

## [Body Mass Index and Response of Heart Rate to Step Test for Primary School Children in Egypt]

### Researchers:

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### Abstract:

The highest prevalence rates of childhood obesity have been observed in developed countries, however, its prevalence is increasing in developing countries as well. Objectives To estimate the prevalence of overweight and obesity among primary school children, aged from 6 to 12 years and to estimate risk factors of obesity and overweight, defined by body mass index .The socioeconomic transformation in Egypt over the previous decade may have created a less active lifestyle and a decline in fitness among Egyptian children. The present study was conducted to determine body mass index (BMI), and response of heart rate in some rural Primary School Children to step test in ages 8-11 years in both sexes.

Study sample consisted of 60 subjects from boys and girls as students between 8-11 years. The sample was divided into two groups; Group (1): boys between 8-11 years and girls in the same ages as Group (2). Each group was subdivided into two groups consisting of 15 boys and 15 girls. Height and weight was recorded to calculate Body mass index (BMI). Response of heart rate was recorded immediately before and after step test protocol. The statistical analysis was done using means, standard deviations and T-test. The results of this study showed that: there was a significant sex mean difference in Body mass index (BMI) between boys and girls in age 8 years for girls. On the other hand, changes in weight, length and BMI were not significant between two sexes in the age of 11 years, except for a significant difference in heart rate before step test for the boys.

**In conclusion**, it is preferably that girls participate in physical activity programs , inside or outside schools in a way that increases the capacity of cardio respiratory fitness and reduces BMI. This should be a lifestyle for both sexes. The family could help by complementing the efforts of the school in ensuring children are active at home. Also, increased aware-ness about childhood overweight/obesity through publications and symposia for parents is important.

**Keywords:** Body Mass Index (BMI), Heart rate, Obesity, Children, Physical fitness, Step test.

### INTRODUCTION:

The prevalence of obesity among children and adolescents has increased dramatically since the mid-1970s in many countries throughout the world (1-2). Functional exercise capacity is a measuring method of the individual's ability to perform meaningful tasks on a safe and dependable basis aiming to collect information about the functional limitations of a person with medical impairment (3).

The most popular clinical exercise tests in order of increasing complexity are stair climbing, six-minute-walk test (6MWT), shuttle-walk test, cardiac stress test and cardiopulmonary exercise test (American Thoracic Society [ATS], 2002 ). The current gold standard for assessing one's aerobic exercise response is the maximum incremental cardiopulmonary exercise test. However, most daily activities are performed at submaximal levels of exertion. Data from Canada and the United States show increases in both the mean body mass index (BMI) and the prevalence of overweight and obesity in children and adolescents (4-6).

Other data indicate that children who report relatively low levels of physical activity are significantly more likely to be overweight or obese than more active children of similar age and gender (7-8).

Childhood obesity can create many complications at the cardiovascular, endocrine, pulmonary, musculoskeletal and gastrointestinal levels, as well as possible psycho-social consequences (Poor self esteem, depression, eating disorders (9).

For this reason, recent studies focused on the possible causes and risk factors associated with obesity in paediatric ages (10).

Low physical fitness in children has been associated with impaired health indicators such as increased body fatness (Ruiz et al., 2006; Dencker et al., 2006) and abdominal adiposity (Ortega et al., 2007; Brunet et al., 2007), several cardiovascular disease risk factors (Buchheit et al., 2007; Thomas et al., 2003), hypertension (Katzmarzyk et al., 2001; Ruiz et al., 2006) and low physical activity (Dencker et al., 2006) (11-17).

Health-related physical fitness involved the components of physical fitness related to health status, including: cardiovascular and respiratory endurance, musculoskeletal fitness, body composition, flexibility and metabolic fitness (18). These components can be measured by means of various laboratory and field tests (18).

For most people, Body Mass Index (BMI) provides a good measure of obesity. BMI is an inexpensive and easy-to-perform method of screening for weight categories that may lead to health problems (18). Furtherer study provided reference values of the six-minute walk test for healthy Egyptian schoolchildren aged from 6-11 years which is affected by age and gender (19).

Recently study demonstrated the relationship between the physical conditions of a person's body which defined by the BMI to the energy expenditure behavior defined in the pattern of heart rate changes (20). Overall, the weight obesity respondents are more likely to develop health problems due to a higher heart rate, even at rest condition (20). The most common health complaint is obesity, which often leads to the emergence of other types of diseases (20).

