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Original Article

Association of physical activity and health status with intelligence quotient of high school students in Jeddah

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Abstract. [Purpose] The present study investigated the relationships of physical activity and healthiness with the intelligence quotients of high school students in Jeddah. [Subjects and Methods] A total of 135 male and female students were randomly drawn from public and private secondary schools in Jeddah. A self-designed questionnaire was distributed to the students that included demographic, physical activity, and health status sections. Body mass index measurement and an intelligence quotient test were carried out for all students. In addition, samples of blood were collected to estimate hemoglobin and serum iron. [Results] The highest proportions of males and females (39.1% and 51% respectively) had an intelligence quotient score of more than 75%. Moreover, the findings revealed that about 35% of the students were categorized as overweight obesity, and there was aninverse correlation between body mass index and physical activity. Students who shared physical education classes and exercising at and outside school showed a positive correlation with high IQ scores. Regarding hemoglobin and iron levels, there were significant correlations between their levels in blood and IQ. [Conclusion] The intelligence quotient of adolescent students is positively associated with physical activity and health status.
Key words: Adolescence, Intelligence Quotient, Physical activity

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INTRODUCTION

Adolescence is defined as the period of transition from childhood to adulthood and adolescents are usually considered to be persons between the ages of 10–19 years[1]. Adolescents account for about 20% of the world's populace, out of 1.2 billion adolescents worldwide, almost 90% exist in developing countries[2, 3]. In Saudi Arabia, adolescents represent 16.7% of the total population[4]. There are two essential predictors of internalizing and externalizing difficulties in adolescents which are socio-economic position of the parents[5, 6] and cognitive deficits or abilities[7]. The Kingdom of Saudi Arabia has undergone enormous modifications in lifestyle over the past three decades and this reflected in physical activity patterns. This has led to a raised rate of obesity incidence among Saudi children and youths[8].

Overall, people who are concerned about their bodies are likely to have more intellectual abilities than those who are not. Physical activity is one of the main indicators of morbidity and death and is one of the most essential behaviors for enhancing well-being[9]. Regular and compound physical activities assist with the building and maintenance of a healthy musculo-skeletal system through the increasing muscle strength[10] and reducing the possibility of obesity and long term disorders. Physical activity also decreases the sense of being depressed and anxiety and enhances other psychological aspects[11]. Therefore, it also affects academic behavior, e.g. time taken on tasks and influences academic achievement through attention in the classroom[12].

Recent studies have found an association between cognitive capacity and well-being[13]. Some research has concentrated on the reaction time and recall duration as fundamental factors connected to health[14]. Until now, few studies have focused on explaining this relationship. Possible explanations for this relationship have been suggested. Anemia is a common blood disease, andalmost 50% of school-age children and teenagers are estimated to have anemia in developing countries[15]. Anemia is mainly caused by iron deficiency due to inadequate intake of iron in the diet[16].

The present work examined the associations of physical activity and health status with the IQ of high school students.

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SUBJECTS AND METHODS

A total of 135 students (70 males and 65 females; age range 16−19 years old) were randomly selected from six public and private high schools in Jeddah, KSA.

This study was approved by the Faculty of Applied Medical Sciences Ethics Committee, King Abdulaziz University. Approval was also obtained from the Ministry of Education for Planning and Development in Jeddah city to collect data. In the first visit to schools, the students were oriented with the research objective and signed a form consenting to participation. A validated self-developed questionnaire was distributed to each student. A second visit was carried out three days later to collect students' responses and to test their IQ using Raven's test[17].

The study questionnaire comprised three parts: demographic information (name, age, school type, gender, cell phone number, and email address); health status (disease, allergies to drugs, or nutritional supplements) and family history (hypertension, obesity, diabetes, heart disease, other hereditary diseases, or allergies); and items about regular physical activity (participation in physical activity per week, sharing in physical education at school, exercises in school, exercise outside school, method of coming to school, either by car or walking, hours watching TV, hours playing computer and video games, and sports participation).

Body Mass Index: Anthropometric parameters were measured for all students. Body weight was measured using a balance beam scale with participants wearing light clothing and without shoes. Height was measured using a wall-mounted stadiometer. The BMI (kg/m^2) was then calculated, and subjects were categorized as underweight, normal weight, overweight, obese, overly obese or morbidly obese[18].

