



CORRELATION OF PUPIL TO LIMBUS DIAMETER RATIO (PLD RATIO) WITH BLOOD PRESSURE AND PULSE RATE

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ABSTRACT

The present study was undertaken to assess the correlation between Pupil to Limbus Diameter (PLD) ratio with blood pressure and pulse rate. 50 apparently healthy working women were part of the study after obtaining written, voluntary, informed consent and ensuring confidentiality. All measurements were performed at 1 pm for the convenience of the participants and to overcome the effect of diurnal variation. Blood pressure and pulse rate was recorded from right hand. Pupil to Limbus Diameter (PLD) ratio was measured by two-box method as described in the literature. PLD ratio was measured at constant luminance for all the participants. Our study provides preliminary evidence for positive correlation of blood pressure and pulse rate with Pupil to Limbus Diameter (PLD) ratio. Further detailed studies with more autonomic parameters and with higher sample size are recommended for further evidence and to introduce measurement of Pupil to Limbus Diameter (PLD) ratio as a simple and convenient autonomic function test.

KEYWORDS: *Pupil to Limbus Diameter (PLD) ratio, Blood pressure, Pulse rate, working women, Correlation.*



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INTRODUCTION

The pupil, an aperture in the eye that controls the passage of light into the retina. The Limbus is the border between the sclera and cornea¹ The muscles that regulate the pupillary size are circumferential sphincter muscle and iris dilator muscle. Circumferential sphincter muscle is innervated by the parasympathetic nervous system and the iris dilator muscle is innervated by sympathetic nervous system.² Sympathetic stimulation and parasympathetic inhibition contributes pupillary dilation through the corresponding muscle fibres.³ 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".¹ In bright light the pupil size is reduced by pupillary light reflex mechanism, so in accordance with variation in light intensity the pupil dilation may vary.²³ There are certain factors which influence changes in pupillary dilation including examiners visual acuity, strength of flash light stimulus, distance and orientation with respect to participants eye. Previous studies show that there is an inverse relationship between the pupil reactivity and ICP ie, decrease in pupil reactivity and increase in ICP. So it may be helpful in identifying various disease condition and helpful in diagnosis.²⁴ Though one out of three adults are hypertensive, more than half of them are unaware of the condition hence regular monitoring of blood pressure may facilitate early diagnosis of hypertension.⁴ As the diameter of pupil is regulated by autonomic nervous system, we hypothesized that PLD ratio may predict the changes in the blood pressure. It can be used as an autonomic function test if the association between the pld ratio with blood pressure and pulse rate is high. It is any easy affordable and cost effective method to assess the pld ratio. Hence the present study was undertaken to prove or disprove our hypothesis by observing the correlation between PLD ratio with blood pressure and pulse rate.

MATERIALS & METHODS

The present study was conducted at Department of Physiology, Little Flower Institute of Medical Sciences

and Research and Department of Ophthalmology, Little Flower Hospital and Research center Angamaly between August 2016 to November 2016. The study protocol was approved by institutional ethical committee (EC 27/1/16). Permission obtained from hospital authorities to carry out the study.

Participants

50 apparently healthy 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 lady medical officer. The Following criteria was followed for recruiting the participants.

Inclusion criteria

Age between 25-50 years
8 hours of working
Married
Willing participants

Exclusion criteria

Participants with eye disorders
Those having any major diseases/complications
Those under any kind of medication /therapy including oral contraceptives

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.¹ PLD ratio was measured at constant luminance for all the participants. Luminance measurement for the ambient light conditions were made using a Luxmeter (Model no. MTQ 1010A, MetroQ with a range of 0-20,000Lux, and resolution of 1-100Lux (Figure 1). 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.

Figure 1
Luxmeter and example of eye images



Recording of Blood pressure and pulse rate

Blood pressure and pulse rate was recorded by using diamond digital sphygmomanometer (BPDG024) from right hand.⁵ Three readings were taken and average value was considered as blood pressure and pulse rate.

