



Association between Handedness, Second-To-Fourth Digit Ratio (2D:4D), and Personality Traits among the Ikwerre Ethnic Group in Rivers State, Nigeria

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Abstract

Original Research

This study examined the relationship between handedness, second-to-fourth digit ratio (2D:4D), and personality traits among the Ikwerre people of Rivers State, Nigeria. The aim was to determine whether biological factors such as digit ratio and hand preference are associated with the Big Five personality dimensions, namely Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience. A cross-sectional design was employed, and data were collected using a structured questionnaire and anthropometric measurements. The data were analysed using descriptive statistics, correlation, regression, and analysis of variance. The results revealed that the majority of participants were right-handed, while a small proportion were left-handed or ambidextrous. The mean 2D:4D ratios for both hands were approximately 0.96, which falls within the normal range reported in the literature. Correlation and regression analyses showed no significant relationships between 2D:4D ratios and any of the Big Five personality traits, nor between digit ratio and handedness. The regression model further indicated that handedness and 2D:4D together explained less than one percent of the variance in personality traits. Analysis of variance revealed that handedness had a statistically significant effect on Extraversion ($p = 0.017$) and a marginal effect on Openness to Experience ($p = 0.066$), with left-handed individuals showing slightly higher scores in these traits. However, no significant associations were found for Agreeableness, Conscientiousness, or Neuroticism. In conclusion, the findings suggest that biological markers such as 2D:4D ratio and handedness have minimal influence on personality traits in this population, indicating that environmental and socio-cultural factors may play a more dominant role in shaping personality.

Keywords: Digit ratio, Handedness, Personality traits, Ikwerre.

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INTRODUCTION

Over the years, researchers have tried to determine whether certain physical traits can offer clues about human behaviour and personality. Among the most studied features are handedness and digit ratio, especially the second-to-fourth digit ratio (2D:4D), because they are often considered biological indicators that may reflect links among development, brain organization, and behaviour (Manning, 2002).

The 2D:4D ratio is obtained by dividing the length of the index finger by the length of the ring finger, and it is the most commonly investigated digit ratio. Finger length is usually measured from the midpoint of the basal crease to the fingertip (Alperovitch-Najenson et al., 2004; Gwunireama and Collins, 2025). A lower 2D:4D ratio has been linked to higher prenatal testosterone exposure, while a higher ratio is often associated with greater prenatal oestrogen exposure (Manning, 2002). This ratio is sexually dimorphic, with males generally showing lower values than females; for instance, males typically have a digit ratio of about 0.96, whereas females often have a ratio close to 1.0, indicating nearly equal lengths of the index and ring fingers in females (Gwunireama et al., 2010; Gwunireama and Collins, 2025). Because of these differences, 2D:4D has been associated with traits such as risk-taking, aggression, sexual orientation, fertility, sports performance, and empathy (Hönekopp & Watson, 2011).

Handedness refers to a consistent preference for using one hand over the other in activities such as writing, eating, or throwing. About 90% of people are right-handed, while roughly 10% are left-handed or ambidextrous (Papadatou-Pastou et al., 2020). Handedness has been linked to differences in brain organization, cognitive processing, and vulnerability to certain psychological conditions (Bryden et al., 2000). It is commonly categorized as right-handedness, left-handedness, and ambidexterity (McManus, 2002; Raymond & Pontier, 2004; Scharoun & Bryden, 2014). The lateral preferences and hemispheric language dominance in students at the University of Port Harcourt have been studied by Okoseimiema and Bob-Manuel (2022), who reported that gender may not necessarily influence lateralization, and that the extent to which culture

and ethnicity affect hand preference may differ from one community to another.

Personality traits are relatively stable patterns of thought, feeling, and behaviour. The most widely accepted model for describing personality is the Five-Factor Model, also called the Big Five, which consists of openness, conscientiousness, extraversion, agreeableness, and neuroticism (McCrae & Costa, 1997). These traits influence academic and occupational performance, social relationships, and responses to stress and emotion. Studies have suggested that biological markers such as 2D:4D may be related to personality expression, since lower digit ratios have been associated with aggression, dominance, and sensation-seeking, traits often interpreted as signs of higher prenatal testosterone exposure (Bailey & Hurd, 2005; Hönekopp & Watson, 2011). Coates et al. (2009) also reported that traders with lower 2D:4D ratios achieved higher financial returns, further indicating a possible connection between digit ratio and risk-taking behaviour.

