Weight profile in young subjects, link with Physical Activity Level (PAL)

نمط الوزن لدى الشباب وعلاقته بمستوى النشاط البدني

Belounis Rachid [1]   **Bouhal Fayçal [2]**   **Ait Amar Toufik[3]**

[1] Université Alger3 (Algérie), belounis.rachid@univ-alger3.dz

[2] Université Alger3 (Algérie), bouhal.faycal@univ-alger3.dz

[3] Université Alger3 (Algérie), aitamar.toufik@univ-alger3.dz

Abstract: Some Algerian regional surveys on the prevalence of adolescent obesity show the extent of this epidemic. Regarding the level of physical activity (PAL), we do not yet have data concerning this category. Conscious of the close link between obesity and lack of physical activity, particularly long-term health consequences, it is necessary to know the proportion of adolescents whose level of physical activity is in line with the recommendations issued by World Health Organization. The aim of this study is to describe the physical activity level (PAL) of obese adolescents by evaluating their energy expenditure. The cross-sectional study was conducted on a sample of 650 high school students from Algiers. It appears from this study that nearly 2/3 of students do not reach the health-promoting PAL. Such an observation is associated with the relatively high prevalence of overweight students (16.30% overweight and 26.15% abdominally obese). Plans to combat physical inactivity must be implemented to promote health by facilitating access to physical activity.

Key words: Physical activities, Weight profile, Physical Activity Level (PAL), high school students.

Corresponding author: Bouhal Fayçal ,   e-mail: fbouhal @yahoo.fr

الملخص :

أظهرت بعض الدراسات الجهوية في الجزائر عن انتشار البدانة عند المراهقين و الحجم الذي بدأت تأخذه هذه الآفة. و فما يخص مستوى النشاط البدني لا نمتلك أي معطيات عن هذه الفئة. ووعيا بالعلاقة الضيقة الموجودة بين البدانة وقلة النشاطات البدنية والمضاعفات المقلقة على الصحة على المدى البعيد، فمن الضروري معرفة مستوى النشاط البدني لدى المراهقين تماشيا مع توصيات المنظمة العالمية للصحة. وتهدف هذه الدراسة لوصف مستوى النشاط البدني عند البدينين من خلال تحديد مستوى استهلاك الطاقة. وتظهر الدراسة بأن ثلثي التلاميذ لا يبلغون مستوى النشاط البدني الملائم للصحة. وتأتي هذه الملاحظة بالاشتراك مع الانتشار العالي نسبيا لدى التلاميذ للوزن الزائد المرجّح (16.30% في الوزن الزائد، و 26.15% بدانة على مستوى الخصر). لذا من الضروري وضع خطط لمكافحة الخمول البدني من أجل ترقية الصحة وذلك أساسا بتسهيل القيام بالنشاط البدني.

الكلمات الدالة : الأنشطة البدنية ، الوزن ، مستوى النشاط البدني ، تلاميذ الطور الثانوي

1. Introduction

Obesity has become a universal phenomenon; its prevalence has not stopped growing to reach alarming proportions. This phenomenon affects adults and children, women and men, all continents and all social classes. Overweight and obesity are associated with numerous biological and clinical abnormalities whose prevalence increases with that of obesity (Desprès, 2007). Even more alarming is the growing rate of overweight among children. It has been estimated that 70% of affected adolescents will become obese as adults (Rossner, (1999), reported by Bergouignan, (2008).

Although some regional surveys exist in Algeria on the prevalence of obesity among children and adolescents (in Constantine and Sidi-Bel Abbes in 2007, in Sétif in 2006, and in Algiers in 2011), who have all shown the scale of this

epidemic, we do not have, to our knowledge, data on the level of physical activity in this category.

The protective effects of physical activity on health of young people are well established. In order to achieve the best health benefits, World Health Organization recommends 60 minutes per day of moderate to vigorous physical activity for children and adolescents.

Aware of the close link between obesity and lack of physical activity on the one hand, and particularly worrying consequences for the child that can cause long-term obesity on the other hand, it is necessary to know the proportion of adolescents whose level of physical activity is consistent with WHO recommendations (Strong, W.B et al., 2005), to redefine and guide the implementation of a prevention program for this category of youth.

