

THE RELATIONSHIP BETWEEN BLOOD PRESSURE AND PUPIL TO LIMBUS DIAMETER RATIO IN HYPERTENSIVE WOMEN: A PILOT STUDY

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ABSTRACT

Objective: This study was undertaken to observe the relationship between blood pressure (BP) and pupil to limbus diameter (PLD) ratio in hypertensive working women.

Methods: A total of 30 hypertensive working women were part of the study after obtaining written, voluntary, informed consent, and ensuring confidentiality. PLD ratio was measured by two-box method as described in the literature.

Results: Positive correlation was observed between PLD ratio of the right eye ($r=0.951$) and left eye ($r=0.927$) and systolic BP. This correlation is statistically significant at 0.01 levels (two tailed). Positive correlation was observed between PLD ratio of the right eye ($r=0.844$) and left eye ($r=0.828$) and diastolic BP. This correlation is statistically significant at 0.01 levels (two tailed). Positive correlation was observed between PLD ratio of the right eye ($r=0.416$) and left eye ($r=0.396$) and pulse pressure. This correlation is statistically significant at 0.05 levels (two tailed). Positive correlation was observed between PLD ratio of the right eye ($r=0.883$) and left eye ($r=0.844$) and mean arterial BP. This correlation is statistically significant at 0.05 levels (two tailed). Positive correlation was observed between PLD ratio of the right eye ($r=0.841$) and left eye ($r=0.819$) and pulse rate. This correlation is statistically significant at 0.05 levels (two tailed).

Conclusion: Positive correlation was observed between PLD ratio and autonomic parameters. We recommend further detailed studies to utilize the measurement of PLD ratio as an autonomic function test.

Keywords: Pupil, Limbus, Autonomic parameters, Blood pressure, Hypertension.

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INTRODUCTION

According to the 7th report of the Joint National Committee on Prevention, detection, evaluation and treatment of high blood pressure (BP), systolic BP (SBP) 130-139 mmHg/diastolic BP (DBP) 80-89 mmHg was included in the category of prehypertension and SBP 140-159 and DBP 90-99 mmHg as stage 1 hypertension [1-3]. In the Women's Health Initiative, black race, poor socioeconomic status, history of cardiovascular disease, physical inactivity, overweight/obesity, and excess alcohol consumption are considered as factors for the prevalence of hypertension [3]. Furthermore, there is a misconception that women have low chance of heart diseases than men, but hypertension is a major risk factor for cardiovascular diseases in women [4]. As more than half of the hypertensive patients are unaware of the condition, regular monitoring of BP may help in the diagnosis of hypertension [5]. By measuring pupil diameter as an indicator of autonomic nervous function, pupil to limbus diameter (PLD) ratio may correlate with alterations in BP [6]. PLD ratio is defined here as "the ratio of the pupillary diameter measured at an axial plane with the limbal diameter measured at a same or parallel axial plane" [7]. Recent studies show that there is a positive correlation between BP and PLD ratio of right and left eye and significant positive correlation between pulse rate and PLD ratio of the right and left eye [8]. This study was undertaken to observe the relationship between BP and PLD ratio in hypertensive working women.

METHODS

This study was conducted at the Department of Physiology, Little Flower Institute of Medical Sciences and Research and Department of

Ophthalmology, Little Flower Hospital and Research Centre, Angamaly, from October 2016 to March 2017.

Participants

A total of 30 hypertensive working women were part of the study after obtaining written, voluntary, informed consent, and ensuring confidentiality. All the participants underwent general physical examination by a qualified female medical officer. The following criteria were followed in recruiting the participants.

Inclusion criteria

Age between 25 and 50 years, SBP in between 130 and 159 and DBP 80-99 mmHg, 8 hrs of working, married, willing participants, participants not having any eye diseases, not having any major diseases/complications, not under any kind of medication/therapy.

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

PLD ratio was measured by two-box method as described in the literature [7]. PLD ratio was measured at constant illuminance for all the participants. Illuminance measurement for the ambient light conditions was made using a Luxmeter (Model no. MTQ 1010A, Metro Q) with a range of 0-20,000 Lux and resolution of 1-100 Lux. Images were captured using Samsung Galaxy J7. Before capturing the image of the eye, the participants were exposed to the ambient light levels for at least 5 minutes.

