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**BODY MASS INDEX, PHYSICAL FITNESS ASSESSMENT AND
INJURIES INCIDENCE AMONG ARAB SCHOOLCHILDREN**

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Abstract

Creating healthier settings and a comprehensive prevention strategy in a multicultural environment for students has become a priority for all schools around the world. The body mass index (BMI) surveillance at the International School of Choueifat, Khalifa City, Abu Dhabi, United Arab Emirates, was organized during the academic year 2016-2017 and used the CDC (Centers for Disease Control and Prevention) criteria. Summary of children's BMI: 1009 students in grades 5th to 10th (588 boys and 421 girls). Results: Underweight (< 5th percentile) for boys 9% and girls 6%. Normal BMI (5th - 85th percentile) for boys 60% and girls 66%. Overweight or obese (\geq 85th percentile) for boys 31% and girls 28%. Obese (\geq 95th percentile) for boys 15% and girls 11%. The two-way ANOVA showed no significant differences in the six fitness components tested between boys and girls: push-ups ($p=0.000$), beep test level ($p=0.015$), shuttle run 9m / 10 cones ($p=0.15$), sit-ups ($p=0.15$), standing long jump ($p=0.012$), flexibility test ($p=0.000$). In correlation with the number of injuries during the physical education lesson, injuries were higher among girls with normal BMI than boys with normal BMI, and overweight/obese boys had more injuries than overweight/obese girls during the school year 2016-2017.

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Keywords: BMI, physical fitness, injuries, schoolchildren.



1. Introduction

In recent years, researchers (Junaibi, Abdishakur, & Nagelkerke, 2012; Al-Haddad, Little, & Ghafoor, 2005), have found that the number of obese and overweight schoolchildren is steadily increasing. The Health Authority of Abu Dhabi, Chairman Dr Mugheer Al Khaili, presented a statistics from the World Health Organisation showing that 15.1% of pupils in the Emirate were obese and 16.7% were overweight (The National, 2016). In regards with the fitness level and musculoskeletal injuries of obese and overweight students during the physical education lesson, researchers have pointed out positive and negative outcomes.

The physical education lesson can help schoolchildren to lose weight, but at the same time can increase the number of injuries: fractures, developmental coordination disorders (AAOS, 2014), muscle pain, back pain, musculoskeletal injuries in the lower and upper body. Truter, Pienaar and Toit (2014) have suggested that flexibility is not negatively influenced by obesity, but on the other hand, injuries may occur (Sothorn, 2014, p.96) due to lack of joint flexibility of overweight children. Lowry et al. (2007) analysed the connections between overweight students, physical activity and injuries that may occur. They found that injuries were not related to overweight students. A cross-sectional study carried out by Chassé, Fergusson and Chen (2014) has shown that increased BMI may cause more injuries to women than men. Valerio et al. (2012) associated obesity with fractures; they found that overweight/obese girls were more prone to fractures than overweight/obese boys. Injuries associated with falls during exercise were suggested by Yamamoto et al. (2010) to happen more likely in obese students. Pomerantz, Timm and Gittelman (2010) have shown that obese youth are at risk for lower extremity injuries than upper body injuries. Other studies, however, suggest that overweight/obese students are not more vulnerable to injuries than students with normal BMI (Ezzat, Schneeberg, & Koehoorn, 2014; Kemler et al., 2015).

2. Problem Statement

Teachers need to have a comprehensive understanding about physical education injury prevention for overweight and obese school children and, according to Doan, Koehoorn and Kissoon (2010), the frequency of sports injuries is higher among overweight school children. However, this assumption implies a preventive approach.

3. Research Questions

What are the possible differences between school children (boys and girls), using three assessment criteria: body mass index, physical fitness level and injury rate, during the physical education lesson?

4. Purpose of the Study

The purpose of our research was to investigate the body mass index (BMI), physical fitness parameters and injury rate among school children and to create a framework of sports injury prevention components adapted for school children.