Handedness has also been associated with personality-related characteristics. Niebauer and Garvey (2004) found that left-handed individuals scored higher on openness to experience and neuroticism than right-handed individuals. Similarly, Nicholls et al. (2010) reported slightly greater creativity and divergent thinking among left-handed participants, which may reflect stronger involvement of the right hemisphere. Faurie and Raymond (2013) observed that left-handedness has at times been linked with artistic or creative tendencies, although it has also been associated with certain developmental and psychological difficulties. Taken together, these findings suggest that both handedness and 2D:4D ratio may be related to personality traits, although the nature and strength of these relationships remain inconsistent across studies.

The Ikwerre ethnic nationality is estimated to have a population of about 1,390,893 in Rivers State and is mainly concentrated in four Local Government Areas, namely Ikwerre, Emohua, Obio/Akpor, and Port Harcourt (Eyindah & Obah, 2021; Collins et al., 2025). Although several studies in other countries have examined the relationship among handedness,

digit ratio, and personality, there is still limited information for the Ikwerre population. Most available evidence comes from Western and Asian populations, which limits how far such findings can be generalized to Africans (Manning et al., 2004). This study therefore aims to address this gap by examining the association between handedness, 2D:4D digit ratio, and personality traits among members of the Ikwerre ethnic group in Rivers State, Nigeria.

METHODOLOGY

Research Design

This study employed a cross-sectional descriptive survey design to examine the association between handedness, second-to-fourth digit (2D:4D) ratio, and personality traits among members of the Ikwerre ethnic group in Rivers State.

Area and Population of Study

The study population consisted of adult members of the Ikwerre ethnic group aged 18–62 years residing in the Local Government Areas of Obio/Akpor, Port Harcourt City, Ikwerre, and Emohua in Rivers State. These Local Government Areas represent the main areas inhabited by the Ikwerre people, with an estimated total population of 1,390,893 (Eyindah & Obah, 2021; Collins et al., 2025).

Sampling

The Ikwerre Ethnic population is about 1,390,893. Utilising the Taro Yamane (1967) formula to determine the sample size from this population.

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = sample size

N = population size (1,390, 893)

e = margin of error (5%; 0.05).

$$n = \frac{1,390,893}{1 + 1,390,893(0.05)^2}$$

$$n = 399.99 \approx 400$$

To account for possible non-response associated with questionnaire-based data collection, a 5% non-response rate was applied using standard sample size adjustment procedures. This yielded an adjusted sample size of approximately 421 respondents.

A multi-stage stratified sampling technique was employed in this study. In the first stage, Local Government Areas predominantly inhabited by the Ikwerre people were purposively selected. In the subsequent stage, the population within the selected Local Government Areas was stratified based on key demographic variables, including sex (male and female), age groups, educational level (no formal education, primary, secondary, and tertiary), and occupation.

Selection criterial

The selection criteria for this study included both inclusion and exclusion conditions. Participants were eligible for inclusion if they were adults aged 18 years and above, self-identified as belonging to the Ikwerre ethnic group with both parents and grandparents (up to the third generation) also of Ikwerre origin, resided in one of the selected Local Government Areas, mentally stable and were willing and able to provide informed consent. Individuals were excluded from the study if they had hand deformities or amputations that could affect accurate digit measurement, had diagnosed psychological or cognitive impairments, or had hormonal conditions such as congenital adrenal hyperplasia that may influence digit development. In addition, non-Ikwerre individuals were excluded to ensure cultural and ethnic homogeneity within the study population.

Method of Data Collection

The data collection process consisted of both anthropometric measurements and questionnaire administration.

For the anthropometric component, digit lengths were measured using a digital Vernier caliper with a precision of 0.01 mm, from the midpoint of the basal crease to the fingertip of each digit. Measurements were taken for both hands to ensure accuracy, and the second-to-fourth digit (2D:4D) ratio was calculated using the formula:

2D:4D = length of the second digit divided by the length of the fourth digit.

Handedness was assessed using the Edinburgh Handedness Inventory (Oldfield, 1971), which consists of ten common activities such as writing, brushing teeth, and throwing. Participants indicated their preferred hand for each activity, and a Laterality Quotient (LQ) was computed using the formula:

$$LQ = [(R - L) / (R + L)] \times 100.$$

Based on the LQ scores, participants were categorized as right-handed (LQ > +40), left-handed (LQ < -40), or ambidextrous (LQ between -40 and +40).

