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Aerobic capacity, Attention and Well-Being in Obese and Normal Adolescents

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Abstract

Background: The main objective of the present study was to verify the association between obesity, VO2peak, and attention in obese and normal school adolescents from urban and rural districts in the Kenitra city (Morocco).

Material and Methods: 170 school adolescents from rural and urban areas of the city of Kenitra, aged between 12 and 18 years were evaluated by using the body mass index (BMI), and the International Obesity Task Force, IOTF thresholds, specific to sex and age, participants were divided into two groups, group 1 of 70 overweight or obese adolescents, and group 2 of 70 adolescents with normal build.

Results: The mean age of the G1 was 16.18 ± 1.90 and that of the G2 was 16.24 ± 1.82 years, the reults show a high significant difference in BMI, VO2peak, and the duration of exercise between these 2 groups ($p < 0.001$). overweight or obese girls go through a major depressive episode, compared to 13.6% of boys of the same status.

Conclusion: Aerobic capacity is one of the determinants of health in adolescents, this parameter is strongly influenced by weight status since according to our results the overweight or obese group showed a low VO2peak.

Key Words: aerobic capacity, adolescents, attention, well-being, obesity.

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INTRODUCTION

The World Health Organization (WHO) states that adolescence is the period when the level of physical activity decreases, more than 80% of adolescents do not meet the recommendation of having moderate to intense physical activity. every day for at least one hour [1-2], in Morocco the rate of physical inactivity increased from 86.2% in 2001 to reach 87.3% in 2016 [3].

Practicing regular physical activity among adolescents helps reduce sedentary behavior, avoid excessive weight gain [4], reduce the risk of obesity in adulthood [5], and improve aerobic fitness [6].

Several studies have shown that overweight or obese adolescents have reduced aerobic running fitness compared to their normal-weight counterparts [11,12], and that this fitness is an important indicator of general health in children [13], adolescents [14], and adults [15], when associated with Body Mass Index (BMI).

The current situation is alarming among children and adolescents with a higher prevalence of overweight and obesity in recent decades [7-8]. Obesity negatively affects not only physical health, but also psychological health [10]. There is, however, growing evidence that obesity is not only a weight problem, but is also linked to the presence of psychological comorbidities [9], to have low self-esteem, with a 55% risk of developing a depressive state [16-17]. On this subject, it has been estimated that an adolescent in one in five overweight people present symptoms of depression and that obesity and depression have common symptoms [18].

Several previous studies support a negative relationship between obesity and cognitive functioning, finding reduced performance on attention tests in obese adolescents, compared to their counterparts with normal build [19-20].

The main objective of the present study was to verify the association between obesity, VO2max, and neurocognitive performance in two groups of school adolescents (G1 overweight or obese, G2 with normal weight), of urban and rural origin in the Kenitra region.

Material and Methods

Participants

A sample of 170 school adolescents from rural and urban areas of the city of Kenitra were evaluated by using the body mass index (BMI), and the International Obesity Task Force, IOTF [21] thresholds, specific to sex and age, participants were divided into two groups:
Group 1 (G1) of 70 overweight or obese adolescents, and another group (G2) of 70 adolescents with normal build.
Inclusion criteria included: age between 12 and 18 years and BMI > 3rd percentile of IOTF standards for BMI.
The exclusion criteria were adolescents with underweight or a disability and were exempt from Physical Education and Sports (PES). 13 participants were excluded from the data analysis, due to a negative concentration capacity (CC) value, this is explained by non-compliance with the instructions and therefore the characters are marked at random [22].
Group 1 (G1) of 66 overweight or obese adolescents, and another group (G2) of 61 adolescents with normal build.

Anthropometric information

To calculate BMI, the height and weight of each subject were measured according to the recommended procedure (WHO, 1995), without shoes. Weight was obtained using an electronic scale (Korona 5818077 KFW 8077 type, precision of 0.1 kg German), and height taken with a vertical measuring rod.