Recording of BP and pulse rate

BP and pulse rate were recorded using diamond digital sphygmomanometer (BPDG024) from right hand [9]. Three readings were taken and average value was considered as BP and pulse rate.

Ethical clearance

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

Statistical analysis

Data were analyzed by SPSS 16.0. Statistical test applied are Pearson correlation coefficient and regression analysis. $p < 0.05$ was considered as significant.

RESULTS

Fig. 1 presents the demographic data of the participants. Positive correlation was observed between PLD ratio of the right eye ($r=0.951$) and left eye ($r=0.927$) and SBP (Fig. 2). This correlation is statistically significant at 0.01 level (two tailed), and unstandardized coefficient (B) obtained by regression analysis is 0.008 for both right and left eye. Positive correlation was observed between PLD ratio of the right eye ($r=0.844$) and left eye ($r=0.828$) and DBP (Fig. 2). This correlation is statistically significant at 0.01 level (two tailed), and unstandardized coefficient (B) obtained by regression analysis is 0.008 for both right and left eye. Positive correlation was observed between PLD ratio of the right eye ($r=0.416$) and left eye ($r=0.396$) and pulse pressure (Fig. 3). This correlation is statistically significant at 0.05 level (two tailed), and unstandardized coefficient (B) obtained by regression

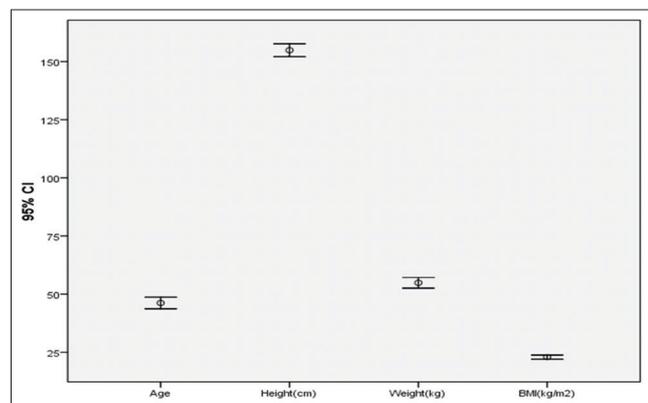


Fig. 1: Demographic data of the participants

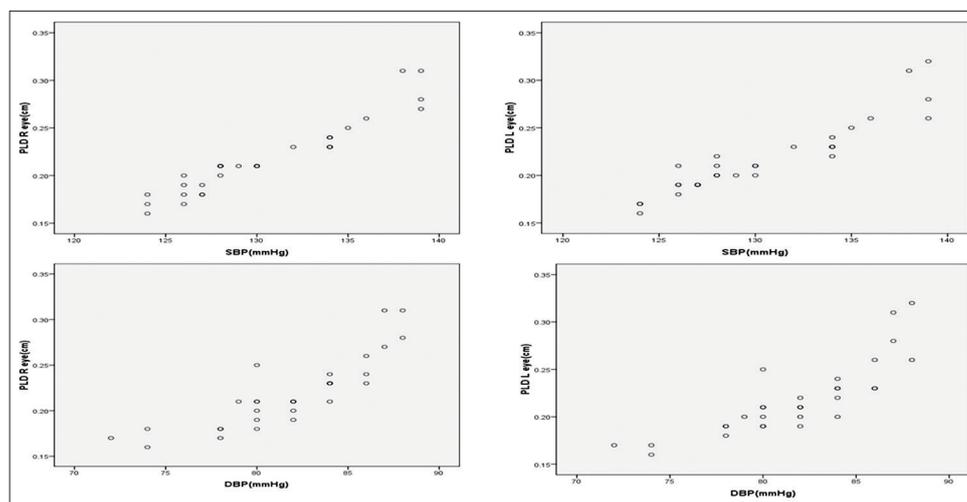


Fig. 2: Association of pupil to limbus diameter ratio of right and left eye with systolic and diastolic blood pressure

analysis is 0.006 for both right and left eye. Positive correlation was observed between PLD ratio of the right eye ($r=0.883$) and left eye ($r=0.844$) and mean arterial BP (Fig. 3). This correlation is statistically significant at 0.05 level (two tailed), and unstandardized coefficient (B) obtained by regression analysis is 0.009 for both right and left eye. Positive correlation was observed between PLD ratio of the right eye ($r=0.841$) and left eye ($r=0.819$) and pulse rate (Fig. 4). This correlation is statistically significant at 0.05 level (two tailed), and unstandardized coefficient (B) obtained by regression analysis is 0.005 for both right and left eye.