Personality traits were evaluated using the NEO Five-Factor Inventory developed by Costa and McCrae (1992), which measures the five major personality domains: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism.

Method of Data Analysis

Data were double-entered to minimize errors, screened for missing values, and appropriately coded prior to analysis. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the demographic characteristics and key study variables. Inferential

statistics were then applied to test the study hypotheses, with Pearson's correlation used to examine relationships among 2D:4D ratio, handedness, and personality traits, while independent samples t-tests and analysis of variance (ANOVA) were used to assess group differences. In addition, multiple regression analysis was conducted to determine the predictive relationships among the variables while controlling for relevant demographic factors. All statistical tests were performed at a significance level of 0.05, with results reported at a 95% confidence interval.

Ethical Considerations

This study was conducted in accordance with the Nigerian Code of Health Research Ethics (NCHRE) and the World Medical Association's Declaration of Helsinki (2013). Informed consent was obtained from all participants after a clear explanation of the study. Confidentiality was strictly maintained by anonymizing all responses, assigning codes, and securely storing the data. Participation was entirely voluntary, and respondents were informed of their right to withdraw from the study at any time without any consequences. In addition, cultural sensitivity was ensured by engaging research assistants who were fluent in both Ikwerre and English to facilitate effective communication.

RESULTS

The results of the study were presented in tables and charts. A total of 420 respondents participated in the study. The demographic information gathered included variables such as age, sex, educational level, marital status, and occupation.

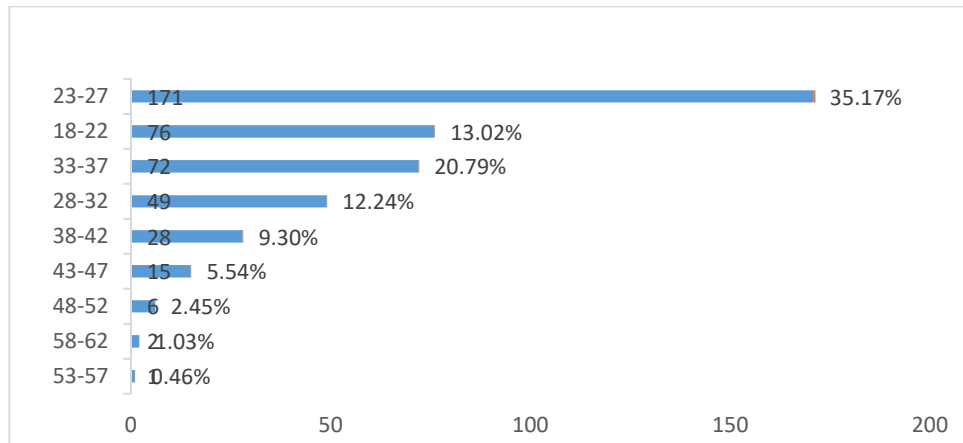


Figure 1: Age Distribution of Study Respondents

The respondents ranged from 18 to 62 years, with a mean age of 28.7 years (SD = 10.1). A majority (approximately 68%) were within the 18–30 age

bracket, reflecting a relatively young sample population.

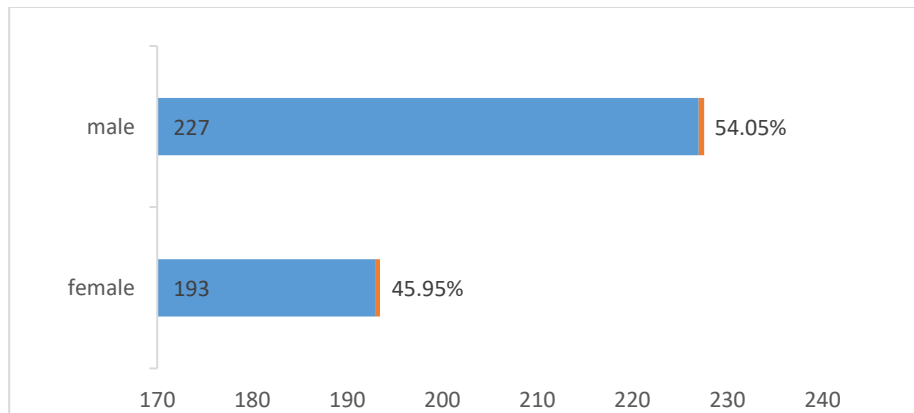


Figure 2: Sex of Respondents

Out of the total participants, 54% were male and 46% female. This nearly equal distribution ensured balanced representation of sex perspectives.

