

## Research Article

# Differential and interactional influence of socio-demographic variables on intellectual ability

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Intellectual ability, also known as intelligence, is a multifaceted construct that is typically measured through intelligence tests. The importance and complexity of intellectual ability have made it of significant interest to researchers and educators. This is coupled with the fact that it is one phenomenon that is influenced by a variety of factors. This prompted the study that sought to investigate the differential and interactional influences of gender, age, education, and ethnicity on intellectual ability in Rivers State Nigeria. The study employed the analytic descriptive survey design with a sample of 390 that was randomly drawn using a stratified sampling technique. A test of general reasoning ability, which is a standardized test, was used to elicit data on the variables of the study. Validity and high reliability coefficients were obtained for the instrument. Data were analysed using mean, standard deviation, t-test, one-way, and three-way ANOVA. The result showed that age and ethnicity had a significant influence on intellectual ability, but gender and educational level did not have a significant influence. Gender, age, and educational level did not have significant interactional influences as well. It was recommended that investing in education, particularly in the early years, can have lasting benefits for cognitive and intellectual ability development.

Keywords: Intellectual ability; Gender; Age; Education; Ethnicity

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## 1. Introduction

Intellectual ability, also known as cognitive ability or intelligence, is a multifaceted construct that has been of interest to researchers and scholars for centuries. It is a broad term that refers to the mental capacity to learn, reason, and solve problems. It is a complex construct that encompasses a range of cognitive skills, including memory, attention, language, critical thinking, and problem-solving. Intelligence is the ability to derive information, learn from experience, adapt to the environment, understand, and correctly utilize thought and reason (American Psychological Association [APA], 2020). It is a very general mental capability that among the other things, involves the ability to resume, plan, solve problems, think abstractly, comprehend complex ideas, quickly learn from experience. (Gottfredson, 1997)

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Intellectual ability or intelligence is typically measured through intelligence tests. There is a significant body of research demonstrating the importance of intellectual ability in a number of domains. For example, studies have consistently found that individuals with higher levels of intelligence tend to have better academic outcomes, including higher grades, test scores, and graduation rates (Deary et al., 2007; Hegelund et al., 2018; Hegelund et al., 2020; Jensen, 1998; Roth et al., 2015; Strenze, 2007). Additionally, intelligence is strongly correlated with job performance, with research indicating that individuals with higher levels of intelligence are more likely to perform well in their jobs and have higher levels of job satisfaction and higher adult financial well-being (Furnham & Cheng, 2016, 2017; Hunter & Schmidt, 1996; Kuncel & Hezlett, 2010; Schmidt & Hunter, 1998).

Intellectual ability has also been found to be related to social outcomes. For instance, research has found that individuals with higher levels of intelligence tend to have better interpersonal skills and are more likely to form and maintain close relationships (Deary, 2001). There is also evidence to suggest that intelligence is related to overall financial well-being, physical and mental health (Furnham & Cheng, 2016, 2017; Gale et al., 2012; Wrulich et al., 2014). They are also more likely to have a positive outlook on life and to be more resilient in the face of stress and adversity (Sternberg, 2003).

Overall, the research suggests that intellectual ability is an important predictor and positively associated with a range of outcomes, such as educational (Ceci, 1991; Clouston et al., 2012; Deary et al., 2007; Hedden & Gabrieli, 2004; Hegelund, et al., 2018; Hegelund et al., 2020; Jensen, 1998; Ritchie & Tucker-Drob, 2018; Roth et al., 2015; Strenze, 2007), physical, financial and mental health (Furnham & Cheng, 2016; Gale et al., 2012; Sternberg, 2003; Wrulich et al., 2014), longevity (Calvin et al., 2017; Christensen et al., 2016), performance at work, occupational health and job satisfaction and financial well-being (Calvin et al., 2017; Furnham & Cheng, 2016, 2017; Kuncel & Hezlett, 2010), and other areas like administration and governance, marriage, family life and the likes

The importance and complexity of intellectual ability has made it of significant interest to researchers and educators. This is coupled with the fact that it is one phenomenon that is influenced by a variety of factors which can impact its influences and effects on other phenomenon in different ways and to varying degrees. Research has consistently revealed that genetic and environmental factors like socio-demographic factors play significant roles in intellectual abilities. Socio-demographic variables play a crucial role in understanding and analysing the diverse characteristics of individuals. Socio-demographic variables encompass a range of factors that capture an individual's social and demographic characteristics. These variables include but are not limited to age, gender, race, ethnicity, socioeconomic status, parental education level, and cultural background. Each of these variables contributes unique information about individuals. By examining socio-demographic variables, researchers can gain valuable insights into patterns, trends, and disparities across different groups, leading to a better understanding of individuals. Literature has shown that each of these variables has been found to be associated with intellectual ability, either independently or through their interactions. Specifically, it is influenced by a range of factors including age, education, gender, ethnicity, personality, socio-economic status just to mention but a few (Plomin et al., 2008).

### **1.1. Age and Intellectual Ability**

Age is one factor that can influence intellectual ability. It is a measure of the time that an individual has been alive, typically measured and expressed in years. The relationship between age and intellectual ability is complex and varies depending on the specific cognitive domain being measured and the age range being considered. Research has shown that intellectual and cognitive function tends to increase during childhood and adolescence before peaking in the late teenage years or early 20s, and then declining slightly in later life (Gow, 2016; Hedden & Gabrieli, 2004; Salthouse, 2010). This is thought to be due to the gradual loss of neurons and the brain's declining ability to regenerate new ones. However, there is significant variability in the rate of

intellectual development and decline among individuals, and factors such as genetics, health and lifestyle, and environmental influences can influence the rate of decline (Hedden & Gabrieli, 2004; Park & Reuter-Lorenz, 2009; Salthouse, 2010).

