



Prevalence of Overweight and Obesity among Children in Private Schools in Aracaju

**José Aderval Aragão^{1*}, Mirian Ellen de Jesus Agripino²,
Elenilde Gomes Santos², Enaldo Vieira Melo²,
Marina Elizabeth Cavalcanti de Sant'Anna Aragão³
and Francisco Prado Reis⁴**

¹*Department of Morphology and Physical Education and Applied Health Sciences Program, Federal University of Sergipe (UFS), Avenida Marechal Rondon, S/N, Jardim Rosa Elze, José Aloísio de Campos, 49100-000, São Cristóvão, SE, Brazil.*

²*Department of Medicine, Resident Physician of Pediatrics, Federal University of Sergipe (UFS), Avenida Marechal Rondon, S/N, Jardim Rosa Elze, José Aloísio de Campos, 49100-000, São Cristóvão, SE, Brazil.*

³*Physician Service Safety and Occupational Health the City Hall of Aracaju, Rua Frei Luís Canolo de Noronha, 42, Ponto Novo, 49097-270, Aracaju - SE, Brazil.*

⁴*School of Medicine, Tiradentes University (UNIT), Avenida Murilo Dantas 300, Farolândia, 49032-490 Aracaju, SE, Brazil.*

Authors' contributions

This work was carried out in collaboration between all authors. Author JAA designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors MEJA, MECSA and EGS managed the analyses of the study. Author EVM performed the statistical analysis. Author FPR co-designed the study, managed the literature search and proof read the first draft manuscript. All authors read and approved the final manuscript.

Original Research Article

Received 11th March 2014
Accepted 28th April 2014
Published 7th May 2014

ABSTRACT

Introduction: Childhood obesity is a matter of growing public health concern worldwide and may be associated with risks of illness and premature death in adulthood. In the light of increasing numbers of individuals presenting excessive weight, studies in Brazilian schools have shown that the prevalence of obesity and overweight among children varies according to the region, age group and type of school attended (public or private).

Objective: To determine the prevalence of overweight and obesity among children in

*Corresponding author: Email: jaafelipe@infonet.com.br;

private schools in Aracaju, Sergipe, Brazil.

Materials and Methods: Anthropometric examinations (weight, height and calculations of body mass index (BMI) and percentiles) were conducted on 600 children aged 7 years to 12 years and 11 months at five private schools in Aracaju. All of them were asked about their physical exercise practices. To determine overweight and obesity, respectively, the 85th and 97th percentiles of the World Health Organization's BMI curve were used.

Results: Among the children studied, 21.5% (129) presented obesity (95% CI:18.3%-24.8%) and 22.3% (134) presented overweight (95% CI:18.8-25.3). There was greater prevalence of obesity among male children ($p=0.05$). Only 10% of the children did not practice physical activities.

Conclusions: High prevalence of childhood overweight and obesity was found in our study, which signals that there is a need to concentrate on preventive, screening and care actions in this population.

Keywords: Obesity; overweight; body mass index; pediatrics.

ABBREVIATIONS

n, number of cases; IOTF: International Obesity Task Force; CDC: Centers for Disease Control and Prevention; WHO: World Health Organization.

1. INTRODUCTION

Overweight and obesity are defined by the World Health Organization (WHO) as abnormal or excessive accumulation of fat that leads to impaired health [1]. Occurrences of these conditions may be associated with nutritional imbalance and genetic or endocrine-metabolic disorders [2].

Over recent decades, there have been positive advances in health conditions worldwide, which have led to increased life expectancy. However, the increasing worldwide prevalence of obesity has reached alarming proportions and seems to threaten the trend of these expectations [3]. Today, 65% of the world's population lives in countries in which obesity and overweight kill more than malnutrition does [1]. According to data from the Brazilian Institute for Geography and Statistics (IBGE) [4], 50% of Brazilian men and 48% of Brazilian women present excessive weight, while 12.5% of men and 16.9% of women are obese. These data show that the growth of overweight and obesity rates among Brazilian adults has followed the worldwide trends. The increasing prevalence among children and adolescents is also a matter for concern.

The Family Budget Survey (POF 2008-2009) carried out by IBGE [4] showed that one in three Brazilian children aged 5 to 9 years presented excessive weight. In the 1970s, 10.9% of boys and 8.6% of girls presented weights that were greater than the level considered healthy by WHO, while in 2008 and 2009, 34.8% of the boys and 32% of the girls were considered to present excessive weight.

