



# A Study In Normative Data Of Interpupillary Distance Between Aryans & Mongolians Race In Dang Valley.

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## ARTICLE INFO ABSTRACT

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**Aim:** To evaluate the normative Interpupillary distances of Aryan and Mongoloid race in Dang valley.

**Methods:** Cross sectional study was performed to evaluate far interpupillary distance (FIPD) and near interpupillary distance (NIPD) on 812 subjects wherein 406 were from the Aryans and 406 subjects were from the Mongolians race. The subjects included equal number of males and females in each group. The mean age was 44.54±20.453 years with minimum age of 10 and maximum age of 80. The FIPD and NIPD was measured by using pupillometer (Topcon PD-5). Statistical analysis was performed, SPSS (ver.20) and Microsoft Excel.

**Results:** Mean FIPD for all the Aryans subjects was 61.37±3.637mm (48.00 -71.50 mm). Mean FIPD for Mongoloids was found to be 62.31±3.203mm (48.00 - 72.00mm). NIPD was 58.28±3.489 mm (46.00-68.50) mm for Aryan and 59.20±3.07mm (46.00-68.00mm) for Mongoloids. The mean FIPD of mongoloids males and Aryan males were 62.71 mm±3.335 and 62.25mm±3.640 respectively. Mean FIPD of Mongoloid females was 61.91mm±3.019 in Aryans females it was 60.48mm±3.421. The mean NIPD of Mongolians males and Aryan males was 59.48±3.189mm & 59.04±3.527mm respectively. Mean NIPD of mongoloid and aryan female was 58.91±2.927mm & 57.51±3.283mm. Males had greater mean IPD than the females in both ethnic groups which were statistically significant.

**Conclusions:** The normative (mean) FIPD for Mongolians and Aryans was 62.31±3.203mm&61.37±3.637mm. IPD was higher in Mongoloids race population than the Aryans of dang valley. Males had greater IPD than in female in both ethnic groups. Intra-ethnic gender difference was higher in Aryans (Male> female).

**Keywords:** Interpupillary distance, Aryans, Mongoloids, Dang valley.

## INTRODUCTION

Interpupillary distance (IPD) is a measurement of the distance between the centers of the two eyes. The normative value of the interpupillary distance (IPD) in relation to a specific population is of theoretical and practical importance for eye care practitioner. IPD is critical for designing binocular viewing systems in which center of both pupils need to correspondent with the exit pupils of the viewing system<sup>1</sup>. It is one of the vital parameters in the field of dispensing optometry for ensuring visual comfort and is applied by the optical industries in designing and manufacturing<sup>2</sup>. IPD is a basic requirement in optical dispensing and various other optometric and ophthalmic investigations such as finding meter angle, assessing fissional reserve by synoptophore, calculating AC/A ratio, and deciding decentration.

IPD is known to vary with respect to age, gender and race and shown to correlate with head size. Ethnicity or racial ethnicity is one of the major elements of social composition. Nepal is a relatively small country but rich in ethnic groups and culture and is known as multi -lingual and multi ethnic country. The majority of Nepal's

population is of Indo-Aryan origin, the remaining are of Dravidian and Mongoloids. Mongoloids are inhabitants of northern and central belt. Therefore, Nepal has become meeting place of Indo-Aryan people of Indian subcontinent and Mongoloid people from Himalayas. Dang valley is situated in inner terai in Lumbini province in mid-western, constitutes a small fraction of the nation's area is the capital of Lumbini province with the area of 2955 square K.M. & has total population of 548,141<sup>6</sup>.

Aryan race is one of the most ancient races that emerged during the late 18<sup>th</sup> century. Prehistorically Aryan used to live in Iran later they split in Persians who settled in Persia (Iran) and Indic who migrate to Afghanistan, Pakistan, north India & then Nepal. Nepali language was brought by Aryans from the old Indo-Iranian language, firstly in Sanskrit and then Nepali. There are more than 1.3 billion people who belong to this race in world & over 26 million in Nepal. Chhetri, brahmin, kami, Madhesi, Sarkis, Kurmi, sunuwar, kumal, paswan ethnicity under Aryan race in Nepal.