Research suggests that engaging in complex cognitive activities may slow the rate of decline in cognitive function (Wilson et al., 2002). Therefore, while age is an important factor, the relationship between age and intellectual ability is complex and influenced by a range of other factors (Cockburn & Smith, 1991; Hedden & Gabrieli, 2004; Park & Reuter-Lorenz, 2009; Salthouse, 2010; Schaie, 1996; Wilson et al., 2002). Overall, the research suggests that age is a significant factor that can influence intellectual ability, but the relationship between age and intellectual ability is complex and influenced by a range of other factors.

## 1.2. Gender and Intellectual Ability

One other factor that has long been thought to potentially influence intellectual ability is gender. Gender is the set of social, cultural, and psychological characteristics associated with being male or female. There have been numerous debates and discussions throughout history about whether men and women differ in their intellectual abilities and, if so, to what extent (Lippa, 2005). In the past, some people believed that men were inherently more intelligent than women. This belief was often used to justify the exclusion of women from education and certain occupations (Sadker & Sadker, 1994). In the 19th and early 20th centuries, for example, women were often discouraged from pursuing careers in science, math, and other fields that were seen as requiring high levels of intelligence (Schiebinger, 1999). However, as research on intelligence and sex differences has progressed, so has understanding of the relationship between gender and intellectual ability changed. (Halpern, 2000). Large body of research has shown that men and women do not differ significantly in their overall intellectual abilities. That is most researches on sex difference and intelligence have posit that gender differences were either the same or so negligibly small and that no significant difference exists between male and female on intelligence test (Brody 1992; Herrnstein & Murray, 1994).

This consensus was disputed by Lynn (1994), who advanced a developmental theory of sex differences in intelligence stating that while there is virtually no sex difference up to the age of 16 years, from this age onwards males develop an advantage that increases with age reaching approximately 4 IQ points among adults (Lynn, 1994). Further data documenting this male advantage was given in Lynn (1998), Lynn (1999), Lynn et al., (2000), Lynn and Tse-Chan (2003), Lynn, et al., (2004), Colom and Lynn (2004), Irwing and Lynn (2005) and in a meta-analysis of sex differences on by Lynn and Irwing (2004) concluding that among adults' males obtain a 5 points higher IQ than females. This is also followed by the research findings of Lynn and Kanazawa (2011) in which results show that at the ages of 7- and 11-years girls have an IQ advantage of approximately 1 IQ point, but at the age of 16 years this changes in the same boys and girls to an IQ advantage of 1.8 IQ points for boys. These findings seem to be supported by the result from Nyborg (2005) and Jackson and Rushton (2006) and Lemos et al. (2013) whose studies showed sex difference in intelligence. However, significant portion of research findings have constantly revealed that no significant sex difference exists between male and female intellectual ability (Anderson, 2004; Aluja-Fabregat et al., 2000; Butterworth, 1999; Carretta & Ree 1997; Cooper, 2015; Colom, et al., 2000; Colom & Garc'ia-L'opez 2002; Colom et al., 2002; Dolan et al., 2006; Deary et al., 2007; Flynn, 1998; Haier, 2007; Halpern & LaMay, 2000; Halpern, 2000, 2007; Hyde et al., 1990; Hines, 2007; Hyde et al., 1990; Jensen, 1998; Keith et al 2008; Mackintosh, 2011; Naderi et al., 2008; Ritchie, 2015; Speke, 2007; van der Sluis et al., 2006; Voyer et al., 1995).

Research has also shown that, when other factors such as education and socio-economic status are controlled for, men and women perform similarly on a wide range of cognitive tasks (Davies et al., 2005). It is therefore important to note that any observed differences in intellectual ability between men and women may be influenced by a variety of other factors, such as education, socio-economic status, societal and cultural expectations. For instance, societal and cultural factors, such

as gender roles and stereotypes, can influence the development of intellectual ability. Also these stereotypes, discrimination, bias and societal expectations can act as barriers to education and career advancement for certain groups especially females and also from pursuing certain fields of study (Casad et al., 2017; Schiebinger, 1999; Shapiro & Williams 2005). They can shape the expectations and opportunities that are available to men and women. For example, women may score lower on certain cognitive tests due to a lack of access to education. As earlier stated, the debate as to whether men and women differ in their intellectual abilities and, if so, to what extent is one that is still ongoing in the research community. However, more research is needed to establish more conclusive positions especially from areas and regions of the world where evidence of sex difference in intellectual abilities is scarce and also in relation to its interaction with other factors that may influence the difference if at all one is observed.

### **1.3. Education and Intellectual Ability**

Education is another factor that may influence intellectual ability. It is a broad term that can encompass many different types of learning, including formal schooling, informal learning, and experiential learning. It is also the process of acquiring knowledge, skills, values, beliefs, and habits through formal and informal learning experiences. Education exposes individuals to a wide range of stimuli and challenges that stimulate the brain and promote intellectual and cognitive development. Through interactions with teachers and peers, and exposure to diverse ideas and concepts, individuals are able to develop higher-order thinking skills and knowledge that are essential for intellectual ability. That is, educational experiences can provide individuals with the knowledge, skills, and critical thinking abilities that are necessary for success in a variety of cognitive and intellectual tasks. It plays a pivotal role in shaping the cognitive skills, knowledge, and critical thinking abilities of individuals. Within the framework of the International Standard Classification of Education [ISCED] by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO, 2011), levels of education are an ordered set of categories, intended to group educational programs in relation to gradations of learning experiences and the knowledge, skills and competencies which each program is designed to impart. Levels of education are therefore a construct based on the assumption that education programs can be grouped into an ordered series of categories. These categories represent broad steps of educational progression in terms of the complexity of educational content. The more advanced the program, the higher the level of education. In most countries of the world, specifically in Nigeria, the educational levels are; the Primary and Secondary Education level which leads to the award of Senior School Certificate [SSC] or the West African Senior School Certificate [WASSC], the tertiary Education level which consist of the undergraduate education that leads to the award of a B.Sc. and post graduate education that climax in a Ph.D. certificate

Education is a crucial factor in the development of intellectual ability. Research has consistently demonstrated the positive relationship between education and intellectual ability. Higher levels of education are associated with better intellectual and cognitive skills, higher levels of knowledge, and improved critical thinking abilities. Higher levels of education are often associated with better cognitive skills and performance on intelligence tests. The review of the literature suggests that education has a significant influence on intellectual ability (Ceci, 1991; Clouston et al., 2012; Deary et al., 2007; Deary & Johnson 2010; Furnham & Cheng, 2017; Halpern, 1998; Hegelund et al., 2018; Hegelund, et al., 2020; Jensen, 1998; Kocaöz & Yalçın, 2022; Roth et al., 2015; Strenze, 2007). Generally, the literature review suggests that education influences intellectual ability. However, more research is needed to fully understand other underlying mechanisms that drive the relationship between education and intellectual ability. This includes examining the influence of other factors in addition to education that may influence intellectual ability.