5. Research Methods

(1) Data on the body mass index (BMI) were collected by the school nurse and the physical education teacher at the beginning of term 1 (2016-2017) and were introduced in the Children's BMI tool for schools (excel sheet), downloaded from the CDC (Centers for Disease Control and Prevention) website. According to the CDC, BMI is divided by the following criteria: underweight (<5th percentile), normal BMI (5th - 85th percentile), overweight or obese (\geq 85th percentile), obese (\geq 95th percentile). Studies using the CDC method reported different overweight and obese percentages for schoolchildren.

(2) The physical fitness test was used to assess six fitness components: abdominal strength (sit-ups 60"), upper body strength (push-ups 60"), lower body strength - standing long jump, agility test - shuttle run (9m/10 cones), cardiovascular (aerobic) endurance - beep test, and flexibility (sit-and-reach test). The comparison of the two groups (boys and girls) was made using the one-way ANOVA. Based on the literature, we created a design for teachers to reduce the risk of sports injuries for overweight and obese schoolchildren. (3) The injury analysis was made with the help of the annual injury report. In this report, the nurse registers all the students with injuries throughout the year.

6. Findings

(1) Body mass index surveillance and Physical fitness level

This study was conducted in 2016-2017 for 1009 students (grades 5th to 10th) from the International School of Choueifat (ISC), Abu Dhabi, Khalifa City, using the CDC criteria. The study contains the following facts: 8% of our students are underweight (9% boys / 6% girls), 63% have normal BMI (66% boys/ 60% girls), 30% are overweight (31% boys / 28% girls) and obese 13% (15% boys / 11% girls).

Table 01. Summary of children's BMI by gender

	Boys	Girls	Total
Number of children assessed	588	421	1009
Underweight (< 5th percentile)	9%	6%	8%
Normal BMI (5th - 85th percentile)	60%	66%	63%
Overweight or obese (\geq 85th percentile)	31%	28%	30%
<i>Obese (\geq 95th percentile)</i>	<i>15%</i>	<i>11%</i>	<i>13%</i>

Table 02. Summary of children's BMI and Fitness test by gender/grade (5th, 6th, 7th)

	Grade 5 th		Grade 6 th		Grade 7 th	
	Boys	Girls	Boys	Girls	Boys	Girls
Number of children assessed	147	107	112	109	131	74
Overweight or obese (\geq 85th percentile)	26%	21%	40%	30%	28%	20%
<i>Obese (\geq 95th percentile)</i>	<i>14%</i>	<i>7%</i>	<i>21%</i>	<i>13%</i>	<i>13%</i>	<i>5%</i>
Physical fitness test components (averages)						
Sit-ups (60")	29	27	34	32	34	34
Push-ups (60")	20	11	18	14	20	11
Standing long jump (cm)	131	111	140	129	147	132
Shuttle run (9m / 10 cones)	31.85	33.79	30	30.88	30.68	31.59
Beep test – level	3.4	3.3	4.4	4	4.5	4
Flexibility (sit and reach) (cm)	20	25	21	28	21.5	27

Table 03. Summary of children’s BMI and Fitness test by gender/grade (8th, 9th, 10th)

	Grade 8 th		Grade 9 th		Grade 10 th	
	Boys	Girls	Boys	Girls	Boys	Girls
Number of children assessed	80	59	73	52	45	30
Overweight or obese (≥ 85 th percentile)	34%	37%	38%	37%	20%	23%
Obese (≥ 95 th percentile)	15%	14%	14%	17%	9%	10%
Physical fitness test components (averages)						
Sit-ups (60")	34	33	39	33	39	33
Push-ups (60")	14	12	22	8	26	10
Standing long jump (cm)	150	132	173	134	174	132
Shuttle run (9m / 10 cones)	31.13	31.41	28.28	31.26	29.09	30.88
Beep test – level	4.6	3.8	4.6	3.5	4.4	3.3
Flexibility (sit and reach) (cm)	19	32	23	29.5	23.5	30