Aerobic capacity

To evaluate the aerobic capacity, the 20m shuttle running test, scientifically validate test in adolescents, was used [23], This is a test which has been, it consists of doing a continuous and maximum progressive race which takes place between two lines spaced 20 meters apart, the participant must carry out a greater number of back and forth trips with a running speed regulated by sound signals and which gradually increases every minute. We then retain the last level announced which corresponds to the maximum aerobic speed (VMA), the latter is the most important parameter. most used to measure aerobic oxygen consumption (VO2peak) in adolescents [24],
The VO2peak (ml min-1 kg-1) is extrapolated from the equation including the maximum speed reached during the test, gender and weight [25] recommended by (Batista et al., 2013) [26].

$$VO2peak = 25{,}8 - (6{,}6 * sex) - (0{,}2 * Weight) + (3{,}2 * VMA).$$

Evaluation of self-esteem

Rosenberg Self-Esteem Scale 1965 [27] is most widely used psychological instrument for assessing the level of self-esteem, of which adolescents were the initial target of the scale, it consists of 10 items with responses in four points ranging from "Strongly disagree" (1) to "Strongly agree" (4), Items 1, 2, 4, 6, 7 are scored 3, 2, 1 and 0, while elements 3, 5, 8, 9, 10 are denoted in reverse form. A score below 31 self-esteem is considered low.
A mental health disorder diagnostic tool developed in 1990 by psychiatrists and clinicians in the United States and Europe [28], it makes it possible to identify 17 mental disorders (including the episode major depressive disorder is the first disorder) in 120 questions according to the diagnostic criteria of the ICD10 and the DSM-IV, The modalities of response to all the questions are dichotomous (YES/NO), during our study We will be interested in first level of mental disorders: major depressive episode MDE.
The international classification of diseases in its 10th revision (ICD-10), classifies depressive episodes according to the duration, severity and nature of the symptoms, to therefore judge an individual in MDE, at least 2 of the following 3 symptoms are required: an abnormal mood level, a reduction in energy, and a loss of interest, to this are added at least one or two symptoms of the remaining 7.

Measure of Attention

The attentional performance of adolescents was assessed using the revised version of the d2 attention test (d2–R), [29] which appeared in 2009, to remedy the problem of gifted or trained subjects arriving at the end of the line. 47 characters (old form of the d2 test), by adding 10 characters per line, thus The test is made up of 14 lines of 57 characters instead of 47, and the subject is required to cross out the maximum number of letters "d » accompanied by two dashes and to ignore all other distractors (the letter "p") randomly integrated on the same line for 20 seconds. The examiner verbally stipulates (stop) the change of line without interrupting the test.
Each student's score was determined by:

• The number of Target Characters Processed (CCT): reflects the processing speed as well as the quantity of work.
• E% accuracy: the percentage of errors made in all elements processed. A lower error rate indicates more successful performance.
• Concentration capacity (CC): corresponds to the number of letters correctly marked minus the sum of errors.
The reliability range of the test was 0.95 to 0.98, and the validity coefficient was 0.47 [22].

RESULTS

Weight status

The Table 1 illustrates the distribution of the mean score of anthropometric parameters between group 1 (obese, n=66) and group 2 (non-obese, n=61), including age, height, weight, and mass index. The mean age of the G1 was 16.18 ± 1.90 and that of the G2 was 16.24 ± 1.82 years, according to the T test did not vary between G1 and G2. However, there is a strong significant difference between the two groups for anthropometric measurements such as: height, weight, and BMI ($p < 0.001$), note also that normal adolescents have taller G2 than their overweight counterparts. or obese.

Tab.1. Comparison between anthropometric, cardiorespiratory measurements between weight status.