Blood analysis: After informing the students' parents through the principal of the schools, blood samples were collected from the students by a laboratory technician, and their levels of iron and hemoglobin were assayed.

Data was statistically analyzed using the SPSS program version 16. Pearson's test was used to examine correlations. The level of significance used was 0.05.

RESULTS

General sample characteristics: Our findings revealed that the mean age of the students was 17.53 ±0.91 years. About 70% of the students were attending public schools while 30% were attending private ones. Male students represented 52% of our study sample.

Regarding the intelligence quotient, the results show that the highest proportions of male and female students (39.1% and 51% respectively) had an IQ score ≥75. Also, the mean value of IQ scores was higher for females than for males (68.1 and 61.1 respectively). In addition, 51.4% and 41.7% of students had IQ score ≥ 75 in the private and public schools respectively (Table 1).

Furthermore, the IQ scores of female students significantly correlated with participation in physical education and exercising in private schools and outside schools. In addition, IQ scores were positively and significantly correlated with the number of hours spent playing video and computer games as well as going to school by walking ($p<0.05$) (Table 2).

The distribution of BMI of all students was 14.1%, 51.1%, 12.6%, and 22.3% for underweight, normal, overweight and obese (classes 2 and 3), respectively, and 35% of the subjects were either overweight or obese (Table 3). The correlation between BMI and different aspect of physical activity for both males and females participating in physical activity was significant ($r = 0.22$ and $p < 0.01$). Participation in physical education classes, exercising at and outside school inversely correlated with the BMI ($p <0.001$), while BMI positively correlated with hours spent watching TV hours (Table 4). Overall, IQ scores negatively correlated with BMI ($p<0.01$).

Regarding health status, 15.6% of students and 25.2% of students' family member(s) were obese and more than half of the students had positive family histories of diabetes (52.6%). Also, 29.6% of students' families had hypertension. Similarly, 11.1% of families had osteoporosis, and 29.6% of families had high blood cholesterol levels (Table 5).

It was also found that only 5.5% of boys had iron deficiency while 20% of girls exhibited iron deficiency. Moreover, most of boys were not anemic (89.5%), while more than half of the girls were anemic (58.1%). There was a significant correlation between blood iron and Hb levels with IQ ($p<0.05$) (Table 6).

DISCUSSION

The Kingdom of Saudi Arabia is considered one of the richest and highest income countries. This elevated revenue together with dietary habits have resulted in a state of overnutrition of macronutrients and malnutrition of micronutrients that has increased rates of obesity in adulthood[19]. The present study revealed that 12.5% of participants were

Table 1. Mean values and percent distribution of IQ scores of students by gender and school type

IQ	Male		Female		Private		Public		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
<25	5	7.8	2	3.6	3	8.6	4	4.8	7	5.9
25–	14	21.9	12	21.8	5	14.3	21	25.0	26	21.8
50–	20	31.2	13	23.6	9	25.7	24	28.5	33	27.7
≥75	25	39.1	28	50.9	18	51.4	35	41.7	53	44.5
Total	64	100	55	100	35	100	84	100	119	100
Mean±SD	61.1±25.51		68.1±23.38		66.2±27.92		63.5±23.35		64.3±24.68	

Table 2. Correlation between IQ and different aspects of physical activity

Physical activity	IQ			
	Male	Female	Private	Public
	r	r	r	r
Participate in physical activity once per week	0.08	0.05	0.09	0.02
Participation in physical education at school	0.02	0.05	0.27*	0.09
Exercises in school	0.05	0.40*	0.22*	0.09
Exercise outside the school	0.09	0.31*	0.09	0.16
Hours watching TV	0.12	0.02	0.06	0.15
Hours playing video and computer games	0.36*	0.41*	0.40*	0.38*
Walk to school	0.43*	0.23	0.42*	0.34*

* Statistically significant correlation ($p<0.05$)

Table 3. Body mass index distribution of the students

BMI	Students	
	No.	%
<18.5 (Underweight)	19	14.1
18.5– (Normal)	69	51.1
25– (Overweight)	17	12.6
30– (Obesity class1)	19	14.1
35– (Obesity class 2)	7	5.2
≥40 (Morbid obesity class 3)	4	3.0
Total	135	100