Aryans (also called Indo-Aryans) is a major ethnic group of Dang and has been dwelling since ancient era. Indo-Aryan immigrants like the lichhavis, mallas, ranas & shahs arrived Dang at different periods and merged eventually with the local indigenous newar, tharu population by adopting their language and customs<sup>3</sup>. These immigrants retained their Indic heritage and brought with them their Sanskrit languages and social structure<sup>7</sup> and have been divided into various castes. Chhetri, Brahman, Nepali, Kami (workers) are major caste of Aryan ethnicity and occupy major portion of population of country in all over the country<sup>8</sup>. In Dang valley also they are major constituent of population.

Ethnicity, also frequently stated as known as racial ethnicity, of Nepalese is generally known from their surnames and can be recognized by physical characteristics. Large Nasal bone, prominent chin projection, straight and prominent nasal spine are some characteristic features of Aryan peoples<sup>9</sup>. Another facial feature of Aryan ethnicity is a double eyelid crease<sup>10</sup>.

Mongolians are indigenous to east, central, north Asia, Polynesia & America. They were introduced in 18<sup>th</sup> century. Epicanthic fold and oblique palpebral fissure are commonly present in Mongolians which differentiate them from Aryans. More than 7.5 million of Mongolians are there in Nepal. Magar, Tharu, Tamang, Newar, rai, limbu, Sherpa, Gurung ethnicity comes under Mongolian race in Nepal.

Mongoloid or sometime stated as Tibeto-Burmese is the general physical type of the populations of East Asia, Central Asia, Southeast Asia, parts of the Pacific islands and parts of South Asia. These peoples thought generally to have Tibetan connections. Individuals within these populations often share certain associated phenotypic traits, such as epicanthic folds and neoteny<sup>11</sup>. Other important and noticeable physical features include medium Nasal spine, large and protruding cheekbones and flat and broad nasal bones<sup>9</sup>, absence of upper lid fold<sup>10</sup>, puffiness of the upper eyelid and absent browridges<sup>13,12</sup>. Major Mongoloid ethnic group residing in Nepal are Newars, Gurung, Magar, Kiratis, Serpa, Rais, Limbus, Tamangs, Sunwars, Jirels, Thakalis, Chepangs and Tharu. Dang is also, one of the best places to observe wide range of mongoloid ethnic groups including tharu, magars, Newars, Sherpas, Tamangs and Gurungs<sup>13</sup>.

IPD is influenced by gender and age of subjects and differs between certain racial groups and between near and far viewing<sup>14</sup>. These contributing factors for variation in IPD have been researched in many geographical and ethnic areas.

Till this time, there are very few published documents describing IPD of general or specific groups of Nepalese population. This study has attempted to provide a descriptive and comparative investigation on IPD of Aryan and Mongolian ethnic population of Dang valley and update the influence of gender and age group on IPD measurement.

## LITERATURE REVIEW

IPD of Turkish population was investigated by Yildiray Y, et al<sup>18</sup> taking subjects with the mean age was 48.42 ± 20.55 years, ranging from 19 to 89 years. The mean IPD was calculated as 62.5 ± 4.1 mm (range 49–76). The mean IPD value was observed to be significantly higher among males compared to females ( $P$ , 0.001). The difference among groups in terms of mean IPD was statistically significant ( $P$ , 0.001). IPD increased by 4.19 mm in males and 3.11 mm in females from the young adults (20–30 years) to older adults (51–70 years), and then a decrease (2.6 and 0.19 mm for males and females, respectively) occurred between 70 and 89 years of age.

Barreto & Mathog<sup>19</sup> (1999) conducted a study in which, IPD differed significantly between the races & sexes; black men -68.97mm, white men - 65.15 mm ( $p < 0.01$ ); black women 65.93 mm, white women 61.47mm ( $p < 0.01$ ) which shows black races has slightly wider IPD than whites.

Mishra MK and associates studied relationship between IPD and the width of maxillary anterior teeth in 85 Aryans and same number of Mongoloids from Nepal (mean age 23.60 ± 5.39, range 19 to 48 years) and showed that mean IPD in Aryans was higher (61.92 ± 5.85) than that of Mongoloids<sup>22</sup> (57.50 ± 7.23).

