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INTELLIGENCE QUOTIENT AND SOME ANTHROPOMETRIC INDICES IN CHILDREN WHO PRACTICE SWIMMING

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ABSTRACT

General human intelligence and anthropometric indices are important factors in the cognitive learning process, but also in the motor learning such as swimming.

In the period March-June 2022, we conducted a longitudinal study on 136 children aged 6.0 to 9.11 years (mean 7.2 years), who practice swimming for leisure (beginner level) in the swimming pools from Iasi city, Romania. The instruments used were the Raven Standard Progressive Matrices for intelligence quotient, an OMRON BF511 device (scale) for body mass index, adipose tissue mass and muscle tissue mass, a Makita laser rangefinder and a Makita scale for waist measurement.

The purpose of the research is finding out if there is an association between the intelligence quotient and certain anthropometric indices in children participating in introductory swimming lessons.

The main hypothesis of the research is that there is a positive association between the intelligence quotient and certain anthropometric indices in children participating in introductory swimming lessons.

The research results show that the association between intelligence quotient and body mass index is negative of moderate strength ($r = -0.41$; $p = 0.04$); the association between the intelligence quotient and the adipose tissue mass is also negative of moderate intensity ($r = -0.47$; $p = 0.02$); and between the intelligence quotient and the muscle tissue mass there is a positive association of low intensity ($r = 0.23$; $p = 0.03$).

In conclusion, we can state that among children who practice swimming in Iași City, the intelligence quotient is inversely related to the body mass index and the adipose tissue mass (if the intelligence quotient increases, the body mass index and the adipose tissue mass will decrease) and in positive relation with the muscle tissue mass (if the intelligence quotient increases, the muscle tissue mass will also increase).

Keywords, *anthropometric indices, intelligence quotient, learning, swimming, children, beginner level.*

Introduction

In its modern, Western guise the concept of intelligence has seemed inextricably linked to the technology for measuring it, the Intelligence Quotient (IQ) test. Developed in its modern form in 1905 by the French psychologist Alfred Binet (1857–1911) and his collaborator Théodore Simon (1872–1961), the intelligence scale and the practices of measuring intelligence it spawned spread quickly to many parts of the world, including England, Spain, Germany, Latin America, and preeminently the United States (Carson, 2015).

Firm evidence that psychometric test scores accurately predict real-world success would have considerable import at the practical and the theoretical levels. It would justify the use of such tests as educational and occupational selection tools and as dependent variables in studies of possible genetic and neurophysiological correlates of cognitive ability differences (Ian et al., 2007).

In this study we want to show what is the association between the intelligence quotient (IQ) and certain anthropometric indices such as body mass index (BMI), fat tissue mass (FTM), muscle tissue mass (MTM) in children participating in introductory swimming lessons.

The association of the IQ with anthropometric indices (in children who practice swimming) is not found in the specialized literature. Also, IQ testing of novice or performance swimmers is lacking. Aspects of approach to the process of learning to swim are encountered (Giannousi et al., 2017; Revesz et al., 2007; Light & Wallian, 2008; Monteiro et al., 2021).

Regarding anthropometric indices, Statkevičienė & Venckūnas (2008) conducted a study that targeted the level of performance in different swimming techniques correlated with anthropometric indices for young people aged 18 years. Their objective was to establish the possible relationship between the somatic development and the physical condition and the learning abilities to swim backstroke, breaststroke, and crawl.

The association of the variables invoked in this study (IQ and certain anthropometric indices) can be found in the specialized literature (Sandjaja et al., 2013; Akubuilo et al., 2020; Mahmud et al., 2022) among children who have problems with food (nutrition).

The authors Akubuilo et al. (2020) presented conclusions such as that, acute and chronic under-nutrition did not adversely affect the IQ and academic performance of the study population. In other studies it was found that, anthropometric nutritional status indicators are significantly associated with cognitive performance (Sandjaja et al., 2013) and nutritional status can have a serious effect on intelligence among preschoolers (Mahmud et al., 2022).

Methodology

Research sample and population

The research sample consists of 136 children (66 girls and 70 boys) with ages between 6.0 and 9.11 years (M age = 7.2), who practice leisure swimming (beginner level) in the swimming pools in the city of Iași, Romania. The composition of the sample was carried out by stratified random sampling on each age level (6, 7, 8 and 9 years).

The research population consists of approximately 500 children who practice swimming in Iași city. This results in a sample of 27.2%; statistically significant.

Table 1 Research subjects

Gender	The research subjects	Percent	Valid Percentage	Cumulative percentage
Male	70	51.47	51.47	51.47
Female	66	48.53	48.53	100.0
Total	136	100.0	100.0	

The research subjects followed a program of two lessons per week, lasting 60–75 min each, following a program that included different exercises structured by learning stages for swimming.

The study was conducted in accordance with the Oviedo Convention of 1997 and the Helsinki Declaration of 1964. Subjects were included with prior written consent obtained from a parent or guardian for each child.