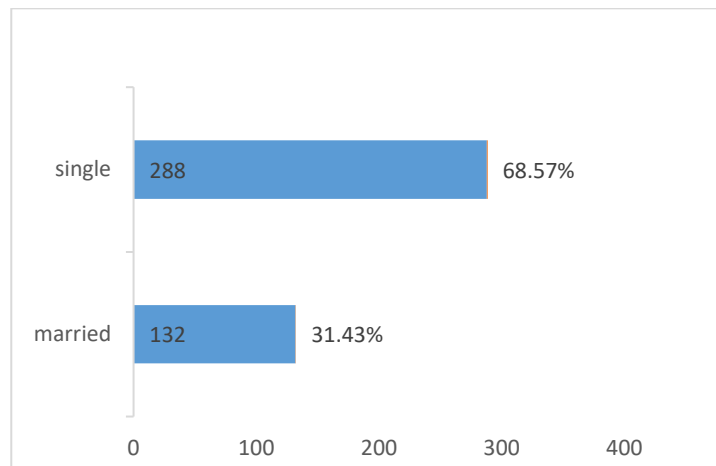


Figure 3: Marital Status of Respondents

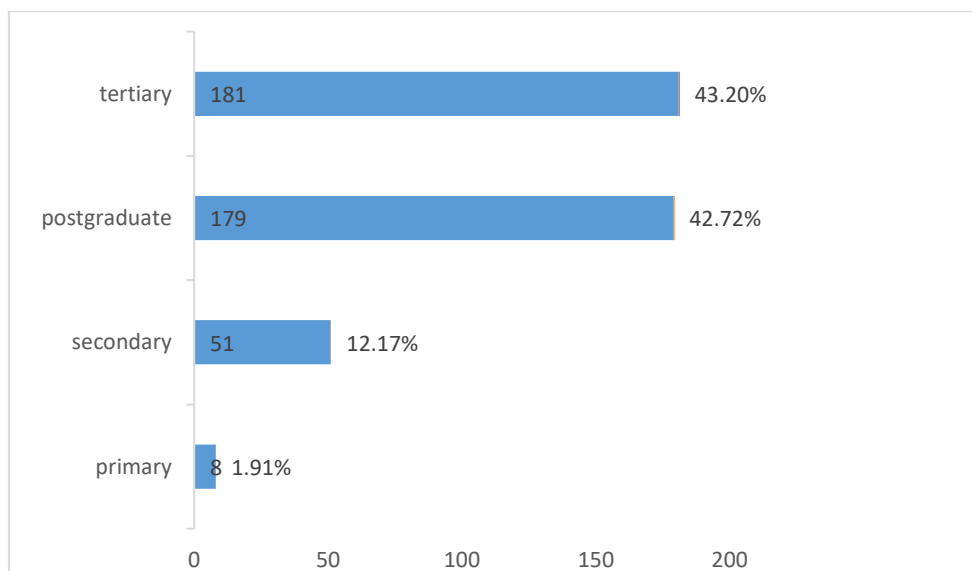


Figure 4: Educational Level of Respondents

The respondents were generally well educated, with 43.3% having tertiary education and 42.6% having postgraduate qualifications.