	G1 (n=66)	G2 (n= 61)	Signification
Age (years)	16,18±1,90	16,24 ±1,82	NS
Height (m)	1,61±0,09	1,67±0,10	**
Weight (kg)	70,21±9,57	58,69±8,68	***
BMI (kg /m²)	26,75±1,71	20,94±1,72	***
VO2peak (ml/kg/min)	37,18±7,52	45,63±7,45	***
Effort duration (min)	10,27±1,27	11,75±1,28	***
AP	10,41±2,64	11,94±2,36	NS
CCT	110,92±25,66	114,72±22,68	NS
CC	78,74±36,42	86,73±27,02	NS
E%	31,32±18,28	24,19±10,61	NS
Self-esteem	29,57±3,80	30,31±4,89	NS

BMI= Body mass index; VO2peak: Maximum oxygen consumption; AP: Academic performance; CCT= processing speed; CC= Capacity of Concentration; E%=accuracy percentage.
NS: no significant, ** significant (P<0.05%), ***: highly significant (p<0.01%)

The aerobic capacity given by the VO2peak value extrapolated from a shuttle test, as well as the duration of effort required to reach this VO2peak are very high in the G2 normal group (45.63 mL/kg/ min, over a duration of 11.75min), against (37.18 mL/kg/min, over a duration of 10.27min) encountered in overweight or obese adolescents, a strong statistically significant difference in VO2peak, and the duration of exercise between these 2 groups ($p < 0.001$).
The scores of the 3 important indices of the d2R test measuring attentional performance such as: speed of processing, ability to concentrate, and percentage of accuracy are high in the normal group compared to their overweight and obese counterparts, however the T test showed no difference in these indices between the 2 groups.
One of the determinants of well-being, self-esteem was judged low in both groups despite the small difference in scores: G1(29.57); G2 (30.31), However the averages of the self-esteem scores did not illustrate any significant difference between G1 and G2.

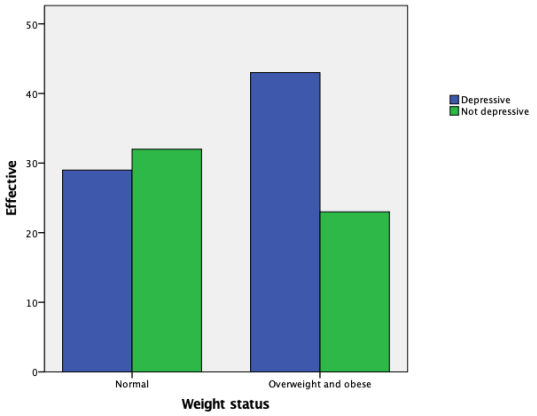

Fig.1. Distribution of depressive and no depressive adolescents according to weight status.

Depression is also considered to be a determinant of well-being in adolescents; the results of the Mini International Neuropsychiatric Interview (MINI) showed that 65.2% of overweight or obese adolescents go through a major depressive

episode, compared to 47.5% of normal adolescents (figure 1), in fact the chi 2 test revealed a significant difference between the 2 groups of the study sample (Pearson's ki-2 =0.04), thus proving that weight status is associated with depression.

According to Figures 2(a and b), the distribution of low self-esteem does not vary among boys and girls with normal build, on the other hand 45.5% of overweight or obese girls are judged to have low self-esteem low, compared to 19.7% of boys of the same weight status. The chi-square revealed no significant difference in self-esteem scores by gender in the two weight status groups.