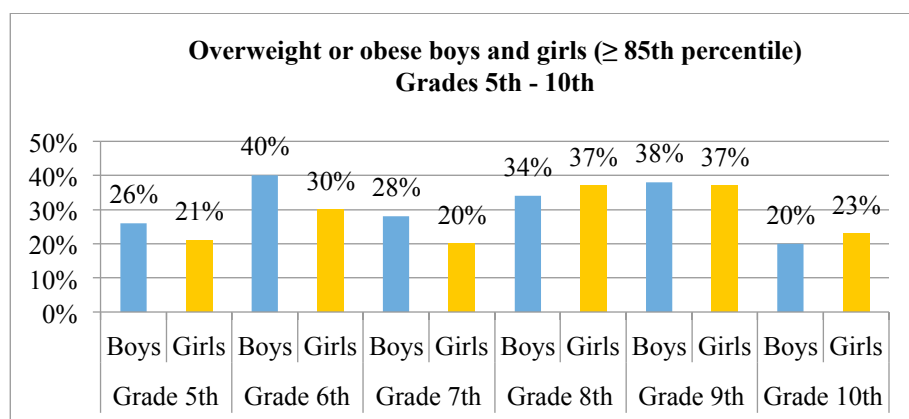


Figure 01. Prevalence of overweight or obese children ≥ 85 th percentile by gender/grade– ISC Abu Dhabi, Khalifa (2016-2017)

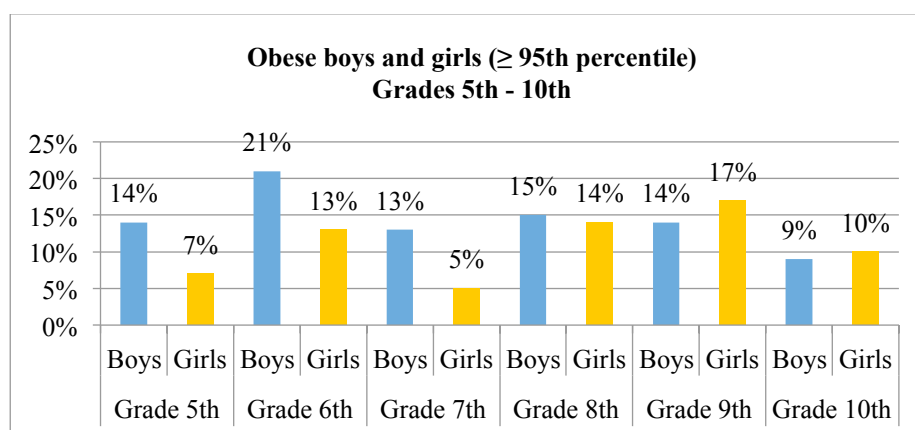


Figure 02. Prevalence of obese children ≥ 95 th percentile by gender/grade – ISC Abu Dhabi, Khalifa (2016 -2017)

The number of overweight boys in grades 5th, 6th, 7th and 9th and obese boys in grades 5th, 6th, 7th and 8th tend to be more numerically than that of girls in the same group. Significant changes have been observed in overweight boys in grades 8th, 10th and obese boys in grades 9th, 10th, and it should be noted that the number of overweight and obese boys is less than that of girls.

The two-way ANOVA showed no significant differences in the averages between overweight/obese boys and girls ($p=0.102$). In addition, boys obtained a better average than girls in the

push-up fitness test ($p=0.000$), beep test level ($p=0.015$) and standing long jump ($p=0.012$), while the average for flexibility test was significant for girls ($p=0.000$).