DISCUSSION

Hypertension is considered as a major health problem worldwide. In 2008, WHO rated 40% of people above the age of 25 years as hypertensive [10]. In 2010, hypertension was attributed as an important risk factor for many diseases in the South Asia [11]. Hypertension plays a leading role in the cause of premature death and disability [12]. Furthermore, it is directly linked to the risk of developing cardiovascular diseases, cerebrovascular diseases, and chronic kidney diseases [13-16]. Studies reveal that 33% urban and 25% of Indians are hypertensive and only 1-10th of rural and 1-5th of urban are on control [17]. Hypertension was described as a syndrome and was considered as a major public health issue, and it is called as silent killer disease [18,19].

Pupil located in the center of the eye play a key role in regulating the light entry, and it quickly responds to modulations in the surrounding environment [20,21]. Variations in the pupil diameter are regulated by two muscles, the sphincter and dilator which are innervated by the parasympathetic nervous system and sympathetic nervous system simultaneously [22]. Pupil dilates through sympathetic stimulation by the release of adrenaline and parasympathetic inhibition [23,24]. Recent studies show that there is positive correlation between BP and PLD ratio and a strong correlation between PLD ratio and pulse rate in healthy women [8]. In our current study, we observe a strong correlation between PLD ratio of right and left eye with BP and pulse rate. The diameter of pupil and BP both are influenced by sympathetic nervous system so the observed correlation may be due to this fact.

CONCLUSION

We have observed a significant positive correlation between PLD ratio and autonomic parameters. We recommend further detailed studies to recommend the measurement of PLD ratio as an autonomic function test.

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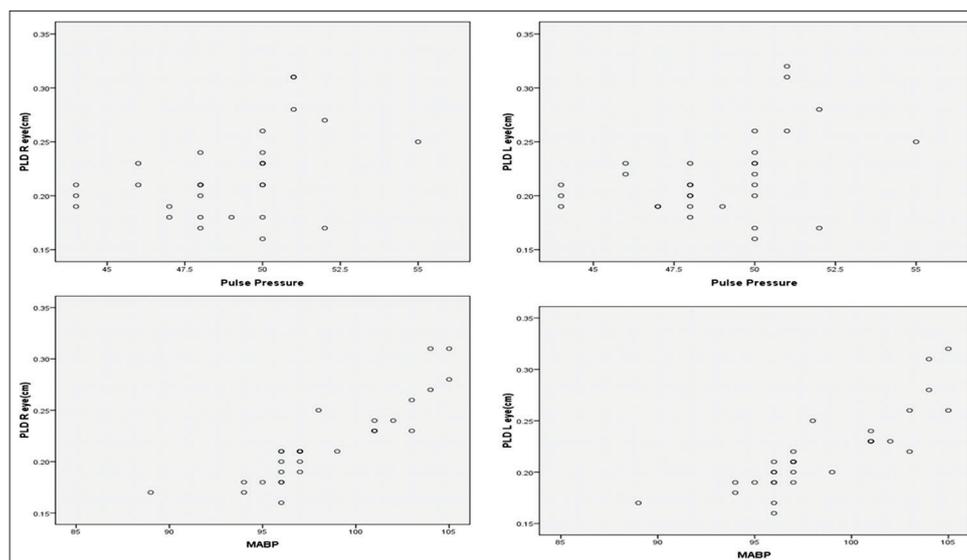


Fig. 3: Association of pupil to limbus diameter ratio of right and left eye with pulse pressure and mean arterial blood pressure

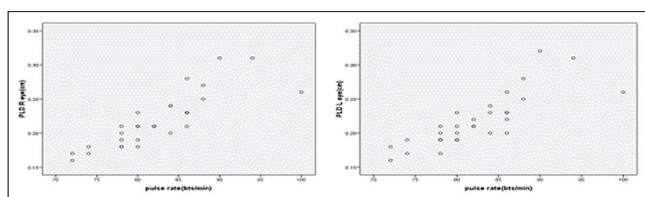


Fig. 4: Association of pupil to limbus diameter ratio of right and left eye with pulse rate

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