There are several methods for assessing energy expenditure, including direct and indirect calorimetry, double labeled water method, heart rate recording method, accelerometer method, and finally, PAL method which is based on the estimation of Physical Activity Level.

In epidemiology, the evaluation of the physical activity level is based on questionnaires. Physical inactivity is then assessed by the absence of declared leisure physical activity. However, sedentary behavior does not only represent little or no physical activity, but corresponds to passive behavior whose energy expenditure is close to the resting value (working on a computer, watching TV, etc.). In addition, the concept of physical activity level (PAL), which represents the relationship between total energy expenditure and basal metabolism, could be a way of differentiating sedentary children from assets. Thus the prevention of obesity could go through the maintenance of a balance PAL > 1.75 according to INSERM, (2000).

The hypothesis of our study would be that obesity among children attending high school would be inversely proportional to their physical activity level (PAL).

The aim of this study is to estimate the prevalence of obesity in high school students, and describe their level of physical activity through the evaluation of energy expenditure, in order to guide the implementation of a prevention and support program for this category.

2. The significant terminology of the research

Physical activity: Any body movement produced by the contraction of skeletal muscles, which results in a substantial increase in energy expenditure above the resting value, Surgeon General, (1996).

It also includes all the movements made in everyday life, and is not restricted to just sports or exercise, Zemati .J-P, (2010).

The physical activity level (PAL): Is a way to express a person's daily physical activity as a number, and is used to estimate a person's total energy expenditure. United Nations University, (2009).

Obesity: Is an excess weight by increasing the weight of adipose tissue, Wainsten. J.P, (2009). It is also defined by Quevauvilliers. J, (2009) as an excessive accumulation of adipose tissue in the body. While Zazzo J.F and Puissant M.P, (2010) defined obesity as an increased body fat, in excess of 20% of body weight in men and more than 25% in women.

3. Similar studies

Oulamara, H. (2005), PhD thesis from University of Constantine; "Obesity and overweight of school children. Prevalence in Constantine 1996-2004, Risk factors associated in Constantine and Jijel".

It is a descriptive cross-sectional study on a representative sample of 26.852 children and adolescents aged between 5 and 18 years old including 13.564 girls

and 13.288 boys in 9 primary schools and 4 colleges and 3 high schools in the district of Constantine between 1996 and 2004.

The objective of this study was to estimate the prevalence of obesity among school children and to describe their level of physical activity by assessing energy expenditure.

The author collected information on two parameters that are the size and the weight of the students, and then calculate the body mass index (BMI), in order to classify them in the normal weight or overweight category. Afterwards, the author used a questionnaire according to the duration of the different daily activities of the children; she measured the physical activities level (PAL) of each student.

The results reveal that the average PAL of children is estimated at 1.65 +/- 0.13, with a mean PAL of boys slightly higher than that of girls.

There are no significant differences between the mean PAL of overweight children and that of children in normal weight (p = 0.30).

According to the PAL category, 57% of children whose 10% are overweight have a low PAL, 34% have a moderate PAL and 9% have a high PAL. In overweight children 61% of them have low PAL, 30% have moderate PAL and 9% have a high PAL.

The author concludes that overweight children do less sport than children with normal weight. An inverse relationship was found between playing time and BMI. Strategies to reduce physical inactivity and promote physical activity must be undertaken.

Koolhass, C., et al (2017), Impact of physical activity on the association of overweight and obesity with cardiovascular disease: The Rotterdam Study

Belounis Rachid   Bouhal Fayçal   Ait Amar Toufik

Being overweight or obese is associated with an increased risk of cardiovascular disease (CVD). Physical activity might reduce the risk associated with overweight and obesity. We examined the association between overweight and obesity and CVD risk as a function of physical activity levels in a middle-aged and elderly population. The study was a prospective cohort study.

The study included 5344 participants aged 55 years or older from the population-based Rotterdam Study. Participants were classified as having high or low physical activity based on the median of the population. Normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obese participants (≥30 kg/m^2) were categorized as having high or low physical activity to form six categories. We assessed the association of the six categories with CVD risk using Cox proportional hazard models adjusted for confounders. High physical activity and normal weight was used as the reference group.

