EVALUATION OF SECOND AND FOURTH DIGIT RATIO, ANTHROPOMETRIC PARAMETERS AND AGGRESSION AMONG STARTISANS AND NON-ARTISANS IN ZARIA, KADUNA STATE, NIGERIA

BY

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DECLARATION

I, **Muhammad Zaharaddeen YUSUF**declare that the work in the thesis titled ‘‘**Evaluation ofSecond and Fourth Digit Ratio, Anthropometric Parameters and Aggression amongst Artisans and non-artisans in Zaria, Kaduna State, Nigeria**”was carried out by me in the Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Ahmadu Bello University, Zaria. The information used for my literature review was fully acknowledged in the text and references. This thesis has it been presented for award of degree or diploma at any University.

_____ _____

Muhammad Zaharaddeen YUSUF Signature Date

CERTIFICATION

This thesis entitled "**Evaluation of Second and Fourth Digit Ratio, Anthropometric Parameters and Aggression amongst Artisans and Non-artisan in Zaria, Kaduna State, Nigeria"**by **Muhammad Zaharaddeen YUSUF** meet the regulation governing the award of Master of Science (M.Sc.) degree in Department of Human Anatomy, Faculty of Medical Sciences, College of Medicine, Ahmadu Bello University, Zaria, under the supervision of Dr**. B. Danborno** and **Dr. A. O. Ibegbu**. It is therefore approved for the contribution to knowledge and literary presentation.

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ABSTRACT

A growing body of literature, has associated exposure to prenatal testosterone, to the length second to fourth digit ratios (2D:4D) and this have been linked to several biological traits e.g. fertility, birth weight, cognitive abilities and psychopathology etc. This study was aimed at evaluating the 2D:4D and 2D:4D and aggressionamongst artisans, non-artisansin Zaria, Kaduna state, Nigeria. A cross sectional study was conducted and a total of 700 subjects participated in this study, 548 subjects from different artisan groups and 152 subjects from non-artisan groups respectively. The artisanswere mainly labour workers between the age ranges of 18-65 years while the non-artisans are mainly students between age ranges of 18-56years.Anthropometric measurements were obtained using stadiometer and weighing scale, standard measuring tape, digital vernier caliper, anthropometric variables such as height, weight, finger length, humeral length, foot length and hand length were measured.The study revealed statistical difference in the variables between artisans and non-artisans except in right finger I and III, right 2D:4D ratio, left finger I, III and III, left 2D:4D ratio,hand length and hand breadth.When artisans were categories according to their trade (auto-mechanics, bricklayers, tailors and carpenters) artisans showed various degree of significant difference within the groups and with the non-artisans. The regression equations derived for bothartisans and non-artisan groups separately using height, weight and body mass index (BMI)by means of which these variablescan be accurately estimated using 2D:4D ratio when such body parts are recovered. Relationships between 2D:4D and different scale of aggressions have been established. The linear regression equations for the association of right and left 2D:4D and anger aggression in overall artisan and non-artisan groups is given as Anger = 28.026 - (10.172 * R2D:4D) (R = 0.176,R^2= 0.0311, SEE 2.148, P=0.001) and Anger = 28.923 - (11.060 * L2D:4D),R =

0.173, R^2= 0.0300, SEE 2.384, P=0.001respectively. The present study showed significant ($p< 0.001$) negative relationship between 2D:4D and all forms of aggression. In conclusion right and left 2D:4D ratio could be applied for estimations of height, weight, BMI and forms of aggression in artisans and non-artisan groups of Kaduna state. Also differences of 2D:4D ratio estimation between the different groups of artisans and non-artisans has been established in this study, indicating population specificity in 2D:4D ratio based on occupation in Kaduna state, Nigeria.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Digit ratio commonly known as 2D:4D is the ratio of the index finger (2D) to ring finger (4D) (Manning, 2002). Digit ratio has been reported by many investigators to show sexual dimorphism (Manning *et al*., 1998; Danborno *et al*., 2007; Ibegbu *et al*., 2012) with women having higher ratio than men (Manning *et al*., 1998; Danborno *et al*., 2007).

For males, the index finger is generally about 96 percent of the length of the ring finger, which gives an average digit ratio for males of 0.96 and females have a digit ratio of about 1.0 (Manning *et al*. 1998).The sexual dimorphism in 2D:4D is influenced by prenatal secretion of testosterone and estrogen (Zhang and Martin, 2011). Testosterone negatively correlates with 2D:4D while estrogen correlates positively with 2D:4D (Manning *et al*, 2002; Putz *et al*., 2004). A plethora of biological trait, have linked 2D:4D as reported by earlier investigators e.g, Zhang and Martin, 2011 fertility and human behavior (Allison *et al*, 2004), aggression and assertiveness (Wilson, 1983; Allison *et al*., 2004; Danbarno *et al*., 2008; Kilduff *et al*., 2013), personality factor and hand skill and medical conditions such as breast cancer, autism and congenital adrenal hyperplasia (Brown,2002; Manning, 2002) have also been explained with digit ratio study. Manning, (2002), reported significant racial and ethnic variations among Caribbean Jamaicans and white Caucasians. Oladipo *et al*. (2006) reported that there is no ethnic variation in digit ratio between Igbo and Urhobo and between Igbo and Yoruba ethnic groups of Nigeria respectively. They however recommended that tribes that are more distant be investigated to establish if any exist. The high value placed by females on male ability to acquire resources has been well documented (Buss, 1989).

This is evident in pre-industrial human societies, where males exhibit a positive relationship between status and number of surviving offspring. Such observations have been made across the continents of Africa, South America and Asia (Kaplan and Hill, 1985a; Pennington and Harpending, 1993; Smith, 2004). It has been suggested that the same is true of contemporary Western society; increasing income has been shown to have a significant effect on male reproductive success and desirability as a marriage partner (Buss, 1989: Pollet and Nettle, 2008: Buunk *et al*., 2002; Nettle and Pollet, 2008). Prior to agriculture, hunting may have represented an important means by which male resourcefulness could be demonstrated. Food is inexorably linked to status in many cultures around the world (Weissner and Schiefenövel, 1996), and there is evidence that superior hunters enjoy social prestige within the community (Altman and Peterson, 1988). Indeed, successful hunters have been shown to enjoy higher reproductive success (Kaplan and Hill, 1985b). Hunting may therefore be motivated by male-male competition (Hawkes *et al.,* 2001). Smith (2004) has reviewed quantitative links between hunting ability and fitness-related factors such as fertility, offspring survivorship and number of mates, and qualitative links between hunting success and knowledge of hunting ability within communities. However, it is not clear whether it is the high social status of hunters (which reflects their ability to acquire resources), or the actual resources they obtain, that provides the mechanism linking hunting success with reproductive fitness. The 2D:4D ratio has been studied in the context of reproductive success (Manning *et al*.,2000), sex-typed behavior (Csathó *et al*., 2003a), spatial/cognitive abilities (Coolican and Peters, 2003; Csathó *et al*.,2003b; Kempel *et al*., 2005), adult personality characteristics (Austin, *et al*., 2002; Fink *et al*., 2004; Bailey and Hurd, 2005a), and more recently in the context of psychopathology (Arato *et al.,* 2004; Bailey and Hurd, 2005b; McFadden*et al.*, 2005;Klump*et al*., 2006; Walder*et*

al., 2006). Generally, digit ratios show positive correlations with female-typical behaviors and negative correlations with male-typical behaviors (Putz*et al.*, 2004).

Intrauterine environment appears to play a role in the formation of 2D:4D, twin studies have indicated a significant additive genetic and non-shared environmental influence on digit ratios (Rubolini *et al*., 2006; Gobrogge *et al*., 2008).It is generally assumed that this difference is established during early prenatal development under the influence of sex hormones. This view was illustrated by the recent experimental mouse work of (Manning, 2011; Zheng and Martin, 2011). They revealed that the sex differences in 2D:4D were the results of prenatal testosterone (PT) and prenatal oestrogen (PE) signalling in a narrow developmental time window in utero. Furthermore, an evidence suggests that in the human male, foetus starts to produce testosterone in week 8 and testosterone peaks at about week 11 or 12 to 14 (Scott *et al.*, 2009). The 2D:4D ratio is probably fixed during this tight time (Mallas *et al.*, 2006). Because of this, there has been increasing use of the 2D:4D ratio as an index of prenatal hormone exposure, and extensive studies in humans have found correlations between digits ratios and a variety of physiological and psychological conditions, including fertility, season of birth, athletic ability, sex-biased diseases, social behaviours, and sexual orientation (Henzi *et al*., 2003;Fisher *et al*., 2010; Zheng and Martin, 2011; Sadhaer *et al*., 2014;Danborno and Danborno, 2015; Wang *et al*., 2016).

Many studies showed that low 2D:4D ratios correlated with athletic ability (Taylor and Manning 2001; Manning *et al.*, 2007b;Honekopp and Schuster, 2010;Longman *et al*., 2011, 2015) and male aggression (Bailey *et al.*,2005a; McIntyre *et.al.*, 2007; Danbarno *et al*., 2008; Honekopp and Watson, 2011).Manning and colleagues have shown that

2D:4D ratios vary greatly between different ethnic groups (Manning *et al*., 2004). In a study conducted among the Nigerian population, showed males have a significantly negative relationship between right and left 2D:4D ratio with birth weight, while females show positively significant relationship in both right and left hands. This means that association exists between 2D:4D ratio and birth weight which could be predicted most especially from the left hands (Danborno *et al*., 2010). Recently, researchers have been trying to investigate the relationship between 2D:4D and traits like coronary heart disease (Fink *et al*, 2006; Wu *et al*., 2013), gym-based physical fitness (Honekopp *et al*., 2006), development of psychopathology (Fink *et al*., 2007), cooperative behaviour (Millet and Dewitte, 2006), attention deficit hyperactivity disorder (Stevenson *et al.*, 2007).

There are some findings on health related outcomes, specifically, an association between smoking and digit ratios was detected by Borkowska and Boguslow, (2013). Using a sample of students they found a positive relationship with female smoking. Manning and Fink, (2011) found a positive association between national means of 2D:4D and number of cigarettes consumed per capita per nation. Another side of health related outcome concerns sports. Particularly, 2D:4D was found to be related to performance in endurance running by Manning *et al*. (2007b). It was shown that higher level of prenatal testosterone (lower 2D:4D) positively correlates with performance in endurance running.

The study of 2D:4D and other digit ratios, as well as their variation among population groups and among individuals may serve as a useful tool for establishing their values as biomarkers. (Ghosh and Garth, 2005; Eachus. 2007;Kyriakidis and Papaioannidou.

2008;Okampa*et al*., 2015) 2D:4D and other digit ratios appear to be attractive anthropometric traits that probably deserve attention by anthropologists, scientists, and clinicians since these digit ratios have continued to show promise as biomarkers of health and diseases (Manning, 2002; Oyeyemi, *et al*., 2014; Mitsui, 2015).

One's personality, outlook and degree of optimism may also be relevant indicators of preference and motivation for public service. Standard measures of personality and outlook, respectively, are the Big Five Inventory (BFI) devised by John (1990) and the Aspiration index (AI) constructed by Kasser and Ryan, (1996).More recently, there has been more work that tries to get at the effects of prenatal T, as proxied by 2D:4D, on life outcomes. For example, Coates *et al*., (2009) have shown that lower 2D:4D (higher prenatal T) correlate with much greater earnings for participants engaged in high-frequency bond trading as compared to their colleagues with higher 2D:4D (lower prenatal T). There is also evidence that suggests that the effects of 2D:4D may be non-linear and sex-differentiated (Manning *et al*., 2010; Hell and Paessler, 2011; Branas-Garza, *et al*., 2012; Nye *et al*, 2012; Nye *et al*., 2015). For instance, Nye *et al*. (2012) show that for academic achievement as measured by grades or school GPA, 2D:4D seems to have a clear and significant quadratic effect for women, but the effects are either mildly linear or even insignificant.

Nye*et al.*, (2012) also tends to confirm the general findings of Manning *et al*. (2010) with regard to the differences in the effects of 2D:4D for women in more stereotypically masculine vs. more stereotypically feminine occupations. Hell and Paessler, (2011), who only record desired rather than actual occupations, find that female 2D:4D is correlated with an interest in things and weaker interest in people or social professions.

This dichotomy between results that sometimes seem to show correlations for male, and other times for female, subjects may be related to measuring actual occupation versus stated interests or preferences.

1.2 STATEMENT OF RESEARCH PROBLEM

The ratio of the length of the second to fourth digit (2D:4D ratio) presumably reflects prenatal exposure to sex hormones. The 2D:4D ratio is sexually dimorphic, and males consistently have a slightly lower value. It is associated with many behavioral and biological variables, including fertility and sexual behavior as well as occupation. There has been no report of studies on the relationship between occupation and 2D:4D and aggression in Zaria, Kaduna state, Nigeria. This study intends to investigate these phenomena.

1.3 JUSTIFICATION/ SIGNIFICANCE OF THE STUDY

Digit ratio has been reported by many workers to show sexual dimorphism with women having higher ratio than men. This study intends to provide information about the digit ratio amongst artisans and non-artisans, which can serve as reference database for the association between 2D:4D ratio, profession and aggression. The result of the present study will also show the influence of anthropometric indices anddigit ratio on occupation and aggression.Therefore the need to correlate 2D:4D ratio among artisans. Results of this study may provide reference for the use of 2D:4D ratio in occupational counselling.

1.4 AIMS AND OBJECTIVES

1.4.1 Aim of the Study

The aim of this study is to evaluate the 2D:4D, amongst artisans and non artisans and the relationship between 2D: 4D,some anthropometric variableand aggression in the sample population.

1.4.2 Objective of the Study

The objectives of this study are to investigate:

i. the differences of 2D:4D ratio between artisans and non-artisans.
ii. The differences of 2D:4D between different group of artisans
iii. the relationships between 2D:4D ratio and other anthropometric characteristics amongst artisans and non-artisans.
iv. investigate the relationships between 2D:4D ratio and aggression among artisans and non-artisans.

1.5 HYPOTHESIS

There will be no difference in 2D:4D of artisans and non-artisans, but level of aggression will significantly correlate with 2D:4D in both artisans and non artisans.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 ASSESSMENT OF DIGIT RATIO

Digit ratio is the ratio of the lengths of different digits or fingers typically measured from the midpoint of bottom crease where the finger joins the hand to the tip of the finger. It has been suggested by some scientists that the ratio of two digits in particular, the 2nd (index finger) and 4th (ring finger), is affected by exposure to androgens e.g. testosterone while in the uterus and that this 2D:4D ratio can be considered a crude measure for prenatal androgen exposure, with lower 2D:4D ratios pointing to higher prenatal androgen exposure. Mayhew *etal.*(2007) shows that male and female digit proportions are determined by the balance of sex hormones during early embryonic development. The 2D:4D ratio is calculated by dividing the length of the index finger of the right hand by the length of the ring finger of the right hand. A longer index finger will result in a ratio higher than 1, while a longer ring finger will result in a ratio of less than 1.

The 2D:4D digit ratio is sexually dimorphic: while the second digit is typically shorter in both females and males, the difference between the lengths of the two digits is greater in males than in females (Manning *et al.,* 1998). A number of studies have shown a correlation between the 2D:4D digit ratio and various physical and behavioral traits.

2.2 HISTORY OF DIGIT RATIO RESEARCH

That a greater proportion of men have shorter index fingers than ring fingers than do women was noted in the scientific literature several times through the late 1800s (Ecker 1875: Baker, 1888) with the statistically significant sex difference in a sample of 201

men and 109 women established by (George, 1930) after which time the sex difference appears to have been largely forgotten or ignored. Wilson (1983) published a study examining the correlation between assertiveness in women and digit ratio. This was the first study to examine the correlation between digit ratio and a psychological trait within members of the same sex. Wilson (2010) proposed that skeletal structure and personality were simultaneously affected by sex hormone levels in utero. Manning *etal*., (1998) reported that sex difference in digit ratios was present in two-year-old children and further developed the idea that the index was a marker of prenatal sex hormones. Since then research on the topic has burgeoned around the world.

A 2009 study in *Biology Letters* argues: "Sexual differences in 2D:4D are mainly caused by the shift along the common allometric line with non-zero intercept, which means 2D:4D necessarily decreases with increasing finger length, and the fact that men have longer fingers than women (Kratochvíl *et al.,* 2009) may be the basis for the sex difference in digit ratios and/or any putative hormonal influence on the ratios.

Zhangand Martin (2011) reports the 2D:4D ratio in mice is controlled by the balance of androgen to estrogen signaling during a narrow window of digit development. The formation of the digits in humans, in utero, is thought to occur by 13 weeks, and the bone-to-bone ratio is consistent from this point into an individual's adulthood (Garn *et al.,* 1975). During this period if the fetus is exposed to androgens, the exact level of which is thought to be sexually dimorphic, the growth rate of the 4th digit is increased, as can be seen by analyzing the 2D:4D ratio of opposite sex dizygotic twins, where the female twin is exposed to excess androgens from her brother in utero, and thus has a significantly lower 2D:4D ratio (Anders *et al.*, 2006).

Importantly, there has been no correlation between the sex hormone levels of an adult and the individual's 2D:4D (Hönekopp *et al.,* 2006) which implies that it is strictly the exposure in utero that causes this phenomenon. A major problem with the research on this topic comes from the contradiction in the literature as to whether the testosterone level in adults can be predicted by the 2D:4D ratio (Hönekopp *et al.*, 2006) but male sexual traits that are stereotypically attributed to testosterone levels have been found in correlation with the 2D:4D. So there should either be a correlation with one or the other but not both.

2.3 EVIDENCE OF ANDROGEN EFFECT ON DIGIT RATIO

Women with congenital adrenal hyperplasia (CAH), which results in elevated androgen levels before birth, have lower, more masculinized 2D:4D on average (Brown *et al.,* 2002, Okten *et al.,* 2002 and Ciumas *et al.,* 2009). Other possible physiological effects include an enlarged clitoris and shallow vagina (Richard *et al.,* 2006). Males with CAH have more masculine (smaller) digit ratios than control males (Brown *et al.,* 2002, Okten *et al.,* 2002) which also suggests that prenatal androgens affect digit ratios, since amniocentesis samples show that prenatal levels of testosterone are in the high normal range in males with CAH, while levels of the weaker androgen androstenedione are several fold higher than in control males (Pang *et al.,* 1980, Dorr *et al.,* 1993 and Wudy *et al.,* 1999). These measures indicate that males with CAH are exposed to greater prenatal concentrations of total androgens than are control males.

Digit ratio in men with Klinefelter's syndrome, who have reduced testosterone secretion throughout life compared to control males, are greater (i.e., more feminine) than in their

fathers or control males (Manning andSanker, 2013). Digit ratio in men correlates with genetic variation in the androgen receptor gene (Manning *et al.*, 2003). Men with genes that produce androgen receptors that are less sensitive to testosterone (because they have more CAG repeats) have greater, more feminine, digit ratios. There are reports of a failure to replicate this finding (Hampson *et al.*, 2012). However, men carrying an androgen receptor with more CAG repeats compensate for the less sensitive receptor by secreting more testosterone (Crabbe *et al.*, 2007), probably as a result of reduced negative feedback on gonadotropins. Thus, it is not clear that 2D:4D would be expected to correlate with CAG repeats, even if it accurately reflects prenatal androgen. XY individuals with androgen insensitivity syndrome (AIS) due to a dysfunctional gene for the androgen receptor present as women and have feminine digit ratios on average, as would be predicted if androgenic hormones affect digit ratios. This finding also demonstrates that the sex difference in digit ratios is unrelated to the Y chromosome per se (Berenbaum *et al.*, 2009).

The sex difference in 2D:4D is present before birth in humans (Malas *et al.*, 2006; Galis *et al.*, 2009) which rules out any social influences that might affect digit growth differentially in the two sexes. Because all somatic sex differences in mammals to date have been found to be due to either androgenic masculinization or effects of the sex chromosomes, and as the AIS finding rules out a role for sex chromosomes in the sex difference in digit ratios, the prenatal sexual dimorphism also indicates that androgens act before birth to affect digit ratios. The ratio of testosterone to estradiol measured in 33 amniocentesis samples correlates with the child's subsequent 2D:4D ratio (Lutchmaya *et al.*, 2004). In pheasants, the ratio of the 2nd to 4th digit of the foot has

been shown to be influenced by manipulations of testosterone in the egg (Romano *et al.*, 2006).

Studies in mice indicate that prenatal androgen acts primarily by promoting growth of the fourth digit (Zheng and Cohn, 2011). There is evidence that this reflects fetal exposure to the hormones testosterone and estrogen (McIntyre, 2006). Several studies present evidence that digit ratios are heritable (Paul *et al.,* 2006; Gobrogge *et al.,* 2008). The level of estrogen in the amniotic fluid is not correlated with higher 2D:4D, and when examined researchers found no difference in estrogen levels between males and females (Lutchmaya *et al.,* 2004). It is not clear why digit ratio ought to be influenced by prenatal hormones. There is evidence of other similar traits, e.g. otoacoustic emissions and arm-to-trunk length ratio, which show similar effects. Hox genes responsible for both digit and penis development (Dickman, 1997), have been implicated in affecting these multiple traits (pleiotropy). Direct effects of sex hormones on bone growth might be responsible, either by regulation of Hox genes in digit development or independently of such genes. Likewise, it is unclear why digit ratio on the right hand should be more responsive than that on the left hand, as is indicated by the greater sex difference on the right than the left (Honekopp and Schuster, 2010).

2.4 GEOGRAPHIC AND ETHNIC VARIATION IN DIGIT RATIO

Manning and colleagues have shown that 2D:4D ratios vary greatly between different ethnic groups (Manning *et al.,* 2000, 2004). This variation is far larger than the differences between sexes; in Manning's words, "There's more difference between a Pole and a Finn, than a man and a woman (Terrance *et al*., 2000).

2.5 CORRELATION BETWEEN DIGIT RATIO AND TRAITS

Some authors suggest that digit ratio correlates with health, behaviour, and even sexuality in later life. Below is a non-exhaustive list of some traits that have been either demonstrated or suggested to correlate with either high or low digit ratio.

Table 2.1: Relationship between 2D:4D ratio with different behaviour, health and other traits.

	digit ratio	digit ratio
Physiology and disease		➢ Lowered sperm counts (Manning *et al.*, 1998) ➢ Increased risk for heart disease in males (Manning *et al.*, 2001) ➢ Increased risk of obesity and metabolic syndrome in males (Fink *et al.*, 2006) ➢ Reduced risk for prostate cancer (Walsh *et.al*, 2010) ➢ Reduced birth size in males (Ronalds *et al.*, 2002; Klimek *et al.*, 2014)
Psychological disorders	➢ Increased rate of ADHD in males (McFadden *et al.*, 2005,Stevenson *et al.*, 2007, and ➢ Martel *et al.*, 2008, 2009) ➢ Reduced risk in females for anorexia nervosa (Klump *et al.*, 2006) and in males for disorders (Smith *et al.*, 2009)	➢ Reduced rate of autism and Asperger syndrome (Manning *et al.*, 2001) ➢ Increased risk for depression in males (Bailey *et al.*, 2005) ➢ Increased rate of schizophrenia (Arató *et al.*, 2004) ➢ Increased rate of psychopathy in females (Blanchard *et al.*, 2010) ➢ Reduced risk of alcohol dependency (Kornhuber *et al.*, 2011) ➢ Reduced risk of video game addiction (Kornhuber *et al.*, 2013) ➢ Increased Anxiety in males (Evardone *et al.*, 2009)
Physical and competitive behaviour		➢ Reduced performance in sports (Manning *et al.*, 2001) ➢ Reduced financial trading ability (Coates *et al.*, 2009) ➢ Right handedness Skills (Fink *et al.*, 2004) inconclusive (Titus-Ernstoff, 2003)
Cognition and personality	➢ Assertiveness in females (Wilson, 1983) ➢ Aggression in males (Bailey *et al.*, 2005; Benderlioglu *et al.*, 2004) ➢ Masculinity of Handwriting (Beech *et al.*, 2005) ➢ Perceived 'dominance' and masculinity of man's face (Neave *et al.*, 2003; Burriss *et al.*, 2007) ➢ In an orchestral context, rank and musical ability in males (Sluming *et al.*, 2007)	
Management	➢ Leadership (Derval, 2010) ➢ Innovation (Derval, 2010)	
Sensory Perception		➢ Smell perception (Derval, 2010) ➢ Color perception (Derval, 2010) ➢ Tactile perception (Derval, 2011)
Sexual orientation	➢ Lesbians have a lower digit ratio, on average, than heterosexual women (Csathó *et al.*, Williams *et al.*, 2000, Tortorice , 2002, McFadden *et al.*, 2002, Hall *et al.*, 2003, Rahman *et al.*, 2003, Putz *et al.*, 2004, Rahman, 2005,Kraemer *et al.*, 2006,Wallien *et al.*, 2008,Grimbos *et al.*, 2010,Hirashi *et al.*, 2012)	➢ Sexual preference for more masculine men among women (Csathó *et al.*, 2003) and gay men (McIntyre, 2003) with high digit ratio; a preference for a masculine facial type means a more "feminized" mindset. ➢ Lesbians are more likely to be femme and less likely to be butch with a high digit ratio (Tortorice, 2002;Brown, 2002). Identical female twins discordant for sexual orientation still show the difference (lesbian less than straight, on average) in digit ratio (Hall *et al.*, 2003; Hirashi *et al.*, 2012). ➢ Homosexuality for men (McFadden *et al.*, 2002; Churchchill *et al.*, 2007) but disputed (Grimbos *et al.*, 2010; Robinson *et al.*, 2000) and subject to geographic variations (Schneider *et al.*, 2006)

2.6 BODY MASS INDEX, WEIGHT, HEIGHT AND DIGIT RATIO

Several studies have noted the recent secular changes in BMI in the United States (Troiano *et al.*, 1995; Adair and Gordon-Larsen, 2001; Ogden *et al.*, 2002), as well as around the world (Fredriks *et al.*, 2000; Bundred *et al.*, 2001; Armstrong *et al.*, 2003; Lissau *et al.*, 2004). Studies in the United States have noted that there has been an increase in mean levels of BMI, with distributions skewed to the right (Flegal and Troiano, 2000), suggesting the extent of overweight has been increasing faster than the prevalence (Jolliffe, 2004). Although the mean BMI has increased for the population, the BMI in children who are heavier has increased more than children who are less heavy.

