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## Relationship Between Cognitive Function and Handgrip Strength Among AEFUNAI Students of Ikwo And Afikpo Indigenes of Ebonyi State

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## ABSTRACT

**Background:** Researchers have studied the connections between handgrip strength and cognitive function and found it positive among individuals. Objective: To assess the relationship between handgrip strength and cognitive function among Alex Ekwueme Federal University students Ndufu-Alike Ikwo (AEFUNAI), an Afikpo and Ikwo case study.

Methodology: A convenient sampling method of 200 students of AEFUNAI from Afikpo and Ikwo, aged 18-25 years was used. Montreal Cognitive Assessment test (MoCA) and Mini-Cog were used to assess cognitive functions, while the Handgrip strength (HGS) was measured with an electronic hand dynamometer.

**Results:** Age, HGS, and MoCA were significant in the male and female Afikpo students (p<0.001; p<0.05). In contrast, HGS (LH and RH) and Mini-Cog were significant in Ikwo students (male and female) at p<0.001 and p<0.05. There was a strong correlation between HGS (RH and LH) and Mini-Cog, while age and HGS (RH) correlate strongly with MoCA in both male and female Afikpo students of AEFUNAI. Afikpo males showed a stronger relationship between HGS (RH) and Mini-Cog at P < 0.05; p < 0.001, while females showed a difference in HGS (RH) and MoCA than Ikwo females.

**Conclusions:** Handgrip strength in both sexes was strongly associated with changes in muscle mass, demonstrating that handgrip strength decreases with increased age.

Keywords: Afikpo; Cognition; Grip strength; Ikwo; MiniCog; Montreal

## Introduction

Handgrip strength is one of the ways of measuring the strength of the several muscles of the upper extremities, mostly the Hand and forearm<sup>1</sup>. Although there are several ways to examine age-related decreases in muscular strength, handgrip strength assessments are the most often used indicator of muscle

tone because they are simple to perform, inexpensive, highly feasible, and yield valid results<sup>2</sup>. Researchers have hypothesized that the decline in HGS results from diminished neuronal and motor systems, even though it is predominantly attributable to age-related alterations in the muscular system<sup>3,4</sup>. In examining strength capability, a neural system insufficiency reduces an

aging adult's muscle force production to around half of what would be predicted from a fully active muscle<sup>5</sup>. Therefore, aging-related motor system dysfunction that affects cognition can also decrease muscle strength<sup>6,7</sup>. Hence, the HGS test is vital for identifying cognitive impairment in all ages<sup>8</sup>. Handgrip strength (HGS) indicates overall physical health among older adults, while decreased HGS is associated with an increased disease risk. Muscle strength is a vital determinant of healthy aging and is significantly related to the development of disability and mortality risk. Deterioration occurs due to aging, physical inactivity, and malnutrition in older adults, which impairs normal bodily function<sup>9</sup>. Physical activity and resistance exercise enhance older adults' muscle strength and function, even when burdened with severe disability<sup>10</sup>. According to Carroll, 2019, a lower baseline of handgrip strength is associated with a higher risk of cognitive decline. Cognitive function decline is observed in middle-aged and older people as a well-known consequence of aging, and it is expected to increase globally<sup>11</sup>. It also hinders fluid cognition; the ability to learn new processes and form new memories has declined from midlife onwards due to normal aging<sup>12</sup>.

In contrast, a cognitive decline of functional or clinical significance, such as a diagnosis of dementia in Alzheimer's disease, is generally not detected until much later in life<sup>13</sup>. Although a connection between physical functioning and cognitive abilities has been suggested, the etiology of that relationship is yet to be fully explained<sup>14,15</sup>. Several researchers have focused on diet, physical activity<sup>16</sup>, and protective and risk factors in preventing cognitive impairment<sup>17,16</sup>. Previous studies reported an association between hand grip strength and cognition<sup>18,19</sup>. According to Zammit, et al, some aspects of cognitive skills, such as the ability to make rapid comparisons<sup>7</sup>, recall unrelated information, and detect relationships, peak at the age of 22 and slowly decline. Declining mental function is often seen as a problem of old age, but a new study suggests that certain aspects of brain function begin their decline in young adulthood<sup>20</sup>. Research has suggested a connection between handgrip strength and cognitive function. Specifically, it has been found that individuals with weaker handgrip strength tend to experience more cognitive decline as they age. Low handgrip strength has also been associated with an increased risk of dementia<sup>21</sup>. This study assesses the relationship between handgrip strength and cognitive function among Ikwo and Afikpo local government indigene students.

