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Original Article

Physical activity assessments in obese and non-obese adolescents using the Bouchard diary

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Abstract

Background Obesity is now a global epidemic problem. Increased prevalence of obesity is associated with increased sedentary behavior and low physical activity.

Objective To assess the physical activity patterns of adolescents aged 10-15 years and to compare mean energy output, intensity of physical activity, duration of moderate-vigorously intensity of physical activity, and length of screen time in obese and non-obese adolescents.

Methods This cross-sectional study was conducted on 7th and 8th grade students aged 12-15 years at 216 junior high schools in West Jakarta. Physical activity was assessed using the Bouchard diary for 2 school days and 1 holiday.

Results There was no significant difference in mean energy output between the obese and non-obese adolescents. The median intensity of physical activity of obese adolescents was lower than that of non-obese adolescents [1.5 (range 0.8 to 1.8) vs. 2 (range 1.6 to 2.8) METs, respectively; P <0.001]. The mean duration of moderate-vigorous intensity of physical activity in obese adolescents was shorter than that of non-obese adolescents [19.3 (SD 6.9) vs. 26.4 (SD 3.4) minutes, respectively; P=0.000]. Median length of screen time was longer for obese adolescents than for non-obese adolescents [2.8 (range 1 to 6.6) vs. 1.8 (range 0.3 to 6.1) hours, respectively; P <0.001]. There was no adolescent who met the recommended physical activity intensity and duration criteria.

Conclusion Physical activity varies among adolescents aged 10-15 years. Obese adolescents have significantly less physical activity duration and intensity than non-obese adolescents, but significantly longer screen time. All adolescents' physical activity is less than the recommended intensity and duration.

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Keywords: *physical activity, obese, adolescents, Bouchard diary*

Childhood obesity is one of the most serious public health challenges of the 21st century. The prevalence has increased at an alarming rate. [1] The worldwide prevalence of childhood overweight or obesity increased from 4.2% in 1990 to 6.7% in 2010.[2] *The International Obesity Task Force* (IOTF) reported that 22 million children under 5 year old in the world are overweight or obese.[3] The *Indonesian Riset Kesehatan Dasar* (RISKESDAS) data also showed an increase in obesity prevalence from 10.3% in 2007 to 14% in 2010.[4,5]

Studies have shown that increased prevalence of obesity is associated with increased sedentary behaviour and low physical activity.[6,7] In addition, the intensity of physical activity of obese adolescents is lower than that of non-obese adolescents.[8,9] Furthermore, obese adolescents spend less time engaging in moderate-vigorously intensity of physical activity than non-obese adolescents, and these obese children spend most of their time in sedentary behavior.[10] There have been few such studies in Indonesia. Studies by Girsang[11] and Kurniawan[12] distinguish the intensity

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of physical activity as active or not active. Studies on differences in physical activity patterns in obese and non-obese adolescents have had varying results.[6]

The purpose of this study was to determine the physical activity patterns of adolescents aged 10-15 years and to assess the differences in energy output, intensity of physical activity, duration of physical activity of moderate-vigorous intensity, and length of screen time in obese and non-obese adolescents. We also assessed adolescents' compliance with engaging in the recommended duration and intensity of physical activity.

Methods

This cross-sectional study was conducted on 7th and 8th grade students aged 12-15 years at 216 junior high schools in West Jakarta from February to May 2012. Subjects were enrolled by consecutive sampling. Children with physical limitations were excluded. The study consisted of two phases: to assess the physical activity patterns of subjects, followed by a comparison of energy output, intensity of physical activity, duration of moderate-vigorously intensity of physical activity, and length of screen time in obese and non-obese adolescents.

Body weight was measured using a digital weight scale stand with subjects wearing a school uniform but without shoes. Height was measured using a stadiometer with subjects in an upright position facing forward and barefooted. Body mass index (BMI) was defined as the weight in kg divided by the square of the height in meters (kg/m^2). The 2000 Centre Disease of Control (CDC) BMI curve was used to classify subjects' BMI by age.[1] Adolescents were classified as either obese or non-obese, with well-nourished nutritional status, based on their BMIs. Structured interviews by a dietician expert were conducted to assess nutritional intake using food models. Results were expressed as kcal/day.

The *American Academy of Pediatrics*, *World Health Organization* (WHO), *American Heart Association* (AHA), and CDC recommend at least moderate intensity of physical activity for 30-60 minutes daily and limit screen time < 2 hours per day. Physical activity was evaluated by the intensity, duration, and length of screen time based on the recommendation. Physical activity data was obtained by Bouchard diary. Subjects noted their physical activity for 3 days, school days with and without exercise, as well as one holiday. All subjects were asked to record the type of physical activity they did every 15 minutes, and to code the type of physical activity by category in the Bouchard diary. Results were expressed as daily energy output (kcal / kg/day). We converted these results into metabolic equivalent of task (MET) units to rate the intensity of physical activity with 1 kcal/kg x hour = 1 MET.