Several factors predisposing to increases in BMI, including increases in total calories and in consumption of fast foods, decreases in physical activity, and, a factor not totally independent of the first two, an increase in hours spent watching television have been proposed. There have been several studies that noted an increase in total consumption of calories over the past 30 years (Jahns *et al.*, 2001), with the greatest increases in consumption of salty snacks and soft drinks and decrease in consumption of milk (Nielsen *et al.*, 2002). When fast food is consumed (which occurred on 30% of the days), more total energy was consumed, with a greater caloric density (Bowman *et al.*, 2004); this study further noted that fast food consumption contributed 57 kcal daily to all US youth (Bowman *et al.*, 2004). Another report noted that when overweight and normal weight adolescents were observed in a fast food setting, overweight participants consumed more calories than their leaner counterparts, and that they consumed more calories on fast food days compared with non-fast food days (Ebbeling *et al.*, 2004). The impact of dietary changes has had an impact on Western as well as non-Western populations. Popkin (2002)

has noted a ‘nutrition transition’ over many societies, with a pattern of diet high in saturated fat, sugar and refined foods, and low in fibre.

2.7DIGIT RATIO AND RISK TAKING

There is now increasing evidence for the hypothesis that prenatal androgens might also increase risk preferences in later life. For example, Coates *et al.* (2009) recently found that male highfrequency financial traders’ long-term profitability was inversely related to digit ratio, indicating more financial risk-taking in individuals with a more masculinized digit ratio. This finding is quite compatible with other hormonal research documenting that testosterone facilitates risk-taking behavior in gambling tasks (van Honk *et al*., 2004; Apicella *et al*., 2008). Other studies examined associations between digit ratio and personality variables that are related to risk-taking behavior. For example, the personality trait sensation seeking has been inversely related to digit ratio (Fink *et al*., 2006; Hampson *et al*., 2008). Sensation seekers underestimate or accept physical, social, legal, and financial risks as the price for the reward provided by the sensation or experience itself. It should be noted that sensation seeking similar to digit ratio has been related to testosterone exposure (Daitzman and Zuckerman, 1980; Resnick *et al*., 1993). Augmenting–reducing is another personality variable that has been related with the choice of risky lifestyles. It refers to the ten tendency to cortically augment or reduce sensory stimuli such that reducers are less responsive to sensory stimulation and, thus, more likely to engage in risk-taking behaviors (Schwerdtfeger, 2007). Similar to sensation seekers, reducers have been found to show a lower digit ratio as compared to augmenters (Schwerdtfeger and Heer, 2008).

2.8MALE-TO-FEMALE TRANSEXUAL PEOPLE

A study in Germany has found a correlation between digit ratio and male-to-female transexualism. Trans-women were found to have a higher digit ratio than cis-gender males, but one that was comparable to control females (Schneider *et al.,* 2007).

2.9 DIGIT RATIO AND DEVELOPMENT

There is some evidence that 2D:4D ratio may also be indicative of human development and growth. Ronalds *et al.,* (2002) showed that men who had an above average placental weight and a shorter neonatal crown-heel length had higher 2D:4D ratios in adult life. Moreover, studies about 2D:4D correlations with face shape suggest that testosterone exposure early in life may set some constraints for subsequent development. Prenatal sex steroid ratios (in terms of 2D:4D) and actual chromosomal sex dimorphism were found to operate differently on human faces, but affect male and female face shape by similar patterns (Fink *et al.,* 2004). He also found that men with low (indicating high testosterone) and women with high (indicating high estrogen) 2D:4D ratios express greater levels of facial symmetry (Fink *et al*., 2005). However, exposure to very high levels of testosterone and/or estrogen in the womb may have negative effects as well.

2.10 AGGRESSION

This is any behavior directed toward another individual that is carried out with the proximate (immediate) intent to cause harm. In addition, the perpetrator must believe that the behavior will harm the target, and that the target is motivated to avoid the behavior (Berkowitz, 1993; Baron and Richardson, 1994; Bushman and Anderson, 2001; Geen, 2001).

Accidental harm is not aggressive because it is not intended. Harm that is an incidental by-product of helpful actions is also not aggressive, because the harm-doer believes that the target is not motivated to avoid the action (e.g., pain experienced during a dental procedure). Similarly, the pain administered in sexual masochism is not aggressive because the victim is not motivated to avoid it indeed, the pain is actively solicited in service of a higher goal (Baumeister, 1989).

2.10.1 Violence

Violence is aggression that has extreme harm as its goal (e.g., death). All violence is aggression, but many instances of aggression are not violent. For example, one child pushing another off a tricycle is an act of aggression but is not an act of violence (Anderson and Bushman, 2002)

2.10.2 Domain Specific Theories of Aggression

Five main theories of aggression guide most current research. The theories themselves overlap considerably, which is what instigated early attempts to integrate them into a broader framework (Anderson *et a*l., 1995, 1996).

2.10.3 Cognitive Neoassociation Theory

Berkowitz (1989, 1990, 1993) has proposed that aversive events such as frustrations, provocations, loud noises, uncomfortable temperatures, and unpleasant odors produce negative affect. Negative affect produced by unpleasant experiences automatically stimulates various thoughts, memories, expressive motor reactions, and physiological responses associated with both fight and flight tendencies. The fight associations give rise

to rudimentary feelings of anger, whereas the flight associationsgive rise to rudimentary feelings of fear. Furthermore, cognitive neoassociation theory assumes that cues present during an aversive event become associated with the event and with the cognitive and emotional responses triggered by the event. In cognitive neoassociation theory, aggressive thoughts, emotions, and behavioral tendencies are linked together in memory (Collins and Loftus 1975). Figure 2.1 contains a simplified schematic of an associative memory structure in which the concept of "gun" is linked to a number of aggression-related concepts (Anderson *et al.*, 1998). Concepts with similar meanings (e.g., hurt, harm) and concepts that frequently are activated simultaneously (e.g., shoot, gun) develop strong associations. In Figure 2.1 associations are illustrated by lines between the concepts, with thicker lines representing stronger associations and shorter distances representing greater similarity of meaning. When a concept is primed or activated, this activation spreads to related concepts and increases their activation as well.

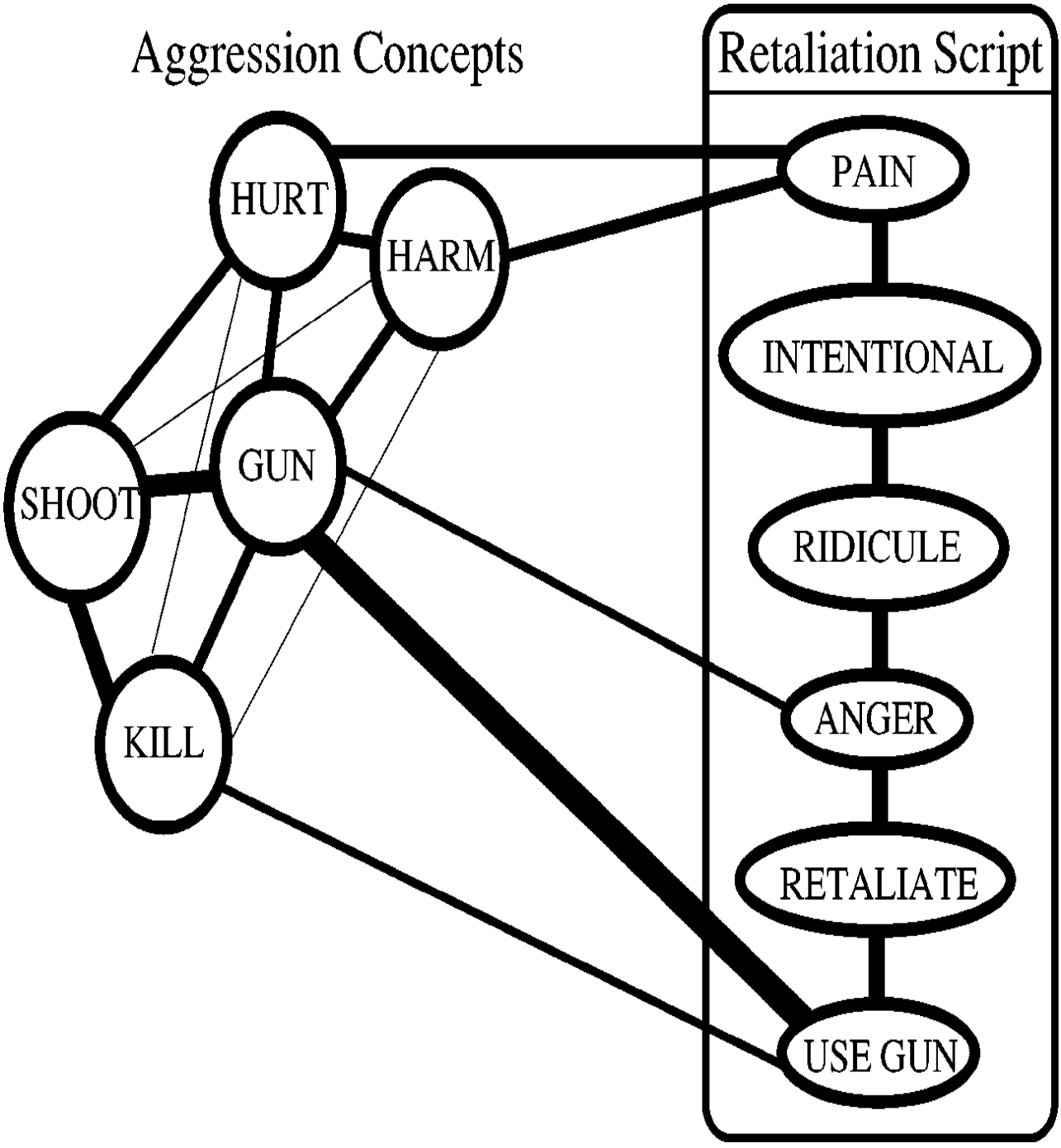


Figure: 2.1:Simplified associative network with aggression concepts and a retaliation script (Anderson *et al*., 1998).

Cognitive neoassociation theory also includes higher-order cognitive processes, such as appraisals and attributions. If people are motivated to do so, they might think about how they feel, make causal attributions for what led them to feel this way, and consider the consequences of acting on their feelings. Such deliberate thought produces more clearly differentiated feelings of anger, fear, or both. It can also suppress or enhance the action tendencies associated with these feelings (Anderson and Bushman, 2002).

Cognitive neoassociation theory not only subsumes the earlier frustrationaggression hypothesis (Dollard *et al*., 1939), but it also provides a causal mechanism for explaining why aversive events increase aggressive inclinations, i.e., via negative affect (Berkowitz 1989). This model is particularly suited to explain hostile aggression, but the same priming and spreading activation processes are also relevant to other types of aggression.

2.11 GENERAL AGGRESSION MODEL

A heap of stones is not a House "Science is built up with fact, as a house is with stone.

But a collection of fact is no more a science than a heap of stones is a house."Jules Henri Poincaree

Poincaree's analogy fits the scientific study of aggression. The several current domain-specific theories are the important stones awaiting blueprints, mortar, and a construction crew to build the much more useful house, a general theory of human aggression.

This chapter presents the most recent version of our integrative framework, called the general aggression model (GAM). This theoretical framework was designed to integrate existing mini-theories of aggression into a unified whole. This model has been used for several years (e.g.,Anderson *et al*., 1995, 1996;Anderson, 1997; Anderson *et al*., 1998;

Anderson and Dill, 2000; Lindsay and Anderson, 2000; Bushman and Anderson, 2001). This general model has at least four advantages over smaller domain theories. First, it is more parsimonious than the set of existing mini-theories. Second, it better explains aggressive acts that are based on multiple motives, e.g., both instrumental and affect-based aggression (Bushman and Anderson, 2001). Third, it will aid in the development of more comprehensive interventions designed to treat individuals who are chronically aggressive; many current treatment attempts fail because they focus on only one specific type of aggression or use only one mini-theoretical approach to treatment (Tate *et al*., 1995). Fourth, it provides broader insights about child rearing and development issues, thus enabling parents, teachers, and public policy makers to make better decisions about child-rearing practices (Zigler *et al*., 1992).

2.12 BIOLOGICAL BASES OF AGGRESSION

2.12.1 Behaviour Genetics

The possibility that some human aggression may be attributable to hereditary factors is supported by a growing number of studies. At one time, especially in the United States when behaviourism dominated psychology, few psychologists believed that human behaviour had hereditary origins (Geen, 2001).

It was practically a truism that all behaviour is learned. Nowadays this premise is not as widely accepted. Hereditary aggression in lower animals has never been seriously questioned, and in recent years the idea that at least some part of human aggressiveness is inherited has been gaining increasingly in acceptance (Geen, 2001). An obvious problem that arises in the study of the genetic bases of aggression in humans is methodological.

Human reproduction cannot be controlled through selective breeding in the same way as that of lower organisms, so alternative means of analysing genetic influence must be found. One such method involves comparison between pairs of twins. Twin studies analyse similarities between members of identical (monozygotic) and non-identical, or fraternal (dizygotic), pairs (Geen and Donnerstein, 1998). The method rests on the fact that whereas dizygotic twins share a common environment but are not identical in genetic make-up, monozygotic twins share a common environment and are also identical in heredity. If a trait has some hereditary basis, therefore, it should be shared by monozygotic twins to a greater extent than by members of dizygotic pairs. Correlations of the trait between pairs of twins of each type are compared, and evidence of higher correlations among monozygotics is taken as evidence of some heritability associated with the trait. The evidence from twin studies on the role of inherited biological factors in human aggression is mixed and inconclusive (Geen and Donnerstein, 1998). The most convincing studies have been those in which comparisons have been made on the basis of self-reports of aggressiveness on personality inventories (McGue *et al*., 1993). In one such investigation, Rushton *et al*. (1986) administered questionnaires assessing five personality traits to more than 500 pairs of adult twins. Three of the traits (altruism, empathy and nurturance) were assumed to be negatively related, and two (aggressiveness and assertiveness) positively related, to aggressive behaviour. The results showed that correlations were higher among monozygotic twins than among dizygotic pairs for each of the five traits. Similar findings of heritability have been reported in studies involving methods other than personality inventories. In one such study, mothers' descriptions of the behaviour of their twin children revealed a significant heritability factor for aggressiveness (Ghodsian-Carpey and Baker, 1987). On the negative side, several studies involving self-report inventories have yielded

either small heritability effects or no such effects at all (Carmelli *et al.*, 1990). In most such cases, inventories different from the ones showing positive effects were used, raising the possibility that heritability effects may depend to some extent on the way on which aggressiveness is defined and measured. Another method that has been used involves assessment of similarities in aggressive behavior between adopted children and their biological parents compared to similarities between such children and their adoptive parents. Mednick *et al*. (1984) compared the criminal behaviours of adopted persons with similar behaviours in their biological parents and found a high level of concordance between the two for non-violent crimes but not for violent ones.

In a review of 24 studies covering a wide range of methods, Miles and Carey (1997) found that evidence for heritability of aggression depends on several variables, such as the age of the sample and whether aggression is quantified in terms of parent- and self-report or observation of behaviour. Outcomes also seem to depend on how aggression is defined. There is no sufficient evidence from any type of study to draw strong conclusions. Replications across samples and research programmes, using similar operations and methods, are badly needed. For the time being, however, the behaviour genetic method has shown that heritability undoubtedly plays some part in human aggression (Plomin *et al.*, 1990).

2.12.2 Ethology and Evolutionary Biology

Explanations of human aggression based on the science of behavioural biology, or ethology, can be traced back at least to Konrad Lorenz's 1966 book on Aggression. Emphasizing the place of human beings within the animal kingdom, Lorenz explained

aggression as behaviour triggered by specific external stimuli following a progressive accumulation of aggression specific energy within the person. Aggression is followed by a cathartic decrease in such energy and the beginning of a new build-up. Although direct evidence for such processes had been obtained through the observation of aggressive behaviour in non-human species, some ethologists have argued that similar processes form the basis for aggression in humans. Evidence adduced in support of this claim is usually based on the method of analogy, i.e. the demonstration that certain patterns of behaviour in one species are similar to patterns in the actions of another because both have evolved under similar environmental demands (Rajecki, 1983). More recently, students of animal behaviour have argued that inferences about human aggression can be drawn from the study of animals that are closely related to humans in terms of genetic endowment, specifically primates. For example, studies of primate organization have shown that social competence is closely tied to an animal's development of the capacity for using aggression appropriately (Higley *et al*., 1994). To be socially competent, the animal must learn sometimes to inhibit aggression, such as when the young male is encountered by a powerful and dominant adult, but at other times to express aggression rather than to withdraw from challenges. The conditions under which the young primate is reared play an important role in determining whether such discriminations are learned. Monkeys that are reared either in isolation or among peers only, without maternal contact, generally show deficits in this sort of learning and, as a consequence, often manifest socially inappropriate aggression. The upshot of this behaviour is that they tend to be socially rejected. Similar rejection of offspring because of either aggressiveness or victimization by others has also been shown among humans (Dishion *et al*., 1994). Another biological approach to human aggression emphasizes the evolutionary history of the human species (Geary, 1998). The case for this

approach has been made primarily in a series of studies by Daly and his associates. For example, these investigators identify male sexual jealousy as a major factor in homicidal violence among young men. Such jealousy is a consequence of the evolution of certain psychological tendencies that enhance the male's confidence in his paternity of offspring borne by the woman or women with whom he has sexual relations. The need to have confidence that alien males have not fathered the offspring motivates the male not only to dominate and control the female (as noted below) but also to compete aggressively with other males for available resources that furnish reproductive opportunities. In modern society such resources are manifested not in nesting sites or feeding territories, as they are in lower animals, but in intangibles such as status and social power. The displays of aggressive machismo shown, for example, in youth gangs represent manifestations of status- and power-driven behaviour. Daly and Wilson (1988) apply this rationale to explaining the commonly observed finding of high rates of homicide among urban men in their twenties. Given an evolved propensity for combative competition, which should be at maximum strength in the years of greatest reproductive power, even minor provocations may elicit violence from such men. The same theoretical reasoning is also used to explain why men kill women more frequently than women kill men. 'Male sexual proprietariness', Daly and Wilson (1988) conclude, 'is the dominant issue in marital violence. In studies of "motives" of spousal homicide, the leading identified substantive issue is invariably "jealousy" the husband's proprietary concern with his wife's fidelity or her intention to quit the marriage led him to initiate the violence in an overwhelming majority of cases.' Arguments from evolutionary biology have generally been ignored or dismissed by social psychologists. One reason is that social psychologists traditionally have considered socio-cultural variables to be more powerful determinants of aggression in humans than psycho-

evolutionary ones. In response to this objection, some evolutionary biologists insist that the development of human culture is itself shaped by evolved constraints. Culture, according to these observers, is the product of 'the psychology of the culture-bearing organism' (Daly and Wilson, 1989), and this psychology is shaped by evolutionary history. Another source of social psychologists' resistance to evolutionary proposals is the impression that acceptance of aggression and violence as 'natural' behaviours necessitates acceptance or endorsement of such actions, an allegation specifically denied by evolutionists (Thornhill and Thornhill, 1992) for a detailed discussion of this issue). Some social psychologists are also sceptical of the evidence that has been adduced for the evolutionary argument to date (Baron and Richardson, 1994). It is too soon to tell whether psycho-evolutionists and social psychologists will eventually find much common ground.

2.13 HORMONES AND AGGRESSION

The importance of androgenic hormones – testosterone being perhaps the best known in aggression among non-human animals has long been recognized. These hormones have two effects on animals that may influence aggression. First, they can influence the bodily development and the structure and function of the nervous system in the fetus prior to birth. Such influences are called organizing effects. Second, they can cause changes in the moods and behaviours of animals after birth, outcomes that are called activating effects. Despite evidence that testosterone activity has been shown to facilitate aggression between males of several vertebrate species and figures, especially at the time of reproductive activity (Archer, 1988), whether similar effects occur in human males is still being debated. Some investigators deny that testosterone has any important function in human aggression, insisting that the dominance of social and cognitive factors in human behavior outweigh

any influence that hormones may have (Campbell *et al*., 1997). Despite such disclaimers, there is evidence that the aggression of humans shows some hormonal effects similar to those seen in animals. Only a few studies with humans have investigated the effects of prenatal administration of androgens on aggression in childhood and the scant evidence that is available is mixed. Given such ambiguous findings, Archer (1991) concluded that is little evidence pointing to a possible organizing role of prenatal androgens on aggression. Evidence of an activating function for testosterone in aggressive in humans has been somewhat more impressive (Archer, 1994). For example, research by Dabbs and his associates has tended to show a reliable positive relationship between testosterone level and aggression in varying samples of males, such as prison inmates (Dabbs *et al*., 1987) and combat veterans (Dabbs and Morris, 1990). Hormonal activity in males has also been shown to be correlated with ratings of aggressiveness made by observers or by the aggressors themselves. Susman *et al*. (1987) found that in a sample of adolescent boys the levels of several hormones were positively correlated with descriptions of the boys, made by their mothers, as 'delinquent', 'nasty' and 'rebellious', while Gladue (1991) found that men with relatively high levels of testosterone activity were more likely to describe themselves in aggressive terms than men showing lower levels. One question that is implicit in all this research is whether hormones raise levels of general aggressiveness or instead create a higher level of readiness to aggress in response to sufficient provocation. For instance, does a high level of testosterone activity make a person more likely to pick fights with others or to seek opportunities for behaving violently, or does it merely increase the likelihood that the person will aggress when attacked? Several studies have shown that levels of testosterone may predispose a person to behave aggressively in provoking situations. For example, Olweus *et al*. (1980) found a significant association between

testosterone and self-reported physical and verbal aggression in a sample of adolescent boys, and noted that the relationship was more characteristic for scale items that described aggression as a response to provocation than for those items in which aggression was described in other ways. A series of studies carried out in Holland by Van Goozen and her associates has provided clear evidence that testosterone activity is related to reactive aggression but not to overall aggressive behavior. In these studies, testosterone level was experimentally manipulated among persons undergoing sex-change treatments. Administration of testosterone to a sample of female-to-male (FM) transsexuals was accompanied by no change in general self-reported aggressive behavior, but by significant increases.