## **Materials and Methods**

#### Study area and population

The study was based at Alex-Ekwueme Federal University Ndufu-Alike Ikwo. All the participants were students who were indigenes of Afikpo and Ikwo, local government areas of Ebonyi state. The study compares handgrip strength and cognitive function among male and female indigenes of Ikwo and Afikpo, respectively. The cross-sectional comparative study was conducted on healthy middle-aged adults to find the relationship between hand grip strength and cognition. Data was collected from 200 individuals: 50 Ikwo males, 50 Ikwo females, 50 Afikpo males, and 50 Afikpo females.

### Informed consent

The study's purpose and procedures were made open to the participants, who verbally consented to participate in the assessments. All data was collected one day at a given interval.

## Materials

The materials used for this study include an electronic digital handheld dynamometer, the Montreal Cognitive Assessment (MoCA) test, and the Mini-Cog test.

## Method of Data Collection

#### Hand grip strength

The study used a convenient sampling method to select the population, and the grip strength was measured in kilograms using a handheld dynamometer (Model: Constant: 14192-709E-17). Cognitive function was carried out using the MoCA and Mini-Cog assessment tests. The data was collected from subjects, which were Ikwo and Afikpo indigenes; their ages ranged from 18 to 25 years. The subjects were consulted personally by issuing a consent form to obtain their willingness before the test administration. Necessary instruction was given to the subjects before the test administration, including the purpose of the study and the procedure for the test explained to the subject. The subjects stood, arms at their sides, not touching their bodies. Keep the elbow bent slightly, and the test was administered on the non-dominant Hand. Ask the subject to squeeze the dynamometer with as much force as possible, carefully squeezing only once for each measurement. Three trials were conducted with a 10-20-second break between trials to avoid muscle fatigue affecting the results. The result of each trial was recorded using the nearest kilogram. The score difference within 3kg was counted complete, but the score tests with a difference of more than 3 kg were repeated after rest. Use the best 3 measurements. When a 4th measurement is taken with the hand grip (when any of the 3 measurements are 3 kg apart), be sure the outlier (the lowest outlier (lowest value) is crossed off with initials so that the 3 highest measurements are indicated for data entry.

#### Montreal cognitive assessment

Montreal Cognitive Assessment (MOCA) is a test created by Ziad Nasreddine in 1996 and is majorly used to assess cognitive impairment. It is a 30-maximum score test that assesses 8 domains of cognitive functioning: concentration and attention, executive functions, memory, visuoconstructional skills, language, conceptual thinking, and orientation. The score is between 0 and 30, and a score above 26 is considered normal. The MOCA provides better psychometric properties in detecting mild cognitive impairment than MMSE. The utility of MOCA is optimal in mild to moderate cognitive dysfunction with internal consistency (coefficient ranging from 0.86- 1.00) and a sensitivity of 92% and specificity of 78%<sup>22</sup>.

#### Mini-cog assessment

Mini-Cog is a short cognitive impairment screening exam, a neurophysiological test to detect cognitive impairment. It combines a brief memory test with a simple clock drawing test to enable fast screening for short-term memory problems, learning disabilities, and other reduced mental functions in dementia patients. The test is a 3-minute test that follows specific procedures such as capturing the individuals' attention, instructing the subject to listen carefully, to remember 3 unrelated words and repeat them back to you to know if they heard them correctly, asking the subject to repeat words to ensure understanding, ask the individual to draw a clock on a provided page, circle the numbers, and set the hands to show ten past eleven. If the person does not complete the drawing in 3 minutes, discontinue the exercise and ask the person to recall the 3 words you gave them from the beginning of the test.

## Covariate

In this study, we considered healthy participants between 18 and 25 years of age, male and female, indigenes of Ikwo and Afikpo with both parents from the two localities, and willing participants. The individuals who were even willing to participate were from Ikwo and Afikpo but were less than 18, with musculoskeletal problems like arthritis, neurological diseases such as stroke and Parkinson's disease, and were not students of Alex Ekwueme Federal University Ndufu-Alike, Ikwo (AEFUNAI) were excluded from the study.

## Statistical analysis

The data for men and women were separately analyzed to avoid alteration due to sex caused by handgrip strength differences in cognition. The population characteristics were evaluated and compared using analysis of variance, for which the collected data were tabulated for analysis. The mean, standard deviation, and t-test were used to test the hypothesis for the significance of the mean difference in hand grip strength. All the statistical calculation was carried out with SPSS version 23, and a significance level was established at p < 0.01 and p < 0.05.

## Results

(Table 1) represents the statistics of age, HGS (LH), HGS (RH), Mini-Cog, and MoCA for both Afikpo and Ikwo female students. The table showed a significant difference in HGS (LH) among the female Afikpo and Ikwo students (P < 0.05).

Table 1: Descriptive result of handgrip strength and cognitive function of female Afikpo and Ikwo population.

