SUMMARY

The scientific findings on finger length ratio date back to a time when ideas of evolution in humans were still young. The “Darwinist” ideas were still just beginning to blossom in the scientific world and to be extrapolated into the various models of specific selective mechanisms, such as predator/prey evolution and the evolution of the eye. These models are all centered on the idea that certain traits in organisms contributed to the continuing survival of a species. The earliest observations of index finger (2D) and ring finger (4D) asymmetry only noted that men had shorter index fingers than women (Ecker, 1875). Though it was not yet speculated as to why this difference existed, this observation would come to be of great interest in the next century. It was not until much later that finger length differences were finally recorded and classified (George, 1930). This is when a statistically significant difference between men and women in the length of their index and ring fingers relative to one another was first noted. George noted for the first time that men tended to have the lower 2D:4D ratios, with a shorter index finger and longer ring finger, while women tended to have the higher 2D:4D ratios, with the longer index finger and the shorter ring finger. Since these findings, 2D:4D ratios have been measured across races and cultures of the world. Manning and colleagues (2007) surveyed 255,116 participants worldwide, including those from White, Asian, Middle-Eastern, Black and Chinese ethnicities. Their data was analyzed for 2D:4D differences across genders and sexual orientations. The results showed Black and Chinese participants had significantly lower ratios than White, Asian and Middle-Eastern participants. Remarkably, differences were also discovered between European nationalities, surveying people of 11 countries (plus the United States) and finding relatively small, but significant, differences.
When the developing human fetus is first designated as male, androgens, produced in the testes, begin to coordinate the growth of typical male physical attributes, most notably sexual reproductive organs. The development of these organs is dependent upon these androgens, one of which, prenatal testosterone (Breedlove, Cooke & Jordan, 1999), will be the hormone of greatest focus in the present study. Several months later, the brain begins to experience changes as a result of the presence or absence of prenatal testosterone. During this time, the presence of prenatal testosterone forms another hormone, called estradiol, which causes the brain to grow more in overall size (Harding, 2004). It is believed that this change in brain mass is where much of the individual’s later gender identity is decided (Swaab & Garcia-Falgueras, 2009). Also, as a result of the presence of androgens, significantly larger amounts of motoneurons survive during the development of the prenatal male, which results in an increase in the number of connections between the male brain and the muscles innervated by these motoneurons (Breedlove et al., 1999).

Before any of this hormonally-influenced neural development begins, another interesting sexual dimorphism takes place in the hands. R. George (1930) was among the first to discover that there is not always a clear pattern among humans whether the index or ring finger is shorter. His results showed, based on 201 males and 109 females, that males tended to have a shorter index finger than ring finger, while females tended to have the opposite. According to George (1930), men typically exhibit lower values in 2D:4D ratio than women. It was suggested that this relationship may owe most, if not all, of its existence to higher levels of prenatal testosterone, which is typical of developing males (Manning, Scutt, Wilson & Lewis-Jones, 1998). Further studies into the link between 2D:4D ratio and testosterone investigated men with genetic variations in the androgen receptor genes making them more sensitive to testosterone (Manning, Bundred, Newton & Flanagan, 2003). These individuals exhibited lower, more masculine 2D:4D ratios. Lower 2D:4D ratios have also been exhibited in individuals with congenital adrenal hyperplasia, which exposes the
developing fetus to higher levels of testosterone both male and female, when compared with control groups (Ökten, Kalyoncu & Yariş, 2002; Brown, Hines, Fane & Breedlove, 2002).

Higher levels of prenatal testosterone will also lead to higher sensitivity to circulating testosterone in the body later in life (Hampson & Breedlove, 2001). This has also been shown to correlate with greater readiness for performance and aggression. For example, studies in the early half of the 20th century have found that manipulations of testosterone in hens (Allee, Colias & Lutherman, 1939) and mice (Beeman, 1947a & b) brought about changes in aggression, with descending levels decreasing aggressive responses, and vice versa. In humans, a positive correlation has been found between levels of circulating testosterone and levels of circumstantial aggression, with the increase being strongest in males (Archer, 2006). Furthermore, physical aggression has also been shown to be correlated with 2D:4D ratio in men, but not women (Bailey & Hurd, 2005). The study revealed that men with lower, more masculine 2D:4D ratios scored significantly higher in trait physical aggression, with the right hand showing much stronger sexual dimorphism than the left. This relationship between finger length, testosterone and testosterone-linked traits has intrigued scientists for years across numerous fields of study, from biopsychology to evolutionary science to endocrinology. Still, despite the breadth and variety of interest in this field, the reason as to why this relationship between these two measures should exist at all remains a mystery, if there is any reason. It is more likely that this relationship owes its existence to the hox genes that are responsible for the development of both fingers and the penis (Dickman, 1997; Jorgenson, Ruman, Doherty & Taylor, 2009), basically citing a genetic coincidence as being responsible.