2.14 REPORTED FINDINGS ON OCCUPATION AND 2D:4D RATIO

Studies have reported the association between exposure to prenatal and second to fourth digit ratios (2D:4D) to various individual outcomes (John *et al.,* 2014). Brosnan *et al*(2011) found that both women and men with lower 2D:4D ratios (i.e. higher prenatal T exposure) perform better in computer science disciplines (specifically, Java programming) and have lower levels of computer related anxiety. Honekopp *et al*., (2006), presented empirical evidence that lower male and female averaged digit ratio is positively associated with physical fitness. Kilduff *et al*., (2012), showed that left hand digit ratios are negatively correlated with levels of male aggression. However, in some studies a non-linear (quadratic) relationship has been observed. An extensive survey of statistical tests of various functional forms was published by Valla and Ceci (2011). Supporting evidence of nonlinear specification came from the studies of Nye *et al*., (2005). Given the complex nature of the studied relationship between 2D:4D and cognitive skills, Luxen and Buunk

(2005) studied 44 men and 37 women to estimate potential correlation between digit ratios and verbal, numerical intelligence and a non-cognitive trait agreeableness. They found a negative correlation of 2D:4D (right hand) with numerical intelligence, but a positive correlation between 2D:4D and verbal intelligence. Agreeableness and right 2D:4D was also positively correlated.

Researchers from Spain showed a statistically significant inverse relationship between 2D:4D (for both the left hand and for the right hand) and results of cognitive reaction test, as developed by Frederick (2005). They used an ordered probit model and a non-random sample (623 students). They controlled for gender, mathematics grade and an indicator which measured patience. The inverse relationship was stronger for females than for males.

Branas-Garza and Rustichini (2011), used a sample of 188 observations and showed that 2D:4D ratio (right hand) was negatively correlated to the level of intellectual development of men, measured by the Raven test. Beaton *et al*. (2011), using correlation analysis and regression methods, estimated the inuence of the difference (between 2D:4D of the right hand and the left hand) on the results of a test, which measures abilities to memorize the word order. The sample consisted of 68 observations. It was shown that larger differences corresponded to higher test scores. Indirect statistical evidence about the association of 2D:4D with cognitive ability differences comes from the study of Jordan-Steen (2009) who found that lower mean 2D:4D ratios (right hand) are related to higher mathematical orientation for female students who participated in pre-service teacher program and selected the mathematics major, rather than mathematics minor. Nye, *et al*. (2005) used a relatively large data set to study the relationship between 2D:4D and student academic

performance in Moscow and Manila. The study revealed a nonlinear association between 2D:4D and academic performance, but only for females. Supporting findings of a non-linear relationship between 2D:4D and academic achievement were documented in the study of Sanchez-Dominguez *et al.* (2013). In particular, an inverted U-shaped relationship was found between Second year mathematics grade and digit ratios, calculated as the average between the right hand and the left hand digit ratio**.** Interestingly, no associations of other academic courses grades and digit ratios were found. Not only cognitive skills, but also personal psychological characteristics have been associated with 2D:4D. It was shown by Austin*et al.* (2002) that left hand 2D:4D weakly but positively correlated to neuroticism on the general sample. Though, this correlation vanishes once male and female sub-sample are taken separately. Also, there is some evidence of statistically significant and negative correlation between both left and right hand 2D:4D and general sensation seeking, measured by Sensation Seeking Scale. Lindova *et al.*(2008) estimated correlations of 2D:4D ratio of the right hand and Cattell test results. Lindova and others used a sample of 301 biology department students from Charles University in Prague. They employed mediator analysis and showed that 2D:4D linearly and negatively correlated with emotional stability and the ability to resolve problematic situations in the society (to give public speeches, to get a community leader, etc.). Also, they showed that emotional stability partially moderated 2D:4D impact. Nevertheless, there are other studies that reject the link between 2D:4D and personal characteristics. Lippa(2006) used a sample of 1000 respondents and showed that links between 2D:4D and Big Five personal characteristics seem weak or non-significant. There is only weak positive correlation between 2D:4D and extroversion and weak negative correlation between 2D:4D and openness to new experience. He also conducted empirical analysis on a sample of more than 2000

individuals and showed that the correlation between 2D:4D and personal characteristics that are typical for men seem to disappear again. But, Lippa in 2006 showed that there is a link between 2D:4D and profession choices that are typical for women. There is evidence in the literature that lower 2D:4D leads to overestimated problem statements (with respect to possibilities), which never get resolved (Dalton and Ghosal, 2014). It was also shown that there is a link between 2D:4D and the ability to administrate. Guiso and Rustichini (2011) showed that administrators with lower 2D:4D manage bigger arms; meanwhile the profitability of such arms is significantly lower. Empirical associations of self-esteem and digit ratios are also under ongoing examination.

Manning and Quinton (2007) documented evidence that digits ratio is negatively related to a number of self-esteems (reported by respondents): with body attractiveness, general attractiveness and facial attractiveness of men. Wade and *et al.* (2004) found that higher 2D:4D correlated with higher reported selfperception of women's attractiveness. There are some findings on health related outcomes. Specifically, an association between smoking and digit ratios was detected by Borkowska and Boguslaw (2011). Using a sample of students they found a positive relationship with female smoking. Manning and Fink (2011) found a positive association between national means of 2D:4D and number of cigarettes consumed per capita per nation.

Another side of health related outcome concerns sports. Particularly, 2D:4D was found to be related to performance in endurance running by Manning *et al.* (2007b). It was shown that higher level of prenatal testosterone (lower 2D:4D) positively correlates with performance in endurance running.

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1 RESEARCH PARTICIPANTS

The subjects that participated in the study were artisans and non-artisans from Zaria Kaduna State (n = 700, mean age 27.21 ± 7.449 years), artisans (n=548, mean age=27.93±7.75,) and non-artisans (n=152, mean age=24.63±5.53).

3. 2 STUDY LOCATION

Zaria is a Hausa land in northern Kaduna State, in the northern part of Nigeria and is located on latitude 11º04' north and longitude 7º 43' east. It is defined by a 15 km radius from the PZ post office and is well connected by roads and rail with other regions of the country. Distances from Kaduna, Kano, Jos and Sokoto are approximately; 75 km, 176 km, 387 km and 404 km respectively. Zaria is the second principal town in Kaduna state after Kaduna and home to the Ahmadu Bello University, established in 1962 and a host to several other Federal Government Institutions like Federal Institute for Chemical and Leather Research, Nigerian College of Aviation Technology and Industrial Development Corporation. The population of Zaria is approximately 975,153 (National Population Comission, 2006). It is made up of two Local Government Councils, Zaria Local Government, consisting of two districts; Zaria walled city and Tudun Wada, and Sabon gari Local Government which consists of three districts; Sabon Gari, Samaru, and the Government Reservation Area (Olamdimeji and Ojibo, 2012).

3.2.1 The Climate of Zaria

The climate of the study area is a tropical savanna climate, with distinct wet and dry seasons (Aw climate Koppens classification). Zaria experiences six (6) months of rainy season and six (6) months of dry season. The rainy season is from May to late October, while the dry season is from early November to April, this is as a result of the interplay of the two dominant air masses within the region i.e. the tropical continental air masses (cT) and Tropical maritime air masses (mT) (Iguisi and Abubakar, 1998). Climate is an important factor that determines the form of any architecture. In Nigeria the Hausa live in northern Savannah type of climate (Moughtin, 1985).

The rainfall intensity is very high between the months of July and August. As a result though the environment is generally dry, crops are frequently lost through too much rain. It also results in rapid surface run-off, soil erosion and water-logging (Udo, 1970). Dry season is the period of harmattan: a transition period between the wet and the hot seasons. It is a period when there is little or no rainfall (Ati, 2002). Daytime temperatures fluctuate between 16 and 32 ºC in November with clear sky of sunshine hours of between 8.9 and 9.5 (DURP, 1979). December to January in Zaria is characterized by the suspension of fine dust particles in the air, due to Harmattan winds which cause surface turbulence. Visibility is poor, disrupting air navigation while sun's rays barely reach ground surface. This action reduces night temperatures to 14 ºC, with sunshine hours between 8.7 and 9.5. Daytime temperature may drop to 31 ºC, giving a variation of 17 ºC, and the highest in the year. This extreme diurnal temperature range is another characteristic of the Savanna type of climate (Areola *et al.*, 2006).

3.2.2 Natural Vegetation

Nigeria has six climatic zones (Bureau for Public Enterprises, 2003-2007); The Mangrove Swamp, Swamp Forest, Rain Forest, Guinea Savanna, Sudan Savanna and Sahel Savanna. The Sudan Savanna approximates in a belt from Latitude 8º north to Latitude 12º north of the Equator, in Nigeria (Anuforom and Okpara, 2004). This region definitely includes Zaria, which is located at latitude 11º 3' N and longitude 7º 25' E. The Sudan Savanna is typified by tall tropical 'savanna' grass (Ati, 2002); the elephant grass (Areola *et al*., 2006). Trees are scattered, typical of wet dry climate. This vegetation is mixed with scrubs and thorny bushes, adapting itself to the climatic rhythm of longer water-drought and shorter summer rain. They are mostly deciduous, shedding their leaves in the dry season to conserve water which would have been lost by transpiration; lying dormant and searching for ground water. Tallest trees in Zaria are the baobab, gingiya, palm and cotton trees (Anselem and Ojonigu, 2010).

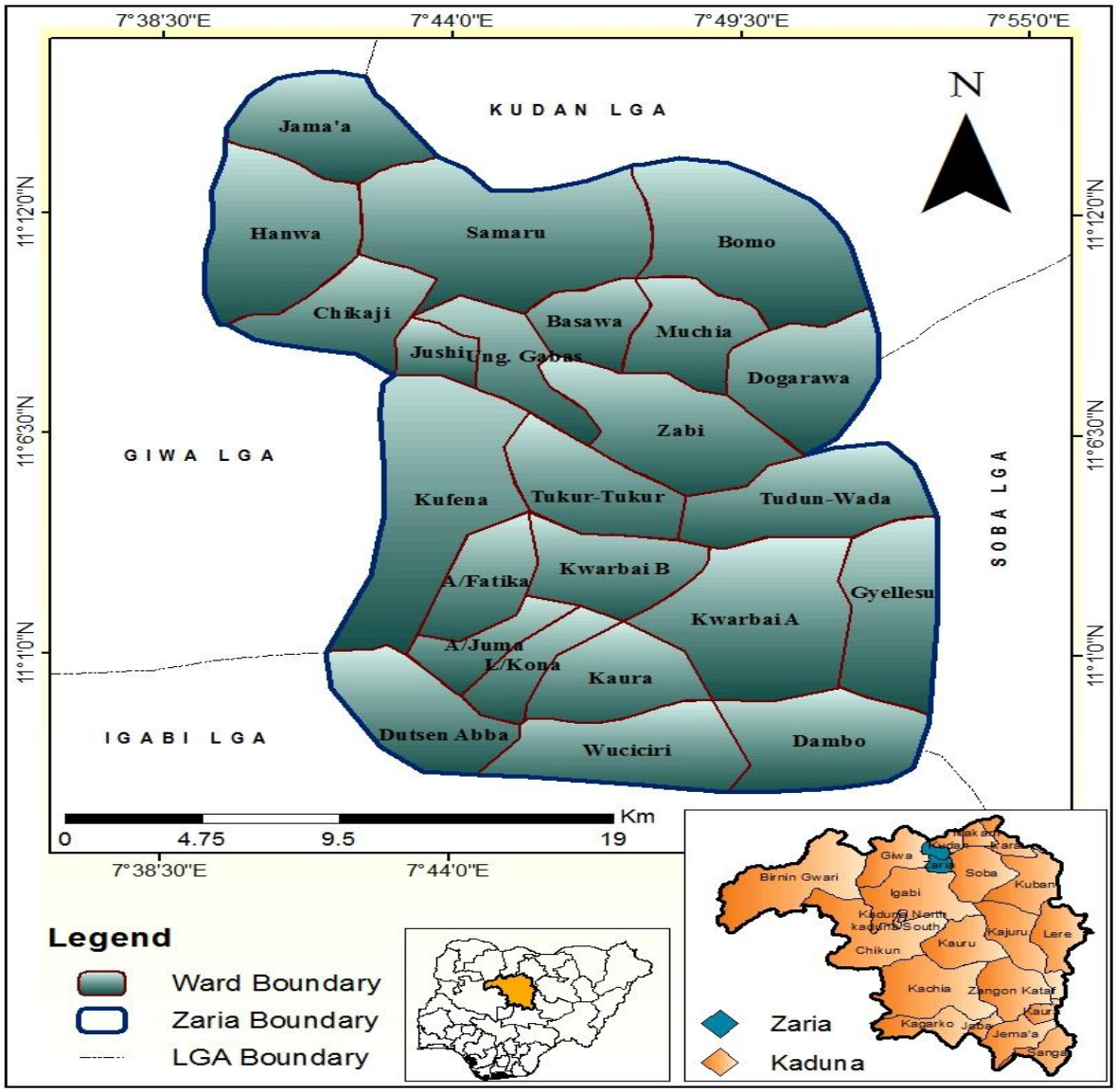


Fig 3.1: An administrative map of Nigeria showing the locations where the research was conducted

3.3 METHODOLOGY

3.3.1 Classification of Artisans

Data for the study were collected from the participants (different classes of artisans and non-artisans).

Finally, artisans involved craft and related trade workers that apply their specific knowledge and skills in their fields, which are classified into different classes that includes; mining and construction, form metal, erect metal structures, make, fit, maintain and repair machinery, equipment or tools, carry out printing work as well as produce textiles, or wooden, metal and other works.

This major group consists of the following sub-major groups:

i. Auto mechanic/Auto electricians, Metals and related workers.
ii. Brick layers, Building and Road construction workers and other related workers,
iii. Tailors, Fashion Designers and Embroiders and other related workers.
iv. Carpenters and relate wood workers.

The work is carried out by hand and by hand-powered and other tools which are used to reduce the amount of physical effort and time required for specific tasks, as well as to improve the quality of the products. The tasks call for an understanding of all stages of the production process, the materials and tools used, and the nature and purpose of the final product. Most occupations in this major group require skills at the second skill level (ISCO, 2013).

Occupational status is a promising measure of social position that can provide information about job characteristics, such as environmental and working conditions, decision-making latitude, and psychological demands of the job.

3.3.2 Assessment of Aggression and Anthropometric Parameters

Aggression was assessed using aggression Questionnaire (Buss and Perry, 1992) and each participant had the protocol explained to them and informed consent was taken from the participant to complete the Questionnaire before the study commenced. The AQ involved 29 items by means of which four subscales were categorized as: Anger Aggression (AA),

Physical aggression (PA), Hostility (HA), Verbal Aggression (VA).

i. Physical aggression having 9 items and yielding a minimum score of 9 points and maximum of 45 points when rated 1 or 5 on a five point scale, 1 being the extremely uncharacteristic and 5 extremely characteristics of the individual.

ii. Anger aggression has 7 items which will yield 7 points on minimum and 35 point on maximum.

iii. Hostility aggression also has its own items which are 8 items, when total will yield 8 – 40 points that is minimum to maximum (1-5) respectively.

iv. Verbal aggression has 5 items related to it and will yield 5 points and 25 points when rated on 1-5 point scale respectively.

3.3.3 Anthropometric Measurements

Relevant data was collected such as anthropometric measurements of individuals wearing light clothing and without shoes were obtained as described by Lohmen *et al.* (1998):

i. **Height:** Standing with bare feet, vertically in midline from heel to vertex (the topmost position of the head) to the nearest 0.1 cm.

ii. **Weight:** The subjects was barefooted and lightly dressed. Weight was taken to the nearest 0.1 kg.

iii. **Body mass index (BMI):** was calculated as weight divided by the square of the height (kg/m).

Plate I: Measurement of standing height (cm) and weight (kg)

iv. **2D:4D Ratio:** was obtained by measuring the length between the basal crease where the fingers join the palm and the tip of the fingers with the vernier caliper. The ratio will then be computed by dividing 2D by 4D

v. **Hand length:** Supine or sitting, at palmar surface, starting at last crease of wrist to tip of mid finger (3rd finger) of non-dominant hand.

vi. **Hand Breadth**: The breadth of hand was measured as straight distance from the most laterally placed point on the hand of 2^{nd} metacarpal to the most medially placed point located on the head of 5^{th} metacarpal

vii. **Foot length:** Supine or sitting, from the tip of heel at posterior to tip of first toe.

viii. **Foot Breadth:**The breadth of foot was measured as straight distance from the most laterally placed point on the foot of 5^{st} metacarpal to the most medially placed point located on the head of 1^{th} metacarpal.

ix. **Forearm length**: Supine or sitting with elbow extension. At palmar surface, starting at olecranon process of elbow to the prominent bone of wrist (styloid process) of non-dominant arm.

Plate II: Measurement of digit length (cm)

Plate III: Measurement of standing height (cm) and weight (kg)

Individual with a BMI of less than 20 were considered underweight; those with BMI in the range of 20-24.9 were considered normal, 25-29.9 over-weight, while those with BMI greater than 30 were considered obese (World Health Organisation, 2010).

3.4 ETHICAL APPROVAL

Ethical approval will be obtained from Ahmadu Bello University Teaching Hospital Health Research Ethics Committee and permission to conduct the study was obtained from the authorities of participating schools. Only subjects who gave informed consent to participate with the research were included in this study.

3.5 INCLUSION AND EXCLUSION CRITERIA

3.5.1 Inclusion Criteria

The following was used as inclusion criteria:

i. Subjects must be either artisan or non-artisans. Only subjects without injuries to the fingers were used.
ii. Subjects must be mentally and physically fit.
iii. Respondent must be between age 18 years old and above

3.5.2 Exclusion Criteria

The following was used as exclusion criteria:

i. Subject with physical deformities of hands; Subject with mental disorders
ii. Abnormalities that might affects our measured parameters;
iii. Subjects that are below the age of 18 years.
iv.

3.6 STATISTICAL ANALYSES

Data were expressed as mean ± standard deviation. Student's t-test was used to test for difference in mean of all variables between artisans and non-artisans groups. One way analysis of variance (ANOVA) was used to evaluate difference in anthropometric variables according to trade categories. Pearson's correlation coefficient was used to establish the relationship betweenmeasured anthropometric parameters and 2D:4D ratio. Linear regression was used to generate equations for predicting anthropometric variables from right and left 2D:4D ratio from certain variables.$P<0.05$ was deemed statistically significant and SPSS version 20 (IBM Corp., New York) and SigmaPlot version 13.0 were used for the statistical analyses.

CHAPTER FOUR

4.0 RESULTS

4.1 ANTHROPOMETRIC VARIABLES AND 2D:4D RATIO

Descriptive statistics of the entire sample population is shown on Table 4.1.The mean age and 2D:4D ratio of all the subjects are respectively (27.21±7.449) years and (0.983±0.089)for right and (0.983±0.081) for left hand ratios respectively. The mean 2D:4D ratio of artisan group are 0.98±0.09 and 0.98±0.08 for the right and left hand respectively, also the mean 2D:4D ratios of non-artisans are 0.98±0.09 and 0.98±0.09for right and left hand respectively. There is no statistically significant difference between right 2D:4D ratio of artisans and non-artisans group ($t = -0.03$, $p = 0.768$). Similar findings are seen in left 2D:4D ratios of artisans and non-artisan group ($t = 0.65$, $p = 0.515$).

There is statistically significant difference in all the measured anthropometric variables except right finger one and right finger three, left finger one, two and three, hand length and hand breadth respectively.

The Artisan groups scored higher in most of the anthropometric parameters than non-artisans except in right finger two to five, and left finger one to five, hand length and foot breadth respectively.

Table 4.1: Mean and standard deviation of the anthropometric parameters of all subjects (n=700 and for subjectsaccording to occupation (n = 548, Artisans and n= 152, non-artisans

Parameters	(All subjects, n= 700) Mean ± SD	Min - Max	(Artisans=548) Mean ± SD	Min – Max	(Non-Artisans n =152) Mean ± SD	Min - Max	t	p
Age (yrs.)	27.21±7.449	18.00-65.00	27.93±7.75	18.00-65.00	24.63±5.54	18.00-56.00	4.92	0.001
Height (cm)	169.89±0.976	120.00-197.00	170.36±0.10	120.00-197.00	168.38±0.11	120.00-191.00	2.21	0.028
Weight (kg)	67.20±11.660	42.00-98.00.	68.33±11.91	42.00-98.00	63.11±9.71	45.00-93.00	4.97	0.001
Body mass index (kg/m^2)	23.38±4.400	12.88-67.36	23.64±4.40	12.88-67.36	22.47±4.22	15.12-36.33	2.89	0.004
Right Finger I(cm)	6.467±0.697	5.00-9.100	6.47±0.70	5.00-9.10	6.47±0.69	5.00-8.70	-0.11	0.916
Right Finger II (cm)	7.267±0.770	5.300-12.100	7.22±0.69	5.30-9.30	7.42±1.01	5.30-12.10	-2.77	0.006
Right Finger III (cm)	8.204±0.724	6.300-13.100	8.19±0.67	6.30-10.50	8.24±0.88	6.50-13.10	-0.78	0.436
Right Finger IV (cm)	7.422±0.763	5.20-12.900	7.39±0.72	5.20-12.9	7.55±0.89	5.60-10.90	-2.40	0.017
Right Finger V (cm)	6.121±0.693	4.780-10.000	6.07±0.60	4.78-8.40	6.30±0.94	5.00-10.00	-3.65	0.001
R2D:4D	0.983±0.089	0.667-1.500	0.98±0.09	0.67-1.50	0.98±0.09	0.81-1.43	-0.03	0.768
Left Finger I (cm)	6.479±0.700	5.00-10.300	6.45±0.67	5.00-9.60	6.57±0.80	5.00-10.30	-1.83	0.067
Left Finger II (cm)	7.310±0.739	5.300-10.800	7.29±0.68	5.30-9.20	7.40±0.93	5.30-10.80	-1.71	0.087
Left Finger III (cm)	8.286±0.766	6.400-13.900	8.28±0.70	6.40-10.50	8.32±0.97	6.40-13.90	-0.55	0.580
Left Finger IV (cm)	7.455±0.766	5.40-11.800	7.42±0.70	5.40-9.50	7.58±0.96	5.70-11.80	-2.27	0.023
Left Finger V (cm	6.154±0.736	4.100-10.300	6.11±0.62	4.78-8.20	6.30±1.05	4.10-10.30	-2.85	0.005
L2D:4D	0.983±0.081	1.000-1.000	0.98±0.08	1.00-1.00	0.98±0.09	1.00-1.00	0.65	0.515
Humeral length (cm)	32.779±4.631	18.000-45.000	33.04±4.38	19.00-45.00	31.86±5.34	18.00-42.00	2.79	0.005
Forearm length (cm)	29.182±4.136	15.50-45.00	29.37±4.11	15.5-45.0	28.50±4.17	18.00-45.00	2.28	0.023
Hand Length (cm)	20.230±2.785	9.300-30.00	20.18±2.83	9.30-30.00	20.40±2.62	10.50-29.10	-0.84	0.404
Hand Breadth (cm)	9.021±4.771	4.800-14.50	9.06±1.10	6.30-14.50	8.87±1.53	4.80-14.30	1.82	0.068
MUAC (cm)	28.997±4.770	12.00-42.00	29.47±4.49	15.00-42.00	27.30±5.35	12.00-39.00	5.03	0.001
Foot Length (cm)	25.74±2.69	9.60-30.00	25.96±2.38	9.60-29.80	24.96±3.50	11.70-30.00	4.05	0.001
Foot Breadth (cm)	9.99±1.283	6.30-18.30	9.90±1.06	6.30-12.50	10.29±1.86	7.50-18.30	-3.25	0.001

Table4.2 shows the comparison of mean anthropometric parameters across the trade categories and non-artisans group.

The mean height, right finger I, left finger I, humeral length, femoral length and foot length of automechanics are significantly higher than those of the other trade categories and non-artisans groups ($p<0.05$).

The mean weight, BMI, Left 2D:4D ratio, hand breadth, mid upper arm circumference (MUAC) are significantly higher in brick layers than the other trade categories and non-artisans groups ($p<0.05$) while the mean right finger III,right 2D:4D ratio are insignificantly higher in brick layers than the other trade categories and non-artisans group ($p> 0.05$).

The mean left finger II, left finger IV, left finger V and hand length of tailors are significantly higher than the other trade categories and the non-artisans groups ($p<0.05$). However, the mean right II, IV, V and foot breadth of non-artisans are significantly higher than the other trade categories ($p < 0.05$) while left finger III is insignificantly higher in non-artisans than the other trade categories.

The mean anthropometric parameters of carpenters scored the lowest anthropometric measurements than the other trade categories and non-artisans group.