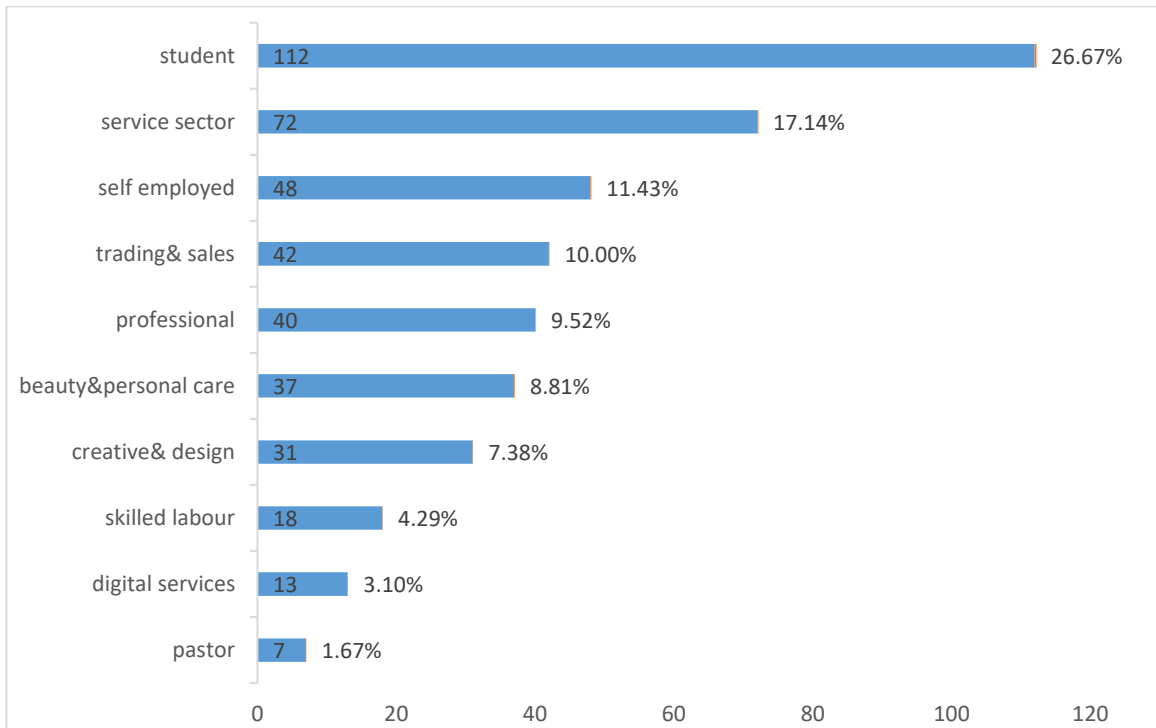


Figure 5: Occupation of Respondents

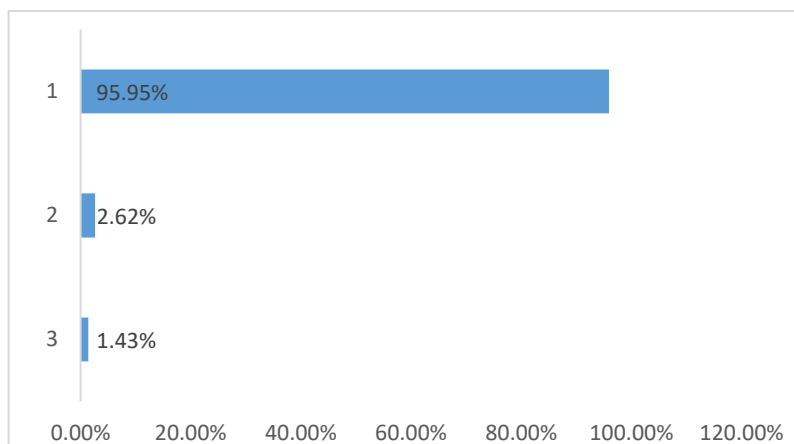


Figure 6: Handedness of Respondents. 1: Right handedness, 2: Left handedness, 3: ambidexterity.

A large proportion, 96% (n = 403), identified as right-handed, while only 4% (n = 17) reported left-handedness or ambidexterity.

Table 1: 2D:4D Ratio of Respondents

Variable	Minimum	Maximum	Mean
Right 2D:4D	0.93	1.05	0.97
Left 2D:4D	0.94	1.03	0.96

The average 2D:4D ratio among the Ikwerre People is 0.97 for right and 0.96 for left.

Table 2: Descriptive Statistics of Personality Traits among the Ikwerre People

Personality Traits	Mean Score Range	Most Frequent Score	Percentage of Respondents at Mode
Extraversion	4 – 20	14	15.0%
Agreeableness	4 – 20	14	14.0 %
Conscientiousness	4 – 20	15	15.7%
Neuroticism	4 – 20	14	15.2%
Openness	4 – 20	14	15.0%

The internal consistency of the personality trait scales was assessed using Cronbach’s Alpha (α). All five subscales demonstrated acceptable levels of reliability, with Cronbach’s alpha values ranging from 0.70 to 0.73. A reliability coefficient of 0.70 or higher is generally considered acceptable (Nunnally

& Bernstein, 1994). Therefore, the scales used for Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness were deemed reliable. The results confirm that the personality measures were internally consistent, allowing the researcher to proceed with inferential analyses confidently.