#### 1.4. Ethnicity and Intellectual Ability

The issue of the influence of ethnicity on intellectual ability is a complex one. Ethnicity is a social identity based on shared ancestry, culture, and experiences. It is a multifaceted idea, which figures the identity of an individual through kinship, religion, language, shared territory and nationality, and physical appearance. (Dein 2006; Mateos 2007). Ethnicity as a concept involves some form of identification, individual identify themselves as belonging to a certain group and the group recognizes individual as belonging to that group (Ogbogo & Opara, 2019). Different parts of the world usually have majority ethnic group as well as minority ethnic groups. Ethnicity is often considered as a potential factor that may impact intellectual ability, but research on this topic has a long and controversial history.

Early intelligence research, which dates back to the early 20th century, often found evidence of differences in intelligence test scores between racial and ethnic groups. The debate and controversies on intellectual ability and ethnicity became worldwide in scope when it was shown that East Asians scored higher on IQ tests than did Whites, both within the United States and in Asia, even though IQ tests were developed for use in the Euro American culture (Rushton & Jensen, 2005). Around the world, the average IQ for persons from East Asians, United States and sub-Saharan Africa differs (Furnham et al., 2010; Jensen, 1998; Lynn & Vanhanen, 2002; Rushton, 2000; Rushton, & Jensen, 2005). Lynn's (1991) review of 11 studies in sub-Sahara Africa also revealed different IQ scores for the persons in the sub-Sahara African and other parts of the world. Also, review of over two dozen studies by Lynn and Vanhanen (2002) found same average IQ scores for persons from West, Central, East, and Southern Africa against a different IQ score from those from the US. The same difference in IQ between persons from different nations were obtained from the study of Glewwe and Jacoby (1992), Sternberg et al. (2001), Zindi (1994), Owen (1992), Grieve and Viljoen (2000), Skuy et al. (2001), Zaaiman et al. (2001), Rushton and Skuy (2000), and Skuy et al. (2002).

Although it has been reported that some of the differences in intelligence test scores between racial and ethnic groups may be due to biases in the tests themselves. These biases may be related to the cultural experiences and backgrounds of the test takers, or to the ways in which the tests are designed and administered. Report has also noted that these differences are often small and may be influenced or due to a variety of factors such as access to education and socio-economic status, gender, nutrition, and other resources, as well as cultural values and beliefs about the importance of intellectual development. Proceeding discuss suggest that ethnicity may play a role in intellectual abilities, it is not the only factor, and further research is needed to understand the complex interactions between ethnicity and other factors like educational level, age and gender.

#### 1.5. The Present Study

Understanding the factors that influence intellectual ability is important for a variety of purposes one of which is that it has major influence on the outcome on domains like education, occupation health, longevity, marriage and the likes as has been evidenced by research from preceding discuss. The influence of age, gender, and ethnicity on intellectual ability is a topic that has garnered significant attention in the field of psychology and education as can be deduced from research evidence in preceding discuss. While it is widely acknowledged that these factors can have some impact on intellectual ability, the extent to which they do so is still a subject of debate. Further research is needed to better understand the complex interactions between these factors and the ways in which they may influence intellectual abilities. Also, researches on the influence of gender, age, ethnicity and educational level on intelligence about sex differences are based almost exclusively on results from modern western societies. It does not take account of the possibility that there could be systematic differences between countries with different school systems, cultural traditions, and gender roles especially in Sub Sahara regions like Nigeria. Thus, there is an urgent need to expand the evidence base on which policies and decisions about the influence of these variables on intelligence are built by including results from regions that are not in literature. All

these created a gap that needed to be filled. The foregoing is where the significance of this study lies as well as its contribution to knowledge. That is, it is significant and contributes to knowledge by clarifying the extent of influence that age, gender, educational level, and ethnicity have on intellectual ability. Furthermore, it expands the evidence base beyond Western societies and fills a gap in understanding, providing valuable insights for future research, policies, and decision-making in the field of intelligence and socio-demographic factors. These were what necessitated this research which is aimed at investigating the differential and interactional influences of socio-demographic factors of age, gender, educational level and ethnicity on intellectual ability. The following research questions guided the study;

RQ 1) Is there a significant influence of gender on intellectual ability?

RQ 2) Is there any significant influence of age on intellectual ability?

RQ 3) Is there any significant influence of educational level on intellectual ability?

RQ 4) Does ethnicity have any significant influence on intellectual ability?

RQ 5) Is there any significant interaction influence of age, gender, educational level and ethnicity on intellectual ability?

## 2. Methodology

### 2.1. Research Design

The research design was the descriptive survey. Within this design, the analytic descriptive design was employed. This design is suitable when comparisons are to be made between various strata of a sample for the variables that are being studied (Nwankwo, 2013).

### 2.2. Participants

The population of the study covers all male and female from primary, secondary and tertiary educational level with age ranges from 10 to 31years above from both minority and majority ethnic groups in Port Harcourt Metropolis, Rivers State. Through disproportionate stratified random sampling technique, a sample of 380 was drawn to cover four age groups (10- 20yrs, 21- 30yrs, 31- 40, 40 above), gender (male and female), two ethnic category (minority and majority) and three educational levels (primary, secondary and tertiary) (see Table 1).