Similar anthropometric variables were seen in left finger two, left finger four and left finger five of tailors and non-artisans which were all statistically significant.

The mean 2D:4D ratio of both the left and right hand of artisans are insignificantly higher than the non-artisans ($p>0.05$).

Table 4.2. Comparison of mean anthropometric parameters across the trade categories and non-artisans group.

Trade Categories	Automechanics, n=164		Brick layers, n= 163		Tailors, n= 110		Carpenters, n= 111		Non-Artisansn= 152		
Parameters	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	P-value
Age (yrs.)	28.73±9.34[a]	18.0-65.0	28.00±6.192[be]	18.0-56.0	27.32±6.90[ce]	18.0-61.0	27.26±8.00[de]	18.0-63.0	24.63±5.54[abce]	18.0-56.0	0.001
Height (cm)	172±8.34[a]	120-192	169.86±1.00	148-192	169±0.097[ac]	145-197	170±0.095	144-189	168.38±10.76[ae]	120-191	0.009
Weight (kg)	68.79±11.74[a]	45.0-97.0	70.53±12.284[b]	42.0-95.0	65.04±10.43[bc]	47.0-95.0	67.65±12.29[d]	44.00-98.00	63.11±9.71[abde]	45.0-93.0	0.001
Body mass index (kg/m^2)	23.35±4.81	16.28-67.36	24.51±4.202[b]	15.36-24.51	23.04±3.961	12.88-33.29	23.38±4.351	16.76-40.09	22.47±4.22[be]	15.12-36.33	0.001
Right Finger I (cm)	6.65±0.618[a]	5.0-8.00	6.21±0.704[ab]	5.0-8.30	6.55±0.710[bc]	5.2-9.1	6.48±0.696[bd]	5.10-8.20	6.27±0.691[be]	5.00-8.70	0.001
Right Finger II (cm)	7.22±0.547	5.8-9.3	7.14±0.747[b]	5.3-9.30	7.31±0.729	5.7-9.0	7.26±0.726	5.30-8.80	7.42±1.008[be]	5.30-8.50	0.027
Right Finger III (cm)	8.12±0.546	6.9-9.7	8.24±0.656	6.9-9.80	8.21±0.732	6.5-10.5	8.21±0.796	6.3-10.50	8.24±0.884	6.50-13.10	0.507
Right Finger IV (cm)	7.43±0.530	5.90-8.59	7.204±0.683[b]	5.2-9.30	7.54±0.811[bc]	5.9-9.2	7.43±0.856	5.00-12.90	7.55±0.896[be]	5.60-10.90	0.001
Right Finger V (cm)	6.05±0.449[a]	5.00-7.43	5.97±0.595[b]	5.0-8.40	6.25±0.651[bc]	4.78-7.90	6.07±0.700	5.00-7.80	6.30±0.941[abe]	5.00-10.00	0.001
R2D:4D	0.97±0.066	0.77-1.27	0.997±0.108	0.74-1.50	0.97±0.095	0.69-1.45	0.98±0.082	0.67-1.35	0.98±0.093	0.81-1.429	0.147
Left Finger I (cm)	6.60±0.569[a]	5.20-7.85	6.22±0.658[ab]	5.0-8.10	6.55±0.693[bc]	5.10-9.60	6.49±0.705[bc]	5.00-8.00	6.57±0.802[be]	5.00-10.300	0.001
Left Finger II (cm)	7.32±0.571	5.30-8.60	7.17±0.730	5.3-9.00	7.40±0.694	5.70-9.20	7.28±0.697	5.30-9.00	7.40±0.932	5.30-10.80	0.042
Left Finger III (cm)	8.26±0.602	6.50-9.50	8.29±0.689	6.7-9.80	8.31±0.750	6.4-10.5	8.25±0.804	6.40-10.40	8.32±0.968	6.40-13.90	0.936
Left Finger IV (cm)	7.53±0.602[a]	5.40-8.80	7.18±0.678[ab]	5.4-9.01	7.58±0.717[bc]	5.90-9.30	7.46±0.763[bc]	5.90-9.50	7.58±0.958[be]	5.70-11.800	0.001
Left Finger V (cm)	6.13±0.455	5.00-7.40	5.97±0.634[b]	4.89-8.20	6.30±0.673[bc]	4.78-7.90	6.12±0.695	5.00-7.60	6.30±1.048[be]	4.10-10.300	0.001
L2D:4D	0.98±0.063[a]	1.00-1.00	1.00±0.104[ab]	1.00-1.00	0.98±0.063	1.00-1.00	0.98±0.072	1.00-1.00	0.98±0.087	1.00-1.000	0.015
Humeral length (cm)	34.81±3.187[a]	22.0-41.0	31.72±4.216[ab]	20.0-45.0	32.26±5.029[ac]	19.0-40.0	33.05±4.57[ad]	19.00-44.00	31.86±5.343[ae]	18.00-42.00	0.001
Forearm length (cm)	30.05±2.921[a]	18.3-39.1	29.75±4.541[bc]	18.8-45.0	28.25±4.451[ac]	16.5-42.1	28.82±4.272	15.50-39.00	28.51±4.173[ae]	18.00-45.00	0.001
Hand Length (cm)	19.88±1.491[a]	14.5-26.7	20.11±3.498[b]	9.5-29.9	20.91±2.962[ac]	10.0-29.5	20.02±3.019	9.30-30.00[cd]	20.40±2.62	10.50-29.10	0.032
Hand Breadth (cm)	8.99±0.870	7.43-12.0	9.34±1.002[b]	9.01-12.00	8.88±1.101[bc]	6.50-13.00	8.94±1.291	6.30-14.50	8.87±1.534[be]	6.30-11.10	0.002
MUAC (cm)	29.76±3.693[a]	20.0-40.0	30.42±5.017[b]	19.0-39.0	28.00±4.45[abc]	18.00-42.00	29.09±4.393[d]	15.0-39.00	27.30±5.35[abde]	12.00-39.00	0.001
Foot Length (cm)	26.47±1.865[a]	19.0-29.8	26.00±2.312[b]	9.6-29.4	25.43±2.762[ac]	12.1-29.50	25.62±2.613	18.4-29.50	25.00±3.504[abe]	11.70-30.00	0.001
Foot Breadth (cm)	9.99±0.916	7.34-12.5	9.94±1.058	6.80-12.2	9.72±1.064[c]	6.30-12.30	9.93±1.217	6.50-12.50	10.29±1.862[ce]	7.50-18.30	0.009

One way analysis of variance (ANOVA) shows statistically significant differences among different trade categories and the non-artisans group as indicated by the letters superscript a, b, c, d and e respectively using a post hoc test.

Table 4.3 shows the mean and standard deviations of different subscales of aggression of overall arisans and non-artisans, on the average the mean value of anger, physical hostility, verbal and total aggression of non-artisans is significantly higher than the artisans group except in verbal aggression, which is insignificant.

Table 4.4. Shows the descriptive statistics of different sub-classes of aggression of the overall population according to trade categories, on the average automechanics tends to have significantly higher mean value of anger, verbal and total aggression than the other trade categories and non-artisans, while non-artisans on average have higher mean values of physical aggression and hostility than the other trade categories.

Table 4.3: Mean and standard deviation of different subscales of aggression of the overall artisans and non-artisans.

	No of all subjects, (n= 700)		(Artisans=548)		(Non-Artisans n =152)			
Parameters	Mean ± SD	Min - Max	Mean ± SD	Min – Max	Mean ± SD	Min - Max	t	p
Anger	18.07±5.154	7.0-33.0	17.74±5.146	7.0-33.0	19.27±5.02	10.0-30.0	-3.258	0.001
Physical Aggression	21.72±6.682	9.0-41.0	21.25±6.639	9.0-41.0	23.43±6.580	9.0-41.0	-3.599	0.000
Hostility	21.55±5.120	8.0-35.0.	21.12±5.141	8.0-35.0	23.11±4.745	12.0-35.0	-4.289	0.000
Verbal Aggression	14.34±4.408	5.0-25.0	14.24±4.369	5.0-25.0	14.72±4.540	5.0-24.0	-1.183	0.237
Total Aggression	75.69±16.842	32.0-130.0	74.34±16.708	32.0-130.0	80.53±16.483	44.0-124.0	-4.047	0.000

Table 4.4: Comparism of different subscales of aggression according to trade categories and non-artisan group.

Trade Categories	Auto mechanics, n=164		Brick layers, n= 163		Tailors, n= 110		Carpenters, n= 111		Non-Artisans= 152		
Parameters	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	P-value
Anger	19.53±5.11[a]	7.0-33.0	16.89±5.23[ab]	7.0-29.0	16.62±4.52[ac]	7.0-28.0	17.46±5.02[ad]	7.0-33.0	19.27±5.02[bcde]	10.0-30.0	0.000
Physical Aggression	23.37±6.889[a]	9.0-41.0	19.95±6.44[ab]	9.0-41.0	20.67±6.50[ac]	9.0-40.0	20.59±6.00[ac]	9.0-37.0	23.43±6.580[bcde]	9.0-41.0	0.000
Hostility	22.52±5.83[a]	8.0-35.0	20.04±4.39[ab]	8.0-32.0	20.92±5.220[c]	9.0-32.0	20.83±4.59[d]	8.0-33.0	23.11±4.75[bcde]	12.0-35.0	0.000
Verbal Aggression	15.57±4.17[a]	5.0-25.0	13.23±4.76[ab]	5.0-24.0	14.15±3.94	6.0-23.0	13.85±4.01[ad]	5.0-23.0	14.72±4.54[be]	5.0-24.0	0.000
Total Aggression	80.99±17.120[a]	37.0-130.0	70.10±16.287[ab]	34.0-110.0	72.35±15.279[ac]	32.0-108.0	72.0±15.261[ad]	39.0-111.0	80.53±16.483[bcde]	44.0-124.0	0.000

One way analysis of variance (ANOVA) shows statistically significant differences among different trade categories and the non-artisans group as indicated by the letters superscript a, b, c, d and e respectively using post hoc test.

(Figure 4.1). The mean right 2D:4D ratio of bricklayers is insignificantly higher than the other trade categories and non-artisans respectively ($p > 0.05$).

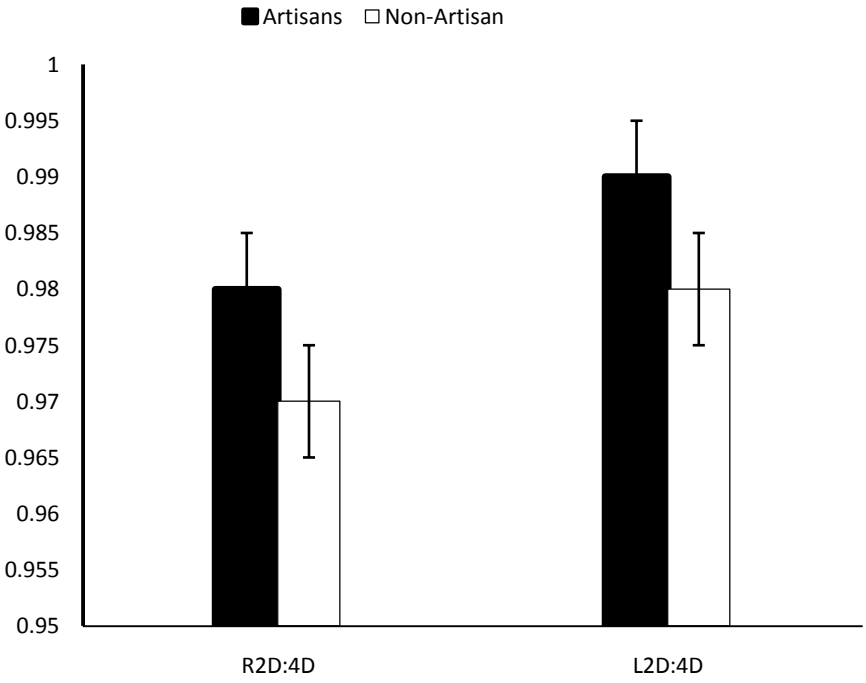


Figure. 4.1. 2D:4D ratio of artisans (black) and non-artisans (white).

Figure 4.2 shows that mean left 2D:4D ratio of bricklayers is higher than the other trade categories and non-artisans group which is significant only in auto-mechanics and bricklayers.

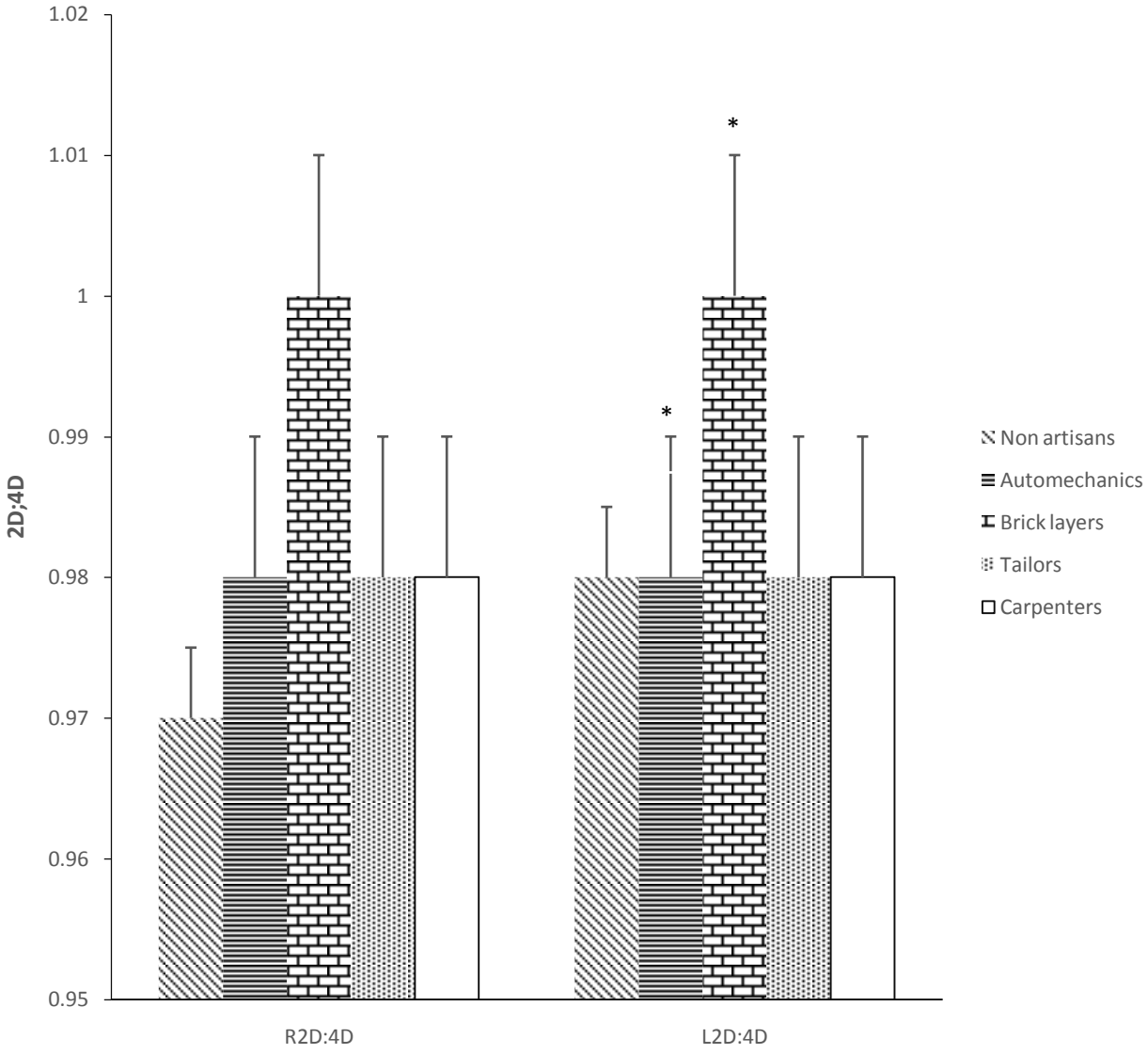


Fig 4.2: Right and left 2D:4D ratio (in non-artisans and artisans of different trade categories).

*Level of significance

4.2 CORRELATION BETWEEN ANTHROPOMETRIC VARIABLES

Table 4.5showed the overall correlation matrix of the studied subjects and their anthropometric characteristics. Pearson's correlation coefficient was used to correlate 2D:4D ratio to the other parameters. Ninety nine percent (99 %) of the parameters correlated at $p < 0.01$ and $p < 0.05$.The right 2D:4D ratio correlated weakly and inversely with height though is not statistically significant ($r = -0.049$, $p > 0.05$). Also a weak positive correlation was seen between weight and right 2D:4D ratio though was not statistically significant ($r = 0.016$, $p > 0.05$).

Table 4.6 showed the overall correlation matrix based on trade categories. The right 2D:4D ratio of the artisan groups correlated weakly and positively with height ($r = 0.012$, $p> 0.05$). Also a weak positive and insignificant correlation was observed between right 2D:4D ratio of the artisan group with weight ($r = 0.043$, $p > 0.05$). Similarly a weak positive and insignificant correlation was observed between right 2D:4D ratio with BMI ($r = 0.054$, $p > 0.05$).

The left 2D:4D ratio of the artisan groups correlated inversely and weakly with height ($r = -0.042$, $p > 0.05$). However, positive weak correlations were observed between left 2D:4D ratio of artisan group with weight ($r = 0.029$, $p > 0.05$) and BMI ($r = 0.053$, $p > 0.05$) respectively.

Furthermore on the non-artisan group a weak inverse correlation was observed between right 2D:4D ratio and height ($r = -0.157$, $p > 0.05$), weight ($r = -0.081$, $p > 0.05$),while positive correlation was observed between right 2D:4D and BMI ($r = 0.048$, $p > 0.05$).

Strong positive correlation was observed between right 2D:4D ratio of non-artisan group and left 2D:4D ratio of artisan group ($r = 0.731$, $p < 0.01$) and vice versa ($r = 0.680$, $p < 0.01$) which were all statistically significant.

Table 4.5: Correlation matrix of 2D:4D and anthropometric characteristics of artisans and non-artisans Groups n=700

	Age	HT	WT	BMI	RFI	RFII	RFIII	RFIV	RFV	R2D:4D	LFI	LFII	LFIII	LFIV	LFV	L2D:4D	HRL	FRL	HL	HB	MUAC	FL	FB
Age	-	0.103**	0.310**	0.212**	0.089*	-0.009	-0.028	-0.049	-0.016	0.042	0.081*	0.008	-0.029	-0.005	-0.001	0.020	0.139**	0.102**	-0.008	0.016	0.175**	0.137**	0-0.014
HT		-	0.317**	-0.378**	0.307**	0.206**	0.200**	0.260**	0.167**	-0.049	0.299**	0.265**	0.236**	0.311**	0.200**	-0.065	0.406**	0.166**	0.008	0.185**	0.150**	0.292**	0.192**
WT			-	0.738**	0.117**	0.056	0.111**	0.044	-0.017	0.016	0.111**	0.089*	0.132**	0.085*	0.007	0.000	0.216**	0.274**	0.025	0.253**	0.428**	0.314**	0.169**
BMI				-	-0.068	-0.065	-0.008	-0.114**	-0.114**	0.051	-0.076*	0.077	0.015	0.108**	-0.114**	0.041	-0.058	0.160**	0.024	0.131**	0.310**	0.099**	0.037
RFI					-	0.536**	0.458**	0.511**	0.501**	0.058	0.790**	0.551**	0.466**	0.582**	0.481**	-0.047	0.293**	0.041	0.091*	0.131**	-0.035	0.162**	0.239**
RFII						-	0.657**	0.631**	0.520**	0.471**	0.655**	0.861**	0.590**	0.565**	0.516**	0.388**	0.101**	0.135**	0.211**	0.079*	0.041	0.076*	0.243**
RFIII							-	0.677**	0.523**	0.026	0.471**	0.713**	0.888**	0.672**	0.503**	0.062	0.136**	0.199**	0.348**	0.232**	0.115**	0.259**	0.259**
RFIV								-	0.614**	-0.373**	0.544**	0.681**	0.659**	0.848**	0.610**	-0.213**	0.212**	0.083*	0.198**	0.077*	-0.019	0.146**	0.155**
RFV									-	-0.095*	0.509**	0.486**	0.469**	0.597**	0.886**	-0.139**	-0.075*	-0.248**	0.291**	0.146**	-0.273**	-0.037	0.236**
R2D:4D										-	0.148**	0.254**	-0.034	0.292**	-0.102**	0.718**	-0.109**	0.087*	0.026	0.029	0.087*	-0.048	0.115**
LFI											-	0.680**	0.476**	0.589**	0.528**	0.113**	0.275**	0.067	0.148**	0.047	-0.028	0.102**	0.213**
LFII												-	0.720**	0.699**	0.527**	0.389**	0.242**	0.221**	0.176**	0.130**	0.109**	0.210**	0.243**
LFIII													-	0.736**	0.497**	-0.011	0.220**	0.246**	0.321**	0.256**	0.146**	0.329**	0.259**
LFIV														-	0.644**	-0.381**	0.329**	0.126**	0.191**	0.118**	0.002	0.265**	0.228**
LFV															-	-0.145**	0.005	-0.202**	0.264**	0.082*	-0.238**	0.011	0.198**
L2D:4D																-	-0.107**	0.132**	-0.004	0.004	0.146**	-0.066	0.013
HRL																	-	0.509**	-0.133**	0.076*	0.419**	0.465**	0.093*
FRL																		-	-0.069	0.173**	0.634**	0.423**	0.123**
HL																			-	0.233**	-0.042	0.015	.209**
HB																				-	0.230**	0.287**	0.380**
MUAC																					-	0.367**	0.115**
FL																						-	0.233**
FB																							-

*HT=height, WT=weight, BMI=body mass index, RFI=right finger I, RFII=right finger II, RFIII=right finger III, RFIV=right finger IV, RFV=right finger V, R2D:4D= right second digit to fourth digit ratio, LFI= left finger I, LFII= left finger II, LFIII= left finger III, LFIV= left finger IV, LFV=left finger V, L2D:4D=left second digit to fourth digit ratio, FT=foot length, HRL=humeral length, FRL=forearm length, HL=hand length, HB=hand breadth, MUAC=mid upper arm circumference, FT=foot length, FB=foot breadth **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed)*

Table 4.6: Correlation matrix of 2D:4D and anthropometric characteristics of artisans (n = 548) and non-artisans (n = 152).