Table 3: Reliability Statistics for Personality Traits

Personality Trait	Cronbach’s Alpha	Number of Items
Extraversion	0.70	4
Agreeableness	0.71	4
Conscientiousness	0.72	4

Neuroticism	0.73	4
Openness	0.71	4

Correlation analysis was conducted to determine whether relationships existed between the key variables: right-hand 2D:4D ratio, left-hand 2D:4D ratio, and handedness.

Table 4: Correlations of Right 2D:4D, Left 2D:4D and Handedness

Variables		Right_2D:4D	Left_2D:4D	Handedness
Right_2D:4D	r	1.000	0.004	0.062
	p-value		0.938	0.207
Left_2D:4D	r	0.004	1.000	0.027
	p-value	0.938		0.575
Handedness	r	0.062	0.027	1.000
	p-value	0.207	0.575	

The correlation coefficients show that there were no significant relationships among the three variables ($p > 0.05$). The correlation between right and left 2D:4D ratios was virtually zero ($r = 0.004$, $p = 0.938$), suggesting that variations in one hand's digit ratio do not predict variations in the other. Similarly, handedness did not significantly correlate with either

right-hand ($r = 0.062$, $p = 0.207$) or left-hand 2D:4D ratios ($r = 0.027$, $p = 0.575$).

These findings indicate that the degree of finger length ratio and hand preference appear to be independent traits within this population.

Table 5: Correlation Between 2D:4D Ratio and personality traits

Personality Trait	Right_2D:4D (r)	p-value	Left_2D:4D (r)	p-value
Extraversion	-0.028	0.561	0.011	0.817
Agreeableness	-0.006	0.895	-0.041	0.397
Conscientiousness	0.023	0.634	-0.019	0.700

Neuroticism	0.024	0.620	0.049	0.314
Openness	0.012	-0.041	0.805	0.401

Pearson’s Correlation was computed to determine the relationship between 2D:4D ratio and the Big Five personality traits. The Analysis was carried out separately for both right and left hand ratios. The results revealed that none of the correlations reached 0.05 level. The correlation coefficients were generally low and ranged from weak positive to weak negative values.

Multiple regression analysis was conducted to examine whether right-hand 2D:4D ratio, left-hand 2D:4D ratio, and handedness could significantly predict the Big Five personality traits. Each personality dimension served as the dependent variable in separate regression models.

Table 6: Regression Analysis of Digit Ratio, Handedness, and Personality Traits

Personality Trait	R	Adjusted R ²	F	p-value	Std. Error
Extraversion	0.10	0.01	1.48	0.220	3.55
Agreeableness	0.06	0.00	0.53	0.659	3.67
Conscientiousness	0.08	0.01	0.94	0.420	3.57
Neuroticism	0.06	0.00	0.43	0.735	3.66
Openness	0.11	0.01	1.59	0.192	3.45

Table 7: ANOVA Results of Handedness and Personality Traits

Personality Trait	Sum of Squares (Between Groups)	Mean Square	F	Sig. (p-value)
Extraversion	102	51.05	4.11	0.017
Agreeableness	16.34	8.17	0.61	0.545
Conscientiousness	38.60	19.30	1.52	0.220
Neuroticism	17.08	8.54	0.02	0.976
Openness	65.07	32.54	2.74	0.066

DISCUSSION

The present study examined the relationship between handedness, the second-to-fourth digit ratio (2D:4D), and personality traits among the Ikwerre people of Rivers State, with the objective of determining whether these biological markers are associated with the Big Five personality dimensions. Analyses using descriptive statistics, correlation, regression, and analysis of variance provided insight into the extent to which biological factors may be linked to personality expression in this population.

The descriptive results showed that most participants were right-handed, which is in line with global estimates that about 90-95% of individuals are right-handed (Papadatou-Pastou et al., 2020). In this study, more than 95% of participants were right-handed, while only a few were left-handed or ambidextrous. This pattern supports evolutionary explanations of cerebral lateralisation, which propose that right-handedness became dominant alongside the development of language and fine motor control in the left hemisphere (Corballis, 2014). However, the very small number of left-handed participants reduced the statistical power to identify possible handedness-related differences.

The mean 2D:4D ratios for both hands were approximately 0.96, which is consistent with values reported in earlier studies (Manning et al., 1998). The 2D:4D ratio has often been used as a putative indicator of prenatal androgen exposure, with lower values suggesting higher prenatal testosterone and higher values indicating relatively greater oestrogen exposure (Lutchmaya et al., 2004). These hormonal influences have been associated with behavioural tendencies such as assertiveness and risk-taking, as well as empathy and emotional sensitivity (Manning & Taylor, 2001; Hönekopp & Watson, 2011). Even so, the present findings suggest that, within the Ikwerre population, 2D:4D ratios are not meaningfully associated with personality traits as measured by the Big Five model.