During 15 years of follow-up (median 10.3 years, interquartile range 8.2–11.7 years), 866 (16.2%) participants experienced a CVD event. Overweight and obese participants with low physical activity had a higher CVD risk than normal weight participants with high physical activity. The HRs and 95% confidence intervals (CIs) were 1.33 (1.07–1.66) and 1.35 (1.04–1.75), respectively. Overweight and obese participants with high physical activity did not show a higher CVD risk (HRs (95%CIs) 1.03 (0.82–1.29) and 1.12 (0.83–1.52), respectively).

The findings of the authors suggest that the beneficial impact of physical activity on CVD might outweigh the negative impact of body mass index among middle-aged and elderly people. This emphasizes the importance of physical activity for

everyone across all body mass index strata, while highlighting the risk associated with inactivity even among normal weight people.

4. Methodology:

It is a cross-sectional study based on a representative sample of students of both sexes, aged between 15 and 18 years old, and enrolled in the public secondary schools of the Academy of Algiers. It used a simple sample: the draw was conducted at each level to determine classes and thus the number of students.

The number of subjects required was estimated at 650 pupils, which was calculated by the EPI ONFO 6 software based on an expected prevalence of overweight / obesity at 10%, α risk at 5% and accuracy of 2%.

4.1. Collected information

Anthropometric parameters: Height (cm), Weight (Kg), Waist (Cm),

Physical Activity Level (PAL).

We proceed to the calculation of the PAL by classifying the different activity identified in groups corresponding to average PALs according to the table below. The average duration spent on the grouped activities is first estimated and the PAL corresponding to each activity is determined, then the approximate value of the PAL is calculated. <u>Coefficient of PAL × duration (hours)</u>

24

Table 1: Classification of activities of children and adolescents aged 10 to 18 in 7 categories according to physical activity level (Martin 2000)

Category	PAL	Different activities
A	1	Sleep and nap, extended rest
B	1.75	Sitting position (TV, computer, homework, meals, transportation)

C	2.1	Standing position (toilet, purchase, cooking, small movements)
D	2.6	Little activities with a low intensity (games not very active)
E	3.5	Moderate activities (brisk walking, handicrafts)
F	5.2	Sports activities (training in club, physical education and sports)
G	10	Sport Competition

4.2. Statistical analysis

All data collected was coded and captured on Epi-Info version 6 software (CDC, Atlanta, USA). The qualitative variables were compared using the chi-square test or possibly Fisher's test in case of reduced numbers.

Quantitative variables were compared using the Student t-test or possibly the Wilcoxon test in case of reduced numbers (95% confidence interval).

5. Results

5.1. Prevalence of overweight

Table 2: Prevalence of overweight (including obesity) by sex

	boys		girls		RR	P
	Group	%	Group	%		
Overweight (obesity included)	44	14.66	62	17.71	1.2	0.1

Normal weight	256	85.34	288	82.29		
Total	300	100	350	100		

The prevalence of overweight (obesity included) is not statistically significant between both sexes. There is 14.66% for boys and 17.71% for girls.

Table 3: Prevalence of abdominal obesity by sex

	boys		girls		RR	P
	Group	%	Group	%		
Abdominally Obese	112	37.33	58	16.57	2.1	0.001
Abdominally non obese	188	62.67	282	83.43		
Total	300	100	350	100		

The distribution of abdominal obesity by sex shows a clear male predominance of the population with 112 boys (37.33%) versus 58 girls (16.57%). The difference between both sexes is statistically significant (p <0.01) and a relative risk (RR) is 2.1 times higher for boys than girls.

5.2. Physical activity level (PAL)

Table 4: Mean PAL in overweight children and normal weight by sex

	Overweight (obesity included)	Normal weight	Mean	p
Girls	1.66 +/-0.11	1.74+/-0.15	1.70+/-0.13	<0.05
Boys	1.61+/-0.14	1.64+/-0.13	1.62+/-0.13	0.19
Mean PAL	1.63+/-0.12	1.69+/-0.14	1.66+/-0.13	0.12

The average PAL of students is estimated at 1.66 +/- 0.13. The average PAL of girls is higher than that of boys (1.70 +/- 0.13 vs. 1.62 +/- 0.13, p = 0.01). There is no significant difference between the average PAL of students (both sexes), overweight (obesity included) and that of students of normal weight (1.63 +/- 0.12 vs. 1.69 +/- 0.14, p = 0.12). However, there is a significant difference in PAL between overweight girls (obesity included) and those with normal weight (p<0.05).