Statistical analysis

The data obtained was analyzed by SPSS software (version 20.0). Regression analysis was used to observe a correlation between the variables.

RESULTS

Figure 2 represents the demographic data of the

participants. Positive correlation was observed between PLD ratio of right ($r^2=0.000535$) and left eye ($r^2=0.000216$) with systolic blood pressure. Positive correlation was observed between PLD ratio of right ($r^2=0.01785$) and left eye ($r^2=0.005777$) with diastolic blood pressure. Positive correlation was observed between PLD ratio of right ($r^2=0.01214$) and left eye ($r^2=0.003714$) with pulse pressure. Positive correlation was observed between PLD ratio of right ($r^2=0.01243$) and left eye ($r^2=0.004571$) with mean blood pressure. Significant positive correlation was observed between PLD ratio of right ($r^2=0.1837$) and left eye ($r^2=0.1969$) and pulse rate.

Figure 2
Age, Body weight, Height and BMI of the participants. (*P<0.05 is significant, ** P <0.01 is significant, * P<0.001 is significant)**

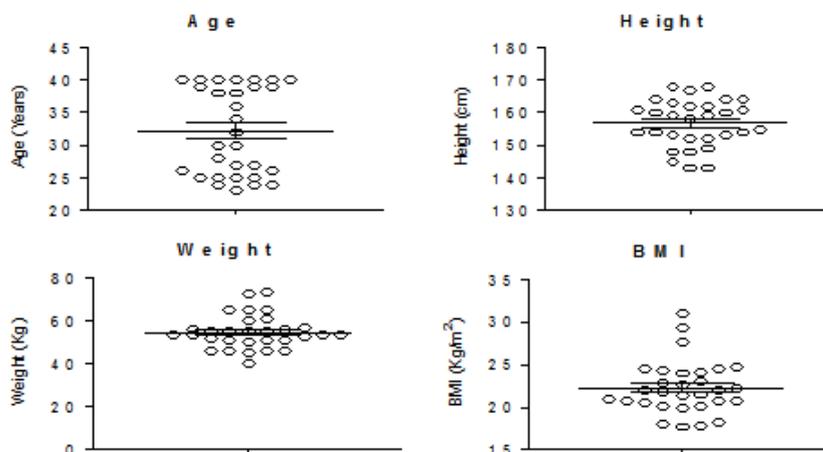


Figure 3
Correlation between PLD ratio of right eye with Systolic pressure, Diastolic pressure, Pulse pressure, Mean blood pressure and Pulse rate. (*P<0.05 is significant, ** P <0.01 is significant, * P<0.001 is significant). (PLD –pupil to limbus diameter ratio, Rt- Right)**