Osuobeni et al<sup>5</sup> (1993) conducted a study in which IPD among young adult Arab males (16 to 25 years) have slightly wider average FIPD (63.25 mm) than young adult (17 to 22 years) American Caucasians males, FIPD (62.00 mm). **Arab and blacks**, older adult African –Americans (mean age 46 years) have wider (63.30 mm) FIPD than older adult Arab males (64.78 mm). **Arabs and Chinese**, adult Hong Kong Chinese men (mean age 25 years) have an average FIPD 64.59 mm that is similar to that of adult Arab males (64.78 mm). **Arabs**

**and Japanese**, young adult Japanese males (17 – 22 years) have wider IPD (66.00 mm) FIPD than young adult Arab males (63.25 mm).

Comparison of IPD was done between Turkish & Azerbaijani population by Ibrahim Sahbaz in which 700 subjects from turkey, in which  $44 \pm 17.6$  years. The mean IPD was  $62.1 \pm 3.7$  mm. The mean IPD in females was 61mm, which was less than males i.e., 63 mm ( $p < 0.05$ ). The mean age of the 700 Azerbaijani subjects was  $44 \pm 3.1$  mm. The mean IPD 66mm in males ( $p < 0.05$ ). Difference in IPD were statically significant ( $p < 0.05$ ). The mean IPD in all age group in Azerbaijani population was greater than Turkish population compared to other ethnic group the mean IPD was remarkably high.

Fesharaki H, et al<sup>17</sup> described that IPD enlargement was more significant in the first three decades of life with mean IPD in adult subjects was  $61.1 \pm 3.5$  mm in women and  $63.6 \pm 3.9$  mm in male.

### Methodology

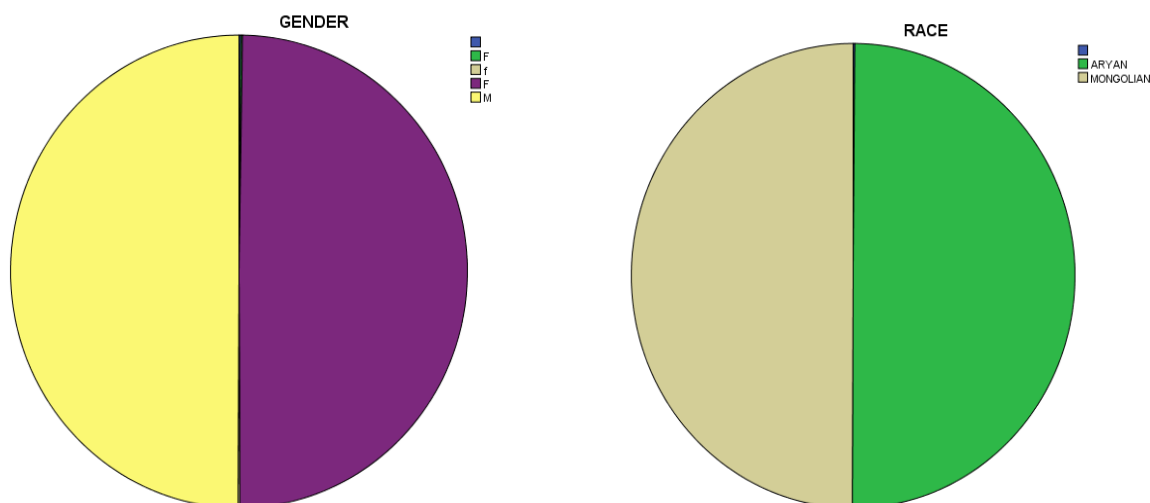
**Subjects:** The subjects of study were 812, 406 from Aryan & 406 from Mongoloid ethnic group, aged between 10 to 80 years. Each ethnic group constituted equal no of male & female subjects in every age group. The mean age of all the subjects was  $44.54 \pm 20.453$  years, where minimum age was 10 & maximum of 80 years. The subjects were included in this study from 12/03/2020 to 02/04/2021 in the study. This was a cross sectional study which was performed in 4 different schools where the general ocular examination as well as IPD was taken of the school going children, staff & another geriatric camp was organized where the examination of older people was performed where we include all the male & female population of Aryans & Mongolians.