Table 5: Mean PAL in children with abdominally obesity and abdominally non-obese by sex

	Abdominally Obesity	Abdominally non obese	Total	p
Girls	1.61+/-0.10	1.74+/-0.13	1.67+/-0.11	0.01
Boys	1.68 +/-0.13	1.71+/-0.15	1.69+/-0.14	0.11
Mean	1.64+/-0.11	1.72+/-0.14	1.68+/-1.12	<0.05

The average PAL of students is estimated at 1.68 +/- 0.12. The average PAL of boys is higher than that of girls (1.69 +/- 0.04 vs. 1.67 +/- 0.11) but with no apparent statistical significant difference. However, there is a statistically significant difference between the average PAL of students (both sexes combined) with abdominal obesity and those abdominally non obese (1.64 +/- 0.11 vs. 1.72 +/- 0.14, p <0.05).

Table 6: Distribution of physical activity level (PAL) in overweight and normal weight children

	Normal weight		Overweight (obesity included)		Total		p
	Group	%	Group	%	Group	%	
Low	240	46.2	56	43	296	45.5	
Moderate	102	19.6	34	26.2	136	21	0.1
High	178	34.2	40	30.8	218	33.5	
Total	520	100	130	100	650	100	

Among overweight students (obesity included), 43% of them have a low PAL, 26.2% have a moderate PAL and 30.8% have a high PAL. In normal weights, 46.2% have a low PAL, 19.6% have a moderate PAL and 34.2% have a high PAL.

There was no statistically significant difference between the average PAL of overweight and normal weight students regardless of the PAL category.

Table 7: Distribution of physical activity level in children with abdominal obesity and abdominally non-obese

	Abdominally non obese		Abdominal Obesity		total		p
	Group	%	Group	%	Group	%	
Low	197	41	99	58.2	296	45.5	< 0.05

Moderate	81	16.9	55	32.4	136	21	
High	202	42.1	16	9.4	218	33.5	
Total	480	100	170	100	650	100	

In the abdominal obesity, 58.2% had low PAL, 32.4% had moderate PAL and 9.4% had a high PAL.

In the non-obese abdominals, 41% have a low PAL, 16.9% have a moderate PAL and 42.1% have a high PAL.

There is a statistically significant difference between the mean PAL of overweight students and those in normal weight by PAL categories (p <0.05).

6. Discussion

In our study, overall overweight (obesity included) is found in 16.30% of high school students according to the IOTF reference (international obesity task force) with a slight predominance in girls (17.71%) and 17.66% in boys, but without a statistically significant difference between both sexes.

This female predominance has been found in other studies (Aspray et al 2000, Musaiger et al 2000, Zagre et al 2001) reported by Oulamara. H (2005).

Similarly, another study in SEMEP, Bouzaréah (2011), concerning adolescents aged between 12 and 17, enrolled in the district of Bouzaréah (Algiers), shows a prevalence of overall overweight of 18%, with 21% among girls and 15% among boys.

Comparing the prevalence of obesity between different countries in the world is not a simple thing. This complexity lies in the methodology and variability of the

criteria used to define obesity. Similarly, comparing results of different studies confronts the problem of height of individuals as well as their age and sex distribution which are not statistically comparable.

Regarding the distribution of overall abdominal obesity, our study showed a prevalence of 26.15%. The distribution by sex shows a clear male predominance at 37.33% against 16.37% for girls, with a statistically significant difference between both sexes (p < 0.01) and a relative risk of 2.1 times higher among boys.

A priori, in our study, the imbalance of the energy balance is more pronounced in boys than girls. Male high school students would do more sedentary concerns than girls (video games, computers, television, etc.).

Although our results for overall overweight (obesity included) were broadly consistent with those found by SEMEP Bouzaréah, this does not seem to be the case for abdominal obesity. In fact, the measurements made during the SEMEP survey show a clear female predominance, with a prevalence of 38% for girls and 19% for boys. The difference between both sexes is significant (p <0.01).

