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The relationship between blood pressure and pupil to limbus diameter (PLD) ratio in pre-hypertensive women: A pilot study

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ABSTRACT

The present study was undertaken to observe the relationship between blood pressure and pupil to limbus diameter (PLD) ratio in prehypertensive working women. 30 pre-hypertensive working women were part of the study after obtaining written, voluntary, informed consent and ensuring confidentiality. PLD ratio was measured by the two-box method as described in the literature. There was a significant positive correlation between PLD ratio and blood pressure and pulse rate ($p < 0.001$). Our study provides further evidence for a positive correlation between blood pressure and pulse rate with PLD ratio. It is the need of the time to conduct further studies including both the genders to support the use of PLD ratio as a simple and cost-effective autonomic function test.



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INTRODUCTION

Pre-hypertension is a warning sign to the development of primary hypertension and untreated it may cause damage to the organs (Scott R Collier and Michael J Landram, 2012). Hypertension was reported to contribute 60% of stroke and over 50% of ischemic heart disease (Lawes CM *et al.*, 2006). It was reported that about 33% urban and 25% of rural Indians are hypertensive. Further, 25% rural and 42% urban Indians are aware of their blood pressure status and only 25% rural and

38% of urban Indians are being treated for hypertension (Raghupathy Anchala *et al.*, 2014). As hypertension does not have symptoms and its outbreak is very severe, it is essential to detect in early stages to prevent the consequences. In India, especially in South India, the prevalence of pre-hypertension and hypertension were reported high when compared to other areas of India (Singh RB *et al.*, 2011). Hence, it is necessary to increase the awareness of monitoring blood pressure at regular intervals to prevent hypertension and to diagnose and treat at early stages. As the size of the pupil varies with alteration in the activity of the autonomic nervous system, pupil to limbus diameter ratio may be used as a cost-effective and straightforward autonomic function test. In our earlier studies, we have observed the correlation between PLD ratio with autonomic activity in healthy and hypertensive women (Archana R *et al.*, 2017; Aruna Sajeevan and Kumar Sai Sailesh, 2017). The current study was undertaken to observe the correlation between PLD ratio and blood pressure and pulse rate in pre-hypertensive working women.

METHODOLOGY

Participants: A total of 30 pre-hypertensive working women were part of the study after obtaining voluntary informed consent. All the participants underwent a general physical examination by a qualified female medical officer. Confidentiality of the data was ensured (Al-Thahab *et al.*, 2018). The following criteria were followed in recruiting the participants.

Inclusion criteria: Pre-hypertensive, married, working women with 8 working hours and in the age group of 25 and 50 years and willing to participate in the study were included.

Exclusion criteria: participants with any eye diseases, any other significant diseases/ complications, under any medication/therapy were excluded from the study.

Methods: All measurements were performed at 1 pm for the convenience of the participants and to overcome the effect of diurnal variation.

Measurement of PLD ratio: It was measured by the two-box method as described in the literature (Mojumder DK *et al.*, 2015).

Recording of BP and pulse rate: BP and pulse rate were recorded using a diamond digital sphygmomanometer (BPDG024) from the right hand. Three readings were taken and the average value was considered as BP and pulse rate.

Ethical clearance: The study protocol was approved by the Institutional Ethical Committee (EC 27/1/16) and permission obtained from hospital authorities to carry out the study.

Statistical analysis: Data was analyzed by using IBM SPSS software 20.0. Demographic values are expressed in boxplot diagrams. Linear regression analysis was used to determine the correlation between the variables and coefficients. $P < 0.05$ was considered significant.