The increasing obesity prevalence rates are even more alarming when it is taken into account that 80% of these children will become obese adults [5]. In the light of this situation,

the aim of our study was to estimate the prevalence of overweight and obesity in private schools in Aracaju, and to compare the nutritional profiles of the different schools studied.

2. MATERIALS AND METHODS

An analytical observational study was conducted, with data gathered prospectively. The sample was of non-random nature and was selected from the presence lists of students in the second to fifth years in five private schools in Aracaju. One in every three children was selected for the study until reaching the number needed for sample saturation was reached. In each school, 120 children aged 7 to 12 years were selected, i.e. 20 children of each age-year per school. To calculate the sample size, the prevalence of obesity was taken to be 10%,[6,7] with an estimated precision of 3% and a 95% confidence interval 95%. Thus, the estimated sample size was 576 children (approximately 600 students). This study was approved by the Research Ethics Committee of the Federal University of Sergipe (FUS), through protocol number 0032.0.107.00-09.

Anthropometric data (weight and height) were gathered by a medical student who had been properly trained. Weight was quantified using an electronic scale with a capacity of 180kg and precision of 100g (Balança Personal 180; Filizola, São Paulo, Brazil). Height was measured using a wooden anthropometer fixed to the wall, with a scale graduated in centimeters and millimeters. For the height measurements, the individual was positioned standing upright, without shoes, feet together and head oriented in the Frankfurt plane parallel to the floor; with heels, gluteals, dorsal region and head in contact with the apparatus, and with arms extended, hanging at the sides of the body. The measurement was made while the subject was breathing in. The cursor was slid along the scale at 90° to it, to the subject's head. The height measurements corresponded to the distance between the plantar region and the vertex. The BMI was expressed as the mass in kilograms divided by the height in meters squared. The children were also asked about whether they practiced physical activities.

The BMI percentile and Z-score calculations were done using an Anthroplus anthropometric calculator, which contains software that uses the WHO references to classify individuals as low weight, eutrophic, overweight or obese. The children with BMI percentile <3, were classified as low weight; with BMI percentile ≥ 3 and ≤ 85 , as eutrophic; with BMI percentile >85 and ≤ 97 , as overweight; and with BMI percentile >97, as obese[8].

The data were analyzed using the SPSS 17.0 software to calculate frequencies and using Bioestat 5.0 to calculate significance, using a binomial test of two proportions. The value of $p < 0.05$ was taken to indicate statistical significance.

3. RESULTS

Six hundred students aged 7 years to 12 years and 11 months were evaluated (100 students in each age-year), from five private schools in Aracaju (120 students in each school), of whom 52.8% (317) were male and 48.33% (283) were female.

Almost half of the schoolchildren (46.3%) were considered to present an inadequate nutritional state. Obesity and overweight were the nutritional alterations most frequently encountered, with prevalences of 21.5% and 22.3% respectively Table 1.

Occurrences of obesity were more prevalent among male students than among female students ($p=0.05$). For overweight, there was no difference in prevalence between the sexes ($p>0.05$) Table 2.

The frequency of obesity at different ages ranged from 16% (12 years) to 29% (10 years), as shown in Table 3, from which it can be seen that the highest prevalence was among 10-year-old students, in relation those aged 11 and 12 years ($p=0.04$ and $p=0.03$, respectively).

The prevalence of obesity ranged from 13.3% (school C) to 28.3% (school D), while overweight ranged from 20.0% (school B) to 25.0% (schools A and C). School D had higher prevalence of obesity than schools C and E ($p=0.004$ and $p=0.04$), as shown in Table 4. School C showed lower prevalence of obesity ($p=0.03$) than schools A, B and D. School E showed significantly lower prevalence ($p=0.046$) of obesity than school D. No significant difference between schools A, B and D was observed.