	AGE	HT	WT	BMI	RFI	RFII	RFIII	RFIV	RFV	R2D:4D	LFI	LFII	LFIII	LFIV	LFV	L2D:4D	HRL	FRL	HL	HB	MUAC	FL	FB
AGE	-	0.100*	0.296**	0.211**	0.115**	0.043	-0.013	-0.012	0.057	0.055	0.136**	0.070	0.008	0.047	0.078	0.035	0.139**	0.113**	0.003	0.037	0.174**	0.157**	0.048
HT	0.053	-	0.340**	-0.333**	0.333**	0.257**	0.209**	0.272**	0.176**	-0.012	0.309**	0.282**	0.224**	0.309**	0.174**	-0.042	0.395**	0.220**	-0.028	0.230**	0.138**	0.338**	0.232**
WT	0.229**	0.196*	-	0.752**	0.166**	0.149**	0.152**	0.106*	0.064	0.042	0.189**	0.182**	0.191**	0.154**	0.104*	0.029	0.236**	0.282**	0.022	0.310**	0.413**	0.335**	0.249**
BMI	0.128	-0.590**	0.665**	-	-0.022	0.000	0.035	-0.056	-0.038	0.054	0.008	0.010	0.059	-0.032	0.001	0.053	-0.014	0.147**	0.044	0.172**	0.320**	0.106*	0.098*
RFI	-0.029	0.233**	-0.082	-0.240**	-	0.565**	0.431**	0.528**	0.512**	0.026	0.853**	0.564**	0.465**	0.607**	0.524**	-0.070	0.388**	0.088*	0.045	0.073	0.023	0.184**	0.211**
RFII	-0.100	0.135	-0.131	-0.198*	0.501**	-	0.665**	0.565**	0.378**	0.478**	0.578**	0.863**	0.629**	0.551**	0.398**	0.371**	0.254**	0.206**	0.099*	0.106*	0.196**	0.234**	0.244**
RFIII	-0.066	0.189*	00.016	-0.118	0.546**	0.648**	-	0.662**	0.472**	0.006	0.449**	0.674**	0.884**	0.614**	0.450**	0.069	0.167**	0.185**	0.293**	0.212**	0.169**	0.300**	0.221**
RFIV	-0.123	0.263**	-0.090	-0.255**	0.477**	0.756**	0.714**	-	0.535**	-0.439**	0.506**	0.613**	0.633**	0.842**	0.504**	-0.284**	0.296**	0.106*	0.132**	0.120**	0.055	0.236**	0.168**
RFV	-0.143	0.197*	-0.148	-0.261**	0.526**	0.728**	0.621**	0.760**	-	-0.180**	0.431**	0.356**	0.441**	0.557**	0.886**	-0.249**	-0.013	0.229**	0.235**	0.189**	-0.227**	0.050	0.177**
R2D:4D	0.000	-0.157	-0.081	0.048	0.174*	0.480**	0.080	-0.201*	0.079	-	0.069	0.274**	-0.006	0.323**	0.124**	0.731**	-0.046	0.123**	-0.033	-0.009	0.164**	0.004	0.066
LFI	-0.067	0.300**	-0.099	-0.315**	0.616**	0.816**	0.520**	0.624**	0.662**	0.379**	-	0.640**	0.500**	0.626**	0.480**	0.001	0.419**	0.143**	0.059	0.060	0.063	0.239**	0.191**
LFII	-0.161*	0.252**	-0.139	-0.292**	0.541**	0.857**	0.793**	0.823**	0.698**	0.211**	0.768**	-	0.694**	0.653**	0.404**	0.404**	0.348**	0.269**	0.075	0.133**	0.238**	0.309**	0.240**
LFIII	-0.152	0.276**	-0.018	-0.210**	0.489**	0.524**	0.898**	0.718**	0.522**	-0.107	0.425**	0.769**	-	0.681**	0.455**	0.011	0.220**	0.222**	0.283**	0.228**	0.210*	0.336**	0.266**
LFIV	-0.121	0.350**	-0.050	-0.291**	0.544**	0.581**	0.791**	0.861**	0.657**	-0.227**	0.504**	0.784**	0.844**	-	0.602**	-0.422**	0.392**	0.126**	0.121**	0.106*	0.060	0.291**	0.220**
LFV	-0.150	0.290**	-0.167*	-0.346**	0.444**	0.677**	0.601**	0.800**	0.886**	-0.069	0.625**	0.718**	0.570**	0.710**	-	-0.244**	0.049	-0.217**	0.226**	0.157**	-0.219**	0.115**	0.192**
L2D:4D	-0.071	-0.142	-0.143	-0.010	0.032	0.455**	0.049	-0.022	0.095	0.680**	0.431**	0.367**	-0.063	-0.286**	0.046	-	-0.048	0.183**	-0.042	0.012	0.222**	0.025	0.005
HRL	0.066	0.417**	0.086	-0.246**	0.022	-0.170*	0.080	0.051	-0.152	-0.287**	-0.048	0.042	0.233**	0.231**	-0.040	-0.280**	-	0.558**	-0.140**	0.010	0.391**	0.446**	0.213**
FRL	-0.031	-0.027	0.190*	0.174*	-0.127	0.006	0.255**	0.052	-0.277**	-0.032	-0.131	0.127	0.329**	0.160*	-0.164*	-0.042	0.356**	-	-0.107*	0.190**	0.680**	0.454**	0.229**
HL	-0.031	0.144	0.076	-0.038	0.269**	0.517**	0.527**	0.405**	0.455**	0.244**	0.435**	0.467**	0.446**	0.394**	0.379**	0.137	-0.100	0.091	-	0.183**	-0.031	0.036	0.093*
HB	-0.114	0.075	0.077	0.008	0.287**	0.052	0.278**	0.012	0.106	0.125	0.037	0.138	0.314**	0.158	-0.010	-0.020	0.193*	0.120	0.396**	-	0.257**	0.228**	0.314**
MUAC	0.043	0.135	0.411**	0.230**	-0.215**	-0.217**	0.016	-0.142	-0.314**	-0.124	-0.213**	-0.127	0.029	-0.072	-0.238	-0.074	0.454**	0.489**	-0.055	0.150	-	0.357**	0.261**
FL	-0.018	0.170*	0.212**	0.034	0.126	-0.142	0.204*	0.020	-0.120	-0.169	-0.140	0.068	0.338**	0.266**	-0.097	-0.288**	0.485**	0.347**	-0.022	0.370**	0.337**	-	0.283**
FB	-0.102	0.167*	0.107	-0.044	0.330**	0.220**	0.322**	0.114	0.284**	0.222**	0.243**	0.237**	0.252**	0.223**	0.183*	0.039	-0.068	-0.041	0.489**	0.509**	-0.060	0.221**	-

HT=*height, WT=weight, BMI=body mass index, RFI=right finger I, RFII=right finger II, RFIII=right finger III, RFIV=right finger IV, RFV=right finger V, R2D:4D= right second digit to fourth digit ratio, LFI= left finger I, LFII= finger II, LFIII= left finger III, LFIV= left finger IV, LFV=left finger V, L2D:4D=left second digit to fourth digit ratio, HRL=right humeral length, FRL=right forearm length, MUAC=mid upper arm circumference, HL=hand length, HB=hand breadth, FT=foot length, FT=foot breadth**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).*

4.3 LINEAR REGRESSION MODELS OF THE ANTHROPOMETRIC VARIABLES

Table 4.7shows derived equations that can be used in the estimation of some studied anthropometric measurements of the body in the overall population of artisans and non-artisans group using right 2D:4D ratio. The range of correlation coefficient was (0.0256–0.115). The foot breadth has the strongest predictions ability and lower standard error of estimate than all the other parameters.

Table 4.8 shows the equations that could be used in the estimation of some studied anthropometric measurements of the body in the overall population of artisans and non-artisans group using left 2D:4D ratio. The range of correlation coefficient was (0.00412–0.146).The MUAC has the strongest predictions ability and lower standard error of estimate than the other parametersindicating the strong estimation ability than other parameters.

Table 4.7 Linear regression equations for estimations ofsome studied anthropometric parameters using right 2D:4D ofartisans and non-artisans (n=700).

Parameters	Predictive Equations	R	R^2	SEE	F	P
Age (yrs)	R2D:4D = 0.969 + (0.001 * Age)	0.0423	0.002	0.013	1.252	0.264
HRL (cm)	R2D:4D = 1.052 - (0.002 * HRL)	0.109	0.012	0.024	8.345	0.004
FRL (cm)	R2D:4D = 0.927 + (0.002 * FRL)	0.087	0.008	0.024	5.336	0.021
HL (cm)	R2D:4D = 0.966 + (0.001 * HL)	0.026	0.001	0.025	0.456	0.500
HB (cm)	R2D:4D = 0.963 + (0.002 * HB)	0.029	0.001	0.029	0.596	0.440
MUAC (cm)	R2D:4D = 0.935 + (0.002 * MUAC)	0.087	0.008	0.021	5.311	0.021
FL (cm)	R2D:4D = 1.024 - (0.002 * FL)	0.048	0.002	0.033	1.615	0.204
FB (cm)	R2D:4D = 0.902 + (0.008 * FB)	0.115	0.013	0.027	9.398	0.002

*HT=height, WT=weight, BMI=body mass index, R2D:4D= right second digit to fourth digit ratio, FT=foot length, HRL=humeral length, FRL=forearm length, HL=hand length **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed)*

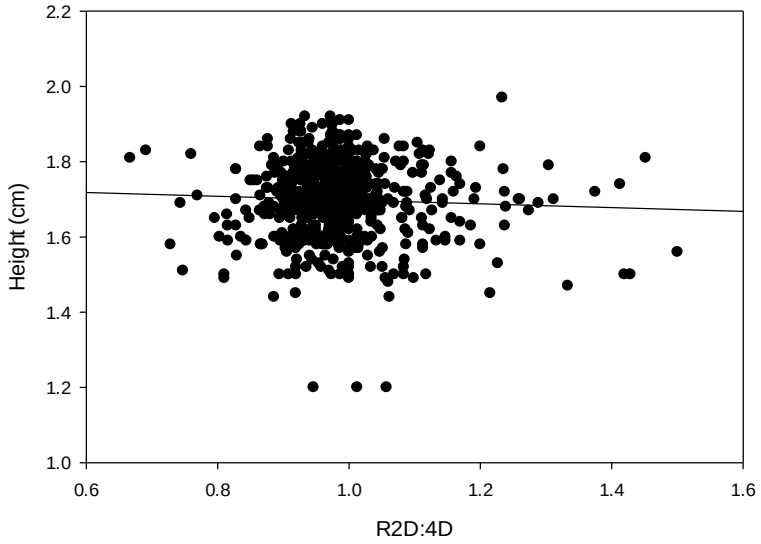
Table 4.8: Linear regression equations for estimations ofsome studied anthropometric parameters using left 2D:4D ofartisans and non-artisans (n=700).

Parameters	Predictive Equations	R	R^2	SEE	F	P
Age (yrs)	L2D:4D = 0.977 + (0.020 * Age)	0.020	0.000405	0.012	0.282	0.595
HRL (cm)	L2D:4D HRL = 1.045 - (0.002 * HRL)	0.107	0.012	0.022	8.086	0.005
FRL (cm)	L2D:4D = 0.908 + (0.003 * FRL)	0.132	0.018	0.022	12.422	0.001
HL (cm)	L2D:4D = 0.986 + (0.000 * HL)	0.004	0.0000170	0.023	0.012	0.913
HB (cm)	L2D:4D = 0.981 + (0.000 * HB)	0.004	0.0000180	0.024	0.013	0.911
MUAC (cm)	L2D:4D = 0.911 + (0.002 * MUAC)	0.146	0.0213	0.019	15.195	0.001
FL (cm)	L2D:4D = 1.035 - (0.002 * FL)	0.0660	0.00436	0.029	3.049	0.081
FB (cm)	L2D:4D = 0.975 + (0.001 * FB)	0.0133	0.000176	0.024	0.123	0.726

*HT=height, WT=weight, BMI=body mass index, R2D:4D= right second digit to fourth digit ratio, FT=foot length, HRL=humeral length, FRL=forearm length, HL=hand length **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).*

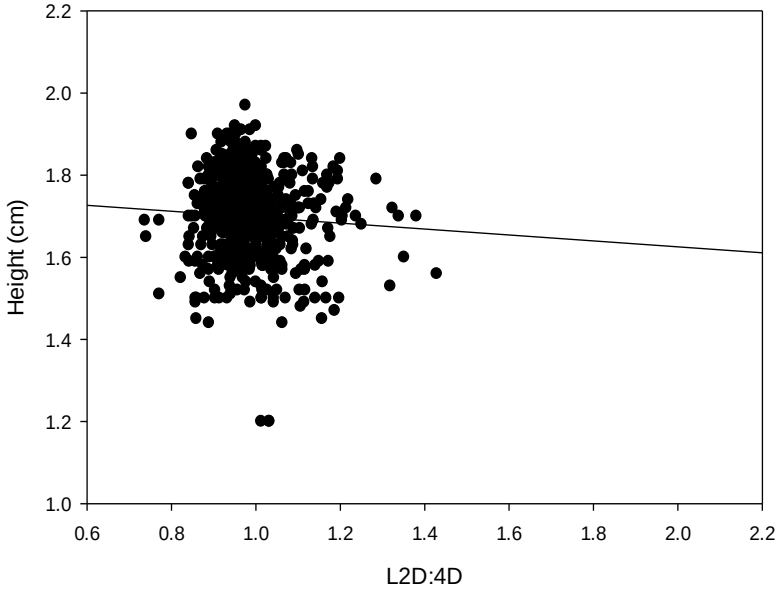
4.4 SCATTER DISGRAMS ANDREGRESSION LINES FOR ARTISANS AND NON-ARTISAN POPULATION GROUPS

The scatter diagrams and regression lines resulting from 2D:4D ratio interaction with height, weight and BMI are shown in figures4.3 to Figure 4.20. From the graph we can deduce that there is high predictive probability between height and all the body variables in bothartisans and non-artisan groups.



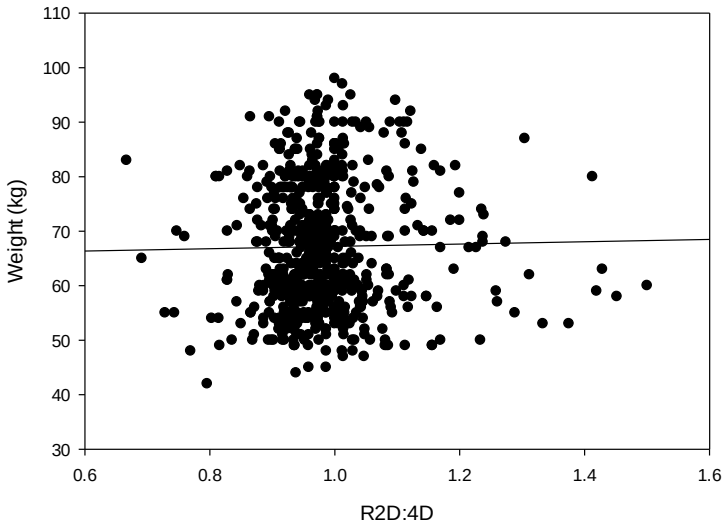
Height = 1.748 - (0.0498 * R2D:4D), R = 0.0460, R^2= 0.00211, SEE = 0.0410, P=0.225

Figure 4.3: Scatter diagram and regression line showing relationship between R2D:4D and height in artisans and non-artisans



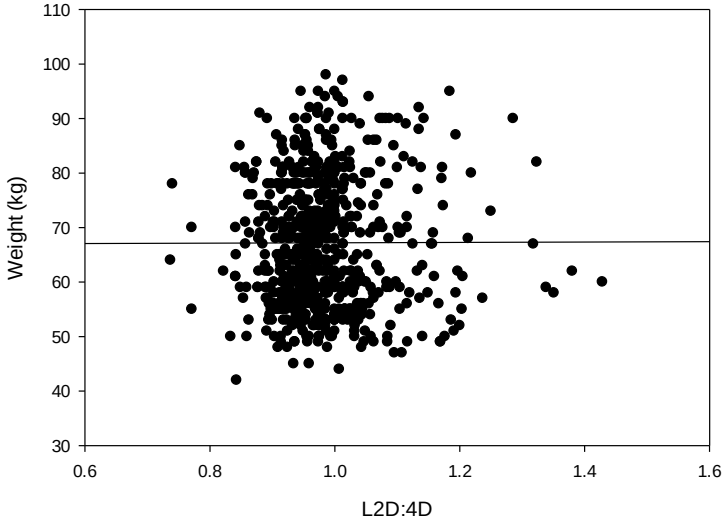
Height = 1.770 - (0.0722 * L2D:4D)
R = 0.0599, R^2= 0.00359, SEE = 0.0455, P=0.113

Figure 4.4: Scatter diagram and regression line showing relationship between L2D:4D and height in artisans and non-artisans



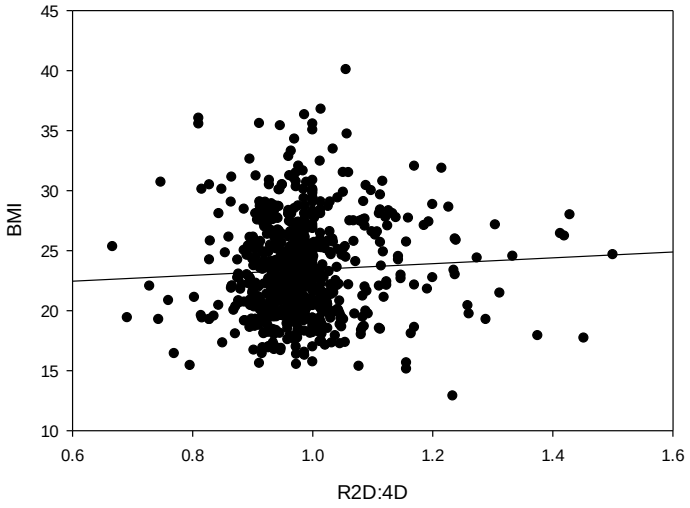
Weight = 65.090 + (2.140 * R2D:4D)
R = 0.0165, R^2= 0.000273, SEE = 4.899, P=0.662

Figure 4.5: Scatter diagram and regression line showing relationship between R2D:4D and weight in artisans and non-artisans



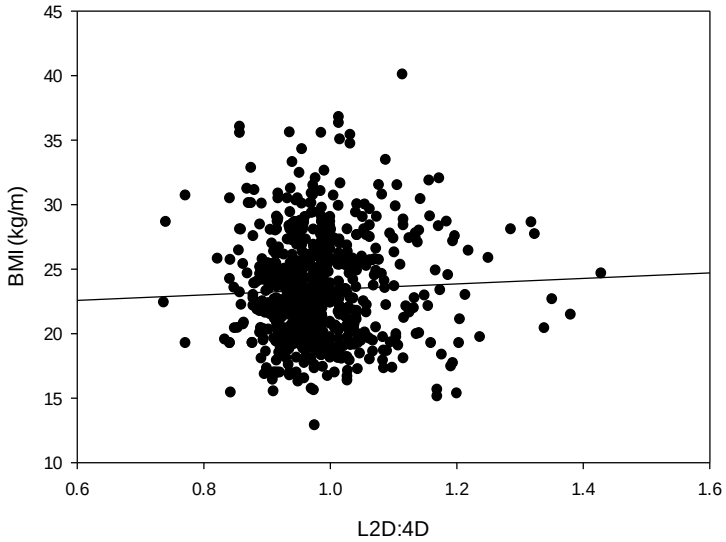
Weight = 66.881 + (0.342 * L2D:4D)
R = 0.00238, R^2= 0.00000566, SEE = 5.440, P=0.950

Figure 4.6: Scatter diagram and regression line showing relationship between L2D:4D and weight in artisans and non-artisans



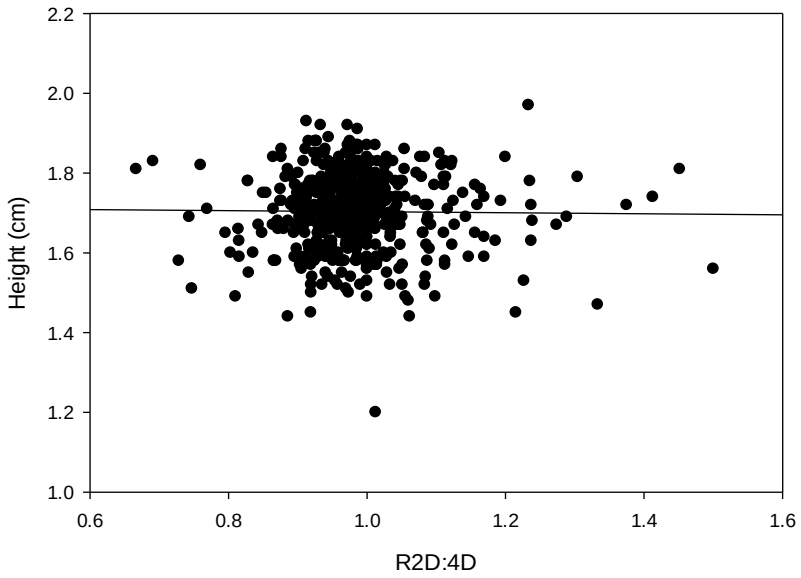
BMI = 20.996 + (2.429 * R2D:4D)
R = 0.0498, R^2= 0.00248, SEE = 1.843, P=0.188

Figure 4.7: Scatter diagram and regression line showing relationship between R2D:4D and BMI in artisans and non-artisans



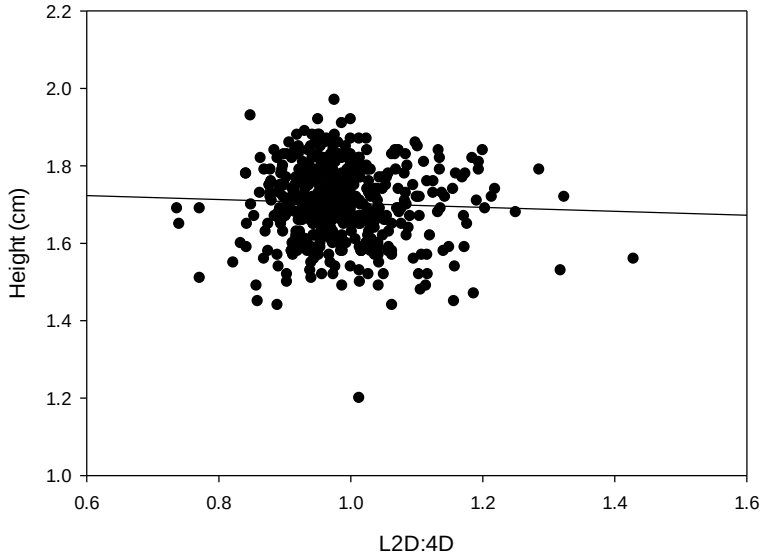
BMI = 21.288 + (2.137 * L2D:4D)
R = 0.0395, R^2 0.00156, SEE = 2.049, P=0.297

Figure 4.8: Scatter diagram and regression line showing relationship between L2D:4D and BMI in artisans and non-artisans



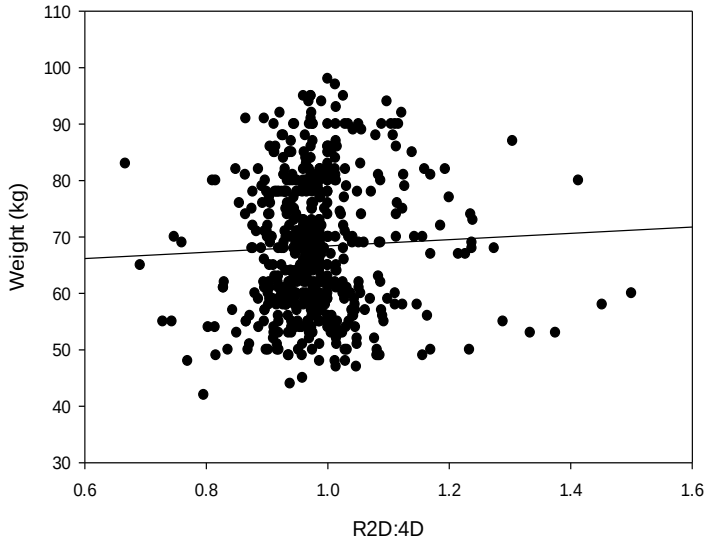
Height = 1.717 - (0.0132 * R2D:4D)
R = 0.0124, R^2= 0.000154, SEE = 0.0454, P=0.772

Figure 4.9: Scatter diagram and regression line showing relationship between R2D:4D and height in artisans group



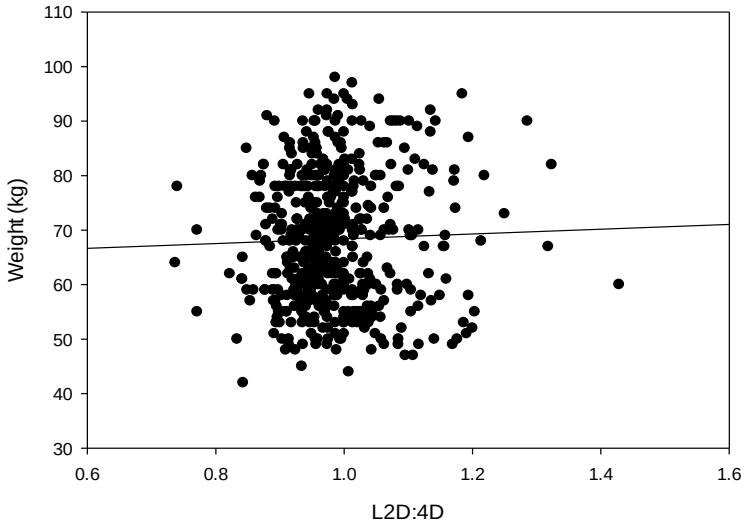
Height = 1.753 - (0.0505 * L2D:4D)
R = 0.0424, R^2= 0.00180, SEE 0.0509, P=0.322

Figure 4.10: Scatter diagram and regression line showing relationship between L2D:4D and height in artisans group



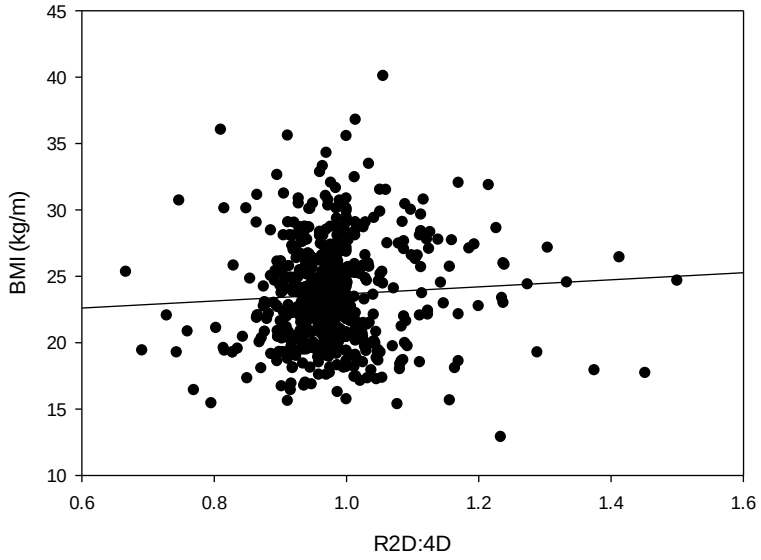
Weight = 62.865 + (5.566 * R2D:4D)
R = 0.0418, R^2 = 0.00174, SEE = 5.699, P=0.329

Figure 4.11: Scatter diagram and regression line showing relationship between R2D:4D and weight in artisans group.