Table 4. Correlation between BMI and different physical activities

Physical activity	r
Participate in physical activity once per week	- 0.22*
Share of physical education at school	- 0.36*
Exercises in school	- 0.48*
Exercises outside the school	-0.24*
Walk to school	-0.22*
Hours watching TV	0.22*

*Statistically significant correlation ($p<0.05$)

Table 5. Distribution of family and student medical histories

Diseases	Family History		Student History	
	No.	%	No.	%
Obesity	34	25.2	21	15.6
Diabetes	71	52.6	1	0.7
Hypertension	40	29.6	4	3
Osteoporosis	15	11.1	3	2.2
Hypercholesterolemia	40	29.6	1	0.7
Thyroid dysfunction	11	8.1	2	1.5

Table 6. Mean values and distributions of iron and Hb levels in students' blood and their correlations with IQ

	Male		Female		Total	
Iron	No.	%	No.	%	No.	%
Iron deficiency	3	5.5	9	20.0	12	12.0
Normal	52	94.5	36	80.0	88	88.0
Total	55	100.0	45	100.0	100	100.0
r	0.26		0.32		0.28*	
Hb						
<12.9 (anemic)	6	10.5	25	58.1	31	31.0
≥12.9 (normal)	51	89.5	18	41.9	69	69.0
Total	57	100	43	100	100	100
r	0.52*		0.30*		0.26*	

* Statistically significant correlation ($p<0.05$)

overweight and 22.5% were obese (classes one, two and three). This agrees with Shelomenseff and Andreoni[20] who reported that in 2000, approximately 14% of adolescents were overweight, nearly three times as many as in 1980. Also, Han et al.[21] found that BMI is higher in females than males. Fernandez and coauthors[22] reported that various risk factors of overweight were linked to socioeconomic level and strongly associated with parents being overweight. Previous studies in developing countries have reported that overweight is more predominant in high socioeconomic levels than in lower ones[23].

The present study also found an inverse correlation between BMI and some physical activities. This agrees with Han et al.[24] who reported that physical exercises reduces %body fat, body fat mass and blood lipids. Also, the results of various researches show that the IQ of children is negatively linked with childhood obesity[25]. Other research works have investigated the association of childhood IQ with adult obesity, but there is no agreement about their relationship. Also, some studies have reported that a low IQ is associated with high BMI in comparison to non-obese persons[26].

The present work found that there was a positive correlation between physical activity and IQ. It is believed that sharing in sports and physical activities promotes cognitive performance, behavior memory, attention and educational success[27].

A possible explanation for this is that exercise stimulates the growth of neural cells via oxygenation, neurogenesis and overflow of neurotransmitters like dopamine. Vigorous exercise also decreases stress and improves cognitive performance. One of the easiest methods of improving IQ is to practice exercise at any suitable time[28].

The WHO has designed a classification of public health severity of anemia[29] in which anemia is considered mild if it affects 1–9% of population, moderate if it affects 10–39%, or a severe health problem if it affects more than 40%. According to this classification, the present study found anemia of moderate severity among the studied adolescents.

The results of the present study have revealed that the percentage of iron deficiency anemia was higher in females (20%) than that in males (5.5%), and that more than half of the girls were anemic. This is in agreement with the findings of Al-Sayes et al.[30] who reported that the prevalence of iron deficiency was 25.9%, and iron deficiency anemia was 23.9% among Saudi girls of university age in Jeddah city. This could be explained by menstrual blood loss being one of the risk factors of iron deficiency anemia throughout adolescence[31].

Finally, the findings revealed significant positive correlations between blood iron and Hb levels in blood with IQ. This agrees with Verdon et al.[32] who identified the negative impact of iron deficiency anemia on the mental and physical growth of children, and on adult occupational productivity. Anemia can influence mental functions and learning abilities. Loss of IQ may occur later in life if anemia affects infants, as well as decreased concentration duration, excitability, lethargy, weakness and decreased resistance to infectious diseases. Thus, anemia can adversely affect vocabulary and reading functions in childhood[33]. Adolescents are one group at risk of iron deficiency anemia because of fast growth and increased demands for iron throughout youth, especially among girls[34]. Iron is extremely important for myelination, neural and glial energy metabolism as well as the production of chemical neurotransmitters[35]. Many studies have postulated that early iron insufficiency has a negative impact on these brain functions with simultaneous behavioral alterations[36].

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