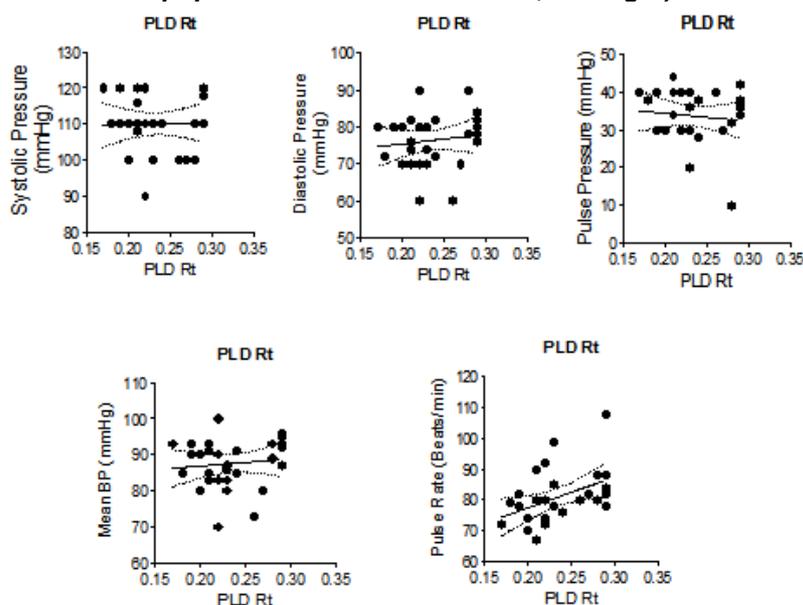
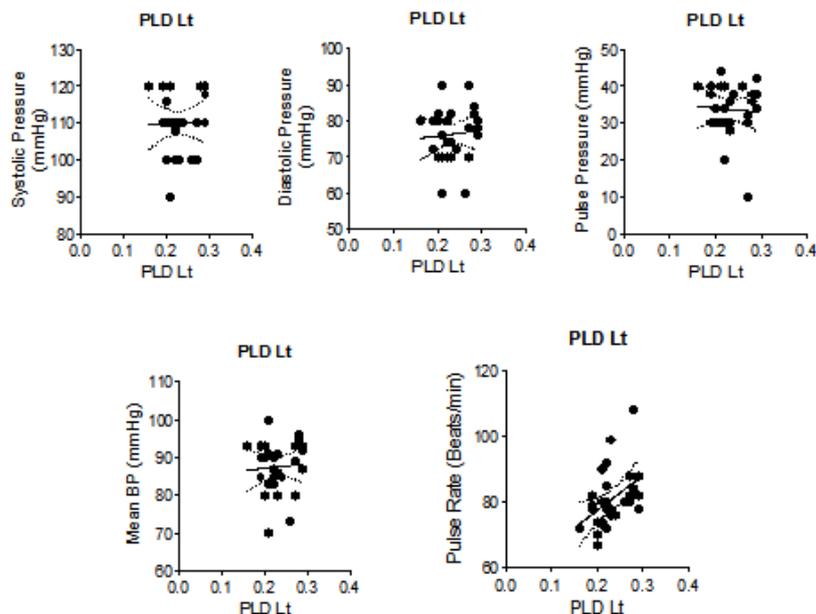


Figure 4
Correlation between PLD ratio of left eye with Systolic pressure, Diastolic pressure, Pulse pressure, Mean blood pressure and Pulse rate. (*P<0.05 is significant, ** P <0.01 is significant, * P<0.001 is significant). (PLD –pupil to limbus diameter ratio, Lt- Right)**



DISCUSSION

Pupil is the important element that controls the amount of light entering the eye. During pupillary response, the diameter of pupil varies between 8 mm to 1.5 mm.⁶ The relation between size of the pupil and emotions was first reported by Hess.^{7,8} later it was reported that emotional arousal is the important component in modulation of pupillary response.⁹ Noxious stimulus results in dilation of pupil via sympathetic division.^{10,11,12} In contrast, it was reported that dilation of pupil reflected general, rather than gender-specific, arousal.¹³ Measurement of pupil diameter was an effective indicator of autonomic nervous activity.¹⁴ The size of pupil depends on balance between the sympathetic and parasympathetic nervous systems. Sympathetic stimulation causes pupil dilation through release of nor adrenaline where parasympathetic stimulation causes constriction of pupil.¹⁵ Earlier studies has evaluated pupil diameter and testified that it is a convenient method of evaluating autonomic activity.^{16,17,18} Most of the earlier studies

measured heart rate variability, skin conductivity for assessment of autonomic functions.^{19,20,21,22} Our study results are in accordance with earlier studies as we have observed positive correlation between blood pressure and PLD ratio of right and left eye and significant positive correlation between pulse rate and PLD ratio of right and left eye.

CONCLUSION

Our study provides preliminary evidence for positive correlation of blood pressure and pulse rate with PLD ratio. Further detailed studies with more autonomic parameters and with higher sample size are recommended for further evidence and to introduce measurement of PLD ratio as a simple and convenient autonomic function test.

CONFLICT OF INTEREST

Conflict of interest declared none.

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