RESULTS

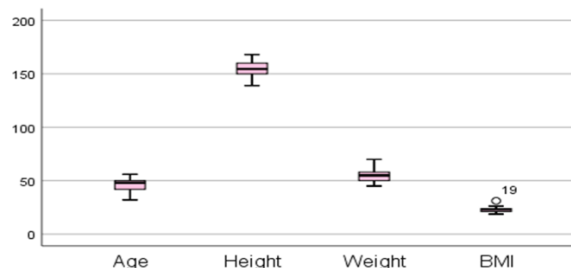


Figure 1: Demographic data of the participants

Figure 1 presents the demographic data of the participants. Figure 2 presents the correlation between pupil to limbus diameter ratio of the right eye (PLDR) and systolic blood pressure (SBP), Diastolic blood pressure (DBP) and pulse rate (PR). Figure 3 presents the correlation between pupil to limbus diameter ratio of the left eye (PLDR) and systolic blood pressure (SBP), Diastolic blood pressure (DBP) and pulse rate (PR). There was a positive correlation between SBP and PLD ratio of the right eye ($r=0.951$, $r^2=0.905$), which was statistically significant ($p < 0.001$). There was a positive correlation between DBP and PLD ratio of the right eye ($r=0.844$, $r^2=0.713$), which was statistically significant ($p < 0.001$). There was a positive correlation between PR and PLD ratio of the right eye

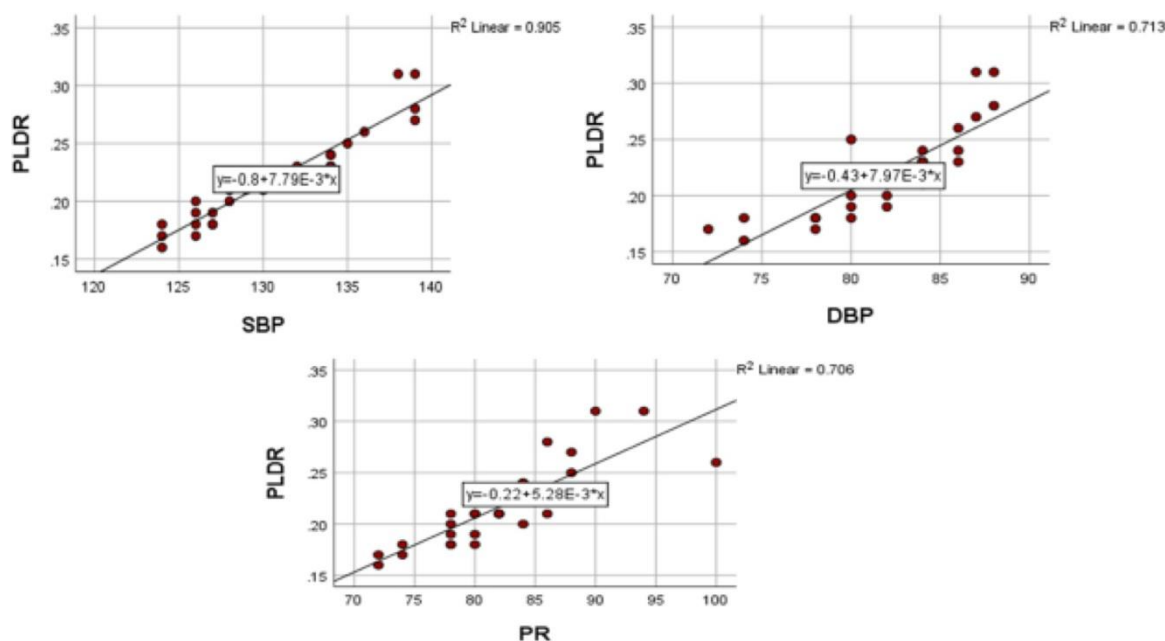


Figure 2: Correlation between pupil to limbus diameter ratio of the right eye (PLDR) and systolic blood pressure (SBP), Diastolic blood pressure (DBP) and pulse rate (PR)