Measurement of variables

The independent variable – IQ was measured using the Raven Standard Progressive Matrices (RSPM).

The RSPM (see Figure 1) is an non verbal test commonly used to measure general human intelligence and abstract reasoning and is regarded as a test for estimating fluid intelligence (Bilker et al., 2012).

The measurement and evaluation of this variable (intelligence quotient – IQ) was done before swimming training sessions in good conditions and without disturbing factors (in the protocol rooms of the swimming pool).

Dependent variables BMI, FTM and MTM were measured using an OMRON BF511 (weighing scale, see Figure 2). The waist of each child was previously measured using a Makita LD050P laser rangefinder and a Makita professional measuring tape. All the anthropometric measurements were carried out in duplicate following standard techniques by trained research personnel.

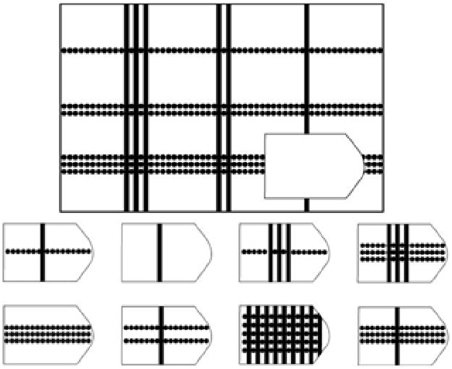

Figure 1 Raven Standard Progressive Matrices (RSPM)

Figure 2 Weighing scale (OMRON BF511)

The measurement and evaluation of the dependent variables of the research was also carried out before the swimming sessions, in the fitness room of the swimming pool, in optimal conditions and without disturbing factors. The research subjects were informed not to eat two hours before the measurements were taken.

The purpose of the research

We want to find out if there is an association between IQ and certain anthropometric indices BMI, FTM and MTM (which can determine buoyancy) in children participating in introductory swimming lessons.

Buoyancy can influence swimming performance because of its potential to affect the drag experienced by the swimmer, the efficiency of the swimmer, and the metabolic cost of swimming (McLean et al., 2000).

Research objectives

1. To create a statistically representative research group that complies with the ethical standards required by the Helsinki Declaration;
2. To test subjects on their level of IQ and to group them into several strata;
3. Testing subjects on certain anthropometric indices (BMI, FTM and MTM) that contribute to the buoyancy of the human body on water.

Research hypotheses

Main hypothesis

There is a positive association between the fluid intelligence and certain anthropometric indices.

Secondary hypotheses

1. There is a positive correlation between IQ and BMI;
2. There is a positive correlation between IQ and FTM;
3. There is a positive correlation between IQ and MTM.

Results

The results from this research were stored and processed using IBM SPSS 20 software. Specifically, the SPSS 20 software used in this research provides data analysis for descriptive statistics, predictions of numerical results, and hypothesis validation.

Descriptive analysis

In the descriptive analysis we calculated the central tendency parameters and the dispersion parameters for all four variables invoked in this research (IQ, BMI, FTM, MTM – see Table 2).

Table 2 Descriptive statistics

		IQ	IMC	FTM	MTM
N	**Valid**	**136**	**136**	**136**	**136**
	Missing	**0**	**0**	**0**	**0**
Mean		96.54	20.078	20.425	33.871
Std. Error of Mean		1.048	.1714	.3766	.3420
Median		97.00	20.100	20.150	34.150
Mode		97	19.8	17.3	33.3[a]
Std. Deviation		9.140	1.4940	3.2835	2.9813
Range		34	7.1	11.5	10.8
Minimum		80	16.3	14.3	28.1
Maximum		114	23.4	25.8	38.9
Sum		7337	1525.9	1552.3	2574.2

[a] Multiple modes exist. The smallest value is shown

Testing the distribution of research variables

Distribution of research variables was verified using the Kolmogorov-Smirnov Test. Based on this test we will know what kind of correlation we can perform. In this study all research variables (BMI, FTM, MTM) have a normal distribution of the values obtained from the measurements performed (see Table 3).

This fact (normal distribution) determines that we use the Person Correlation for hypothesis testing.

Table 3 Kolmogorov-Smirnov Test of research variables

Research variables	Kolmogorov-Smirnov (K-S)	Threshold of significance (*p*)	Distribution
IQ	0.63	0.81	normal
BMI	0.61	0.83	normal
FTM	1.27	0.07	normal
MTM	0.71	0.68	normal

Testing hypothesis 1

There is a positive correlation between IQ and BMI.

Among the children who practice swimming in Iași City (beginner level – novice swimmers), the association between IQ and BMI is negative of moderate intensity ($r = -0.41$; $p = 0.04$). The significance threshold $p = 0.04$ allows us to state that hypothesis 1 is rejected (see Table 4). Using the coefficient of determination ($r^2 = 0.17$) we deduce that 17% of the variation in BMI can be "explained" by the relationship (association) with the IQ variable.