Table1

*Demographic information of the sample for the study*

<i>Demographic Information</i>	<i>N</i>	<i>%</i>
Gender		
Male	134	34
Female	256	66
Age		
10-20yrs	134	34
21-31yrs	163	42
31-40yrs	40	10
41yrs Above	53	14
Ethnicity		
Majority	256	66
Minority	134	34
Educational Levels		
SSC/WASSC	236	60
B.SC	135	35
MSC& Ph.D	19	5

The study sample comprised 390 participants, out of these, 134 participants identified as male, constituting approximately 34% of the total sample, while 256 participants identified as female, representing 66% of the total sample. The age distribution of the participants in the study showed

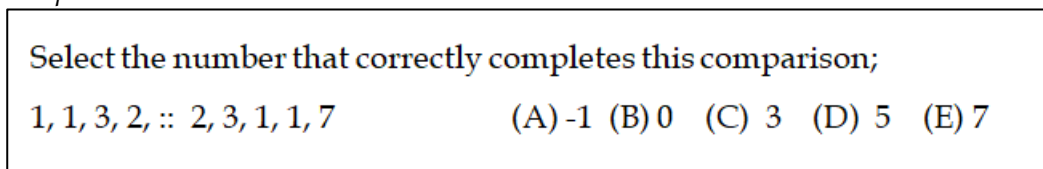
that 10-20 years had 134 participants representing 34%, 21-31 years had 163 participants representing 42%, 31-40 years has 40 participants representing 10% and participants 41 years and above were 53 participants representing 14%.

### 2.3. Instrument for Data Collection

The instrument for data collection was the Test of General Reasoning Ability [TOGRA] by Reynold (2014), the TOGRA is a speeded measure of reasoning and intellectual abilities as well as problem-solving skills. It consists of items that assess verbal skills, nonverbal skills, quantitative reasoning, and problem-solving skills through tasks that are inductive and deductive in nature. The Test of General Reasoning Ability (TOGRA) is a flexible and effective assessment that measures general reasoning and problem-solving skills in about 16 minutes and is scored in 2 to 3 minutes. It can be administered to an individual or to groups in a variety of settings. It contains 60 items with each items containing options lettered A-E. TOGRA items are dichotomously scored with the right answer scored 1 and the wrong answers scored 0. It is a timed test designed for individuals aged 10 to 75 years. Figure 1 shows a sample of item from the test.

Figure 1

Sample item



TOGRA have internationally been acclaimed validity. TOGRA was standardized on a sample of 3,013 individuals in US. The test has .75 to .95 as construct validity via correlation with another test (RAIT), (WISC-IV), (WAIS-IV), (RIAS), Wonderlic, (Beta III), (WRAT), (TIWRE).

The reliability for TOGRA as reported by Reynold (2014) ranges from 0.74 to 0.99 from ages 10 to 75 for test-retest reliability, .87 to .94 from ages 10 to 75 for Cronbach alpha reliability, .85 to .94 for alternate form reliability. Although the above instrument has known reliabilities, the researcher however carried out a pilot study. Thus, the reliability of the instrument was reestablished through pilot testing. The reliability of the instrument was established using various reliability methods, Parallel form yielded a coefficient of .617; split-half reliability analysis yielded a coefficient of .677 while Cronbach alpha yielded a coefficient of .904.

### 2.4. Data Analysis

TOGRA was administered to the respondents directly. Ethics was taken into consideration in the course of this research. Respondents were duly briefed on the research and the instruments they were going to respond to. They gave their consent by filling an informed consent form. Respondents were assured of their privacy by telling them that the information provided would be kept confidential and strictly used only for research purpose. Furthermore, the coded information was kept on computers accessible only to the researchers and protected with a security system to prevent unauthorized access to the collected data. Data obtained was cleaned. Normality test was carried out on the data. The test showed skewness coefficient to be .97 while the kurtosis coefficient was .743. This test result showed that the distribution for the study did not fall outside the range of normality, so the distribution was considered normal. These statistical data depict the normal distribution of the scores (Byrne 2010; George & Mallery, 2010; Hair et al., 2010, 2022; Tabachnick & Fidell, 2013). The data for the study fulfilled the assumption of normal distribution, thus mean, standard deviation, independent samples t-test, one way, and three-way ANOVA was used to analysed the data. All these analyses were conducted through Statistical Package for the Social Sciences (SPSS) version 21.

### 3. Results

#### 3.1. Result on the Influence of Gender on Intellectual Ability

Table 2 shows the result of independent samples t-test analysis of influence of gender on intellectual ability

Table 2

*Independent samples t-test results of influence of gender on intellectual ability*

Gender	N	Mean	SD	df	t	Sig.	Decision
Male	134	20.30	11.68	388	1.121	.263	Accept Ho <sub>1</sub> $p > .05$
Female	256	19.02	10.18				

The table reveals that the males have a mean score of 20.30 representing their intellectual ability while the females have 19.02 representing their intellectual ability. The difference in the means scores of these groups shows that on the average, the intelligence of male and female differs as represented by their IQ scores on the intelligence test administered. A comparison of these two means shows there is difference between the mean score of male and female. The difference which is higher for the male as seen by the mean of 20.30 to the mean score of females which was 19.02, reveals that on the average, the IQ of males are slightly higher than female as there is a mean difference of 1.28.

The table reveals as well shows that  $t(388) = 1.121$   $p > .05$ , i.e.,  $p = .263$  is greater than .05 and this is statistically not significant at the chosen alpha level of .05. This implies that though there is a difference in the average IQ scores of male and female persons in Port Harcourt metropolis, this difference is not statistically significant.