Table 1. Distribution of nutritional status among students at private schools according to the WHO body mass index percentiles. Aracaju, SE, 2012

Nutritional status	% (n)	95% confidence interval*
Obese	21.5%(129)	18.3%-24.8%
Overweight	22.3%(134)	18.8%-25.3%
Normal	53.7%(322)	49.7%-57.7%
Low weight	2.5%(15)	1.2%-3.8%

*95% confidence interval was estimated by means of the Bootstrap technique based on 1000 samples with replacement

Table 2. Distribution of nutritional status among students at private schools according to sex. Aracaju, SE, 2012

Nutritional status	Sex		
	Male	Female	P
Obese % (n)	24.6%(78)	18.0%(51)	0.05
Overweight % (n)	20.8%(66)	24.0%(68)	0.34
Normal % (n)	52.1%(165)	55.5%(157)	0.40
Low weight % (n)	2.5%(8)	2.5%(7)	0.96
Total % (n)	52.8%(317)	47.2%(283)	

Table 3. Distribution of nutritional status among students at private schools according to age. Aracaju, SE, 2012

Nutritional status	Age group					
	7	8	9	10	11	12
Obese% (n)	24%(24)	24%(24)	19%(19)	29%(29)	17%(17)	16%(16)
Overweight % (n)	17%(17)	23%(23)	29%(29)	17%(17)	27%(27)	21%(21)
Normal % (n)	57%(57)	51%(51)	47%(47)	52%(52)	56%(56)	59%(59)
Low weight % (n)	2%(2)	2%(2)	5%(5)	2%(2)	0%(0)	4%(4)
Total (n)	100% (100)	100% (100)	100% (100)	100% (100)	100% (100)	100% (100)

* $p^a=0.04$ (association between obesity in the 10-year-old group and obesity in the 11-year-old group); $p^b=0.03$ association between the 10-year-old group and the 12-year-old group

One in every ten children was not practicing physical activity. However, there were differences regarding sports activity practice between the schools. School C stood out through having a greater number of children in sports activity than schools A, B and D ($p < 0.03$) Table 5.

Table 4. Distribution of nutritional status among students at private schools according to school. Aracaju, 2012

Nutritional status	School				
	A	B	C	D	E
Obese % (n)	24.2%(29)	24.2%(29)	13.3%(16)	28.3%(34)	17.5%(21)
Overweight % (n)	25.0%(30)	20.0%(24)	25.0%(30)	20.8%(25)	20.8%(25)
Normal % (n)	47.5%(57)	53.3%(64)	60.0%(72)	50.0%(60)	57.5%(69)
Low weight % (n)	3.3%(4)	2.5%(3)	1.7%(2)	0.8%(1)	4.2%(5)

* $p^a=0.03$ (association between obesity in A and obesity in C); $p^b=0.03$ (association between obesity in B and obesity in C); $p^c=0.004$ (association between obesity in D and obesity in C); $p^d=0.046$ association between obesity in E and obesity in D

Table 5. Distribution of physical activity among schools. Aracaju, 2012

Physical activity	School				
	A	B	C	D	F
Yes	86.7%(104)	88.3%(106)	95.8%(115)	87.5%(105)	91.7%(110)
No	13.3%(16)	11.7%(14)	4.2%(5)	12.5%(15)	8.3%(10)

$p^a=0.01$ for correlation between schools A and C; $p^b=0.03$ for correlation between schools B and C; $p^c=0.02$ for correlation between schools D and C

4. DISCUSSION

Childhood obesity is a disease that has been recognized to have short and long-term consequences and to be an important predictor of adult obesity. Prevention during the first stages of life, along with early diagnosis and effective treatment, is fundamental for improving the prognosis [5]. Thus, early detection of children who are at higher risk of developing obesity, together with taking measures to control this problem, can lead to a favorable long-term prognosis.

The present study found high levels of overweight (22.3%) and obesity (21.5%) in private schools in the city of Aracaju (situated in a poorly developed region of Brazil). Recently, Ogden et al. [9] in the United States described prevalences of obesity of 18.8% and overweight of 37.2% among an age group similar to ours (6-11 years). El Mouzan et al. [10] in Saudi Arabia, found lower prevalence (obesity of 9.3% and severe obesity of 2%). In Brazil, Ducan et al. [11] studied 22 schools (11 public and 11 private) in São Paulo and found that 19.4% of the boys and 16.1% of the girls were overweight, while 8.9% and 4.3% were obese in the respective sexes.

There are differences in the Brazilian literature regarding the prevalences of overweight and obesity according to the type of school studied (public or private), region (northeastern or southeastern) and age group. The Family Budget Survey (POF, 2008/2009) showed that in the northern and northeastern regions, the prevalence of excessive weight ranged from 25% to 30%, while in the southeastern, southern and central-western regions, the range was 32% to 40%, and it was also more prevalent in urban settings than in rural areas [4]. In other

studies conducted in northeastern Brazil, Balaban et al. [12] found that the prevalence of obesity in a private school in Recife was 8.5%; Mendonça et al. [13] described a general prevalence in Maceió (public and private schools) of 4.5% and Leão et al. [14] found prevalences of 30% in private schools and 8.2% in public schools in the city of Salvador. Mendonça et al. [13] observed that, in relation to students in public schools, students in private schools were twice as likely to present overweight and five times as likely to present obesity. In the present study, the prevalence of childhood obesity was high (21.5%), but it was compatible with the findings of Leão et al. [14] which were also from a private school in northeastern Brazil (Salvador), with a slightly younger age group (5-10 years).