Table 4 Pearson Correlation Test for Hypothesis 1 (association between IQ and BMI)

		Variable IQ	Variable BMI
Variable IQ	Correlation Pearson	1	−.412**
	Sig. (2-tailed)		.043
	N	136	136
Variable BMI	Correlation Pearson	−.412**	1
	Sig. (2-tailed)	.043	
	N	136	136

** Correlation is significant at the 0.05 level (2-tailed).

Testing hypothesis 2

There is a positive correlation between IQ and FTM.

Among the children who practice swimming in Iași City (beginner level – novice swimmers), the association between IQ and FTM is also negative of moderate intensity ($r = -0.47$; $p = 0.02$). The significance threshold $p = 0.04$ allows us to state that hypothesis 2 is rejected (see Table 5). Using the coefficient of determination ($r^2 = 0.22$) we deduce that 22% of the variation in FTM can be "explained" by the relationship (association) with the IQ variable.

Table 5 Pearson Correlation Test for Hypothesis 2 (association between IQ and FTM)

		Variable IQ	Variable FTM
Variable IQ	Correlation Pearson	1	−.471**
	Sig. (2-tailed)		.024
	N	136	136
Variable FTM	Correlation Pearson	−.471**	1
	Sig. (2-tailed)	.024	
	N	136	136

**. Correlation is significant at the 0.05 level (2-tailed).

Testing hypothesis 3

There is a positive correlation between IQ and MTM.

Among the children who practice swimming in Iași City (beginner level – novice swimmers), the association between IQ and MTM is a weak positive association ($r = 0.23$; $p = 0.03$).

The significance threshold $p = 0.03$ allows us to state that hypothesis 3 is confirmed (see Table 6). Using the coefficient of determination ($r^2 = 0.05$) we deduce that 5% of the variation in MTM can be "explained" by the relationship (association) with the IQ variable.

Table 6 Pearson Correlation Test for Hypothesis 3 (association between IQ and MTM)

		Variable IQ	Variable MTM
Variable IQ	Correlation Pearson	1	.237**
	Sig. (2-tailed)		.036
	N	136	136
Variable MTM	Correlation Pearson	.237**	1
	Sig. (2-tailed)	.036	
	N	136	136

**. Correlation is significant at the 0.05 level (2-tailed).

Discussion

Among children aged 6.0 – 9.11 years who practice swimming in Iasi City (learning level), the relationship between IQ and certain anthropometric indices is as it follows: negative with BMI and FTM and positive with MTM. This fact shows that if IQ were to increase, BMI and FtM would decrease and MtM would increase (see Table 7).

The specialized literature does not present studies that show the association/relationship between IQ and certain somatic or anthropometric indices.

The main hypothesis of this research – *There is a positive association between fluid intelligence and certain anthropometric indices* – is partially confirmed.

Studies show other relationships such as association between IQ and school performance. There is broad agreement that there is a moderate to strong correlation between the two variables. Jencks et al.'s (1979 *apud.* Ian et al., 2007) detailed account of eight samples from six longitudinal studies reported correlations ranging from 0.40 to 0.63 between cognitive test scores and amount of education obtained. More recent overviews are provided by various authors and reach similar conclusions (Bartels et al., 2002a; Bartels et al., 2002b; Neisser et al., 1996; Sternberg, Grigorenko, & Bundy, 2001).

For example, Mackintosh's (1998 *apud*. Ian et al., 2007) survey reckoned that there is a correlation between 0.4 and 0.7 between IQ scores and school performance grades.

Table 7 Dependent variables and relationship/association between IQ

Research variables	Pearson Correlation	Coefficient of determination	Variation of variables	Threshold of significance (p)
BMI	−0.412	0.17	17%	0.043
FTM	−0.471	0.22	22%	0.024
MTM	0.237	0.05	5%	0.036

Other studies present IQ as the dependent variable and show an association between sleep duration and performance on IQ tests, but the mechanisms underlying this interplay remain unknown. Several authors have proposed that sleep spindles may physiologically underpin intelligence or high-level general mental ability (Bódizs, et al., 2005; Fogel et al., 2007).

Conclusions

For the research sample and for the population it represents, children (aged 6.0 to 9.11 years) who swim in Iasi City (beginner level), IQ is in inverse association/relationship with BMI and FTM. These results show that, by increasing IQ, anthropometric indices BMI and MTF are kept under control. We can conclude that children who swim and have a good IQ level have a reduced risk of adipose tissue and of being overweight.

Also, increasing IQ levels in swimming children leads to an increase in MTM.

Swimming is a sport where smart kids control their BMI and FTM and develop MTM.

Anthropometric indices and cognitive abilities may be predictors for learning and performance in sport swimming.

In future research we will have the following directions of study:

- testing the link between cognitive abilities (IQ) and sports swimming technique (freestyle and backstroke);
- verification of the association between antripomentric indices and sports swimming technique (freestyle and backstroke);
- testing the relationship between psychomotricity and sports swimming technique (freestyle and backstroke).

Conflict of interests

The author declares that there is no conflict of interests.

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