#### 3.2. Result on the Influence of Age on Intellectual Ability

Table 3 shows the result of one-way ANOVA analysis analysis of influence of age on intellectual ability

Table 3

*One-way ANOVA analysis of influence of age on intellectual ability*

Age	N	Mean	SD	df	Mean Square	F	Sig.	Decision
10-20yrs	134	20.51	10.23	3.386	112.366	4.188	.006	Reject Ho <sub>1</sub> $p < .05$
21-30yrs	163	20.53	11.87					
31-40yrs	40	16.00	8.277					
41 above	53	16.11	8.681					

As shown by the mean scores of 20.51, 20.53, 16.00 and 16.11, persons between the ages of 10-20, 21-30, 31-40 and 40 years above have varying levels of intelligence. The varying intelligence scores shows there is a difference in the intellectual ability and invariably intelligence of persons across the different age groups covered in this study. Persons between the ages of 10-20 and 21-30 had almost identical average intelligence score (mean 20.51 and 20.53 respectively). This was also same for persons between 31-40 and 40 above (16.00 and 16.11 mean scores, respectively). A comparison of the means of these four age groups shows there is difference between the mean score of these groups. The difference in the means scores of these groups shows that on the average, the intelligence of persons across these age groups differs as represented by their IQ scores on the intelligence test administered. As shown by the mean score of 20.5 compared to 16.00 for those between the ages of 31-41 and above, the difference was greater among persons between the ages of 10-30. This indicates that on the average, the intelligence of persons aged 10-30 is higher than persons from age 31-40 and above for persons in Port Harcourt metropolis.

The table reveals as well shows that the computed  $F(3, 388) = 4.188$ ,  $p < .05$ , i.e.,  $p = .006$ , i.e.,  $p = .006$  is less than .05 and this is statistically significant at the chosen alpha level of .05. This implies that there is a difference in the average IQ scores of persons between age 10-20, 21-30, 31-



40 and 40 above and this difference is statistically significant. That is statistical evidence shows that the difference observed between these age groups average intelligence is not due to chance occurrence.

### 3.3. Result on the Influence of Educational Qualification on Intellectual Ability

Table 4 shows the result of one-way ANOVA analysis of influence of educational qualification on intellectual ability.

Table 4

*Mean, SD and One-way ANOVA Analysis of influence of educational level on intellectual ability*

<i>Edu Level</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>	<i>Decision</i>
SSC	236	19.94	10.89					
B.Sc.	135	18.14	11.08	2.387	249.706	2.182	.114	Accept Ho <sub>1</sub> $p > .05$
Ph.D.	19	22.78	12.3					

Note. SSC: Senior School Certificate

Table 4 reveals that persons with SSC, B.Sc.s. and Ph.Ds. have varying intelligence scores represented by the mean scores of 19.94, 18.14, and 22.78 respectively. The varying intelligence scores shows there is a difference in the intellectual ability and invariably intelligence of persons from the three educational levels covered in this study. Persons with SSC educational level had average mean score of intelligence, 20.51, while persons with B.Sc. had a mean score of 18.14 and those with Ph.D. 22.78. The difference in the means scores of these groups shows that on the average, the intelligence of persons across these educational levels differs as represented by their IQ scores on the intelligence test administered. A comparison of these means shows there is difference between the mean score of these three educational levels. The difference was higher for persons from educational level with Ph.D. generally as seen by the mean score of 22.78 and lowest for persons with B.Sc., 18.14. This indicates that on the average, the intelligence of persons with Ph.D. educational level is higher than persons with B.Sc. and SSC in Port Harcourt metropolis.

The table reveals as well shows that the computed  $F(2, 387) = 2.182$ ,  $p < .05$ , i.e.,  $p = .114$ , i.e.,  $p = .114$  is greater than .05 and this is statistically not significant at the chosen alpha level of .05. This shows that there is no difference in the average IQ scores of persons from SSCE, B.Sc.s. and Ph.D. educational level and this difference is statistically not significant.

### 3.4. Result on the Influence of Ethnicity on Intellectual Ability

Table 5 shows the result of independent samples t-test analysis of influence of ethnicity on intellectual ability

Table 5

*Independent samples t-test analysis of influence of ethnicity on intellectual ability*

<i>Ethnicity</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>Sig.</i>	<i>Decision</i>
Minority	134	18.59	9.891	388	2.215	.027	Reject Ho <sub>1</sub>
Majority	256	21.11	12.03				$p < .05$

According to Table 5, people from minority ethnic groups had a mean score of 18.59, while people from majority ethnic groups had a mean score of 21.11. The difference in the means scores of these groups shows that on the average, the intelligence of persons from the both ethnic groups differ as represented by their IQ scores on the intelligence test administered. A comparison of these two means shows there is difference between the mean score of these two ethnic groups. The difference which is higher for the majority ethnic as seen by the mean score of 21.11 reveals that on the average, the IQ of majority ethnic groups are slightly higher than the minority group as there is a mean difference of 2.52.

It also shows that  $t(388) = 2.215$ ,  $p < .5$ , i.e.,  $p = .027$  which is statistically significant at the chosen alpha level of 0.05. This implies that the difference in the average IQ scores of minority and majority ethnic groups in port Harcourt metropolis is statistically significant.

### 3.4. Result on the Influence of Ethnicity on Intellectual Ability

Table 5 illustrates the t-test results for independent samples on the influence of ethnicity on intellectual ability.

Table 5

*Independent samples t-test analysis of influence of ethnicity on intellectual ability*

<i>Ethnicity</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>Sig.</i>	<i>Decision</i>
Minority	134	18.59	9.891	388	2.215	.027	Reject Ho <sub>1</sub>
Majority	256	21.11	12.03				$p < .05$

Those from minority ethnic groups had a mean score of 18.59 representing their intellectual ability, while those from majority ethnic groups had a mean score of 21.11. The difference in the means scores of these groups shows that on the average, the intelligence of persons from the both ethnic groups differ as represented by their IQ scores on the intelligence test administered. A comparison of these two means shows there is difference between the mean score of these two ethnic groups. The difference which is higher for the majority ethnic as seen by the mean of 21.11 to the mean score of the minority ethnic group which was 18.59, reveals that on average, the IQ of majority ethnic groups is slightly higher than the IQ of minority ethnic groups, with a mean difference of 2.52.

The table reveals that  $t(388) = 2.215$ ,  $p < .5$ , i.e.,  $p = .027$  is less than .05. This implies that the difference in the average IQ scores of minority and majority ethnic groups in port Harcourt metropolis is statistically significant.

### 3.5. Result on the Interaction Influence of Age, Gender, and Educational Level on Intellectual Ability

Table 6 shows the result of analysis of influence of ethnicity on intellectual ability.