Parameters	AFIKPO			IKWO	P value		
	Mean ± SD	Mini	Max	Mean ± SD	Mini	Max	
Age(years)	20.20±1.78	18.00	24.00	$20.16\pm2.07$	18.00	25.00	0.776
HGS(LH)	23.53±7.03*	11.00	40.90	29.23±15.33*	12.30	92.70	0.020
HGS(RH)	$27.89 \pm 8.07$	11.60	47.00	$32.01 \pm 14.00$	11.60	90.20	0.062
Mini-Cog	$3.98 \pm 1.44$	0.00	5.00	$3.52 \pm 1.34$	0.00	5.00	0.132
MoCA	$24.72 \pm 3.92$	14.00	30.00	$24.14 \pm 4.83$	5.00	30.00	0.505

\* significant difference in HGS (LH) of the female Afikpo and Ikwo populations (P<0.05).

(Table 2) shows the age, HGS (LH), HGS (RH), Mini-Cog, and MoCA statistics for both Afikpo and Ikwo male students. The table showed a significant difference in HGS (LH) among the male Afikpo and Ikwo students (P < 0.05).

Table 2: Descriptiv	e result of hand	lgrip strength	and cognitive fu	inction of i	male Afikpo and	l Ikwo population.

Parameters	.AFIKPO			IKWO	P-value		
	Mean ± SD	Mini	Maxi	Mean ± SD	Mini	Max	
(Age(years	21.08±2.30	18.00	25.00	1.81 21.38±	18.00	25.00	0.480
(HGS(LH	42.77±14.64	21.00	83.20	43.51±16.27	16.80	86.60	0.320
(HGS(RH	50.69±17.92	21.60	118.20	49.50±17.39	21.00	110.40	0.734
Mini-Cog	$0.97 \pm 4.20$	1.00	5.00	$1.21 \pm 4.08$	1.00	5.00	0.629
MoCA	*26.74±2.38	20.00	30.00	*25.32±3.46	13.00	30.00	0.022

\*significant difference in MoCA of the male Afikpo and Ikwo indigenes at P<0.05.

(Table 3) represents a paired student t-test of handgrip strength and cognitive function among male and female Afikpo students. The table shows that Age, HGS (LH), HGS (RH), and MoCA were significantly different in the male and female Afikpo students at P<0.001 and 0.05. In contrast, Mini-Cog did not show a significant difference between sexes at P<0.05.

Table 3: Paired student t-test of handgrip strength and cognitive function among male and female Afikpo students.

Parameters	MALES	FEMALES	P-value				
	Mean ± SD	Mini	Maxi	Mean ± SD	Mini	Maxi	
(Age(years	*21.08±2.30	18.00	25.00	*20.20±1.78	18.00	24.00	0.032
(HGS(LH	**42.77±14.64	22.00	83.20	**23.55±7.03	11.00	40.90	0.000>
(HGS(RH	**50.69±17.92	21.60	118.20	**27.89±8.07	11.60	47.00	0.000>
Mini-Cog	$0.97 \pm 4.2$	1.00	5.00	3.98±1.44	0.00	5.00	0.356
MoCA	*26.74±2.38	20.00	30.00	*24.72±3.92	14.00	30.00	0.003

\*significant difference in the male and female Afikpo at p < 0.05; \*\*significant difference in the male and female Afikpo at P < 0.001; p < 0.05

(Table 4) represents a paired student t-test of handgrip strength and cognitive function among male and female Ikwo students. The table shows that Age, HGS (LH), HGS (RH), and Mini-Cog were significantly different in the male and female Afikpo students at P<0.001 and 0.05. In contrast, MoCA did not show a significant difference between sexes at P<0.05.

**Table 4:** Paired sample t-test of handgrip strength and cognitive function among the male and female Ikwo population.

Parameters	MALE			FEMALE	P- value		
	Mean±SD	Mini	Maxi	Mean ± SD	Mini	Maxi	
(Age(years	**81.21.38±	18.00	25.00	**20.16±2.07	18.00	25.0	0.004
(HGS(LH	**43.51±16.27	16.80	86.60	**29.23±15.33	12.30	92.70	0.000>
(HGS(RH	**49.50±17.39	21.00	110.40	**32.01±14.00	11.60	90.20	0.000>
Mini-Cog	*4.08±1.21	1.00	5.00	*1.34 ± 3.52	0.00	5.00	0.023
MoCA	25.32±3.46	13.00	30.00	$4.83 \pm 24.14$	5.00	30.00	0.207

\*significant difference in both sexes at p < 0.05, \*\*significant difference in both sexes at P < 0.001; p < 0.05

(Table 5) below represents the correlation between age, handgrip strength, and cognitive function among female Afikpo and Ikwo students. There was a strong correlation between age, HGS (RH and LH), and Mini-Cog in male and female Afikpo students of AEFUNAI, while age and HGS did not correlate with MoCA, as shown in Table 5 below.