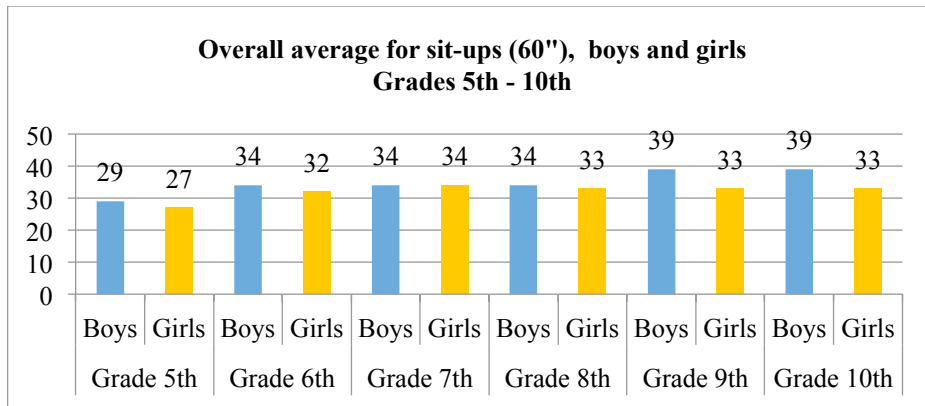


Figure 03. Overall average for sit-ups (60'') - Grades 5th-10th, boys and girls

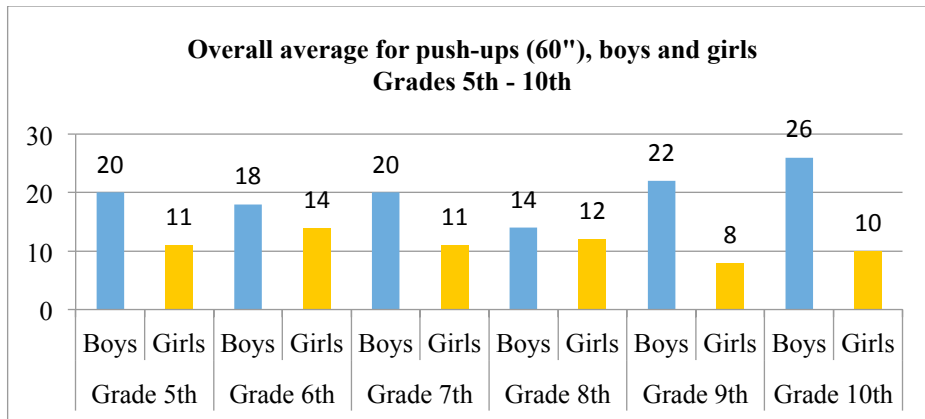


Figure 04. Overall average for push-ups (60'') - Grades 5th-10th, boys and girls

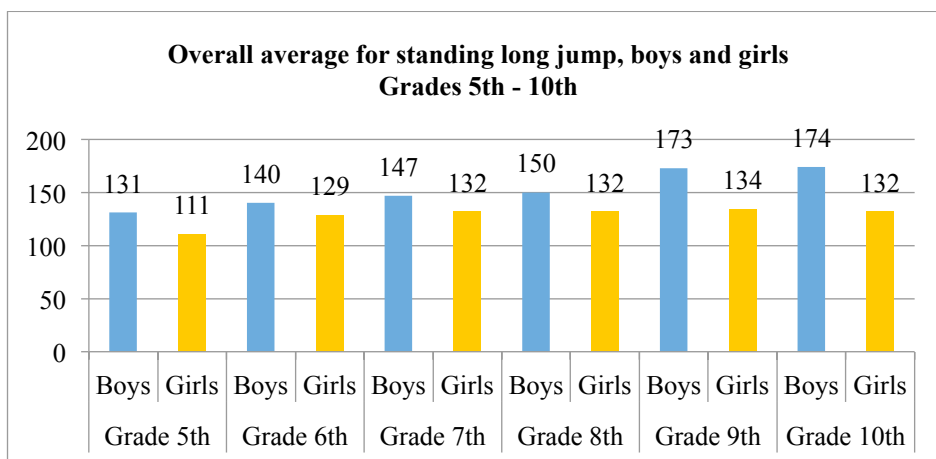


Figure 05. Overall average for standing long jump - Grades 5th-10th, boys and girls