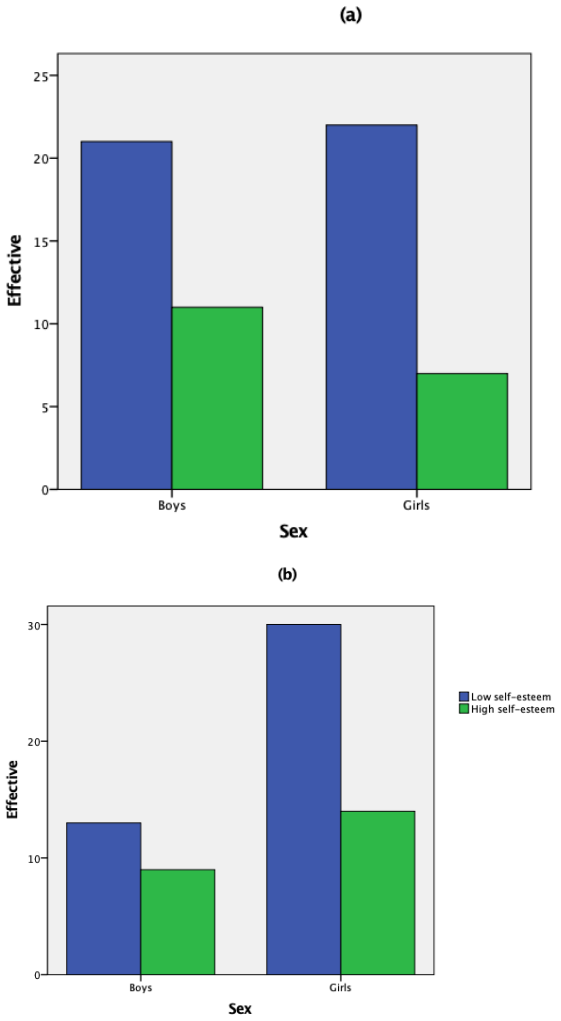

Fig.2. Distribution of type of self-esteem in normal weight (a) and in overweight and obese adolescents (b).

According to figures 3 (a and b), 51.5% of overweight or obese girls go through a major depressive episode, compared to 13.6% of boys of the same status, the chi-square revealed a statistically significant difference between overweight or obese boys and girls presenting depressive symptoms (Pearson coefficient = 0.03), the same observations between girls 29.5% and boys 18% with normal build, the difference according to the sex of normal adolescents is significant with Pearson co=0.03).

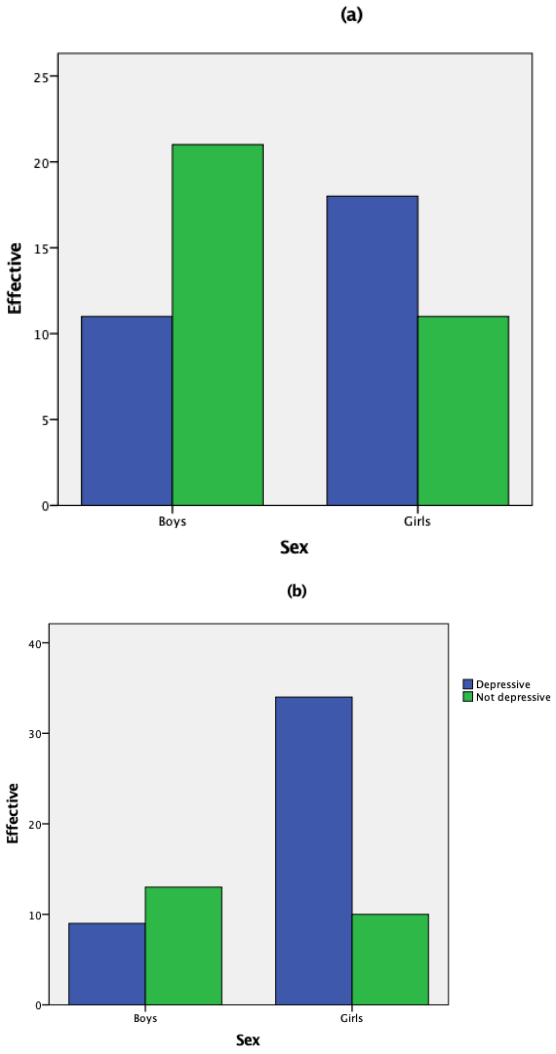

Fig.3. Distribution of type of depression in normal weight (a) and in overweight/obese adolescents (b).

According to gender (table 2), the VO2peak of boys is higher than girls between the two groups G1 and G2, in fact the t test showed a strong statistically significant difference according to gender within the groups G1 and G2.