POF 2008-2009 showed a prevalence of excessive weight of 33.5% among Brazilian children aged 5 to 9 years, with proportions of six to ten times greater in the highest per capita income class in relation to the poorest class [4]. In our study, just under half (43.8%) of the children at private schools presented weights that were greater than desirable.

In an evaluation on preschool children aged 3.5 to 5.5 years in the city of Aracaju, Silva [15] found that the prevalence of overweight was 16% and obesity, 7.9%. In 2002, Lima et al. [16] found prevalences of overweight and obesity in the same city that were similar to those already described in the literature (10% and 6%, respectively). However, they noted that there were higher proportions of obesity and overweight in private schools (12.1% and 16.2%) than in public schools (4.5% and 8.5%). The prevalences found in the present study were greater than those found by Lima et al. [16] among students in private schools of similar age group (7-14 years). However, it should be noted that these two studies used different diagnostic criteria, given that in 2002, the WHO BMI curve had not yet been published.

In comparing the different schools evaluated, we noted that school C stood out through having the lowest prevalence of obesity and the highest frequency of students practicing sports, in relation to schools A, B and D ($p \leq 0.03$). Studies have shown that practicing physical activity may decrease body fat and, consequently, the risk of obesity [17].

There are disagreements regarding differences in the prevalence of overweight and obesity in relation to sex. Authors like Mendonça et al. [13] did not find any significant association with sex. In our evaluation, the difference in prevalence between the sexes presented threshold significance ($p=0.05$); Costa et al. [18] and Balaban et al. [12] also found a significant difference. In relation to overweight, Balaban et al. [12] showed that this was more frequent among males and Costa et al. [18] among females, while in the present study, there was no statistical difference. POF described greater obesity among boys (16.6%) than among girls (11.8%).

Mendonça et al. [13] found greater prevalence of obesity in the age group from 7 to 9 years than from 10 to 13 years. The present study found greatest frequency among 10-year-old students. However, the lack of standardization of the age groups studied, the variation of prevalence according to the type of school evaluated and the socioeconomic differences between the Brazilian regions hinder comparison between different studies on the prevalence of obesity among children in Brazil. Nonetheless, there is a consensus among the authors that the prevalence of excessive weight, rather than malnutrition, has grown in a worrying manner and deserves attention from the authorities as a public health problem (POF 2008-2009) [4]. This is despite the current lack of consensus regarding the criteria to be used for classifying adolescents as overweight or obese. However, Bibiloni et al. [19]

have highlighted the International Obesity Task Force (IOTF) criteria as the ones most frequently used.

In Table 6, we compare our findings with those in the Brazilian literature and from other countries [20-31]. In addition to the countries where the studies were conducted, this table presents the authors, year of publication, total number of participants in the study, number of adolescents, age range, proportions of boys and girls and definitions of overweight and obesity according to the classification system used. Regarding the limitations of the present study, these relate especially to non-inclusion of important variables, such as food consumption and better evaluation of sports practices, with detailing of the quality of the sport, number of hours and frequency, which would make it possible to understand the results better. Because the sample was selected only in private schools, greater generalization to the general population, regarding the prevalence of excessive weight among children of this age group, is not possible. The most important limitation of the present study was that it did not assess the quality of the canteens in different schools and thus did not evaluate the dietary habits of the children.