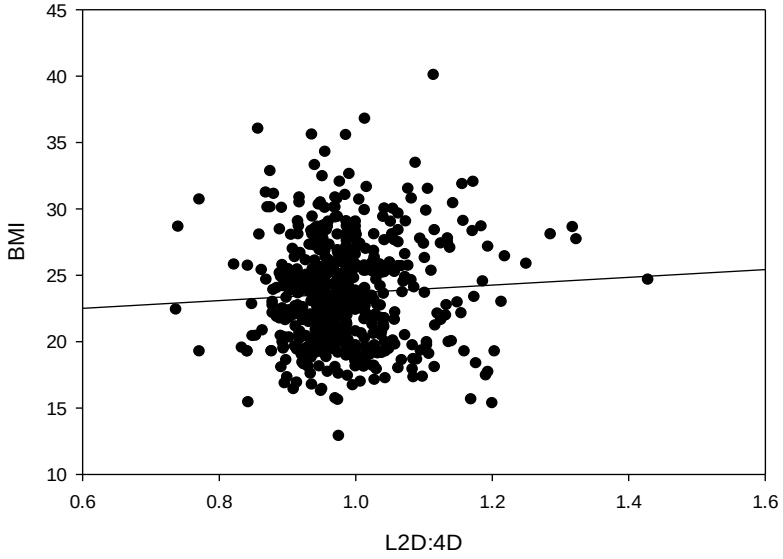
Weight = 64.036 + (4.398 * L2D:4D)
R = 0.0295, R^2=0.000868, SEE 6.393, P=0.492

Figure 4.12: Scatter diagram and regression line showing relationship between L2D:4D and weight in artisans group



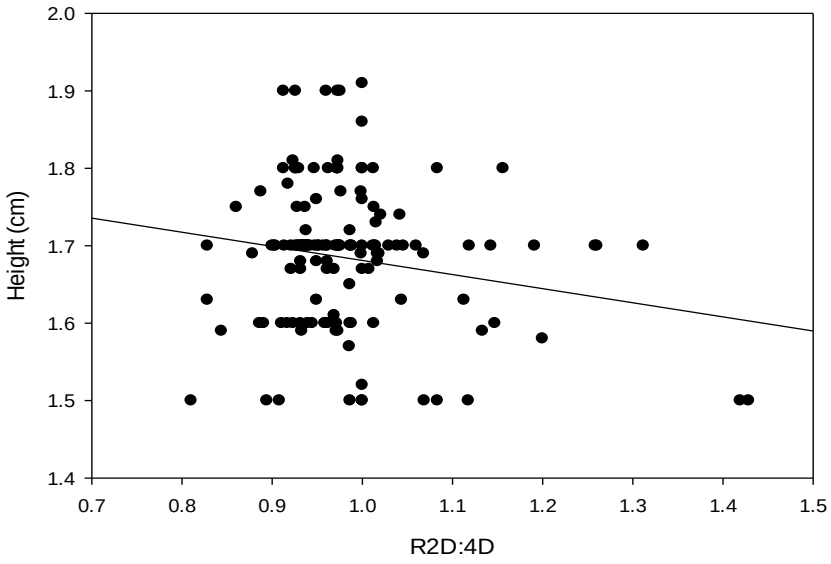
BMI = 21.005 + (2.668 * R2D:4D)
R = 0.0542, R^2= 0.00294, SEE = 2.104, P=0.205

Figure 4.13: Scatter diagram and regression line showing relationship between R2D:4D and BMI in artisans group



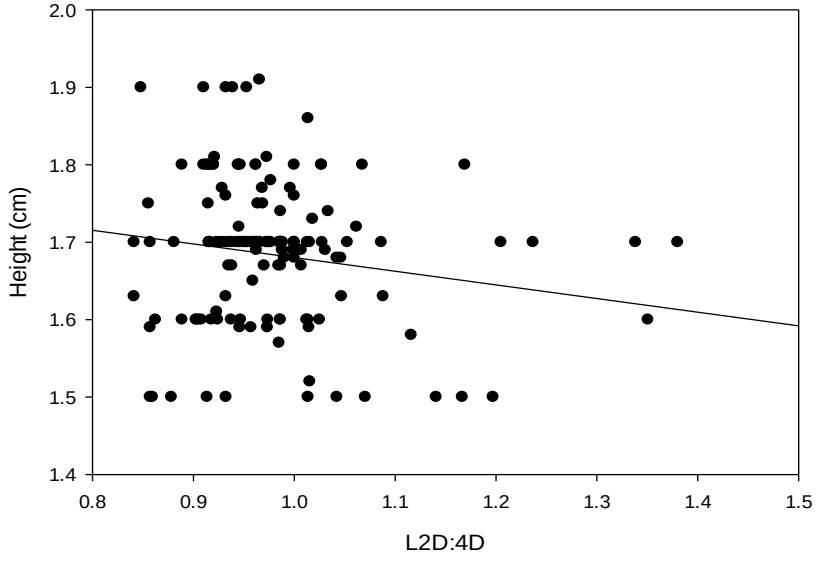
BMI = 20.754 + (2.926 * L2D:4D),
R = 0.0530, R^2= 0.00281, SEE 2.362, P=0.216

Figure 4.14: Scatter diagram and regression line showing relationship between L2D:4D and BMI in artisans group



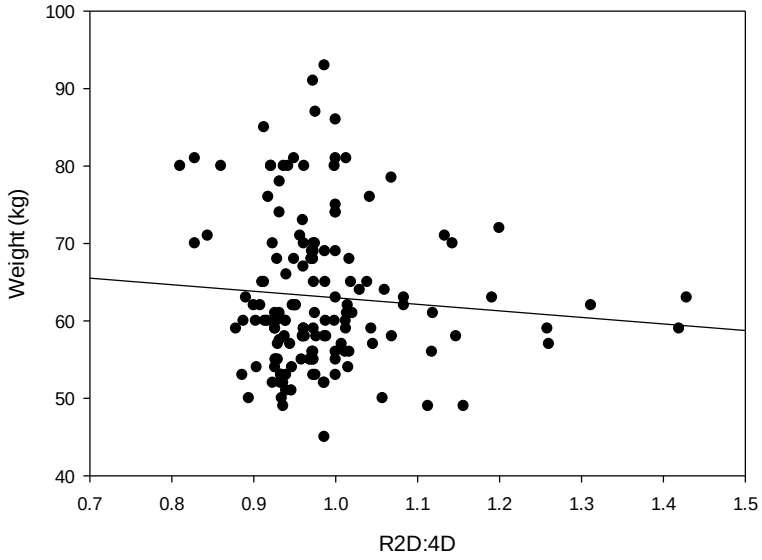
Height = 1.863 - (0.182 * R2D:4D)
R = 0.157, R^2= 0.0246, SEE = 0.0937, P=0.053

Figure 4.15: Scatter diagram and regression line showing relationship between R2D:4D and height in non-artisans group



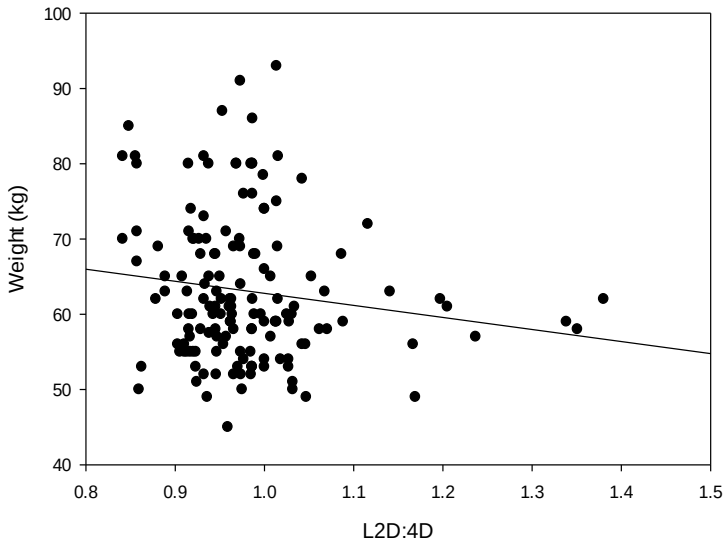
Height = 1.857 - (0.176 * L2D:4D)
R = 0.142, R^2= 0.0202, SEE 0.100, P=0.081

Figure 4.16: Scatter diagram and regression line showing relationship between L2D:4D and height in non-artisans group



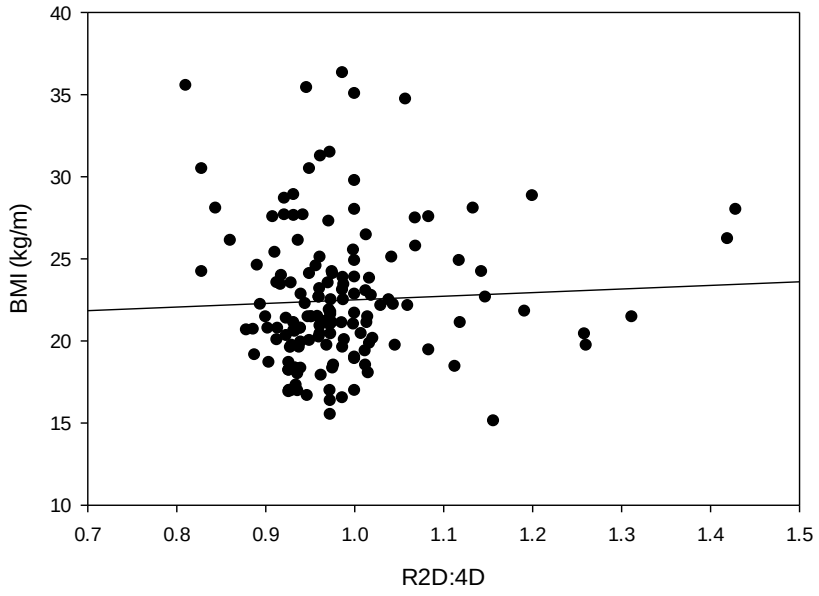
Weight = 71.430 - (8.450 * R2D:4D)
R = 0.0807, R^2= 0.00651, SEE = 8.525, P=0.323

Figure 4.17: Scatter diagram and regression line showing relationship between R2D:4D and weight in non-artisans group



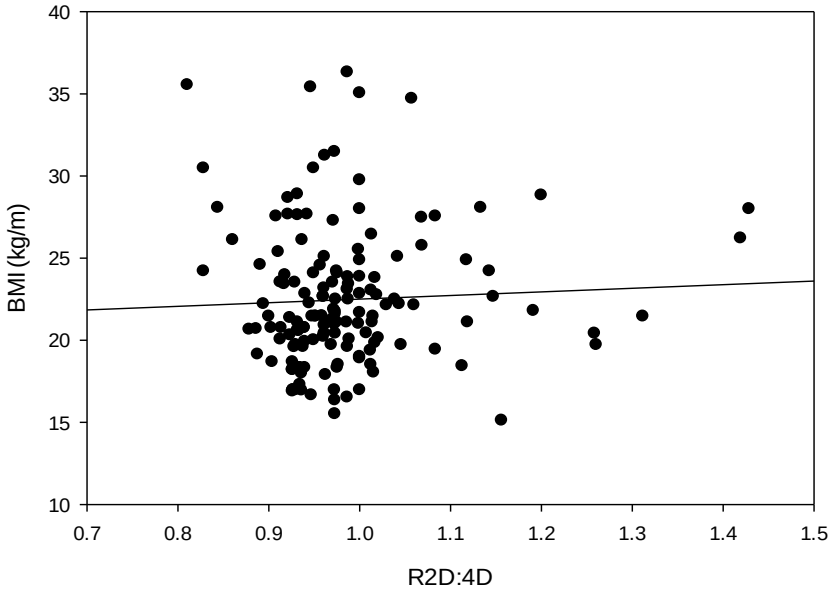
Weight = 78.822 - (16.038 * L2D:4D)
R = 0.143, R^2 = 0.0205, SEE 9.051, P = 0.078

Figure 4.18: Scatter diagram and regression line showing relationshipbetween L2D:4D and weight in non-artisans group



BMI = 20.305 + (2.199 * R2D:4D)
R = 0.0483, R^2 0.00233, SEE 3.716, P= 0.555

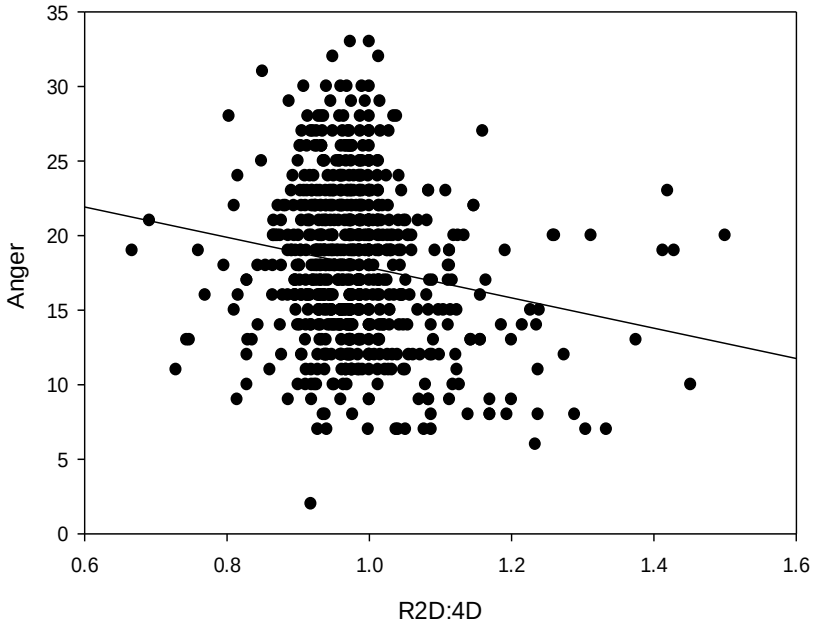
Figure 4.19: Scatter diagram and regression line showing relationship between R2D:4D and BMI in non-artisans group



BMI = 22.968 - (0.509 * L2D:4D)
R = 0.0104, R^2 0.000109, SEE 3.978, P=0.898

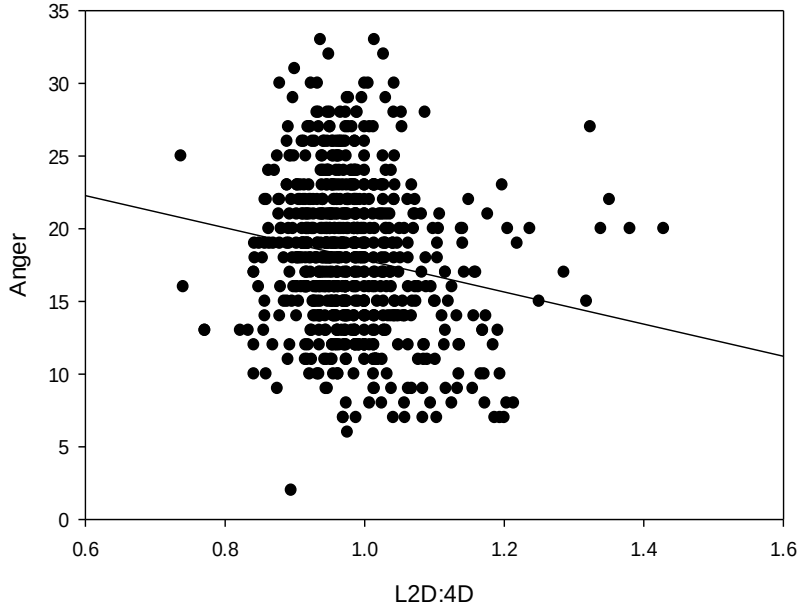
Figure 4.20: Scatter diagram and regression line showing relationship between L2D:4D and BMI in non-artisans group

Figure 4.21to Figure 4.44 showed the comparison of scatter diagram and regression line showing relationship between right and left 2D:4D ratio and aggression, from the graph it can be deduce that there is high predictive probability between right and left 2D:4D ratio with anger in the overall study population which where all statistically significant. Similar findings is seen in artisans group. However right 2D:4D have more predictive ability with anger and left 2D:4D with physical aggression in non-artisans group respectively.



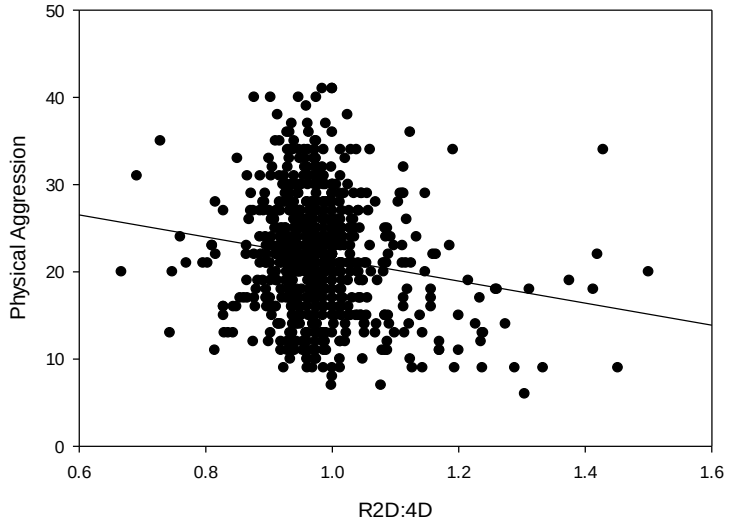
A = 28.026 - (10.172 * R2D:4D)
R = 0.176, R^2= 0.0311, SEE 2.148, P=0.001

Figure 4.21: Scatter diagram and regression line showing relationship between R2D:4D and Anger in artisans and non-artisans



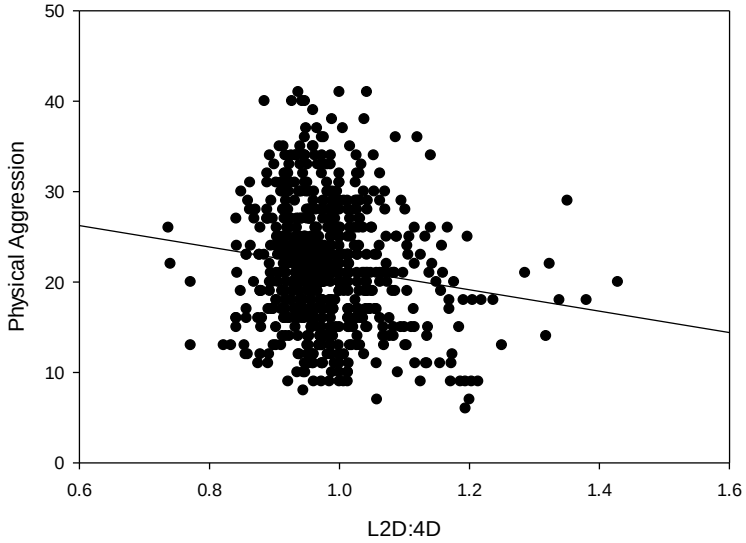
A = 28.923 - (11.060 * L2D:4D)
R = 0.173, R^2= 0.0300, SEE 2.384, P=0.001

Figure 4.22: Scatter diagram and regression line showing relationship between L2D:4D and anger in artisans and non-artisans



PA = 34.125 - (12.655 * R2D:4D)
R = 0.169, R^2= 0.0286, SEE = 2.790, P=0.001

Figure 4.23: Scatter diagram and regression line showing relationship between R2D:4D and Physical in artisans and non-artisans



PA = 33.349 - (11.839 * L2D:4D)
R = 0.143, $R^2$0.0204, SEE 3.111, P=0.001

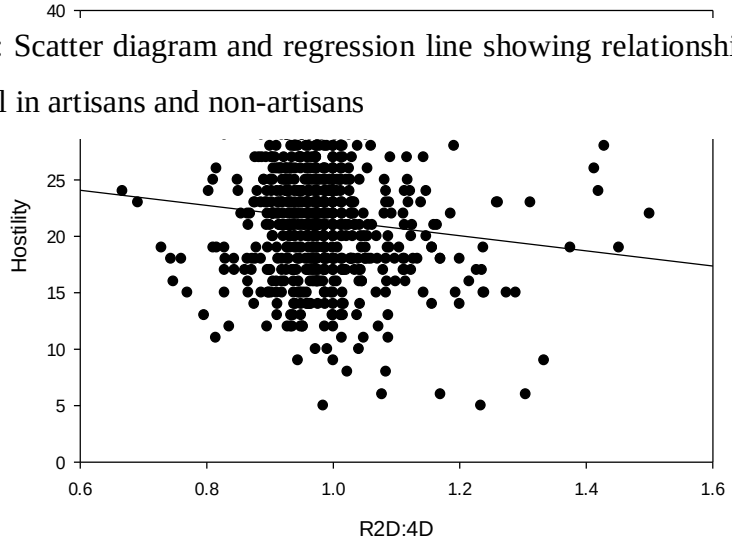
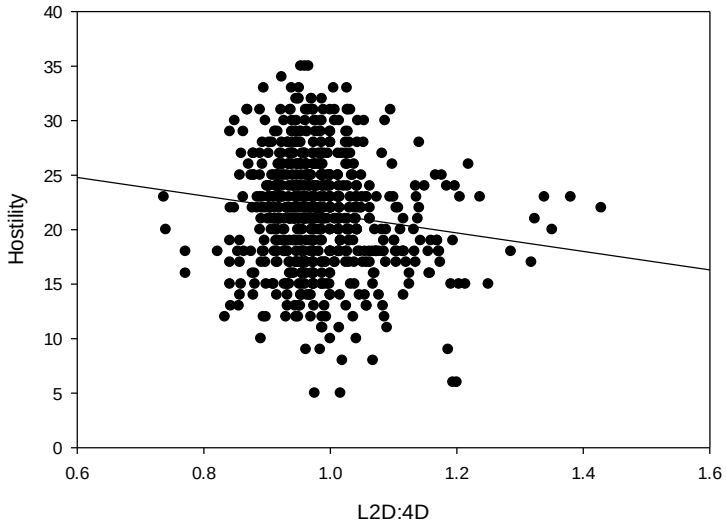


Figure 4.24: Scatter diagram and regression line showing relationship between L2D:4D and Physical in artisans and non-artisans

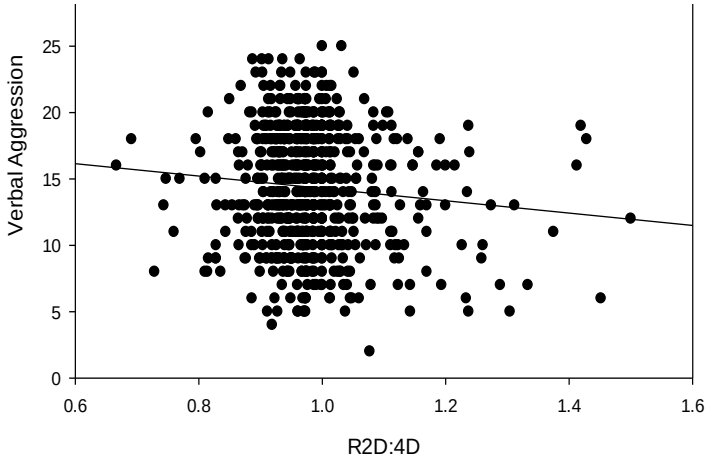
H = 28.102 - (6.700 * R2D:4D)
R = 0.116, R^2= 0.0135, SEE = 2.172, P=0.002