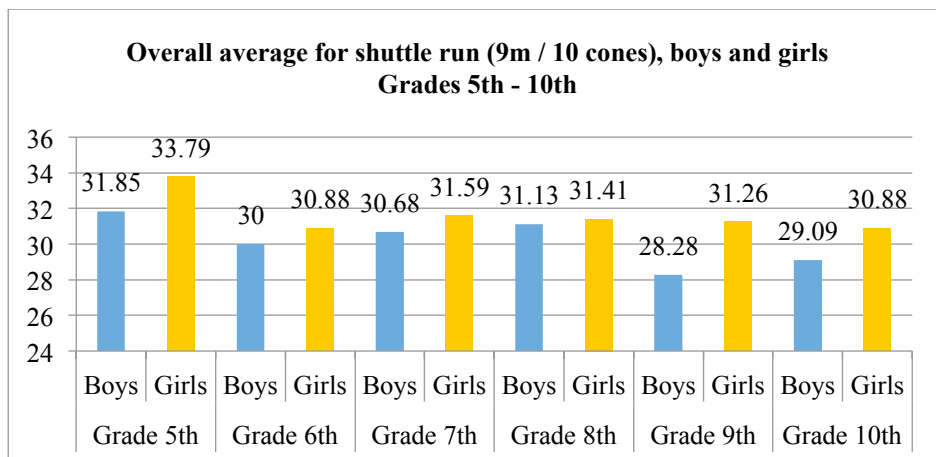


Figure 06. Overall average for shuttle run (9m / 10 cones) - Grades 5th-10th, boys and girls

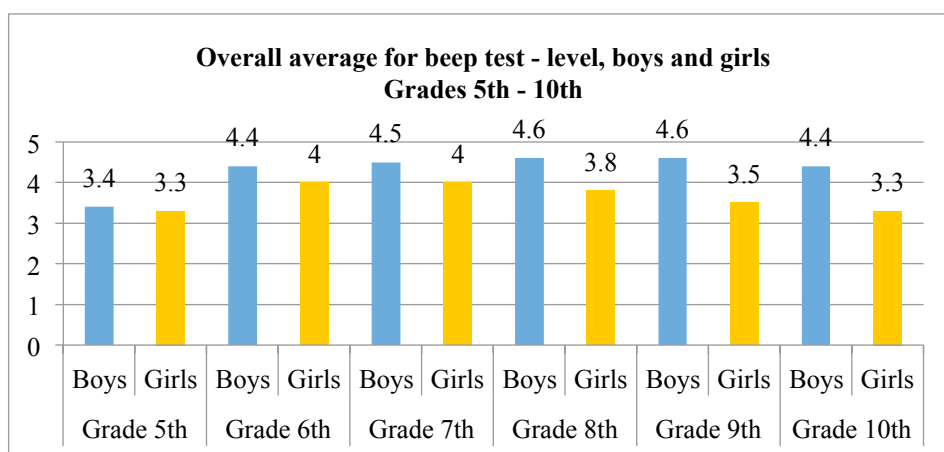


Figure 07. Overall average for beep test - level - Grades 5th-10th, boys and girls

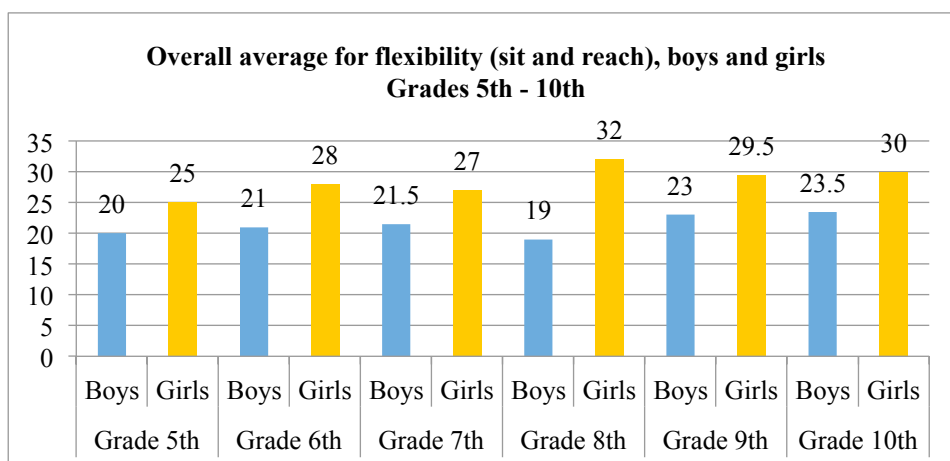


Figure 08. Overall average for flexibility (seat and reach) - Grades 5th-10th, boys and girls

(2) Examining the annual injury report, we discovered that the following injuries had occurred during physical education lessons: knee pain, back pain, bruises and scratches because of falls, muscle pain, ankle pain, wrist pain, twisted leg, foot pain and neck pain (Figure 09).