Table 6. Comparison of the prevalence of overweight and obesity between our results and those in the Brazilian literature and from other countries

Study	Country	n	Obesity %		Overweight %		Age	Criterion
			Boys	Girls	Boys	Girls		
Abrantes et al. [20]	Brazil	7260	11.8	13.3	7.3	9.3	2-17	WHO
Quadros, Zambonato [21]	Brazil	132	13.2	18.48	21.12	38.28	10-11	WHO
Tassitano et al. [22]	Brazil	4210	0.78	1.66	4.53	6.93	14-19	IOTF
Ferreira et al. [23]	Brazil	1550	10.17	5.81	12.74	12.40	7-11	CDC
Balaban, Silva, [24]	Brazil	762	14.7	4.4	34.6	20.6	6-19	WHO
Romagna et al. [25]	Brazil	272	18.0	14.2	13.7	15.5	5-18	CDC
Dumith, Farias Júnior [26]	Brazil	525	7.6	7.2	19.6	22.5	7-15	IOTF
Aounallah-Skhiri et al. [27]	Tunisia	1295	1.9	3.2	11	14.1	15-19	IOTF
Shields, Tremblay, [28]	Canada	8661	14.3	9.6	17	14.7	12-17	CDC
Khader et al. [29]	Jordan	1034	12.4	8.2	11.3	15.5	13-18	IOTF
Blüher et al. [30]	Germany	93028	7.6	4.6	19.3	17	12-16	IOTF
Utter et al. [31]	New Zealand	9107	10.8	9.5	23.3	24.7	13-17	IOTF
Present study	Brazil (Aracaju)	600	24.6	18.0	20.8	24	7-13	WHO

5. CONCLUSION

The prevalence of overweight and obesity in private schools in the city of Aracaju (situated in a poorly developed region of Brazil) resembles the high prevalence in developed countries. It was noted that schools with higher frequency of physical activity had lower prevalence of obesity. These findings reaffirm that there is an urgent need to implement strategies for health education, which would involve society, schools and families, in order to promote health and prevent future illnesses correlated with the presence of obesity among these children at this school age. Among these needs, individualized physical activity programs, healthy eating and weight control at schools can be mentioned.

CONSENT

All authors declare that written informed consent was obtained from the parents of the patient for publication of this study.

ETHICAL APPROVAL

The study protocol was examined and authorised by the Research and Ethics Committee of the FUS in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki on biomedical research on human subjects.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organization–WHO. Obesity and overweight. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/>.
2. Brazilian Association for the Study of Obesity and Metabolic Syndrome. Brazilian Guidelines on Obesity 2009/2010 ABESO - Brazilian Association for the Study of Obesity and Metabolic Syndrome. 3rd edition, Sydney (Itapevi): Ac Pharmaceuticals; 2010.
3. Franks, PW, Hanson RL, Knowler WC, Sievers ML, Bennett PH, Looker HC. Childhood Obesity, other cardiovascular risk factors, and premature death. *New Engl J Med*. 2010;362(6):485-93.
4. Brazilian Institute of Geography and Statistics. Household Budget Survey 2008-2009: anthropometry and nutritional status of children, adolescents and adults in Brazil [Internet]. Rio de Janeiro: IBGE; 2010. Available at: http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pof/2008_2009_en_caa/comentario.pdf . Accessed on: 02/11/2012.
5. Setian N. *Pediatric Endocrinology: Physical and Metabolic Aspects of newborn to teenager*. 2. Ed., São Paulo, Sarvier. 2002;567-82.
6. Yanovski S, Yanovski J. Obesity. *N Eng J Med*. 2002;346(2):591-6.
7. Monteiro CA, Mondini L, de Souza AL, Popkin BM. The nutrition transition in Brazil. *Eur J Clin Nutr*. 1995;49(2):5-13.
8. World Health Organization–WHO. Anthro plus software. 2007. Available at: <http://www.who.int/growthref/tools/en/>. Accessed on: 28/04/2012.