Among G1 adolescents, the 3 indices of the d2R test (CCT; CC; E%) of boys are high compared to the performances found in girls, however the speed of processing is high in girls (115.8), compared to boys (113.8) of G2 adolescents the 2 other indices are in favor of boys, finally note that the t test revealed no significant difference according to sex in attentional performance in two groups.

Tab.2. Comparison between anthropometric, cardiorespiratory measurements between weight status.

	G1 (n= 66)			G2 (n= 61)		
	Boys	Girls	P	Boys	Girls	P
VO2peak(ml/kg/min)	40,48± 7,31	35,52± 7,14	**	49,56± 5,56	41,29± 6,90	***
DE	10,85± 1,27	9,97±1 ,17	**	12,53± 0,94	10,89± 1,02	***
CCT	112±2 5,06	110±2 6,23	NS	113,8± 22,07	115,8± 23,66	NS
CC	85,40± 31,13	75,40± 38,69	NS	88,71± 27,56	84,55± 26,72	NS
E%	26,11 %	33,93 %	NS	22,54 %	26%	NS

VO2peak: Maximum oxygen consumption; DE: Academic performance; CCT= processing speed; CC= Capacity of Concentration; E%=accuracy percentage.
NS: not significant, ** significant (P<0.05%), ***: highly significant (p<0.01%)

Discussion

The weight status has a significant impact on health and well-being, the aim of this study is to examine the associations of different variables in relation to physical health (aerobic fitness), well-being - psychological being (self-esteem and depression), and cognition (attention), in two groups of adolescents, the first (G1) with normal build, and the second (G2) overweight or obese from the city of Kenitra in Morocco, were at the center of this study.

Self esteem

The results showed that self-esteem is classified as low in the two studied groups G1 (m=29.57) and G2 (m=30.31), according to the rating of the esteem scale. of Rosenberg, these results are similar to several previous studies [29-32]. However, our results did not find a difference significant between self-esteem and weight status, this is confirmed by mixed results from several studies, these results are perhaps explained by the effect of the crucial period of puberty that those raised during adolescence go through and which acts indirectly on their self-esteem which is generally low in normal and obese people [33].

Attention

Our results showed that the 3 indices of the d2R test of focused attention did not change between the two weight groups. However, many studies support a negative correlation between obesity and attention from preschool age to adolescence. Other previous studies suggest that cognitive function in healthy children and adolescents is not associated with high BMI [34-37], also, Krombolz et al. and Franklin et al. [38-40] found that there no relationship between BMI and sustained attention in German preschoolers and Australian children and adolescents, respectively.
The absence of association between weight status and attentional performance in the two groups of normal and overweight/obese ca be explained by the duration of the effort less than 15 min, it has been demonstrated that a duration between 15 and 30 min of aerobic exercise led to improved performance on attention tests. In our study, the duration of effort of G1 (10.27); and G2 (11.75), other studies have shown the effect of aerobic exercise on attention after 20 min [41-43].

Aerobic fitness and duration of exercise

Adolescents in G1 show poorer VO2peak performance, compared to their normal counterparts in G2, moreover our results revealed a strong association between the level of VO2peak and weight status, these results are consistent with those of others research [44-47], these poor performances encountered in obese adolescents are explained by increased fatigability of the lower limbs [48], an altered muscular oxidative capacity [49-51] and finally by the premature appearance of neuromuscular fatigue [52].

Limitations

The results of our study must be taken into account with certain limitations, due to the small number of participants which is distributed unequally according to sex. Additionally, our sample included adolescents ranging from pre- to post-pubertal stages, which may affect psychological and cognitive test responses due to the changes and transformations that occur during puberty.

Conclusion

Aerobic capacity is one of the determinants of health in adolescents, this parameter is strongly influenced by weight status since according to our results the overweight or

obese group showed a low VO2peak, which increases the risk of having diseases in adulthood. Attention is not influenced by weight status.
Self-esteem in our study is low and is not associated with weight status.
Psychological well-being has shown that the presence of depressive episodes is associated with weight status, this is confirmed by several studies.

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