Figure 4.25: Scatter diagram and regression line showing relationship between R2D:4D and Hostility in artisans and non-artisans



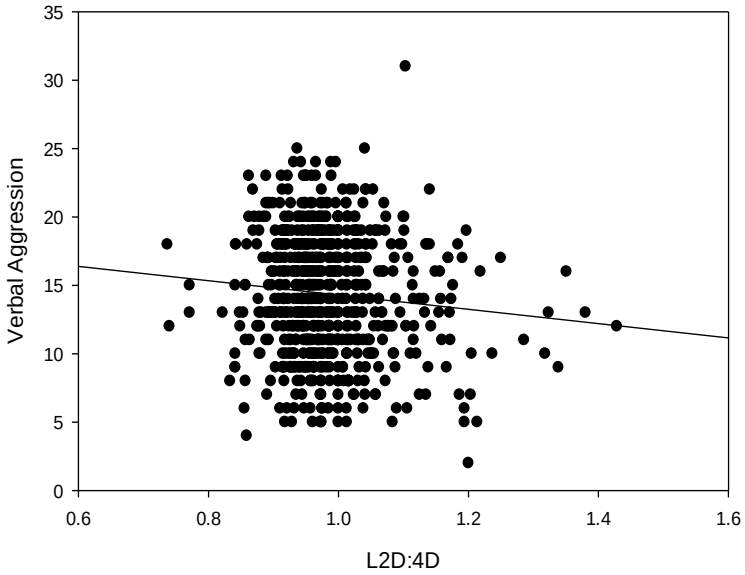
H = 29.891 - (8.491 * L2D:4D)
R = 0.133, R^2= 0.0177, SEE = 2.394, P=0.001

Figure 4.26: Scatter diagram and regression line showing relationship between L2D:4D and Hostility in artisans and non-artisans



VA = 18.959 - (4.666 * R2D:4D)
R = 0.0943, R^2= 0.00890, SEE = 1.864, P = 0.013

Figure 4.27: Scatter diagram and regression line showing relationship between R2D:4D and Verbal in artisans and non-artisans



VA = 19.533 - (5.237 * L2D:4D)
R = 0.0954, R^2= 0.00911, SEE = 2.069, P = 0.012

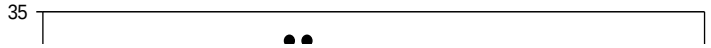
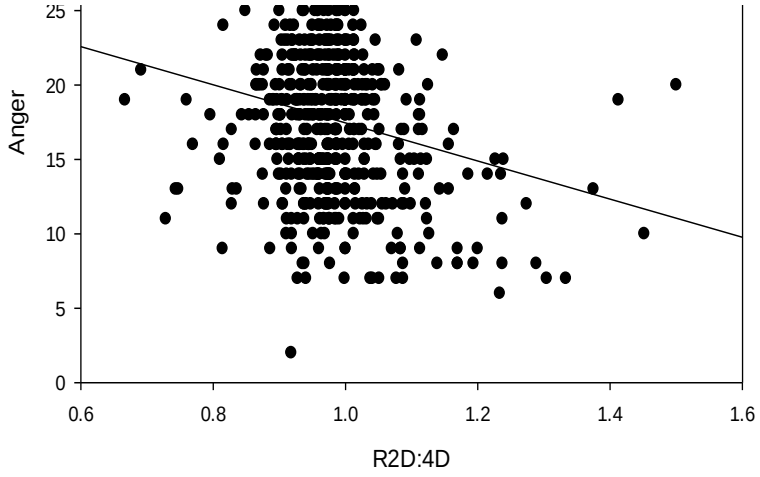
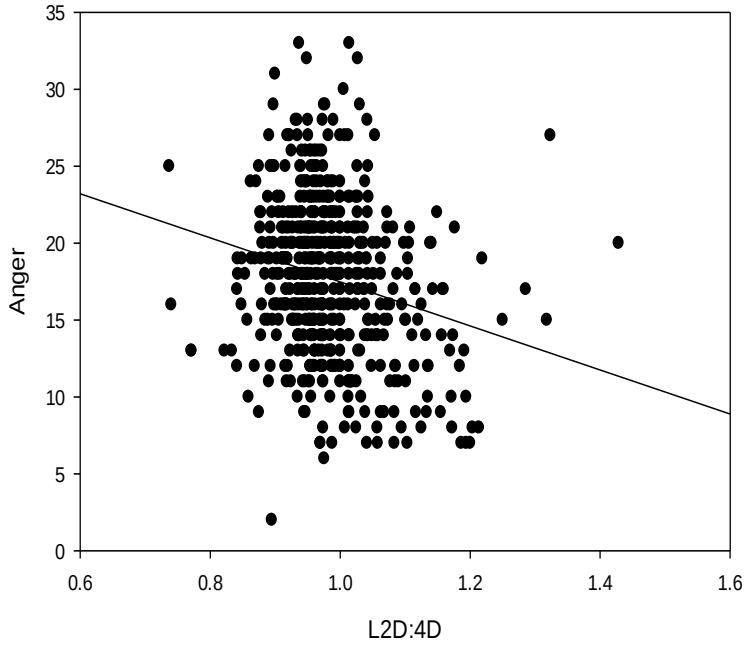


Figure 4.28: Scatter diagram and regression line showing relationship between L2D:4D and Verbal in artisans and non-artisans



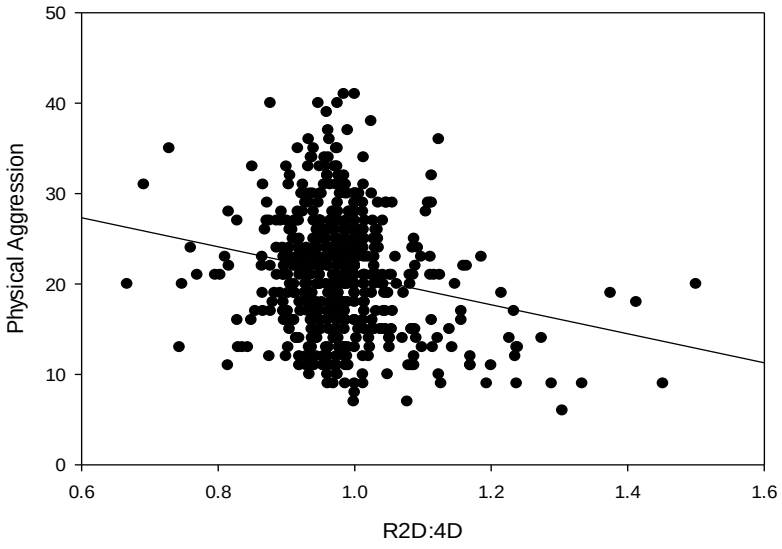
A = 30.279 - (12.822 * R2D:4D)
R = 0.221, R^2= 0.0488, SEE = 2.424, P = 0.001

Figure 4.29: Scatter diagram and regression line showing relationship between R2D:4D and Anger in artisans



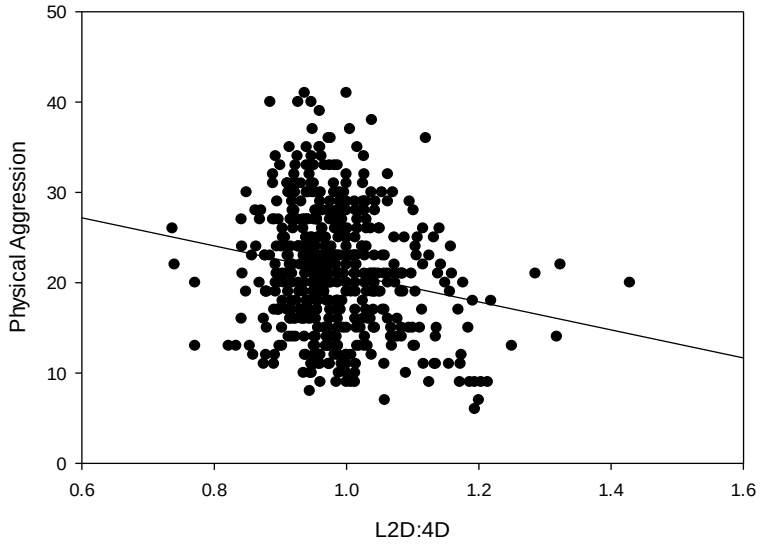
A = 31.803 - (14.321 * L2D:4D)
R = 0.220, R^2= 0.0486, SEE = 2.715, P = 0.001

Figure 4.30: Scatter diagram and regression line showing relationship between L2D:4D and Anger in artisans



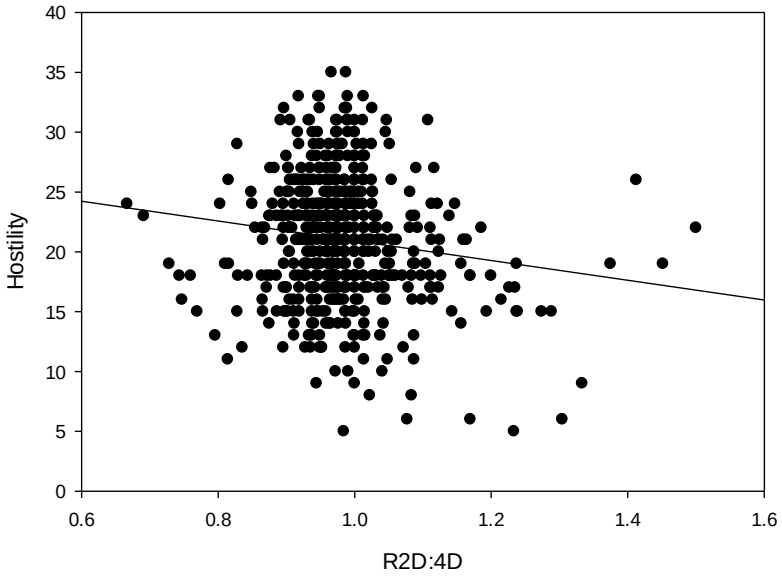
PA = 36.977 - (16.058 * R2D:4D)
R = 0.214, R^2= 0.0458, SEE = 3.135, P = 0.001

Figure 4.31: Scatter diagram and regression line showing relationship between R2D:4D and Physical in artisans



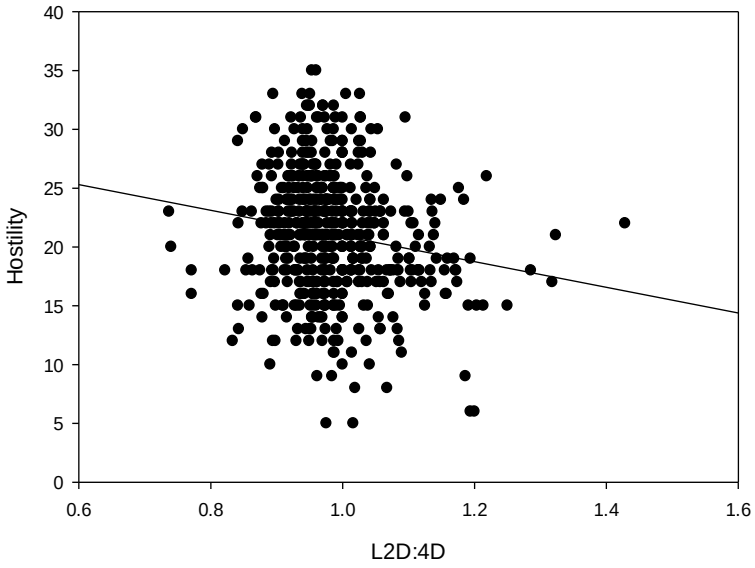
PA = 36.507 - (15.524 * L2D:4D)
R = 0.185, R^2= 0.0341, SEE = 3.538, P = 0.001

Figure 4.32: Scatter diagram and regression line showing relationship between L2D:4D and Physical in artisans



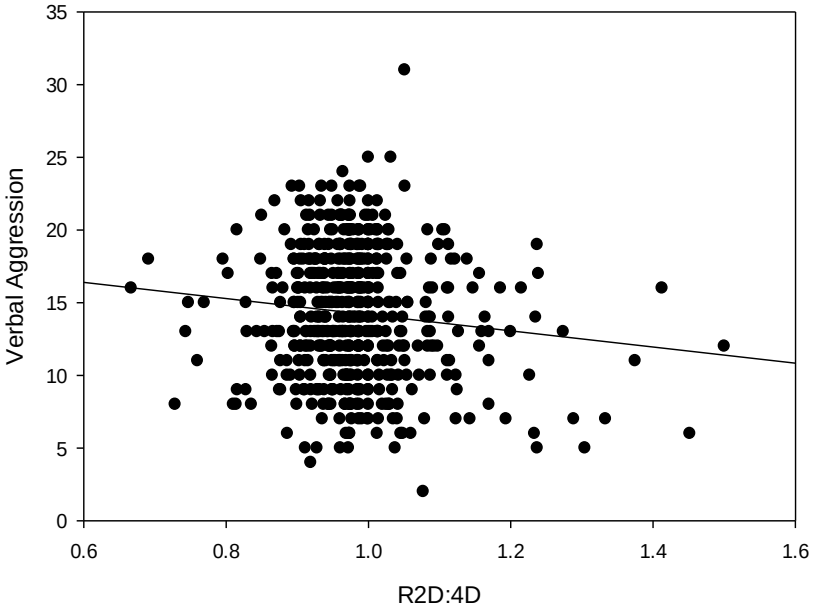
H = 29.193 - (8.263 * R2D:4D)
R = 0.141, R^2= 0.0199, SEE = 2.484, P = 0.001

Figure 4.33: Scatter diagram and regression line showing relationship between R2D:4D and Hostility in artisans



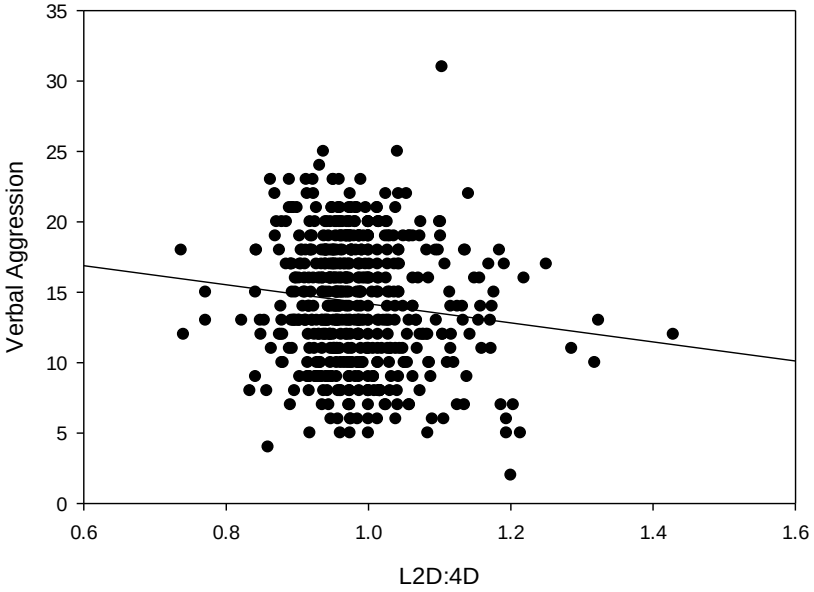
H = 31.856 - (10.920 * L2D:4D)
R = 0.167, R^2= 0.0279, SEE = 2.759, P = 0.001

Figure 4.34: Scatter diagram and regression line showing relationship between L2D:4D and Hostility in artisans



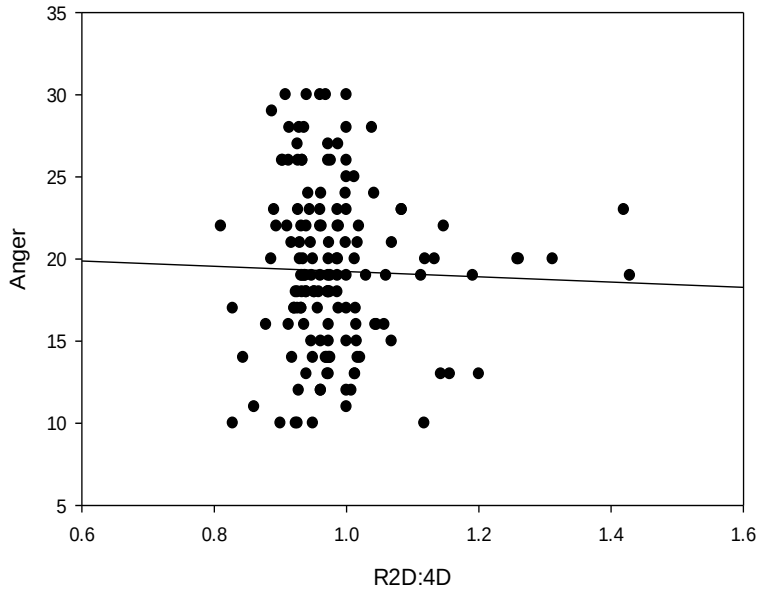
VA = 19.751 - (5.572 * R2D:4D)
R = 0.112, R^2= 0.0126, SEE = 2.107, P = 0.008

Figure 4.35: Scatter diagram and regression line showing relationship between R2D:4D and Verbal in artisans



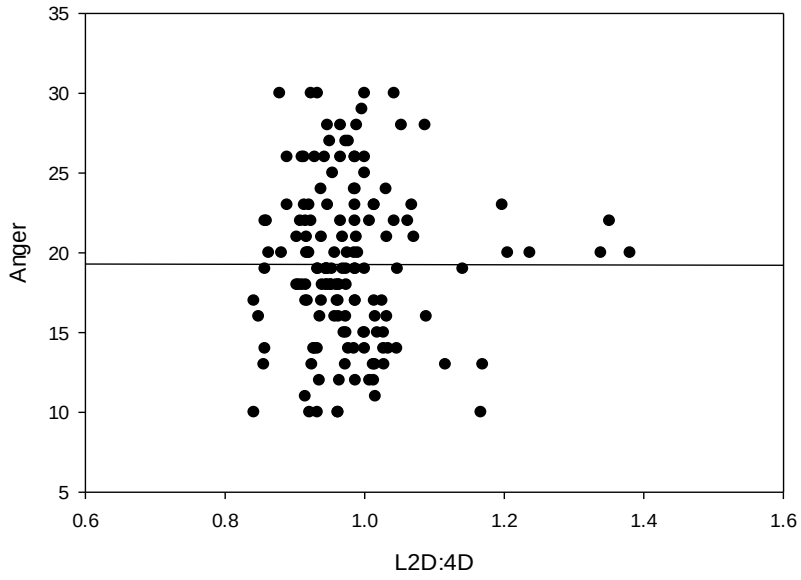
VA = 20.971 - (6.786 * L2D:4D)
R = 0.122, R^2= 0.0149, SEE = 2.361, P = 0.004

Figure 4.36: Scatter diagram and regression line showing relationship between L2D:4D and Verbal in artisans



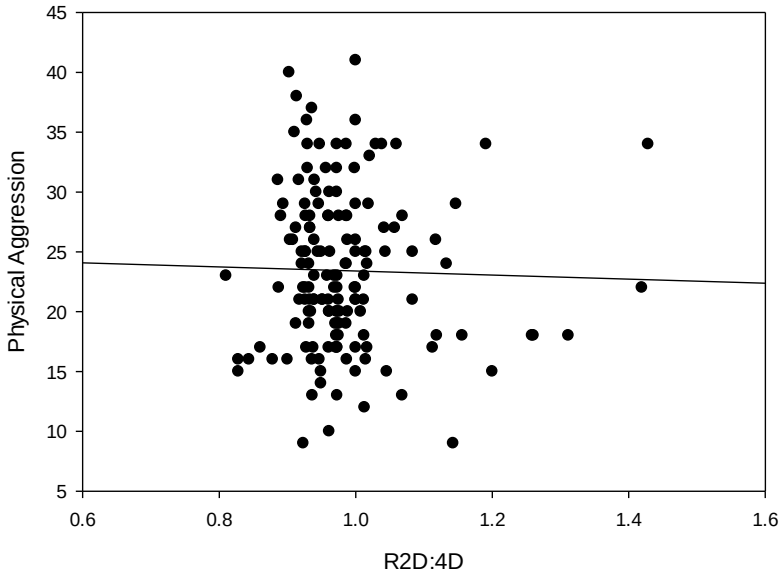
A = 20.854 - (1.609 * R2D:4D)
R = 0.0297, R^2= 0.000882, SEE = 4.422, P= 0.716

Figure 4.37: Scatter diagram and regression line showing relationship between R2D:4D and Anger in non-artisans



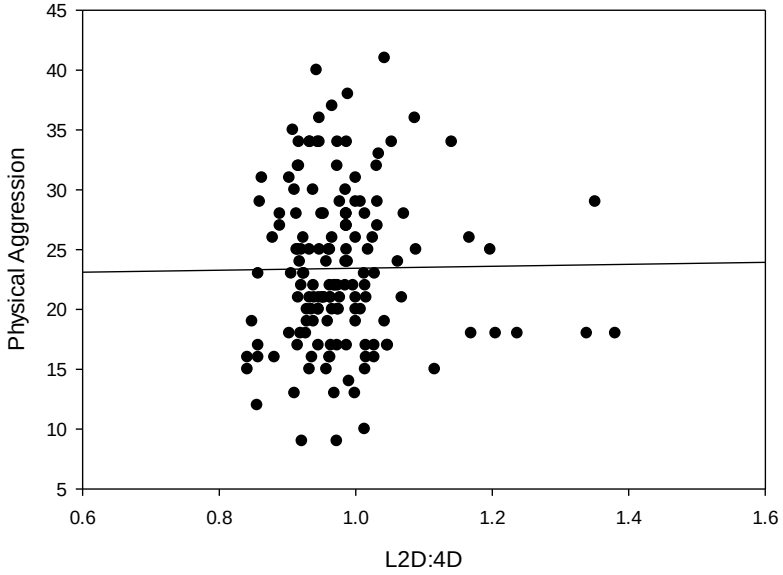
A = 19.341 - (0.0724 * L2D:4D)
R = 0.00125, R^2= 0.00000156, SEE = 4.731, P = 0.988

Figure 4.38: Scatter diagram and regression line showing relationship between L2D:4D and Anger in non-artisans



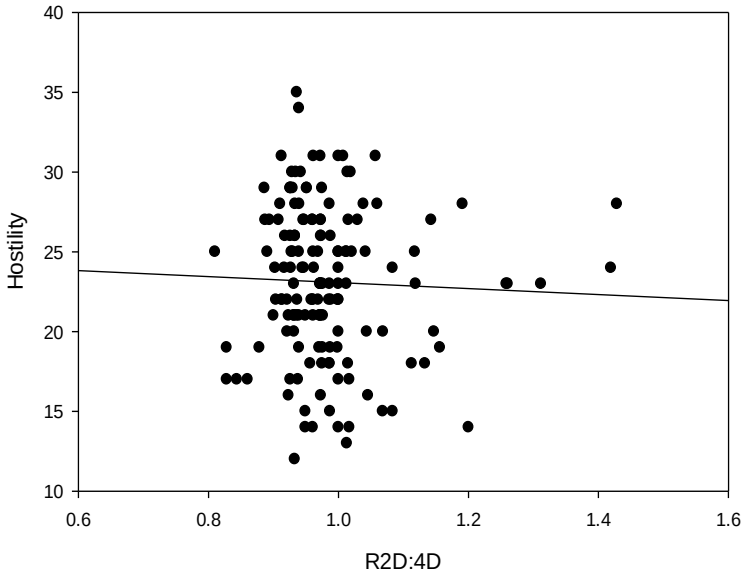
PA = 25.106 - (1.698 * R2D:4D)
R = 0.0239, R^2= 0.000572, SEE = 5.797, P = 0.770

Figure 4.39: Scatter diagram and regression line showing relationship between R2D:4D and Physical in non-artisans