### **Study Purpose:**

The purpose of this study was designed to determine body mass index (BMI), and evaluate response of heart rate in some rural Primary School Children to step test in ages 8-11 years in both sexes.

### **SUBJECTS AND METHODS**

#### **Study design:**

This study involved primary school children attending public schools, and the school chosen was not different in characteristics from the other public rural primary schools in Mansoura area.

#### **Geographical location**

Mansoura is located on the eastern bank of the Nile River- Damietta branch, 120 km north-east of Cairo, Egypt.

#### **Subjects**

Sixty healthy subjects from boys and girls as students between 8-11 years were included in this study. The participants were all children and having the same socioeconomic background. The study sample were recruited for the study on the basis of random sampling from a rural primary school, The

sample was divided into two groups; Group (1): boys and girls at the age of 8 years (for boys and for girls) and subdivided into two groups consisting of 15 boys and 15 girls, and Group (2); boys and girls at the age of 11 years (for boys and for girls) and subdivided into two groups consisting of 15 boys and 15 girls. having the mean (Body mass  $18.56 \pm 0.23$  Kg, Body height  $182.22 \pm 0.39$  cm, Body mass Index  $25.05 \pm 0.29$ ), and girls in the same ages as Group (2) having the mean (Age  $18.56 \pm 0.23$  yr, Body height  $182.22 \pm 0.39$  cm, Body mass Index  $25.05 \pm 0.29$ ). Classification into study children was done based on the difference in the chronological age and sex.

### Anthropometric measurement

Body height was measured using a seca stadiometer to the nearest 0.1 cm and body mass was measured to the nearest 0.1 kg using medical scales. Body mass index was derived from the general equation,  $BMI = \text{body mass} / \text{height}^2$  ( $\text{Kg}/\text{m}^2$ ); that is mass divided by height ( $\text{m}^2$ ).

### Experimental design

The step test protocol was performed on a stool of 16.25 inches (41.3 cm) height for a total duration of 2 minutes at the rate of 24 cycles per minute, which was set by metronome. The subject was asked to remain standing and the carotid pulse rate was measured from 5-20 seconds immediately before and after completion of the exercise. This 15 second pulse rate was converted into beats per minute to determine response of heart rate in both sexes to step test in ages between 8 to 11 years. All study children received verbal encouragement from the researcher during step test protocol.

### Statistical Analysis

Statistical analysis was done using means, standard deviations and t-test. Descriptive statistics including means and standard deviations for Body mass, Height, body mass index and response of heart rate before and after step test protocol for boys and girls in each age group as well as for all students. In all statistical tests, the alternative hypothesis was accepted at 5% level of probability ( $\alpha \leq 0.05$ ).

### Results:

The results of this study showed that: there was a significant sex mean difference in Body mass index (BMI) between boys and girls in age 8 years for girls. On the other hand, changes in weight, length and BMI were not significant between two sexes in the age of 11 years, except for a significant difference in heart rate before step test for the boys. The results are shown in Table 1 and Figures 1 and 2.

Table (1) Body mass, Height, body mass index and response of heart rate before and after step test protocol for boys and girls between 8-11 years

Age	Variables	Girls		Boys		T	Significant
		Mean	SD	mean	SD		
8 years	Body mass (kg)	27.53	3.77	32.93	4.58	*3.51	0.002
	Height (cm)	122.46	5.27	124.93	6.75	1.11	0.275
	Heart-rate before (beat/min)	98.53	6.82	101.66	9.91	1.00	0.322
	Heart-rate after (beat/min)	156.13	20.61	139.26	24.82	2.02	0.053
	BMI (Kg/m <sup>2</sup> )	18.29	1.57	21.40	2.56	*3.66	0.001
11 years	Body mass (kg)	45.40	10.94	41.40	6.31	1.22	0.230
	Height (cm)	134.73	7.92	137.06	4.93	0.986	0.341
	Heart- rate before (beat/min)	98.00	6.80	90.93	10.30	*2.21	0.035
	Heart- rate after (beat/min)	154.46	15.86	141.60	19.77	1.96	0.059
	BMI (Kg/m <sup>2</sup> )	24.86	4.83	22.06	2.83	1.93	0.063

Values are mean, SD; BMI= body mass index; P = indicate P (0. &lt;05)