To sum up, research has found numerous relationships between 2D:4D and observable personality phenotypes: sexual preferences, with higher ratios correlating with more feminine-typical preferences (Manning, Churchill & Peters, 2007); sexual practices, with lower ratios correlating with male-typical practices and presentations (Fink, Seydel, Manning & Kappeler, 2007;
Nottebohm, 1980); aggression, with lower finger ratios correlating with greater aggression (Bailey & Hurd, 2005); competition, with lower finger ratios correlating with more competitive individuals (Manning & Taylor, 2001). It is the objective of this study to add to the growing number of studies in 2D:4D research and further illuminate the relationship between a measurable finger ratio and differences psychological parameters specially aggression level and emotional intelligence of in elite sports and non sports personal. This study should help develop a stronger understanding of the nature-nurture relationship in humans.

**Statement of Problem**

“A comparative study of digital finger ratio and psychological variables of elite sportsmen and non sportsmen”

**Objectives**

1. To find out the digital finger ratio (2d:4d) of elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

2. To find out the digital finger ratio (2d:4d) of non sports persons (both men & women).

3. To find out the level of emotional intelligence and aggression in elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

4. To find out the level of emotional intelligence and aggression in non sports persons (both men & women).

5. To find out the difference in the digital finger ratio (2d:4d) between non sports persons (both men & women) and elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

6. To find out the difference in the level of emotional intelligence between non sports persons (both men & women) and elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.
7. To find out the difference in the level of aggression between non sports persons (both men & women) and elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

8. To find out the correlation between the digital finger ratio and level of aggression present in the elite sports persons and non sports persons.

9. To find out the correlation between the digital finger ratio and level of emotional intelligence present in the elite sports persons and non sports persons.

**Hypothesis of the study**

1. There exists no significant difference in the digital finger ratio (2d:4d) between non sports persons (both men & women) and elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

2. There exists no significant difference in the level of emotional intelligence between non sports persons (both men & women) and elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

3. There exists no significant difference in the level of aggression between non sports persons (both men & women) and elite sports persons (both men & women) participating in Volleyball, Basketball, Wrestling, Boxing, Shooting and Archery.

4. There exists no significant correlation between the digital finger ratio and level of aggression present in the elite sports persons and non sports persons.

5. There exists no significant correlation between the digital finger ratio and level of emotional intelligence present in the elite sports persons and non sports persons.
**Delimitations of the study**

1. The study was confined to 520 elite sports persons both male and female participating in Volleyball, Basketball, Wrestling, Shooting, Archery, and swimming.
2. The study was based on purposive sample method and only those subjects above 18 years were selected as samples in the elite sports person, who have won position (first/second/third) at National/All India Interuniversity.
3. Two hundred fifty students (125 males & 125 females) of above 18 years were selected in the non sports categories from different colleges/Institutes of Haryana, who had never participated in any competitive sports.
4. The study was further delimited to digital finger ratio (2d:4d) of both right and left hands.
5. Only two psychological variable emotional Intelligence and aggression were studied.

**Limitation of the study**

The life style, habits, heredity, nutritional intake, physical fitness level, other psychological and physiological variables are beyond control of the research worker. These were considered as limiting factors of the study.

**Selection of Subjects**

In the present study purposive sampling method has been used for the collection of data. The research worker has selected a total of 770 subjects (400 males and 370 females as shown in Table No. 3.1) to measure the digital finger ratio 2D:4D out of the total of 770; 250 were non sportspersons who have never participated in any competitive sport/game at any level till date and remaining 520 were elite sports persons both male (N-275) and female (N-245) who have won first/second/third position at least at national/inter-university levels during the years of study in the discipline of Volleyball, Basketball, Boxing, Wrestling, Shooting and Archery. The age of all the subjects selected for the present study above was 18 years in all categories.
Variables Studied

In the present study following three variables which includes two psychological and one anthropometrical were studied:

a) First Variable - Digital Finger Ratio (Ratio between the length of Index finger and Ring finger) i.e. 2D:4D.

b) Second Variable - Aggression level

c) Third Variable - Emotional Intelligence

Tool Used for the Collection of Data

Following tools were used for the collection of data for different variables:

(i) Digital Finger Ratio (2d:4D) was measured with Digital Veriner Caliper.