9. Ogden CL, Carrol MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*. 2012;307(5):483-90.
10. El Mouzan MI, Foster PJ, Al Herbish AS, Al Salloum AA, Al Omer AA, Qurachi MM, et al. Prevalence of overweight and obesity in Saudi children and adolescents. *Ann Saudi Med*. 2010;30(3):203-208.
11. Ducan S, Duncan EK, Fernandes RA, Buonani C, Bastos KDN, Segatto AFM, et al. Modifiable risk factors for overweight and obesity in children and adolescents from São Paulo, Brazil. *BMC Public Health*. 2011;11:585.
12. Balaban G, Silva GAP. Prevalence of overweight and obesity in children and adolescents from a private school in Recife. *J. Pediatr*. 2001;77(2):96-100.
13. Mendonça MRT, Silva MAM, Rivera IR, Moura AA. Prevalence of overweight and obesity in children and adolescents in the city of Maceió. *Rev Assoc Med Bras*. 2010;56(2):192-6.
14. Leão LSCS, Araújo LMB, Moraes LTLP, Assis AM. Prevalence of Obesity in School of Salvador, Bahia. *Arq Bras Endocrinol Metab*. 2003 Abr;47(2):151-7.
15. Silva DAS. Prevalence of overweight and obesity in preschool children from high socio-economic status of the city of Aracaju-SE. *Medicine (Ribeirão Preto)*. 2008 abr/jun;41(2):177-81.
16. Lima IB, Gurgel RQ; Fontes FJG, Oliveira SMG, Oliveira ACC. Prevalence of obesity and overweight among elementary school students in Aracaju / SE. [Dissertation] Aracaju: Federal University of Sergipe; 2002.
17. Faith MS, Berman N, Heo M, Pietrobelli P, Gallagher D, Epstein LH, Eiden MT, Allison DB. Effects of Contingent Television on Physical Activity and Television Viewing in Obese Children. *Pediatrics*. 2001;107(5):1043-1048.
18. Costa RF, Cintra IP, Fisberg M. Prevalence of overweight and obesity in schoolchildren of the city of Santos. *Arq Bras Endocrinol Metab*. 2006;50(1):60-7.
19. Bibiloni MD, Pons A, Tur JA. Prevalence of Overweight and Obesity in Adolescents: A Systematic Review. *ISRN Obes*. 2013;2013:392747.
20. Abrantes MM, Lamounier JA, Colosimo EA. Prevalence of overweight and obesity in children and adolescents in the Southeast and Northeast regions. *J Pediatr (Rio J)*. 2002;78(4):335-40.
21. Quadros MP, Zambonato F. Prevalence of overweight and obesity in children aged between 10 and 11 years of the state system of education in the municipality of Erechim / RS. *Perspective, Erechim*. 2011;35(129):203-214.
22. Tassitano RM, Barros MVG, Tenório MCM, Bezerra J, Hallal PC. Prevalence and factors associated with overweight and obesity in adolescents, students from high schools in Pernambuco, Brazil. *Cad Public Health, Rio de Janeiro*. 2009;25(12):2639-2652.
23. Ferreira AP, Morais PP, Oliveira RJ, Ferreira CB, França NM. Prevalence of overweight and obesity in schoolchildren Wansbeck-DF. *Rev Inst Ciênc Health*. 2008;26(2):161-6.
24. Balaban G, Silva GAP. Prevalence of overweight and obesity in children and adolescents from a private school in Recife. *J Pediatr (Rio J)*. 2001;77(2):96-100.
25. Romagna ES, Silva MCA, Ballardín PAZ. Prevalence of overweight and obesity in children and adolescents in a basic health unit in Canoas, Rio Grande do Sul, and comparison of nutritional diagnosis between the graphs from the CDC 2000 and the WHO 2006. *Scientia Medica (Porto Alegre)*. 2010;20(3):228-231.
26. Dumith SC, Farias Júnior JC. Overweight and obesity in children and adolescents: Comparison of three classification criteria based on body mass index. *Rev Panam Salud Publica*. 2010;28(1):30-5.

27. Aounallah-Skhiri H, Romdhane HB, Traissac P, Eymard-Duvernay S, Delpuech F, Achour N, Maire B. Nutritional status of Tunisian adolescents: Associated gender, environmental and socio-economic factors. *Public Health Nutr.* 2008;11(12):1306-17.
28. Shields M, Tremblay MS. Canadian childhood obesity estimates based on WHO, IOTF and CDC cut-points. *Int J Pediatr Obes.* 2010;5(3):265-73.
29. Khader YS, Batieha A, Jaddou H, Batieha Z, El-Khateeb M, Ajlouni K. Metabolic abnormalities associated with obesity in children and adolescents in Jordan. *Int J Pediatr Obes.* 2011;6(3-4):215-22.
30. Blüher S, Meigen C, Gausche R, Keller E, Pfäffle R, Sabin M, Werther G, Odeh R, Kiess W. Age-specific stabilization in obesity prevalence in German children: A cross-sectional study from 1999 to 2008. *Int J Pediatr Obes.* 2011;6(2-2):199-206.
31. Utter J, Denny S, Crengle S, Ameratunga S, Robinson E, Clark T, Percival T, Maddison R. Overweight among New Zealand adolescents: Associations with ethnicity and deprivation. *Int J Pediatr Obes.* 2010;5(6):461-6.

© 2014 Aragão et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sciencedomain.org/review-history.php?iid=516&id=12&aid=4498>