Children were screened on the school site where visual acuity using logMAR chart was used then retinoscopy was performed with streak retinoscope after then general ocular examination was checked.

The details of the study were presented before the school administration as well as brief eye health awareness & purpose of the study for parents was conducted. Written informed consent was obtained from parents for children less than 16 years and written consent was taken from subjects aged between 17-80 years, prior to start the study verbal consent was taken and all the procedure about the study was explained.

Sample subjects age range was from 10 to 80 years, both in Aryans and Mongolians in which group 1 was between 10-20, group 2 from 21-30, group 3 from 31-40, group 4 from 41-50, group 5 from 51-60, group 6 from 61-70 & group 7 from 71-80, with equal number of participants both in male & female in Aryans as well as Mongolians.

Subjects having corneal opacity, appparent strabismus, nystagmus, post up cataract pupillary abnormalities, affixational movements, craniofacial anomalies & orbit facial trauma & unwilling subjects were excluded.



**Fig 1- chart showing equal no of male and female**      **Fig 2- chart showing equal no of Aryans and Mongolians**  
**50% male & 50% female**      **50% Aryan & 50% Mongolian**

**Instrumentation:** pupilometer was used to take measurement of far IPD and near IPD was measured using pupillary reflex method. The instrument used was Topcon PD-5 that can measure IPD from 46 mm to 82 mm. This pupilometer provides separate distance IPD for the left and right eye taking ocular asymmetry into account. The pupilometer was set for infinite distance to get FIPD. Near IPD was performed at 40cm distance using IPD ruler and torch light.

**Statistical analysis:** After collection of data, coding and inputting of data was performed promptly within the date of data collection. The data was analyzed and interpreted using Microsoft excel and SPSS (ver. 20) software for different statistics.

### Results

The normative (mean) FIPD for all the Aryans subjects was  $61.37 \pm 3.637$ mm (48.00 to 71.50 mm) and that calculated for Mongoloids was found to be  $62.31 \pm 3.203$ mm (48.00-72.00mm). Near IPD was  $58.28 \pm 3.489$  mm (46.00 to 68.50mm) for Aryan and  $59.20 \pm 3.070$ mm (46.00 to 68.00mm) for Mongoloids which is shown in table 1 & 2, the mean FIPD & NIPD both are comparatively high in Mongolians than Aryans.

RACE	FIPD	N	Std. Deviation
Aryan	61.37	406	3.637
Mongolian	62.31	406	3.203
Total	61.84	812	3.457

**Table-1 IPD FOR DISTANCE IN ARYANS & MONGOLIANS**

#### FIPD- Far interpupillary distance, N- Number

RACE	NIPD	N	Std. Deviation
Aryan	58.28	406	3.489
Mongolian	59.20	406	3.070
Total	58.74	812	3.316

**Table-2 IPD FOR NEAR IN ARYANS & MONGOLIANS**

NIPD- Near interpupillary distance, N- Number

The normative (mean) FIPD for all the male & female Aryans for distance was  $62.25 \pm 3.640$ mm and  $60.48 \pm 3.421$ mm and that calculated for near was found to be  $59.04 \pm 3.527$ mm and  $57.51 \pm 3.283$ mm respectively which clearly shows that the mean IPD for distance and near both was greater in male than female. (Table 4 & 5)

The normative (mean) FIPD for all the male & female Mongolians for distance was  $62.71 \pm 3.335$ mm and  $61.91 \pm 3.019$ mm and that calculated for near was  $59.48 \pm 3.189$ mm &  $58.91 \pm 2.927$ mm respectively which clearly shows that the mean IPD for distance & near both was greater in male than female. (Table 3 & 6)

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**Table-3 FIPD IN MONGOLIANS MALE & FEMALE**

Mongolians	Mean	N	Std. Deviation
MALE	62.71	203	3.335
FEMALE	61.91	203	3.019
Total	62.31	406	3.203

#### Report

**Table-4 FIPD IN ARYANS MALE & FEMALE**

Aryans	Mean	N	Std. Deviation
MALE	62.25	203	3.640
FEMALE	60.48	203	3.421
Total	61.37	406	3.637

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**Table-5 NIPD IN ARYANS MALE & FEMALE**