Table 6

*Results on the interaction influence of age, gender, and educational level on intellectual ability*

<i>Gender</i>	<i>Age</i>	<i>Edu Level</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>N</i>
Male	10-20YRS	SSC	23.58	11.24	31
		BSC	12.00	.	2
		PHD		.	
		Total	23.36	11.10	33
	20-30YRS	SSC	27.48	13.35	27
		BSC	17.18	11.14	33
		PHD	20.50	14.84	2
		Total	21.77	13.06	62
	30-40YRS	SSC	14.66	4.72	3
		BSC	16.44	9.36	9
		PHD	8.50	2.12	2
		Total	14.92	8.10	14
	40ABOVE	SSC	13.50	7.89	12
		BSC	16.44	9.38	9
		PHD	20.25	3.50	4
Total		15.64	8.09	25	
Total	SSC	23.00	12.36	73	
	BSC	16.82	10.29	52	
	PHD	18.55	8.45	9	
	Total	20.3060	11.68781	134	

Table 6 continued

<i>Gender</i>	<i>Age</i>	<i>Edu Level</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>N</i>
Female	10-20YRS	SSC	19.64	9.76	87
		BSC	17.38	8.20	13
		PHD	43.00	.	1
		Total	19.58	9.80	101
	20-30YRS	SSC	19.43	11.39	48
		BSC	20.35	11.01	51
		PHD	13.50	4.94	2
		Total	19.78	11.09	101
	30-40YRS	SSC	14.00	7.27	10
		BSC	15.30	7.07	13
		PHD	30.66	4.04	3
		Total	16.57	8.46	26
	40ABOVE	SSC	13.72	4.61	18
		BSC	18.66	7.50	6
		PHD	26.00	19.71	4
		Total	16.53	9.30	28
	Total	SSC	18.58	9.91	163
		BSC	18.97	9.91	83
		PHD	26.60	14.47	10
		Total	19.02	10.18	256
Total	10-20YRS	SSC	20.67	10.27	118
		BSC	17.00	8.00	14
		PHD	35.50	10.60	2
		Total	20.51	10.23	134
	20-30YRS	SSC	22.33	12.66	75
		BSC	19.10	11.10	84
		PHD	17.00	9.89	4
		Total	20.53	11.87	163
	30-40YRS	SSC	14.15	6.59	13
		BSC	15.77	7.89	22
		PHD	21.80	12.51	5
		Total	16.00	8.27	40
	40ABOVE	SSC	13.63	6.00	30
		BSC	17.33	8.46	15
		PHD	23.12	13.46	8
		Total	16.11	8.68	53
	Total	SSC	19.94	10.89	236
		BSC	18.14	10.08	135
		PHD	22.78	12.39	19
		Total	19.46	10.72	390

The interaction influence of gender, age and educational level is presented in Table 6. It shows that the most influential interaction was for female between 30-40yrs with Ph.D. educational qualification with an average intelligence mean score of 30.66. This is followed by that of male, aged 20-30yrs with SSCE with a mean score of 27.48, followed by that of male, aged 20-30yrs with SSC with a mean of 27.48, then female who are 40yrs with Ph.D. educational qualification with an average intelligence mean of 26.00. This is followed by male, aged 10-20yrs with SSCE with a mean of 23.5, followed by female, aged 20-30yrs with B.Sc. with a mean of 20.35. This followed by the interaction of male jointly from 31-40 and 40years above with Ph.D. with the same mean of 20.25, then that of female, aged 10-20yrs with SSC with a mean of 19.64, then female aged 20-30yrs with SSCE with a mean of 19.43 then male aged 20-30yrs with B.Sc. with a mean of 17.18. This is followed by the interaction of male jointly from 31-40 and 40 years with B.Sc. and above with the same mean of 16.44 and then other interactions as can be deduced from the table 5.1. The differing

intelligence scores indicates that male and female from the four age groups (10-20yrs, 21-30yrs, 31-40yrs, 41 above) from the three educational levels have differing intellectual ability.

### 3.6. Results on the Interaction Influence of Age, Gender, and Educational Level on Intellectual Ability

Table 7 shows the result of three-way ANOVA Analysis of the no significant interaction influence of age, gender, and educational level on intellectual ability.

Table 7

*Three-way ANOVA Analysis of the interaction influence of age, gender, and educational level on intellectual ability*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5858.567	23	254.720	2.395	.000
Intercept	33503.566	1	33503.566	315.012	.000
Gender	166.332	1	166.332	1.564	.212
AGE	471.898	3	112.366	4.188	.006
Edu Level	546.048	2	249.076	2.182	.114
Gender * Age	470.319	3	156.773	1.474	.221
Gender * Edu Level	578.009	2	289.005	2.717	.067
Age * Edu Level	1371.882	6	228.647	2.150	.047
Gender* Age * Edu Level	803.325	6	133.888	1.259	.276
Error	38926.430	366	106.356		
Total	192537.000	390			
Corrected Total	44784.997	389			

The table shows that  $F(1, 366) = 1.564$ ,  $p < .05$ , i.e.,  $p = .212$ , i.e., which is greater than .05 and implies that though there is a difference in the average IQ scores of male and female persons in Port Harcourt metropolis, this difference is not statistically significant.

The table also reveals as well shows that the computed  $F(3, 388) = 4.188$ ,  $p < .05$ , i.e.,  $p = .006$ , i.e.,  $p = .006$  is less than .05 that implies that there is a difference in the average IQ scores of persons between age 10-20, 21-30, 31-40 and 40 above and this difference is statistically significant. That is statistical evidence shows that the difference observed between these age groups average intelligence is not due to chance occurrence.

Another implication from the table was that the computed  $F(2, 366) = 2.182$ ,  $p < .05$ , i.e.,  $p = .114$  is greater than .05. This value shows that there is no difference in the average IQ scores of persons from SSCE, B.Sc.s. and Ph.D. educational level and this difference is statistically not significant.