In this case too, the comparison is difficult because it is confronted on the one hand with the measurement method used by the authors of the study (waist/size> 0.5 as the threshold beyond which we confirm the abdominal adiposity) and in the other hand by the age of the sample (12-17 years).

In the young child, before the age of 8 to 10 years, the simple fact of going to play outdoor games (traditional pre-sport games) allows him to spend his energy. In other words, the simple reduction of physical inactivity is proving effective, so it is one of the first measures to be advocated, INSERM (2000). Indeed, the important thing is to offer a more dynamic life, punctually during the day and not necessarily in clubs with a competitive spirit.

Subsequently, when the child is older, enrollment in sports clubs becomes necessary, to meet his physical and mental needs, specifically during the period of adolescence, where the benefits to be derived from a regular sport activity is obvious.

Several studies suggest a close relationship between the increase in the prevalence of obesity in children and adolescents, and the current trend towards decreased physical activity. Despite the decrease in total energy and lipid intake, prevalence increases, suggesting the important role played by the multiplication of physical activity, Amisola, V.B et al (2003).

Regarding the PAL category, 45.5% of our population has a low PAL, 21% have a moderate PAL and 33.5% have a high PAL.

With regard to overweight, (obesity included), we found no statistical difference between the average PAL of overweight and normal weight students. However, we observe a statistically significant difference in PAL between overweight girls and those with normal weight ($p < 0.05$).

In addition, comparing the percentages of overweight (including obesity) and normal weight students in each PAL category, showed no statistically significant difference. A low level of physical activity would not have a direct impact on the onset of general obesity.

In contrast, for abdominal obesity, we found a statistically significant difference in the mean PAL of students (both sexes combined) between abdominal obese and abdominally non obese ($p < 0.05$). Also, comparing the percentages of students with abdominal obesity and abdominally non obese in each category of PAL, shows a statistically significant difference ($p < 0.05$). Indeed, the occurrence of abdominal obesity in high school students is inversely proportional to their level of physical activity.

In the details of our questionnaire, the results of our study show that normal weight children are more important to exercise than those who are overweight. Also, we found that the majority of the obese, who practice a sport, choose sports with dominant anaerobic.

The lack of a negative association between the practice of an energy-dominated sport in the anaerobic sector and the indicators of obesity can be explained by the fact that fatty acids are only oxidized in mitochondria in strict aerobic conditions in sub maximal efforts, and this occurs only about 20 to 30 minutes after the start of exercise when the reserves of liver and muscle glycogen are depleted. These conditions are not met in sports characterized by high intensity efforts and short duration (sport with dominant anaerobic). In this type of sports, the preferential substrate is glucose on the one hand; lipolysis is absent or almost absent, because this one is observed for moderate intensities of endurance activity corresponding to 50-60% of the maximum aerobic capacity.

Despite the difficulty of quantifying physical activity, several studies conducted among adolescents show that the level of physical activity decreases between 9 and 18 years, especially among girls, Sallis et al (1993); Kimm et al (2002). This decrease is around 50% in adolescence, and can lead to a total cessation of any activity. However, the difference between girls and boys disappears when their biological age is taken into account.

However, it is essential to maintain regular physical activity in order to adjust body composition during childhood. Indeed, it has been shown that in children with high energy intake, an inverse relationship exists between their physical activity level and their percentage of body fat. In this study, the percentage of body fat would be related to inactivity, Hala. Y (2008, p. 38).

Another cross-sectional study by Di-Piétro in 1995 reported by Dubot-Guais.P.,(2005) showed that a negative association exists between usual level of physical activity and indicators of obesity. Another study, according to the same author, is Fleurbaix-Laventie, which reports that boys are twice as likely to be overweight if they do not practice physical activity.

Even though methods used to evaluate level of physical activities have been criticized by many authors as rudimentary and imprecise (Oulamara 2005), results we have reached show a relationship between low PAL and abdominal obesity. Nevertheless, we cannot exclude the presence of bias related to certain inaccuracies such as the students' estimation of actual times spent in different daily activities, as well as factors related to food. Additional data are therefore necessary for generalization of our results.