Aryans	Mean	N	Std. Deviation
MALE	59.04	203	3.527
FEMALE	57.51	203	3.283
Total	58.28	406	3.489

**Table-6 NIPD IN MONGOLIANS MALE AND FEMALE**

Mongolian	Mean	N	Std. Deviation
Male	59.48	203	3.189
Female	58.91	203	2.927
Total	59.20	406	3.070

**Table-7 COMPARISION OF FIPD & NIPD FOR DISTANCE AND NEAR IN MONGOLIANS & ARYANS**

Mongolians	Mean FIPD	NO	Std. Deviation	Aryans	Mean FIPD	NO	Std. Deviation
MALE	62.71	203	3.335	MALE	62.25	203	3.640
FEMALE	61.91	203	3.019	FEMALE	60.48	203	3.421
Mongolians	Mean NIPD	NO	Std. Deviation	Aryans	Mean NIPD	NO	Std. Deviation
MALE	59.48	203	3.189	MALE	59.04	203	3.527
FEMALE	58.91	203	2.927	FEMALE	57.51	203	3.283

The mongoloids male and female had greater FIPD than their Aryan counterpart by the amount of 0.46mm and 1.43mm respectively whereas for NIPD the difference was 0.44 mm and 1.4mm respectively. Mongoloid male & females had wider IPD compared to Aryan male & females and calculated mean difference of mongoloid was larger than mean difference of Aryans.

There was significant difference between male and female IPD of both races as illustrated in the table 7, the mean intra-group difference in FIPD between male and female of Aryan respondent in the study was 1.77mm whereas the difference in NIPD was 1.53mm. For mongoloid group FIPD difference between Male and females was 0.8mm and 0.57 for near (table7). In both race males had greater IPD than female. The larger intra-group gender difference was found in Aryan group that showed Aryan females had smallest average IPD in the study.

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Age category	Mean	N	Std. Deviation
10-20	59.01	58	3.812
21-30	61.71	58	3.570
31-40	60.94	58	3.880
41-50	61.49	58	4.122
51-60	62.04	58	2.596
61-70	62.39	58	3.592
71-80	61.98	58	2.670
Total	61.37	406	3.637

**Table-8 NORMATIVE FIPD IN ARYANS IN DIFFERENT AGE CATEGORY**

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Age category	Mean	N	Std. Deviation
10-20	55.99	58	3.706
21-30	58.78	58	3.272
31-40	58.01	58	3.788
41-50	58.42	58	3.950
51-60	58.67	58	2.688
61-70	59.20	58	3.295
71-80	58.87	58	2.635
Total	58.28	406	3.489