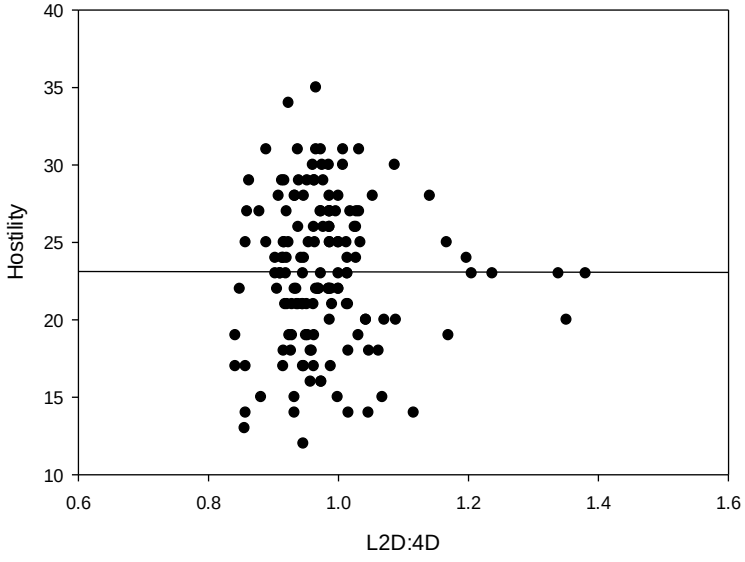
PA = 22.629 + (0.822 * L2D:4D)
R = 0.0108, R^2= 0.000117, SEE = 6.199, P = 0.895

Figure 4.40: Scatter diagram and regression line showing relationship between L2D:4D and Physical in non-artisans



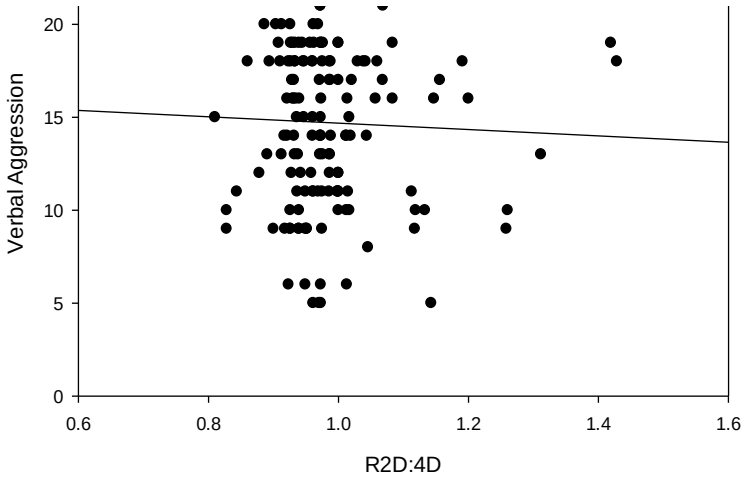
H = 24.969 - (1.893 * R2D:4D)
R = 0.0370, R^2= 0.00137, SEE = 4.179, P = 0.651

Figure 4.41: Scatter diagram and regression line showing relationship between R2D:4D and Hostility in non-artisans



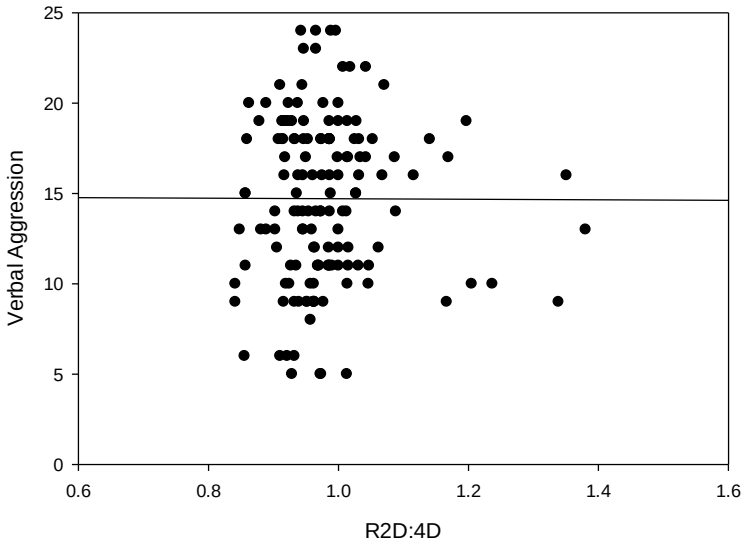
H = 23.163 - (0.0585 * L2D:4D)
R = 0.00107, R^2= 0.00000114, SEE = 4.471, P = 0.990

Figure 4.42: Scatter diagram and regression line showing relationship between L2D:4D and Hostility in non-artisans



VA = 16.405 - (1.715 * R2D:4D)
R = 0.0350, R^2= 0.00122, SEE = 3.999, P= 0.669

Figure 4.43: Scatter diagram and regression line showing relationship between R2D:4D and Verbal in non-artisans



VA = 14.865 - (0.151 * L2D:4D)
R = 0.00288, R^2= 0.00000832, SEE 4.278, P= 0.972

Figure 4.44: Scatter diagram and regression line showing relationship between L2D:4D and Verbal in non-artisans

CHAPTER FIVE

5.0 DISCUSSION

The study of 2D:4D and other digit ratios, as well as their variation among population groups and among individuals may serve as a useful tool for establishing their values as biomarkers (Ghosh and Garth, 2005; Eachus. 2007;Kyriakidis and Papaioannidou. 2008; Danborno *et al.,* 2010;Okampa*et al*., 2015.) 2D:4D and other digit ratios appear to be attractive anthropometric traits that probably deserve attention by anthropologists, scientists, and clinicians since these digit ratios have continued to show promise as biomarkers of health and diseases (Manning, 2002; Danbormo *et al*., 2010;Oyeyemi, *et al*., 2014; Mitsui, 2015).

One's personality, outlook and degree of optimism may also be relevant indicators of preference and motivation for public service. Standard measures of personality and outlook, respectively, are the Big Five Inventory (BFI) devised by John (1990) and the Aspiration index (AI) constructed by Kasser and Ryan (1996).More recently, there has been more work that tries to get at the effects of prenatal T, as proxied by 2D:4D, on life outcomes. For example, Coates *et al*. (2009) have shown that lower 2D:4D (higher prenatal T) correlate with much greater earnings for participants engaged in high-frequency bond trading as compared to their colleagues with higher 2D:4D (lower prenatal T). There is also evidence that suggests that the effects of 2D:4D may be non-linear and sex-differentiated (Manning *et al*., 2010; Hell and Paessler, 2011; Branas-Garza, *et al*., 2012; Nye *et al*, 2012; Nye and Orel, 2015). For instance, Nye *et al*.,(2012) show that for academic achievement as measured by grades or school GPA, 2D:4D seems to have a clear and significant quadratic effect for women, but the effects are either mildly linear or even insignificant,

Nye, *et al.* (2014) also tend to confirm the general findings of Manning *et al*. (2010) with regard to the differences in the effects of 2D:4D for women in more stereotypically masculine vs. more stereotypically feminine occupations. Hell and Paessler (2011), who only record desired rather than actual occupations, find that female 2D:4D is correlated with an interest in things and weaker interest in people or social professions. This dichotomy between results that sometimes seem to show correlations for male, and other times for female subjects, may be related to measuring actual occupation versus stated interests or preferences.

This study indicates that artisans group scored higher values in anthropometric parameters than non-artisans group except in right finger two to right finger five, left finger one to left finger four, hand length and foot breadth respectively, which shows higher values in non-artisans than the artisan group.

Even though there has not been previous work on the relationship between 2D:4D ratio, anthropometric characteristics and aggression among artisan and non-artisans in Zaria population of Kaduna Stateto the best of our knowledge, this study sought to investigate the possible differences in 2D:4D ratio, anthropometric measurements and aggression that exist between artisans and non-artisans based on left and right hand as well as occupation. It is evident from this study that the 2D:4D ratio (left and right) and other anthropometric parameters considered were higher in artisan groups than non-artisan group except the above mentioned parameters, which could be due to less physical activities by the non-artisans than theartisan group, this is in line with the report of Brosnan *et al.*(2011) who found that both women and men with lower 2D:4D ratios (i.e. higher prenatal T exposure)

perform better in computer science disciplines (specifically, Java programming) and have lower levels of computer related anxiety. This is also line with the report of Danborno *et al*. (2010) on relationship between birth weight and the length of second and fourth digits in Nigeria, which says that male newborn generally, have higher anthropometric values than female's newborn.

The result of this study indicate that among several categories of artisan groups, the bricklayers have higher right and left 2D:4D ratio than the other artisan groups which is significant in the left 2D:4D ratio between bricklayers and auto mechanics using post-hoc tests. Auto-mechanics and tailors have the lowest right 2D:4Dratio than the other trade categories and non-artisans groups. However bricklayers have the highest left 2D:4D ratio than other trade categories.This is in line with the report of Jacob *et al*.(2015) in theirstudy of second and fourth digit ratio with physical attributes in south Indian population which demonstrated that the males have greater 2D:4D ratio compared to females as well known that male engaged more in physical activities than females but is contrary to the report of Danborno *et al.*(2010) from the Nigerian population which showed that females have higher right and left 2D:4D ratio than their male counterparts.

The result of the current study showed there is weak and inverse correlation between right 2D:4D ratio and height. Also a weak positive correlation was seen between right 2D:4D ratio with weight ($r = 0.0165$) and BMI ($r = 0.05$). A similar finding is also seen in left 2D:4D ratio with height ($r = -0.06$, $p > 0.05$), weight ($r = 0.00238$, $p > 0.05$) and BMI ($r = 0.0395$, $p > 0.05$) respectively. This is in line with the report of Danborno *et al*., 2007 in their study of sexual dimorphism and relationship between chest, hip and waist

circumference with 2D, 4D and 2D:4D in Nigerians which reported height, weight and BMI correlated with 2D:4Dratios in males but is not statistically significant but height and weight correlated significantly with left 2D:4D ratio in females subjects but is contrary with the report of Jacob *et al*., 2015, from the Indian population which showed a positive correlation between the digit lengths and height in both males and females and between weight and second digit length in case of males but the 2D:4D digit ratio had no relationship to height, weight or BMI.

Other studies by Manning *et al*., 2003 and Neave *et al*., 2003 have established relationship between height, weight and BMI. The present study investigated the same phenomena among artisans and non-artisan in Nigerian population. The result did not show any significant relationship between 2D:4D ratio either in right or left hands, which agrees with the report of Neave *et al*.(2003) and Vehmas *et al*.(2006) but it is in contrast to that of Manning *et al*., (2003), who reported relationship between 2D:4D with Waist, hip circumferences and BMI. When considering digit lengths as entities both right and left 2D and 4D showed significant correlation with weight and height. Fesseler, *et al.*(2005)has reported sexual dimorphism in the length of hand and foot in humans. The findings from the present study confirms this reports by the fact that 2D and 4D lengths are significantly longer in males than in females. The correlation of 2D and 4D with height in both males and females, also agrees with previous reports, the only new information is that BMI do not show any correlation with 2D and 4D according the results of the present study.

Human beings have emotions throughout their life. Every emotion is related to the achievement or non-achievement of personal goals; therefore, happiness is linked to the

progress towards the goal whereas sadness is linked to the failure or non-achievement of a goal. Anger arises when a plan goes away or is blocked and anxiety emerges when a goal is threatened, and so on (Johnson, 1987).

In this study an association between right and left 2D:4D ratio with anger, physical and Hostility was found. However an association was found between right 2D: 4D ratio and verbal aggression but no association was found between left 2D:4D ratio and verbal aggression this is contrary to earlier report (Virupaxi *et al*., 2012; Benderlioglu and Nelson, 2004).

In the artisan group an inverse association was found between right and left 2D:4D ratio with anger, physical aggression, hostility and verbal aggression respectively which were all statistically significant this is contrary to the report of Virupaxi *et al*.(2012). Moreover in the non-artisans group, no significant association was found between right and left 2D:4D ratio with anger, there is also no association between right 2D:4D ratio with physical aggression and verbal aggression but there is positive association between left 2D:4D ratio with physical aggression. There is no association between right and left 2D:4D ratio with hostility, this is in line with the report of (Voracek and Stieger, 2009; Austin *et al.*, 2002; Coyne *et al*., 2007: Bailey and Hurd, 2004; Lindova *et al*., 2008; Millet and Dewitte, 2006) but contrary to the report that says there is association between 2D:4D ratio and physical aggression, we found no association between 2D:4D ratio and physical aggression as also reported by Butovskaya *et al*., 2010 in African population.

From the present study, we found significant correlation of Anger with Physical aggression, hostility and verbal aggression in artisan group this is in line with the report of Mehta *et al*. (2014) from the Indian population, who reported correlation of Anger with physical aggression and hostility in male. Also is in line with the report of Bailey *et al*. (2005) who reported that anger correlated with all the three subscales of aggression (physical, verbal and hostility) in male. We found an association between physical aggression with hostility and verbal aggression. Also an association was found between hostility with verbal aggression which is in line report of Mehta *et al*. (2014).

Similar findings in the non-artisan groups showed an association between anger, physical aggression, hostility and verbal aggression. Also physical aggression correlated with hostility and verbal aggression. Moreover association was found between hostility and verbal aggression this is in line with the report of Mehta *et al*. (2014).

Regression equations were derived for estimation of 2D:4D ratio from different anthropometric variables and aggression. The artisan groups correlated more strongly with the anthropometric variables than the non-artisan groups giving a better prediction capability than the non-artisan groups. It is evident in this study that combining two or more anthropometric parameters tends to predict 2D:4D ratio more strongly than the single parameter giving it a better predictive capability with lower standard error of estimate, this is in line with the report of Danborno and Elukpo (2007) and Danborno *et al.* (2010).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Among the different trade categories of artisans studied in this research. The brick layers have significantly higher left 2D:4D ratio than the other trade categories.

Differences in 2D:4D ratio, aggression and occupation of Kaduna state of Nigerian population has been established in this study, indicating occupational specificity in 2D:4D ratio and aggression.

In conclusion, the artisan group was found to have significantly higher level of physical aggression, verbal aggression and anger as compare to the non-artisan group.

6.2 RECOMMENDATIONS

Based on the findings of the present study, the following recommendations are formulated:

I. The 2D:4D to be used as tool for assessment of professionalism

II. Similar study can be taken up on different scale of aggression.

III. Studies that provide a direct test of the link between 2D:4D and Prenatal testosterone should be done on different groups of artisans.

IV. Research work can be done on larger population of different ethnicity.

V. Current study offers up the question: can 2D:4D be used to predict future potential in occupation?

VI. Along with digital finger ratio (2D:4D) different ratios 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 research.

6.3 CONTRIBUTION TO KNOWLEDGE

The present has contributed to knowledge as follows:

i. This study added to the reference and data base line for the study of 2D:4D and aggression among different groups of artisans and non-artisans in Zaria Kaduna State, Nigeria.

ii. The study established predictive equations for aggressionamong different categories artisans and non-artisans using 2D:4D ratio for right (Anger = 28.026 - (10.172 * R2D:4D)) and left (A = 28.923 - (11.060 * L2D:4D).

iii. An association has been established between aggression and 2D:4D ratio(A = 28.026 - (10.172 * R2D:4D)), and 2D:4D ratio with some other anthropometric variables(Height = 1.748 - (0.0498 * R2D:4D)) in Zaria, Kaduna state Nigeria.This is thefirst of its kind to the best of our knowledge.

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APPENDIX**I**

DEPARTMENT OF HUMAN ANATOMY
FACULTY OF MEDICAL SCIENCES
COLLEGE OF MEDICINE
AHMADU BELLO UNIVERSITY, ZARIA

Dear Mr. /Miss,

I am Yusuf Muhammad Zahradden an MScstudent in the Department of Human Anatomy of the above named institution.I am carrying out a research on study of Evaluation Second and Fourth Digit Ratio amongstArtisans in Zaria, Nigeria**.**Participation is voluntary. It involves collection of certain information about your personal and family characteristics and anthropometric variables will be measured and recorded as well.

The information collected from you will be used strictly to achieve the objectives of this study and for scientific publication. I assure you that this study has been reviewed and approved by my supervisors and the University Committee on Research Ethics.

Thank you for your understanding.

Yours sincerely,

Yusuf Muhammad Zahraddeen

APPENDIXII

CONSENT TO PARTICIPATE IN RESEARCH

Study of Evaluation of Second and Fourth Digit Ratio amongst Artisans and Non-artians in Zaria, Nigeria

INTRODUCTION

You are kindly being asked to participate in a research study conducted by Yusuf Muhammad Zaharaddeen for a Master of Science degree under the supervision of Dr. B. Danborno, and Dr. Austin. O. Ibegbufrom the Department of Human Anatomy, Faculty of Medical Sciences, College of Medicine, Ahmadu Bello University, Zaria.

If you have any questions or concerns about the research, please feel free to contact: Yusuf Muhammad Zaharadden, Faculty of Medicine, Tel: 08034067235, Dr. B. Danborno, Faculty of Medicine, Tel: 08139429300; or Dr. Austin Ibegbu, Faculty of Medicine, Tel: 08032188042.

PURPOSE OF THE STUDY

The purpose of this study is to derive model to examine the association of 2D:4D, anthropometric indexes, artisan and white colour job employees among Nigerians in Zaria Kaduna State.

However it is also expected that the results might implicate certain anthropometric variables, ethnicity, demography, nutrition and occupational status that affect the individual within the designated groups. This study is a partial requirement for the award of MSc degree in Department of Human Anatomy in Ahmadu Bello University, Zaria.

WHY ARE YOU BEING ASKED TO PARTICIPATE?

You are being invited because you are18 year or above old male or female belonging to Nigeria's ethnic groups.

WHAT WILL HAPPEN DURING THIS STUDY?

Information pertaining to height, demographics (i.e. age, ethnicity, etc.), and body parameters like sitting height, etc will be collected using anthropometric equipment and reported on questionnaire.

POTENTIAL RISKS AND DISCOMFORT

This study does not pose any form of physical, emotional or psychological risks to you as no sharp or dangerous objects will be used.

POTENTIAL BENEFITS TO PARTICIPANTS

The result of this study, when published will help in establishing a baseline data for examination of the effect of 2D:4D on artisans and non-artisans in Zaria, Kaduna state Nigeria, and how anthropometric variables affects ethnicity, demography and occupational status.

WILL THERE BE ANY COSTS TO ME?

Aside from your time, there are no costs for taking part in the study.

PAYMENT FOR PARTICIPATION

Participation will not attract any financial benefit.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information provided by participants in this study. You will not be identified in any reports or publications resulting from the study.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you do not want to answer and still remain in the study. The investigator may withdraw you from this research, if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research. This study has been reviewed and received ethical clearance through Ahmadu Bello University Research Ethics Board. If you have any questions regarding your rights as a research participant, you can obtain further information about the research or voice your concerns to:

Dr. B. Danborno,
Department of Anatomy,
Faculty of Medical Sciences,
College of Medicine,
Ahmadu Bello University.
Tel: 08139429300
E-mail: sbdanborno@abu.edu.ng

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study "**EvaluationofSecond and Fourth Digit Ratio, Anthropometric Parameters and Aggressionamongst Artisans and Non-artisan in Zaria, Nigeria**"

As described herein. I have been given a copy of this form.

_____

Name of Participant

_____ _____

Signature of Participant Date

SIGNATURE OF WITNESS

_____

Name of Witness

_____ _____

Signature of Witness Date

Questionnaire for the Study of Evaluation of Second and Fourth Digit Ratio, Anthropometric Parameters and Aggression amongstArtisans and Non-artisans in Zaria, Nigeria

Name: Yusuf Muhammad Zaharaddeen

Position: MSc Student

Contact Address: Department of Anatomy, Faculty of Medical Sciences, College of Medicine, Ahmadu Bello University, Zaria

1. I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐
3. I agree to take part in the above study. ☐
4. I agree to the use of anonymised quotes in the publications. ☐

_____	_____	_____
Name of Participant	Date	Signature

_____	_____	_____
Name of Researcher	Date	Signature

APPENDIX III

Questionnaire for the Study of Evaluation of Second and Fourth Digit Ratio, Anthropometric Parameters and Aggression amongst Artisans and Non-artisans in Zaria, Nigeria

Please tick or circle the appropriate letter where necessary below:

DEMOGRAPHY OF PARTICIPANT

1. Place of birth: _____
2. Have you spent your whole life there? Yes [ ] No [ ]
3. If no, where else have you lived? _____
4. Where do you live now? _____
5. Date of birth _____ (DD/MM/YYYY)
6. Age_____ (yrs)
7. Number of siblings:
   a. Brothers: _____ (from your mother only)
   b. Sisters: _____ (from your mother only)
8. What's your birth order?
   a. Firstborn [ ] b. Second born [ ] c. Third born [ ] d. Last born [ ]

9. ETHNIC BACKGROUND

Mother's Ethnic Group:_____

Grand Mother's Ethnic Group: _____

Father's Ethnic Group: _____

Grand Father's Ethnic Group:_____

10. EDUCATIONAL BACKGROUND

a. None [ ]
b. Primary school [ ]
c. Secondary school [ ]
d. Tertiary [ ]

11. Trade Categories

Keys of the categories:

a. Auto mechanic/Auto electricians, Metals and related workers

b. Brick layers, Building and Road construction workers and other related workers

c. Tailors, Fashion Designers and Embroiders and other related workers

d. Carpenters and related wood workers

e. Civil individuals (non-artisans)

12.Occupational Choice.

a. How keen are you to your work?

b. Do you feel you are relegated in your place of work? Yes [ ] No [ ]

c. Are you statisfied with your work? Yes [ ] No [ ]

d. Do you believe you can achieve your life goal with your work? Yes [ ] No [ ]

e. Is it of your best interest doing this work? Yes [ ] No [ ]

f. Are you forced to be in this work? Yes [ ] No [ ]

ANTHROPOMETRIC ASSESSMENT

13. Weight: ---------- (kg)
14. Height: ---------- (cm)
15. BMI: ---------- (kg/m^2)
16. Humeral length---------- (cm)
17. Forearm length---------- (cm)
18. Mid upper arm circumference---------- (cm)
19. Hand length: ---------- (cm)
20. Hand Breadth: ---------- (cm)
21. Foot length: ---------- (cm)

22. Foot Breadth---------- (cm)

23. What's your occupation? ----------

24. HAND ANTHROPOMETRY

Length of digits (mm)

Hand	**Fingers**				
	I	**II**	**III**	**IV**	**V**
Right					
Left					

Aggression Questionnaire (Buss & Perry, 1992)

Instructions:
Using the 5 point scale shown below, indicate how uncharacteristic or characteristic each of the following statements is in describing you. Place your rating in the box to the right of the statement.
1 = extremely uncharacteristic of me (strongly disagree).
2 = somewhat uncharacteristic of me (disagree).
3 = neither uncharacteristic nor characteristic of me (undecided).
4 = somewhat characteristic of me (agree).
5 = extremely characteristic of me (strongly agree).

SNO	ITEM DESCRIPTION	SCORE	ID
1	Some of my friends think I am a hothead		
2.	If I have to resort to violence to protect my rights, I will.		
3.	When people are especially nice to me, I wonder what they want.		
4.	I tell my friends openly when I disagree with them.		
5.	I have become so mad that I have broken things.		
6.	I can't help getting into arguments when people disagree with me.		
7.	I wonder why sometimes I feel so bitter about things.		
8.	Once in a while, I can't control the urge to strike another person.		
9.	I am an even-tempered person.		
10	I am suspicious of overly friendly strangers.		
11.	I have threatened people I know.		
12.	I flare up quickly but get over it quickly.		
13.	Given enough provocation, I may hit another person.		
14.	When people annoy me, I may tell them what I think of them.		
15.	I am sometimes eaten up with jealousy.		
16.	I can think of no good reason for ever hitting a person.		
17.	At times I feel I have gotten a raw deal out of life.		
18.	I have trouble controlling my temper.		
19.	When frustrated, I let my irritation show.		
20.	I sometimes feel that people are laughing at me behind my back.		
21.	I often find myself disagreeing with people.		
22.	If somebody hits me, I hit back.		
23.	I sometimes feel like a powder keg ready to explode.		
24.	Other people always seem to get the breaks.		
25.	There are people who pushed me so far that we came to blows.		
26.	I know that "friends" talk about me behind my back.		
27.	My friends say that I'm somewhat argumentative.		
28.	Sometimes I fly off the handle for no good reason.		
29.	I get into fights a little more than the average person.		

Scoring

The Aggression scale consists of 4 factors, Physical Aggression (PA), Verbal Aggression (VA), Anger (A) and Hostility (H). The total score for Aggression is the sum of the factor scores.