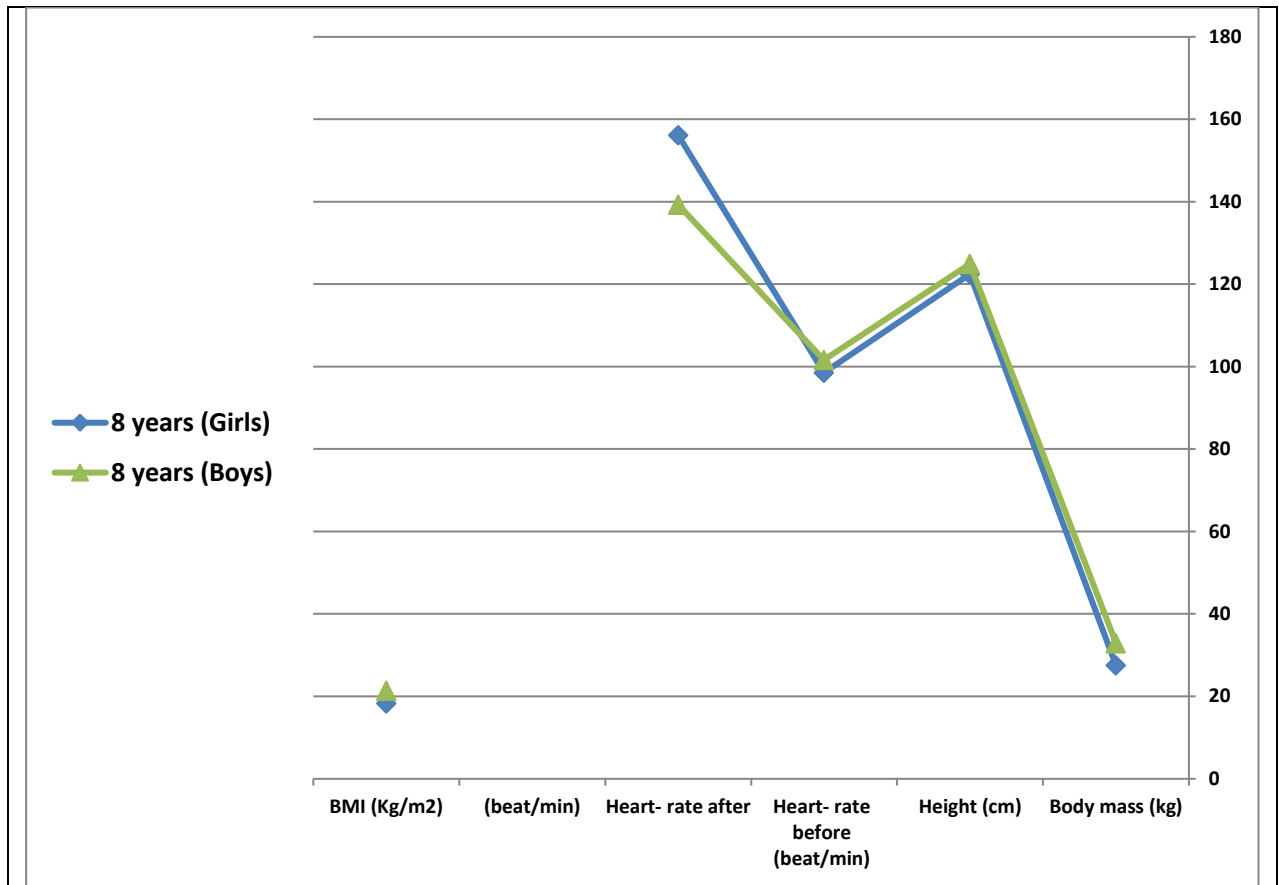


Fig (1) Body mass, Height, body mass index and response of heart rate before and after step test protocol for boys and girls 8 years.