**Table-9 NORMATIVE NIPD IN ARYANS IN DIFFERENT AGE CATEGORY**

### Report

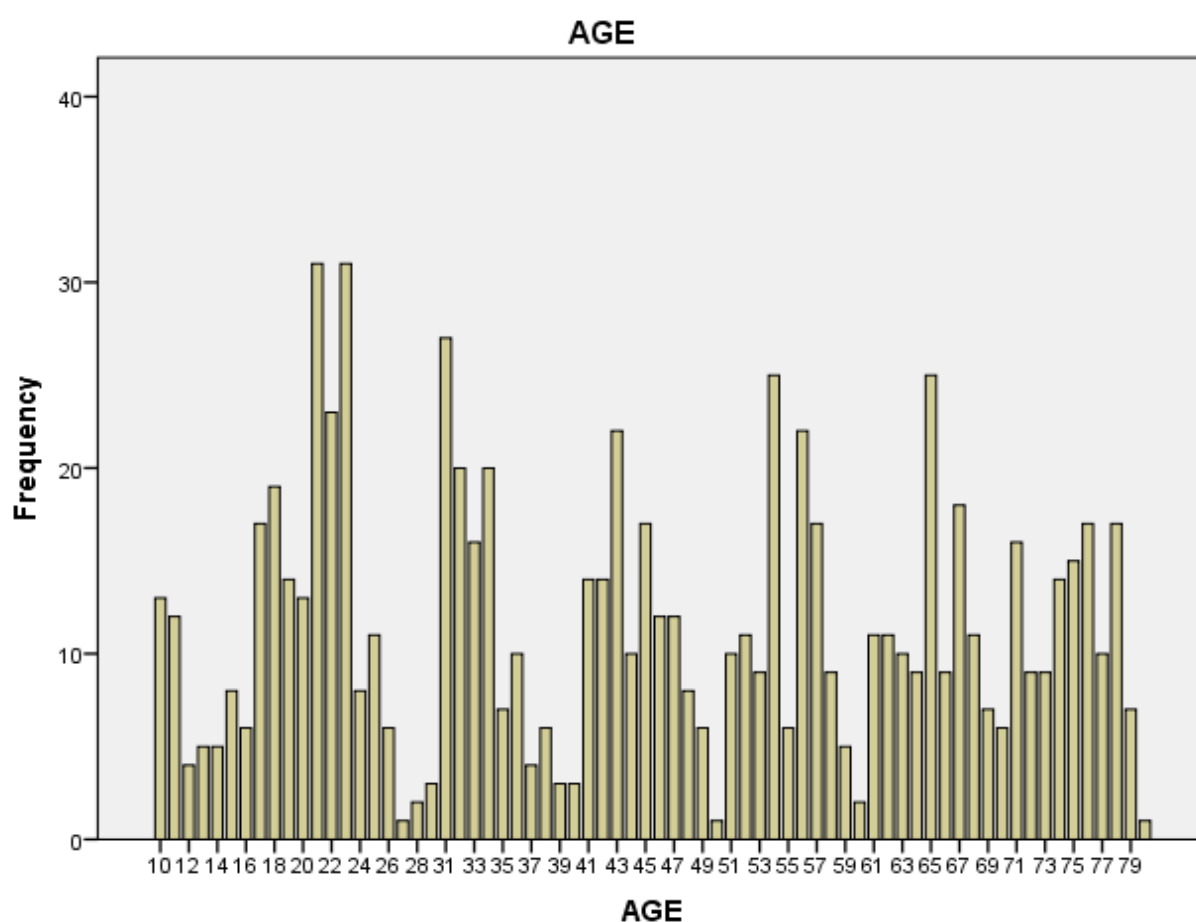
Age category	Mean	N	Std. Deviation
10-20	61.53	58	3.165
21-30	62.21	58	3.334
31-40	61.34	58	4.191
41-50	62.22	58	2.771
51-60	63.13	58	2.982
61-70	63.18	58	2.632
71-80	62.57	58	2.754
Total	62.31	406	3.203

**Table-10 NORMATIVE FIPD IN MONGOLIANS IN DIFFERENT AGE CATEGORY**

The mean FIPD and in all age group was greater in mongoloids group than in Aryans (Table 8 & 10). The NIPD also was higher in Mongoloid race subjects than in Aryans subjects of corresponding age groups (Table 9 & 11).

Age category	Mean	N	Std. Deviation
10-20	58.65	58	3.078
21-30	59.20	58	3.210
31-40	58.52	58	4.129
41-50	59.25	58	2.659
51-60	59.78	58	2.779
61-70	59.77	58	2.536
71-80	59.21	58	2.729
Total	59.20	406	3.070

**Table-11 NORMATIVE NIPD OF MONGOLIANS IN DIFFERENT AGE GROUPS.**



**Fig.12 Bar chart showing different age and the no. of participants in Aryans & Mongolians.**

### Discussion

Accuracy of IPD is important for all types of prescription spectacle glasses including single vision and multifocal lenses and special lenses such as aspheric lenses. Knowledge of normal IPD values has important application in proper mounting of spectacle lenses in order to eliminate unwanted prismatic effects. In modern optometric dispensing, for example fitting of progressive addition lenses and aspheric lenses, there is increased demand of accurate PD measurement. It is also influencing factor for comfort of anisometric spectacle lenses. It is known to be dependent on factors such as age, gender and race or ethnicity but independent of instrument use to determine.

In this study the mean far IPD for Aryans was  $61.37 \pm 3.637$ mm and that for Mongoloids was  $62.31 \pm 3.203$ mm. It showed that the Mongoloids have slightly greater IPD than the Aryans. The result was contradicted with

the finding by Mishra MK<sup>22</sup>, et al obtained in a study from eastern region of Nepal in which IPD of mongoloid was found to be  $57.50\text{mm} \pm 7.23$  and smaller than that of Aryans.