The table goes further to shows that the computed  $F(2, 366) = 1.474$ ,  $p > .05$ , i.e.,  $p = .22$ . This implies that there is no significant two-way interactions in the average IQ scores of persons that are, male and female between age 10-20, 21-30, 31-40 and 40 above and this difference is statistically not significant. That is statistical evidence shows that the difference observed between these age groups based on gender average intelligence may be due to chance occurrence

Another result revealed from the table was  $F(2, 366) = 2.717$   $p > .05$ , i.e.,  $p = .067$ . The value was found to be greater than 0.05 and this is statistically not significant at the chosen alpha level of 0.05. This implies that there is no significant two-way interactions in the average IQ scores of persons that are, male and female from SSCE, B.Sc.s. and Ph.D. educational level and this difference is statistically not significant. That is statistical evidence shows that the difference observed from persons from SSCE, B.Sc.s. and Ph.D. educational level based on gender average intelligence may be due to chance occurrence

The goes further to shows that the computed  $F(6, 366) = 2.150$ ,  $p > .05$ , i.e.,  $p = .047$  i.e.,  $p = .047$  is less than 0.05 and this is statistically significant at the chosen alpha level of 0.05. This implies

that there is a significant two-way interaction in the average IQ scores of persons between age 10-20, 21-30, 31-40 and 40 above with SSC, B.Sc.s. and Ph.D. educational level. That is statistical evidence shows that the difference observed from persons from SSCE, B.Sc.s. and Ph.D. educational level for persons between age 10-20, 21-30, 31-40 and 40 above average intelligence is not due to chance occurrence as statistical difference exists.

Finally, it was obtained that  $F(6, 366) = 1.259, p > .05, i.e., p = .227, i.e.,$  that implies that there is no significant three-way interaction between the average IQ scores of persons between male and female age 10-20, 21-30, 31-40 and 40 above with SSC, B.Sc.s. and Ph.D. educational level. That is, the difference observed from male and female with SSC, B.Sc.s. and Ph.D. educational level for persons between age 10-20, 21-30, 31-40 and 40 above average intelligence may be due to chance occurrence as no statistical difference exists. The inference from the above is that neither age nor gender, nor educational qualification on interaction, has any significant influence on intelligence.

#### 4. Discussion

The result shows that the slight difference that exists between male and female intelligence is not statistically significant. The result shows that the slight difference that exists between male and female intelligence is not statistically significant. This result is same as most researches on sex difference and intelligence that have posited that gender differences were either the same or so negligibly small and that no significant difference exists between male and female on intelligence test (Brody 1992; Herrnstein & Murray, 1994). This finding is also in line with the research findings of so many researches from around the world like Aluja-Fabregat et al., (2000) who found null sex difference, likewise Carretta and Ree (1997) and Colom et al. (2000). This result is also similar to that of Colom and Garc'ia-L'opez (2002) who found no gender difference. In the same vein, Colom, et al. (2002) found small sex variance likewise Dolan et al., (2006) and Deary et al. (2007) found no significant sex difference as well. Flynn (1998) and Haier (2007) found a small gender difference. The same was obtained from Mackintosh (2011). Result for this observed similarity between the finding of this present study and the ones reviewed, could be that the study sample and demographic are quite similar to the ones reviewed

Also, slight difference observed in intellectual ability between male and female may be influenced by a variety of other factors, such as education, age, socio-economic status, societal and cultural expectations. For instance, societal and cultural factors, such as gender roles and stereotypes, may have influenced the development of intellectual ability, and discrimination and bias can act as barriers to education and career advancement. This available research does not support the belief that men are inherently more intelligent than women. While there was a small difference, statistically this difference was not significant and this is not large enough to have practical significance in most real-world situations. This finding generally aligns with previous research studies that have also indicated minimal or negligible gender differences in intelligence. The implication is that there is no inherent superiority or inferiority in intelligence between males and females. Future researchers can build upon this finding by exploring the underlying societal and cultural factors that may influence the development of intellectual abilities

Result reveals that there is a difference in the average intelligence of persons between age 10-20, 21-30, 31-40 and 40 above. It showed that persons aged 20-30 and 10-20 had the highest intelligence on the average compared to persons aged 31 and above. Result shows that this difference is statistically significant. This result is in tandem with the research findings of Salthouse (2010). The result showed that performance on measures of fluid intelligence peaked at around the age of 20 and declined steadily. Same with that of Hedden and Gabrieli (2004) who found that performance on measures of cognitive function tended to decline with age that is after reaching its peak, intellectual ability tends to decline slightly in the later years of life. Other researches evidences also show that intellectual or cognitive abilities differ and declines with age (Cockburn & Smith, 1991; Gow, 2016; Hedden & Gabrieli, 2004; Park & Reuter-Lorenz, 2009; Schaie, 1996; Salthouse, 2010;

Salthouse, 2010; Wilson et al., 2002). One reason for this could be due to the decline in the brain's ability to generate new neurons and also possible psychological make up of individuals

The influential difference for persons aged 10-30 having the highest intellectual ability may be attributed to the fact that intellectual ability tends to increase during childhood and adolescence, reaching a peak in the late teenage years or early 20s. This pattern is thought to be due to the ongoing development of the brain, which continues to grow and change throughout the lifespan. While the decline in intellectual ability or intelligence may be due to the gradual loss of neurons and the decline in the brain's ability to regenerate new neurons as we age. The rate of decline in intellectual ability is not the same for all individuals. Some individuals may experience a more pronounced decline in cognitive function in their later years, while others may not experience a decline at all. There is significant variability in the rate of intellectual development and in the age at which individuals reach their peak of intellectual ability. However, this difference can also be due to other factors like educational level, socio-economic status, personality and other environmental variables. Basically, this finding is consistent with prior research showing a peak in cognitive abilities during the late teenage years or early 20s, followed by a gradual decline. The implication is that intellectual ability varies with age, with a decline typically observed in later years. Future researchers can further investigate the factors contributing to this age-related difference, such as brain development, the influence of socio-economic status, personality, and other environmental variables.