Correlation analysis showed no significant relationships between 2D:4D ratios on either hand and any of the Big Five personality traits. Likewise, no significant association was found between digit

ratio and handedness. These findings indicate that digit ratio is not a dependable predictor of personality traits in this sample and are consistent with earlier reports of weak or inconsistent relationships between these variables (Voracek & Dressler, 2006). The lack of significant associations may reflect the complex nature of personality, which is influenced by biological, environmental, and cultural factors rather than a single biological marker (McCrae & Costa, 2008).

Regression analysis further supported this interpretation, showing that 2D:4D ratios and handedness accounted for less than one percent of the variation in personality traits ($R^2 < 0.01$). This means that these biological variables contributed very little to explaining personality differences in this population. Nevertheless, a slight pattern was observed for handedness, as left-handed participants tended to score somewhat higher in Openness to Experience and Extraversion. Although these differences were small, they may reflect variations in cognitive processing related to hemispheric organization. Similar findings have been reported in previous research suggesting that left-handed individuals may show greater creativity and cognitive flexibility, traits associated with Openness (Nicholls et al., 2010).

The analysis of variance revealed that handedness had a statistically significant effect on Extraversion ($p = 0.017$) and a borderline effect on Openness ($p = 0.066$). These findings, however, should be interpreted cautiously because of the very small number of left-handed participants. The tendency for left-handers to score higher in Openness may also be influenced by environmental adaptation, since left-handed individuals often function in a world designed primarily for right-handers, which may encourage adaptability and unconventional thinking (Papadatou-Pastou et al., 2020).

No significant relationships were observed between 2D:4D ratios or handedness and the traits of Agreeableness, Conscientiousness, or Neuroticism. This suggests that these traits may be more strongly shaped by environmental and cultural influences than by biological markers. In the Ikwerre setting, where communal values, social harmony, and

respect for social norms are emphasized, traits such as agreeableness and conscientiousness may be largely shaped through socialisation processes (Triandis, 1995).

The reliability analysis of the Big Five questionnaire showed acceptable internal consistency, with Cronbach's alpha values ranging from 0.70 to 0.73 (Nunnally & Bernstein, 1994). This indicates that the instrument was suitable for the study population and suggests that the absence of significant findings was not due to measurement error.

Overall, the findings indicate that biological variables such as digit ratio and handedness have minimal influence on personality traits among the Ikwerre people. This supports the broader view that personality develops through a complex interaction between biological predispositions and environmental influences (McCrae & Costa, 2008).

When compared with previous studies, the findings show both similarities and differences. Earlier research reported weak associations between 2D:4D ratios and traits such as dominance and sensation seeking (Manning & Taylor, 2001; Austin et al., 2002), whereas more recent meta-analyses have shown that these relationships are inconsistent and often not replicable (Hönekopp & Watson, 2011; Voracek & Dressler, 2006). The present study aligns with these later findings and reinforces the view that digit ratio is not a strong predictor of personality traits.

Regarding handedness, previous studies have produced mixed outcomes. Some research has suggested that left-handers display higher creativity and openness (Nicholls et al., 2010), while others have found no consistent personality differences between handedness groups (Papadatou-Pastou et al., 2020). The present study offers limited support for the former view, as left-handers showed slightly higher scores in Openness and Extraversion, although the effects were small.

Importantly, this study adds to the limited literature on biological correlates of personality in African populations. The findings are consistent with socio-cultural perspectives that emphasize the role of communal values and socialisation in shaping

personality (Triandis, 1995). In such contexts, individual differences may be less pronounced because strong cultural norms encourage behavioural conformity.

CONCLUSION

From the findings of this study, it is concluded that there is no significant association between digit ratio (2D:4D), handedness, and personality traits among the Ikwerre people of Rivers State. Although handedness showed a slight influence on Extraversion and Openness to Experience, the overall predictive power of both handedness and 2D:4D ratio on personality traits was negligible. These findings suggest that the biological factors examined do not substantially shape personality patterns in this population, indicating that personality is more likely influenced by other factors, such as environmental and socio-cultural variables.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this study.

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