The mean IPD determined in present study for the two ethnic groups closely agreed with the findings obtained by Yildiray Y, et al<sup>18</sup> in study of Turkish population in which their mean IPD was  $62.5 \text{ mm} \pm 4.1$  and with adult mean IPD of Iranian population ( $62.1\text{mm} \pm 3.7$ ) found by Fesharaki H, et al<sup>17</sup>. This close agreement may be the result of inclusion criteria as both the study used adults' subjects. The mean IPD of both groups in this study was slightly lower than the international standard value mentioned by Fritz (2015)<sup>24</sup> but lies within the range. IPD has been quoted in literatures to vary between 58 mm to 70 mm.

Gender difference (male > female) of IPD was found in both ethnic groups. The mean difference (male vs. female) in Aryans was 1.77mm whereas the difference in Mongoloids was 0.8mm. Wider male IPD in both ethnic groups was inconsistent with the study of Osuobeni et al in which they noted male IPD wider by 2 to 3 mm than females in researched ethnic groups.

Although the largest IPD was found in mongoloid males, the higher inter-ethnic difference was noted between IPD of females, Mongoloids females having wider IPD than Aryan Females.

Intra- ethnic group gender difference in IPD was higher in Aryan group (male > female). The difference was proportional with the increasing FIPD.

Comparative studies on various ethnicities has shown that racial differences exist for IPD value and measurement, which suggest that racial background should be considered when evaluating and measuring interpupillary distance. The findings of this study represented the normal value of IPD of Aryan and Mongoloid peoples of Dang valley and described the variation of IPD size in the Aryans & Mongolians.

### Conclusion

The study concluded that Mongoloids have greater mean Value of IPD than mean that value of Aryans. The mean far IPD appeared in all the Aryans subjects was  $61.37 \pm 3.637\text{mm}$  (48.00 to 71.50 mm) and that calculated for Mongoloids was found to be  $62.31 \pm 3.203\text{mm}$  (48.00-72.00mm). Near IPD was  $58.28 \pm 3.489 \text{ mm}$  (46.00 to 68.50mm) for Aryan and  $59.20 \pm 3.070\text{mm}$  (46.00 to 68.00mm) for Mongoloids which is shown in table 1 & 2, the mean FIPD & NIPD both are comparatively high in Mongolians than Aryans.

The normative (mean) FIPD for all the male & female Aryans for distance was  $62.25 \pm 3.640\text{mm}$  and  $60.48 \pm 3.421\text{mm}$  and that calculated for near was found to be  $59.04 \pm 3.527\text{mm}$  and  $57.51 \pm 3.283\text{mm}$  respectively which clearly shows that the mean IPD for distance and near both was greater in male than female. (Table 4 & 5)

The normative (mean) FIPD for all the male & female Mongolians for distance was  $62.71 \pm 3.335\text{mm}$  and  $61.91 \pm 3.019\text{mm}$  and that calculated for near was  $59.48 \pm 3.189\text{mm}$  &  $58.91 \pm 2.927\text{mm}$  respectively which clearly shows that the mean IPD for distance & near both was greater in male than female. (Table 3 & 6)

The mongoloids male and female had greater FIPD than their Aryan counterpart by the amount of 0.46mm and 1.43mm respectively whereas for NIPD the difference was 0.44 mm and 1.4mm respectively. Mongoloid male & females had wider IPD compared to Aryan male & females and calculated mean difference of mongoloid was larger than mean difference of Aryans.

There was significant difference between male and female IPD of both races as illustrated in the table 7, the mean intra-group difference in FIPD between male and female of Aryan respondent in the study was 1.77mm whereas the difference in NIPD was 1.53mm. For mongoloid group FIPD difference between Male and females was 0.8mm and 0.57 for near (table7). In both race males had greater IPD than female. The larger intra-group gender difference was found in Aryan group that showed Aryan females had smallest average IPD in the study.

Male had higher mean IPD value than the female in both races. In all the age range the mean IPD is comparatively high in Mongolians than Aryans.

Intra-ethnic gender difference was found to be higher in Aryans (Male > female). Ethno-racial background should be considered when evaluating and measuring interpupillary distance.

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