Result shows that educational level of persons with SSC, B.Sc. and Ph.D. differ in terms of their intellectual ability, although the difference was not significant. One possible explanation for the influence of education level on intellectual ability could be that education exposes individuals to a wide range of stimuli and challenges that stimulate the brain and promote cognitive development. Through interactions with teachers and peers, and exposure to diverse ideas and concepts, individuals are able to develop higher-order thinking skills and knowledge that are essential for intellectual ability. This result finding is somewhat in line with the result of past researchers in that education was seen to have an influence on intelligence (Ceci, 1991; Clouston et al., 2012; Deary et al., 2007; Dole et al., 1991; Furnham & Cheng, 2017; Hegelund et al., 2018; Halpern, 1998; Hegelund, et al., 2020; Jensen, 1998; Roth et al., 2015; Strenze, 2007). The difference between these researches and this current study is that no significant influence was found. The difference in these results could be in the test used in measuring the intelligence of the respondents, and other demographic variables like location as while this study was conducted in Nigeria in Africa, other studies were conducted mostly in western countries. Already, previous research has suggested a link between education and intelligence, with education providing exposure to various stimuli that stimulate cognitive development. However, the lack of a significant influence in this study suggests that other factors or test measures may have contributed to the result. Researches in future can explore the specific aspects of education that may influence cognitive development and intelligence, taking into account factors such as teaching methods, exposure to diverse ideas and concepts, and the impact of educational systems in different cultural contexts.

Result shows that the difference in the average intelligence scores of minority and majority ethnic groups in Port Harcourt metropolis is differs and is statistically significant. This is in syn with other research findings where different intelligence scores were obtained for persons from different ethnicity from around the world and Sub-Sahara Africa (Glewwe & Jacoby 1992; Grieve & Viljoen 2000; Jensen, 1998; Rushton, & Jensen, 2005; Lynn, 1991; Lynn & Vanhanen, 2002; Owen 1992; Rushton, 2000; Rushton & Skuy, 2000; Rushton & Jensen, 2005; Sternberg et al., 2001; Skuy et al., 2001, 2002; Zaiman et al., 2001; Zindi, 1994). This observed small differences may be influenced or due to a variety of factors such as access to education and socio-economic status, gender, nutrition, cultural experiences and backgrounds such as cultural values and beliefs about the importance of intellectual development. This finding generally aligns with previous research studies that have reported variations in intelligence scores across different ethnic groups worldwide. The implication is that factors such as access to education, socio-economic status,

cultural experiences, and beliefs may contribute to these observed differences. Further research could delve into the complex interplay between ethnicity, education, socio-economic status, and cultural experiences to better understand these differences.

Results shows that there is an interaction in the average IQ scores of persons that are, male and female between age 10-20, 21-30, 31-40 and 40 above and this difference is statistically not significant. It shows also that there is an interaction in the average IQ scores of persons that are, male and female from SSCE, B.Sc.s. and Ph.D. educational level and this difference is statistically not significant. Result shows also that there is a significant two-way interaction in the average IQ scores of persons between age 10-20, 21-30, 31-40 and 40 above with SSCE, B.Sc.s. and Ph.D. educational level. Result shows that there is a three-way interaction between the average IQ scores of male and female ages 10-20, 21-30, 31-40 and 40 above with SSC, B.Sc.s. and Ph.D. educational level. That is, there is a difference observed from male and female with SSC, B.Sc.s. and Ph.D. educational level for persons between age 10-20, 21-30, 31-40 and 40 above; Although the interaction influence is not significant. The inference from the above is that age gender, educational qualification on interaction, influence intelligence, however this interaction influence is not significant. This finding is somewhat in line with the position of researchers who posits that intelligence is influenced by a variety of factors like gender, educational attainment and age and other environmental factors. Although, these researchers did not clearly study these variables studied in this research together, neither did they indicate if a significant interaction was found or not (Davies et al., 2005; Hyde, 1999, 2014; Park & Reuter-Lorenz, 2009). This result aligns with existing research that acknowledges the influence of gender, age, educational attainment, and other environmental factors on intelligence. Future research could explore these variables in more depth and examine significant interactions, if any, among them.

## 5. Conclusion

In conclusion, intellectual ability is a complex trait that is influenced by a variety of factors, including gender, age, ethnicity, and education. While these factors have been seen to influence intellectual ability, they should not be used to stereotype or make assumptions about individuals. It is important to recognize that intellectual ability is not fixed, and that individuals have the potential to develop and improve their cognitive skills throughout their lives.

That is whilst, this study has provided evidence that there is evidence that gender, age, ethnicity, and education influence intellectual ability and intelligence, it is important to recognize that intelligence is a multifaceted trait that is influenced by a variety of other factors. It is also important to approach research on this topic with caution, as it has the potential to be misused and to reinforce harmful stereotypes.

## 6. Implications and Recommendation

The implication of the study is that gender does not significantly impact intelligence, challenging the belief of inherent superiority or inferiority. It implies also that Intelligence tends to peak in early adulthood and decline with age. and that education alone does not have a significant influence on intelligence. Furthermore, ethnicity is implicated in variations in intelligence scores. There are interaction effects among gender, age, and education on intelligence, although not statistically significant. The study generally implies that multiple factors, such as gender, age, education, and ethnicity, may play a role in shaping intelligence, but their direct influence is not substantial or statistically significant.

The findings of this study have important implications for education policy and practice. Based on findings, it is recommended that since education and age influence intellectual ability, investing in education, particularly in the early years, can have lasting benefits for the cognitive development and intellectual ability of individuals for both male and female alike.

## 7. Limitation and Suggestion for Further Study

Although, the research was able to achieve its aim, the research is limited by not using a larger sample size from a more diverse geographical location. Although the following limitations notwithstanding, a representative sample was obtained and the findings were not affected and thus valid generalization is enabled.

It is suggested that future research in this area should continue to examine the role of genetics, education, and other psychological factors like personality in any observed differences in intellectual ability between men and women. It will also be important to study the impact of societal and cultural factors on intelligence and performance, and to identify ways to reduce the influence of discrimination and bias.

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