(ii) Aggression level was measured with Aggression Questionnaire constructed by Buss, A. H., & Perry, M. P. (1992). It measure physical aggression, verbal aggression, hostility and anger as aspect of aggression.

(iii) Emotional Intelligence was measured with Trait Emotional Intelligence Questionnaire– Short Form (TEIQue-SF) by Petrides, K. V. & Furnham, A. (2006). This was a 30-item questionnaire designed to measure global trait emotional intelligence (trait EI) measure scores for four factors: Wellbeing, self- control, emotionality, and sociability. It is based on the long form of the TEIQue (Petrides & Furnham, 2003).

Statistical Techniques Used

Keeping in view the objective and design of the study, the statistical technique of mean, standard deviation, analysis of variance, ‘t’ – test and product movement coefficient of correlation was used to analyze the data for finding the results. Co-efficient of co-relation technique was used to find out the relationship between the different groups
CONCLUSIONS

I) Digital Finger Ratio

1. Both male and female elite sports personals of volleyball, basketball, boxing and wrestling were having significantly shorter digital finger ratio (2d:4d) as compare to non sports personals.

2. Both male and female elite shooters and archers were having similar finger ratio (2d:4d) as compare to non sports personals.

II) Psychological Variables

1) Aggression

1. Elite men volleyball players were found with significantly higher level of physical aggression, verbal aggression and anger as compare to non sportsmen.

2. Elite men Basketball players were found with significantly higher level of physical and verbal aggression as compare to non sportsmen.

3. Elite men Boxers were found with significantly higher level of physical aggression, verbal aggression and anger and as compare to non sportsmen.

4. Elite men wrestlers were found with significantly higher level of all aspect of aggression i.e. physical aggression, verbal aggression, hostility and anger as compare to non sportsmen.

5. Both elite male shooters and archers were having almost similar level of aggression (physical aggression, verbal aggression, hostility and anger) as compare to the non sportsmen as no significant difference was found between them.

6. Elite women volleyball and basketball players were found with significantly higher level of physical aggression as compare to non sportswomen.

7. Women boxers and wrestlers were found with significantly higher level of physical aggression as compare to non sportswomen.

8. Women boxers and wrestlers were found with almost similar level of verbal aggression, hostility and anger as compare to non sportswomen.
9. The elite women shooters and archers were found with similar level of aggression (physical aggression, verbal aggression, hostility and anger) as compare to the non sportsmen.

2) **Digital Finger Ratio and Aggression**

1. A significant (P <0.001) moderate degree of negative correlation between digital finger ratio and verbal aggression and physical aggression has been found in sportsmen.

2. A low level of negative insignificant correlation between digital finger ratio and hostility has been in sportsmen.

3. In non sportsmen a low level of negative insignificant correlation between digital finger ratio and verbal aggression, hostility and anger has been found.

4. A moderate significant (P <0.001) level of negative correlation between digital finger ratio and physical aggression & verbal aggression has been found in sportswomen.

3) **Emotional Intelligences**

1. Elite men volleyball and basketball players were having significantly higher level of emotional intelligence as compare to non sportsmen.

2. Elite men boxers, wrestlers, shooters and archers were not having significantly higher level of emotional intelligence as compare to non sportsmen.

3. Elite women volleyball and basketball players were having significantly higher level of emotional intelligence as compare to non sportswomen.

4. Elite women boxers, wrestlers, shooters and archers were not having higher level of emotional intelligence as compare to non sportsmen as the mean difference was not significant.

4) **Emotional Intelligences and Digital Finger Ratio**

1. A significant (P <0.001) moderate level of negative correlation between digital finger ratio and emotional intelligence in elite sportsmen and non sportsmen.
2. A significant (P <0.001) moderate level of negative correlation between digital finger ratio and emotional intelligence in elite sportswomen and non sports women.

**Recommendations**

1. Similar study can be taken up on different games/sports.
2. Similar study can be taken up on different psychological and physiological variables.
3. Research work can be done on larger population of different ethnicity.
4. Current study offers up the tantalizing question: can 2d:4d be used to predict future potential in sport?
5. Along with digital finger ratio (2D:4D) different rations like 1D:2D, 1D:3D, 1D:4D, 1D:5D, 2D:3D, 2D:4D, 2D:5D, 3D:4D, 3D:5D, and 4D:5D can be considered for further researchers.