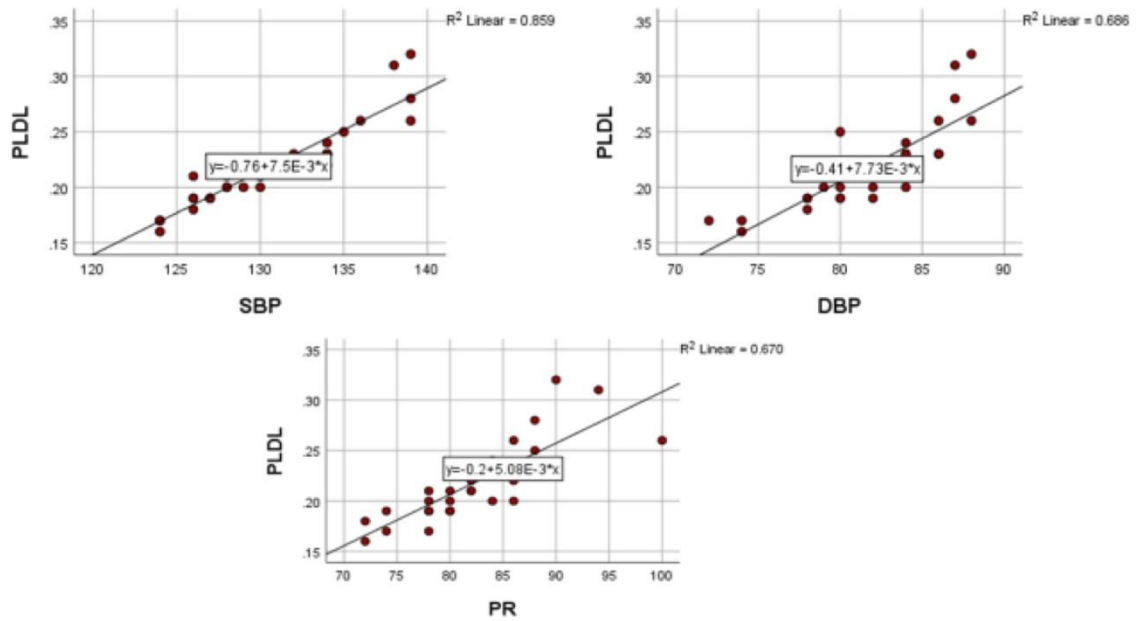


Figure 3: Correlation between pupil to limbus diameter ratio of the left eye (PLDL) and systolic blood pressure (SBP), Diastolic blood pressure (DBP) and pulse rate (PR)

($r=0.841$, $r^2=0.706$), which was statistically significant ($p<0.001$). There was a positive correlation between SBP and PLD ratio of the left eye ($r=0.927$, $r^2=0.859$), which was statistically significant ($p<0.001$). There was a positive correlation between DBP and PLD ratio of the left eye ($r=0.828$, $r^2=0.686$), which was statistically significant ($p<0.001$). There was a positive correlation between PR and PLD ratio of the left eye ($r=0.819$, $r^2=0.670$), which was statistically significant ($p<0.001$).

DISCUSSION

Though the prevalence of hypertension is reported as increasing in both developed and developing countries, the awareness and treatment of hypertension were not up to the mark. Diagnosing hypertension in early stages is essential to offer effective treatment and to prevent further complications. The current study was undertaken to observe the correlation between the pupil to limbus diameter ratio with blood pressure and pulse rate to provide further evidence to introduce PLD ratio as a cost-effective and straightforward autonomic function test. Earlier studies reported a positive correlation between the PLD ratio of right and left eye with blood pressure and pulse rate in healthy and hypertensive working women (Archana R *et al.*, 2017; Aruna Sajeevan and Kumar Sai Sailesh, 2017). The observed correlation may be because the autonomic nervous system regulated both pupil diameter and blood pressure and pulse rate (Lateef *et al.*, 2018; Azhar Omaran, 2017). The diameter of the pupil is increased during activation of the sympathetic nervous system and inhibition of the parasympathetic system to increase the field

of vision. Due to an increase in the diameter of pupil the ratio of pupil to limbus diameter increased with an increase in the sympathetic activity and decreased parasympathetic activity.

Similarly, a decrease in the activity of sympathetic and increased parasympathetic activity causes a decrease in the size of the pupil and hence decreases pupil to limbus diameter ratio. Hence, the PLD ratio may be used as an indicator of the activity of the autonomic system. Earlier studies supported the current study testified usefulness of measuring PLD ratio as an indicator for autonomic activity (Yamanaka K, Kawakami M, 2009; P. Baum *et al.*, 2013; R. Dundaroz *et al.*, 2009; Yesim Altay *et al.*, 2016).

CONCLUSION

Our study provides further evidence for a positive correlation of blood pressure and pulse rate with PLD ratio. It is the need of the time to conduct further studies including both the genders to support the use of PLD ratio as a cost-effective and straightforward autonomic function test.

Conflicts of interest: Nil

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