Table 04. Summary of injured children’s BMI by gender]

	Boys	Girls	Total
Number of children assessed	18	9	27
Underweight (< 5th percentile)	0%	11%	4%
Normal BMI (5th - 85th percentile)	61%	56%	59%
Overweight or obese ($\geq 85^{\text{th}}$ percentile)	39%	33%	37%
Obese ($\geq 95^{\text{th}}$ percentile)	11%	11%	11%

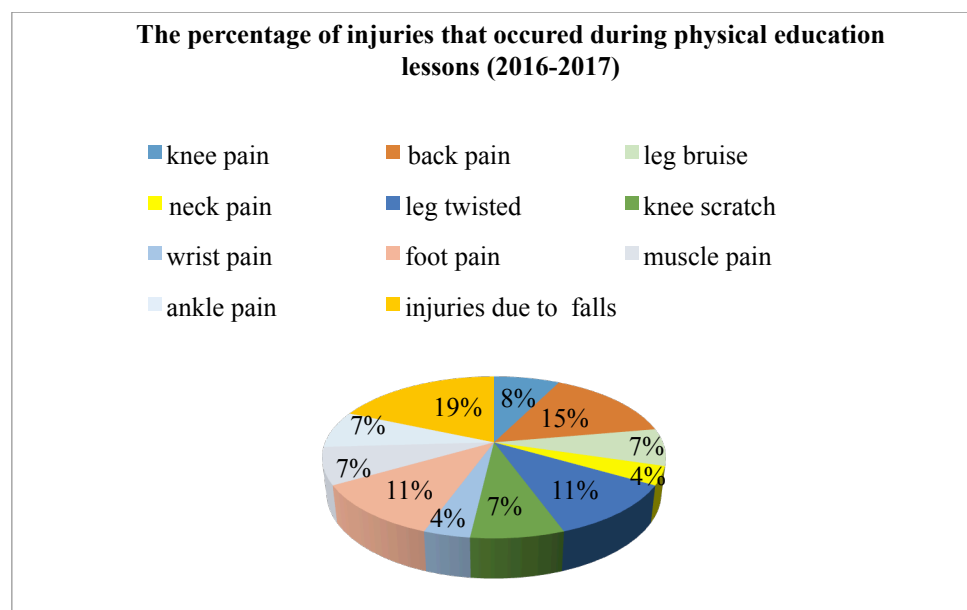


Figure 09. Injuries that occurred during physical education lessons- Grades 5th -10th

Upon the visual examination of annual injury report, we found 27 students with injuries during physical education lessons. Injuries caused by falls (19%) were most common, followed by back pain (15%), twisted leg (7%) and foot pain (7%). Overweight boys seem to be more prone to injuries than overweight girls, and students with normal BMI have more injuries than overweight/obese students.

(3) Preventive measures to reduce the risk of sports injuries for overweight and obese schoolchildren during the physical education lesson –a framework for effective teaching:

1. Identify the risk factors boys.
2. Create healthy environment settings.
3. Follow the warm-up and cool down routines.
4. Include in the lesson plan “balance training and motor coordination, which will help protect the students against injury” (*Heavy kids at slightly higher risk for sports injuries*, 2016).
5. Adapt exercise to the fitness level of overweight and obese schoolchildren.
6. Use lower impact exercise for the lower body.
7. Teachers will provide precise information about the position of the body segments during each exercise to avoid injuries.
8. Develop school awareness programs about the long-term effects of obesity.

7. Conclusion

It is important to emphasise that, before designing a program for obese and overweight schoolchildren, we have to choose the correct type of exercise that reduces the pressure exerted over the bones, ligaments and muscles.

According to Paes, Marins and Andreazzi (2015), physical activity promotes positive adaptations to childhood obesity and acts as an adjuvant for its prevention and treatment. To create a comprehensive prevention strategy, parents' involvement and perception of obesity are very important (Junaibi, Abdishakur & Nagelkerke, 2013).

Our findings show that, in grades 5th to 10th, the number of overweight/obese girls is less than that of overweight/obese boys. Compared to the body mass index and injuries, in the conducted study, boys are more vulnerable to injuries than girls during the physical education lesson.

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