7. Conclusion

At the end of this study, it appears that nearly two-thirds of school children do not attain the level of physical activity conducive to health. Such observation is associated with relatively high prevalence of overweight students (16.30% overweight and 26.15% abdominally obese). Nearly 70% of overweight students (including obesity) have low to moderate PAL. Also, this low PAL is found in over 90% of students who have abdominal obesity.

Anti-sedentary plans should be put in place to promote health by facilitating access to physical activity, and creating safe spaces and facilities for students to practice in their spare time, as well as developing a more important physical activity program, in terms of number of sessions per week, and to define type of sports activities that can be offered in high schools.

Bibliographie

1. Amisola, V.B & Jacobson, M.S. (2003). Physical activity, Exercise and Sedentary Activity : relationship to the causes and treatment of obesity. Adolescent Medicine.

2. Bergouignan, A. (2008). Effet de l'inactivité physique sur les balances énergétique et oxydative : Inférences sur le rôle de la sédentarité dans l'étiologie de l'obésité. Doctorat physiologie et biologie des organismes, non publiée, université Louis Pasteur-Strasbourg, France.

3. Després, J-P. (2007). L'obésité abdominale, une maladie métabolique. ED JL Eurotext, Paris.

4. Dubot-Guais, P. (2005). La prévention de l'obésité chez l'enfant et l'adolescent : Thèse de Doctorat en médecine, non publiée, Faculté mixte de médecine et de pharmacie, Rouen.

5. Hala, Y. (2008). L'obésité de l'adolescent Libanais : étude épidémiologique et effets d'un exercice aigu et chronique sur le stress oxydant d'adolescentes en surpoids.

6. INSERM. (2000). Expertise collective, obésité, dépistage et prévention chez l'enfant. Editions INSERM, France.

7. Koolhass, C., et al (2017), Impact of physical activity on the association of overweight and obesity with cardiovascular disease: The Rotterdam Study. European Journal of preventive cardiology, Volume: 24 issue: 9, page(s): 934-941.

8. Kimm, S.Y et coll. (2002). Decline in physical activity in black girls and white girls during adolescence. N. Engl. J. Med.

9. Martin, A. (2000). Apports nutritionnels conseillés pour la population Française. Tec et Doc. Nut. Lavoisier. Paris.

10. Quevauvilliers. J, Somogyi. A, Fingerhut. A (2000). Dictionnaire médical, 6e édition Elsevier Masson.

11. Oulamara, H. (2005). Obésité et surpoids des enfants scolarisés, prévalence à Constantine 1996-2004. Facteurs de risque associés à Constantine et Jijel. Thèse de Doctorat en science de nutrition, non publiée, Université Mentouri de Constantine.

12. Sallis, JF. (1993). Epidemiology of physical activity and fitness in children and adolescents.. Rev.Sci. Nutr.

13. SEMEP. (2011). Etude du surpoids et de l'obésité et des facteurs associés au surpoids chez les élèves du cycle moyen scolarisés dans les collèges publique de l'EPSP de Bouzareah.

14. Strong, W.B et coll. (2005). Evidence based physical activity for school-age youth. J. Pediatr. 146.

15. Surgeon General (1996). US Department of Health and Human Services, Physical activity and health: A report of the CDC, Atlanta.

16. Wainsten J. P (2009). Dictionnaire Le Larousse Médicale, Ed Antoine Caron.

17. Zazzo J.F , Puissant M.P (2010). Dictionnaire de nutrition et diététique. Ed Maloine. Paris.

18. Zermati J.P, Apfeldorfer G, Waysfeld B. (2010). Traiter l'obésité et le surpoids, Ed Odile Jacob, Paris.

19. "Total energy expenditure (TEE) and physical activity levels (PAL) in adults: doubly-labelled water data". Energy and Protein requirements, Proceedings of an IDECG workshop. United Nations University. 1994-11-04. Retrieved 2009-10-15

20. قميني حفيظ (2018), دراسة لبعض مؤشرات مكون السمنة لدى شبان كرة القدم الجزائريين.
الابداع الرياضي مجلة Volume 09, n°02 du 23/12/2018، ص 142 – 168 .