Table 5: Correlation of Age, handgrip strength, and cognitive function of female Afikpo and Ikwo populations.

Parameters	AFIKPO				IKWO				
	Mini-Cog Mo		MoCA	MoCA		Mini-Cog			
	r	р	r	р	r	р	r	р	
(Age(years	0.125	0.203	0.009	**0.365	0.956	0.008	0.501	-0.097	
(HGS(LH	0.034	*0.300	0.128	0.218	0.598	0.076	0.678	-0.060	
(HGS(RH	0.001.	**0.456	0.050	.0.279	0.781	0.040	0.960	0.007	

\*strong relationship between HGS (RH) and Mini-Cog of the male Afikpo students (P<0.05; 0.001).

(Table 6) below represents the correlation between age, handgrip strength, and cognitive function among male Afikpo and Ikwo students. There was a strong correlation between age, HGS (RH) Mini-Cog, and MoCA among male Afikpo students of AEFUNAI, while age and HGS did not correlate with MoCA and Mini-Cog and HGS (LH), as shown in Table 6 below.

Table 6: Correlation of Age, handgrip strength, and cognitive function of male Afikpo and Ikwo population.

Parameters	AFIKPO				IKWO			
	Mini-Cog		MoCA		Mini-Cog		МоСА	
		n		n.		n.		n
	I	þ	I	h	I	þ	I	h
(Age(years	0.317	-0.145	0.919	-0.015	0.823	0.033	0.684	0.059
(HGS(LH	0.796	-0.38	0.441	-0.112	0.090	0.242	0.612	.0.074
(HGS(RH	0.07	**0.380	0.012	*-0.354	0.168	.0.198	0.615	.0.073

\*strong relationship between HGS (RH) and Mini-Cog of the male Afikpo students (P<0.05; p<0.001).

## Discussion

The study compared Handgrip strength and cognitive abilities among young males and females of Afikpo and Ikwo indigenes, respectively. There was a significant difference in HGS (LH) of female Afikpo and Ikwo populations with (p <0.05), with variables of Ikwo females showing higher mean values than Afikpo females. The hand grip strength varies among females of Afikpo and Ikwo as an indicator that depicts health, especially in the young population, and works as an independent risk factor when it comes to the mortality rate of adults<sup>23</sup>. There was a significant difference in MoCA of male Afikpo and Ikwo indigenes with p < 0.05. There was a correlation between age, handgrip strength, and cognitive function of female Afikpo and Ikwo indigenes; likewise, A correlation between age, handgrip strength, and cognitive function of male Afikpo and Ikwo population was seen. It showed a strong relationship between HGS (RH) and Mini-Cog of male Afikpo population with P < 0.05; p < 0.001), while Afikpo females showed a difference in HGS (RH) and MoCA than Ikwo females. Sartorio, et al. reported that age-dependent increases in handgrip strength in males and females were strongly associated with changes in muscle mass during childhood<sup>24</sup>. The present study is consistent with previous research demonstrating firmer grip for men than women within the same age, and that handgrip strength decreases with advancement in  $Age^{18,25}$ .

The study indicates that there was a significant an increase in age, HGS (RH), HGS (LH), Mini-Cog, and MoCA among the male Afikpo population compared to the female Afikpo population may be due to high muscle mass<sup>24</sup>. Age-dependent increases in handgrip strength in males and females were strongly associated with changes in muscle mass, which agrees with this study. Shayamal & Sartinder's, study showed that males have higher mean values than females, which agrees with these findings. Christensen, et al, reported that change in handgrip strength predicts changes in memory task performance<sup>26</sup>. Females have faster cognitive deterioration than males across various cognitive domains<sup>13</sup>, which was confirmed in this study. Men typically engage in activities that enhance intellectual experiences through education and occupation more than women, as reported<sup>27</sup>. A paired sample t-test of handgrip strength and cognitive function in male and female students of Afikpo and Ikwo indigenes. MoCA shows a significant increase in the male Afikpo indigenes, while Mini-Cog showed a substantial difference in both sexes. The paired sample t-test of handgrip

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strength and cognitive function in both male and female students of Ikwo origins was also used in Table 4. Each case shows each variable's mean  $\pm$  SD, minimum, maximum, and p values. Age, HGS (LH), HGS (RH), HGS (LH), and Mini-Cog showed significant differences in both sexes (p < 0.001; p < 0.05), while MoCA did not show a considerable difference which agrees<sup>28</sup>. Also, handgrip strength can be influenced by age, and this shows that as age increases, grip strength decreases linearly for hands.

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There wass no financial support for this work.

## **Conflict of Interest**

There is no conflict of interest to declare.

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