11] In this study, RPP was more in study group indicating the higher CV risk in these subjects, as RPP is an established marker of CV risk.[10] RPP is a measure of myocardial workload and oxygen consumption and increased RPP has been documented to be associated with poor CV health. In this study, RPP was not only significantly increased in study group, but also was significantly correlated with BMI, as demonstrated by bivariate logistic regression. Therefore, it is expected that BMI increases CV risk. Obesity *per* se is a CV risk factor. Therefore, obesity and increased RPP potentiate the CV risk in young FDR of type 2 diabetics. Further, the BHR was also high in study group. Resting tachycardia is a CV risk, and in susceptible individual is reported to be associated with sudden cardiac death.[12] Thus, finding of the present

**Table 1:** Comparison of age, body mass index, cardiovascular parameters of control group (subjects with no family history of diabetes) and study group (first-degree relatives of Type 2 diabetics) subjects

| Parameters | Control group ($n$=92) | Study group ($n$=58) | $P$ |
|---|---|---|---|
| Age (years) | 18.95±2.90 | 18.78±3.12 | 0.7940 |
| BMI (kg/m$^2$) | 23.45±3.60 | 26.42±4.15 | <0.0001 |
| BHR (/min) | 70.80±8.71 | 81.35±9.15 | <0.0001 |
| SBP (mmHg) | 110.55±7.80 | 119.80±8.17 | <0.0001 |
| DBP (mmHg) | 69.95±6.86 | 78.1±76.62 | <0.0001 |
| MAP (mmHg) | 83.34±6.80 | 92.36±7.70 | <0.0001 |
| RPP (mmHg/min) | 78.25±7.42 | 97.33±8.16 | <0.0001 |

RPP: Rate-pressure product, BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure, BHR: Basal heart rate

**Table 2:** Bivariate logistic regression analysis of rate-pressure product (as dependent variable) with body mass index (as independent variable) in control group and study group subjects after adjusting for gender

| | Control group | | Study group | |
|---|---|---|---|---|
| | OR (95% CI) | $P$ | OR (95% CI) | $P$ |
| RPP | 0.60 (0.445-2.310) | 1.90 | 2.12 (1.120-5.317) | 0.009 |

$P$<0.05 considered significant. OR: Odds ratio, RPP: Rate-pressure product, LF-HF: Ratio of low-frequency to high-frequency power of heart rate variability, CI: Confidence interval

study indicate that FDR of type 2 diabetics is more prone to CV risks, which could be linked to their high BMI.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

## REFERENCES

1. Joshi SR. Type 2 diabetes in Asian Indians. Clin Lab Med 2012;32:207-16.
2. International Diabetes Federation. Diabetes Atlas. Brussels: International Diabetes Federation Publication; 2009. p. 1-27.
3. Ginter E, Simko V. Global prevalence and future of diabetes mellitus. Adv Exp Med Biol 2012;771:35-41.
4. Pradeepa R, Prabhakaran D, Mohan V. Emerging economies and diabetes and cardiovascular disease. Diabetes Technol Ther 2012;14 Suppl 1:S59-67.
5. Laslett LJ, Alagona P Jr., Clark BA 3rd, Drozda JP Jr., Saldivar F, Wilson SR, *et al.* The worldwide environment of cardiovascular disease: Prevalence, diagnosis, therapy, and policy issues: A report from the American College of Cardiology. J Am Coll Cardiol 2012;60 25 Suppl: S1-49.
6. Anselmino M, Rydén L. Strategies to enhance cardiovascular disease prevention in patients with diabetes. Curr Opin Cardiol 2009;24:461-7.
7. Karaman A, Bayram F, Gundogan K, Ozsan M, Karaman H, Kelestimur F. Prevalence of diabetes mellitus and glucose metabolism disorders in the first degree relatives of type 2 diabetic patients. Bratisl Lek Listy 2012;113:361-7.
8. Johansen NB, Hansen AL, Jensen TM, Philipsen A, Rasmussen SS, Jørgensen ME, *et al.* Protocol for ADDITION-PRO: A longitudinal cohort study of the cardiovascular experience of individuals at high risk for diabetes recruited from Danish primary care. BMC Public Health 2012;12:1078.
9. Amini M, Horri N, Zare M, Haghighi S, Hosseini SM, Aminorroaya A, *et al.* People with impaired glucose tolerance and impaired fasting glucose are similarly susceptible to cardiovascular disease: A study in first-degree relatives of type 2 diabetic patients. Ann Nutr Metab 2010;56:267-72.
10. White WB. Heart rate and the rate-pressure product as determinants of cardiovascular risk in patients with hypertension. Am J Hypertens 1999;12 (2 Pt 2):50S-5S.
11. Neves FJ, Bousquet-Santos K, Silva BM, Soares PP, Nóbrega AC. Preserved heart rate variability in first-degree relatives of subjects with type 2 diabetes mellitus without metabolic disorders. Diabet Med 2008;25:355-9.
12. Jensen MT, Suadicani P, Hein HO, Gyntelberg F. Elevated resting heart rate, physical fitness and all-cause mortality: A 16-year follow-up in the Copenhagen Male Study. Heart 2013;99:882-7.