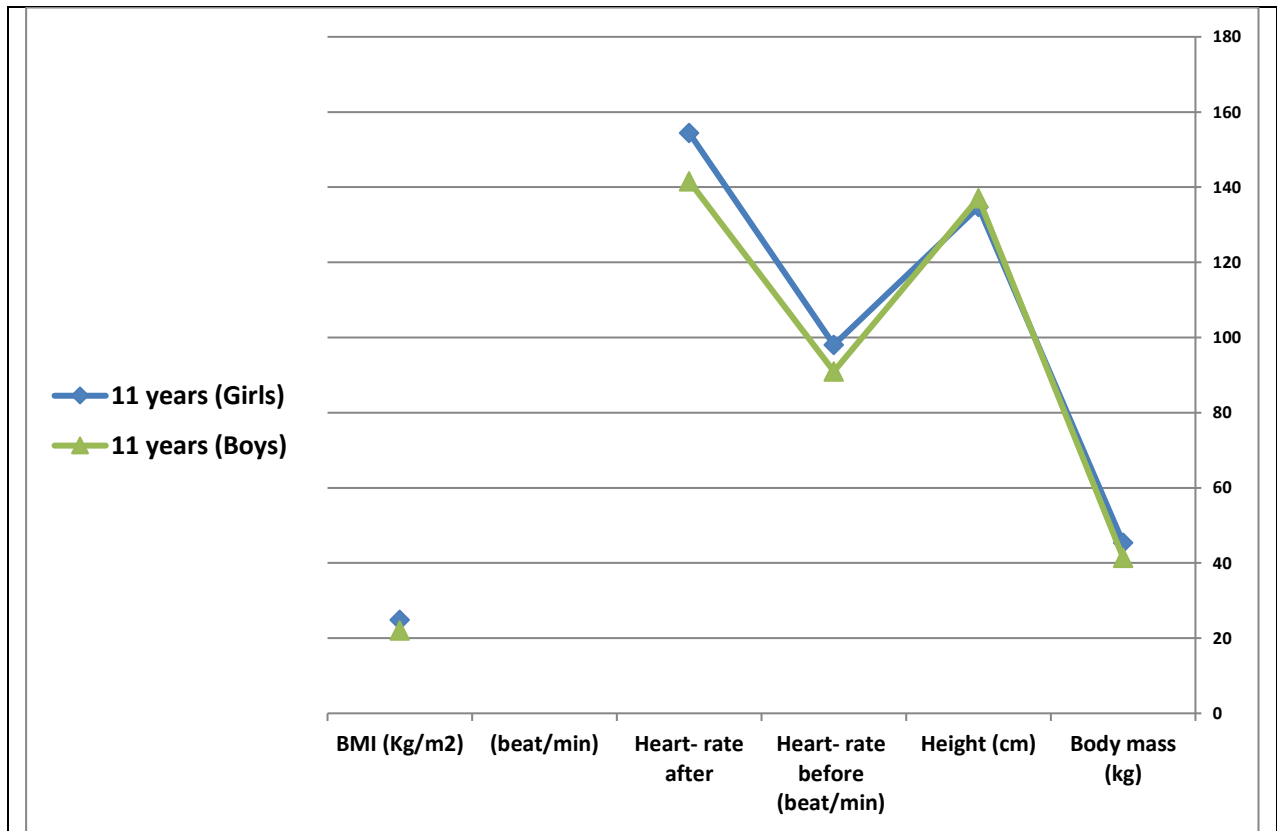


Fig (2) Body mass, Height, body mass index and response of heart rate before and after step test protocol for boys and girls 11 years.

**DISCUSSION:**

The lifelong health benefits of adequate physical activity in childhood are well established (21). Interactions exist between physical activity, physical fitness, motor competence, the human psyche, and body weight, and their interplay has important effects on health(22)

Although the body mass index for girls was lower than boys at the age of 8 years (18.29 VS 21.4 kg/m<sup>2</sup>), these means are within the normal level, according to the International Obesity Task Force which indicated that BMI values between 18.5 and 24.9 are considered normal or healthy, and that BMI values between 25 and 29.9 are considered overweight, and 30 and above are considered obese (23). The results in the same table (1) show the increased means of heart rate for girls at the age of 8 years (156.13 for girls VS 139.026 beat /min for boys) immediately after the Step test protocol. Another increase in the means of heart rate for girls at the age of 11 years was recorded (154.46 beat /min for girls VS 141.060 beat /min for boys).

However, this increase did not have any significance. The same table shows the decrease of BMI for girls when compared with boys at the age of 8 years (18.29 kg/m<sup>2</sup> for girls VS 21.40 Kg/m<sup>2</sup> for boys), and increased BMI for the girls at the age of 11 years (24.86 kg/m<sup>2</sup> for girls VS 22.6 kg/m<sup>2</sup> for boys) which refers to the possibility of more fat accumulation in girls than boys, which might be due to the

higher physical activity among boys than girls (24), though physical activity was not assessed among the children in the present study. Hormonal changes too, cannot be ruled out, though this was not evaluated too ( 25 ).

Girls gain weight due to the stimulation of their sex hormones and the development of their reproductive organs (Viznamos and Marti-Hennenberg (2000) (25). However, Table (1) shows the increased means of heart rate in girls compared to boys at the ages of 8-11 years since the boys have a better cardio respiratory fitness than girls. Traditionally, the boys tend to work at farming-related tasks which enhance physical activity level, whereas girls tend to do more household chores such as washing and cooking at home (26). As our results revealed no significant differences between girls and boys regarding changes in weight, length and BMI in the age of 11 years, except for a significant difference in heart rate before step test for the boys, may be attributed to gender difference regarding muscle strength that starts to appear with puberty. Miller (27) stated that women are approximately 52% and 66% as strong as the men in the upper and lower body respectively.

The men are also stronger relative to lean body mass. Women had 45, 41, 30 and 25% smaller muscle cross-sectional areas for the biceps brachii, total elbow flexors, vastus lateralis and total knee extensors respectively. Many study reported reported significant correlations between gait velocity and lower limb muscle strength (28-29). The skeletal muscles of men are faster and render higher maximum output compared to women's skeletal muscles. Estrogen-B seems to have an effect in muscle contractile speed, making men more efficient in producing power. Men also release testosterone which is very important in muscle-building (30).

## CONCLUSION

Although the study shows that there is no significant difference in BMI among boys and girls at the age of 11 years, it is preferably that girls participate in physical activity programs , inside or outside schools in a way that increases the capacity of cardio respiratory fitness and reduces BMI. This should be a lifestyle for both sexes. The family could help by complementing the efforts of the school in ensuring children are active at home. . Also, increased aware-ness about childhood overweight/obesity through publications and symposia for parents is important.

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### الملخص العربي:

لقد أحدث التحول الاجتماعي والاقتصادي والذي ظهر في مصر خلال العقد الأخير حالة من قلة النشاط صاحبت أسلوب الحياة اليومي في معظم مجالات الحياة ، وربما انعكس تأثير ذلك على انخفاض مستوى اللياقة لدى الأطفال .

ولذا هدفت هذه الدراسة إلى تحديد مؤشر كتلة الجسم، واستجابات معدل القلب لاختبار الخطو لدى بعض أطفال الريف من الجنسين بالمرحلة الابتدائية لمحافظة الفيوم، وذلك خلال المرحلة السنوية التي تراوحت من ( 8-11 ) سنة.

اشتملت عينة الدراسة على بعض تلاميذ المرحلة الابتدائية من الجنسين وعددهم (60) ، تم تقسيم عينة الدراسة على أساس العمر الزمني، والاختلاف الجنسي إلى أربع مجموعات وبحيث تضم المجموعة الأولى، والثانية الأولاد والبنات في عمر (8) سنوات ، وفي حين تضم المجموعة (3) ، (4) الأولاد والبنات في عمر (11) سنة وبواقع (15) تلميذ أو تلميذة داخل كل مجموعة من المجموعات الأربع.

تم تسجيل قياسات الطول والوزن لدى الجنسين قبل تنفيذ بروتوكول اختبار الخطو والذي استمر لمدة (2) دقيقة فقط ، وأجريت قياسات النبض في الدقيقة قبل وبعد تنفيذ اختبار الخطو مباشرة عن طريق الجس على الشريان الكعبري لفترة (15) ثانية وضرب الناتج في (4)، كما تم حساب مؤشر كتلة الجسم من خلال قسمة كتلة الجسم (بالكيلو جرام) على مربع الطول (بالمتر)، وأوضحت نتائج الدراسة ما يلي: وجود فروق ذات دلالة إحصائية بين الجنسين في عمر (8) سنوات لمتغير مؤشر كتلة الجسم BMI لصالح البنات (18.29 كيلو جرام/ متر<sup>2</sup> للبنات مقابل 21.40 كيلو جرام/ متر<sup>2</sup> للأولاد) ، وفي مقابل ذلك أوضحت نتائج الدراسة أن التغيرات الحادثة في كل من الوزن ، الطول ، مؤشر كتلة الجسم BMI لم تكن ذات دلالة إحصائية بين الجنسين في عمر (11) سنة باستثناء التغير المعنوي للنبض قبل الأداء والذي جاء لصالح الأولاد.

في الختام يفضل أن تشارك الفتيات في برامج النشاط البدني داخل المدارس أو خارجها بشكل يزيد من قدرة القلب والجهاز التنفسي ويقلل من مؤشر كتلة الجسم. يجب أن يكون هذا أسلوب حياة لكلا الجنسين. يمكن للأسرة أن تساعد من خلال استكمال جهود المدرسة لضمان نشاط الأطفال في المنزل. من المهم أيضًا زيادة الوعي حول زيادة الوزن / السمنة في مرحلة الطفولة من خلال المنشورات والندوات للآباء والأمهات.