The intensity of physical activity assessed by the conversion of the type of physical activity according to the compendium of physical activities: sedentary behavior (energy output <1.5 MET), light intensity of physical activity (energy output 1.6-2.9 MET), moderate intensity of physical activity (energy output 3-6 MET), and vigorously intensity of physical activity (energy output > 6 MET). Duration of moderate-vigorously intensity of physical activity was classified as <30 minutes, 30-60 minutes, and > 60 minutes.

Data were processed using the *Statistical Software and Service Solutions* (SPSS) for *Windows* version 17 and presented in text and tables. Data was analyzed for differences in energy output, intensity of physical activity, duration of moderate-vigorously intense physical activity, and length of screen time by T-test for normal data distribution and by Mann-Whitney test for non-normal data distribution. Results were considered to be statistically significant for $P<0.05$ with 95% confidence intervals.

This study was approved by the Ethics Committee of the Faculty of Medicine, University of Indonesia.

Results

Screening for nutritional status was conducted on 573 students in 7th and 8th grades. A total of 225 students met the inclusion criteria and completed the Bouchard diary for three days (**Figure 1**). One hundred seventy eight adolescents, consisted of 94 well nourished and 84 obese, underwent dietary analysis. The stages of the study are shown in **Figure 2**.

The prevalences of obesity and well-nourished nutritional status in this study were 37% and 42%, respectively (**Table 1**). Most obese and well nourished adolescents were girls.

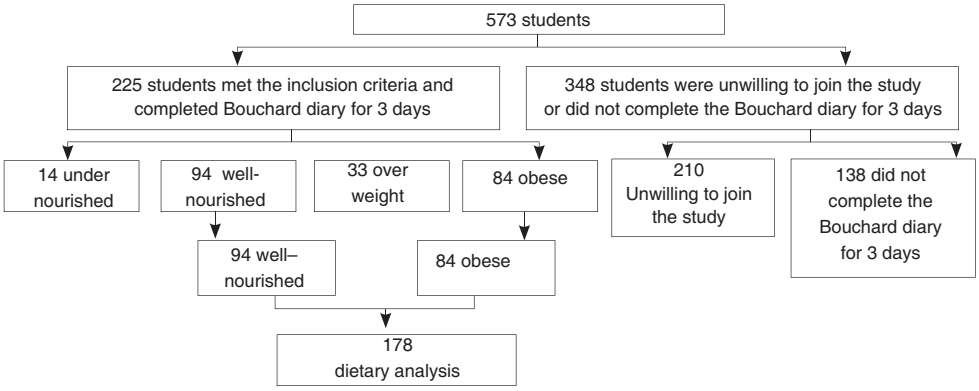

Figure 1. Flow chart of subject selection

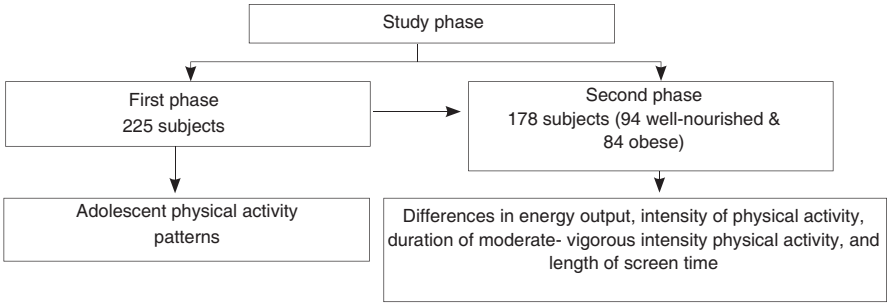

Figure 2. Phases of the study

Frequent physical activities were watching TV and school works (sedentary intensity), walking (light intensity), swimming (moderate intensity), and football (vigorous intensity). A comparison of the types of physical activities that boys and girls engaged in is shown in **Figure 3.** We found that 45.6% of boys and 54.4% of girls exercised outside of lesson time. Of subjects who exercised outside of lesson time (40%), 57.8% were well-nourished, 6.7%

Table 1. Baseline characteristics

Characteristics	n=225
Median age (range), years	13.2 (12-15)
Gender	
Female, n (%)	149 (66.2)
Male, n (%)	76 (33.8)
Median weight (range), kg	53.7 (28.5-108.2)
Median height (range), cm	153 (137.8-179)
Nutritional status, n (%)	
Undernourished	14 (6.2)
Well-nourished	94 (42)
Overweight	33 (15)
Obese	84 (37)

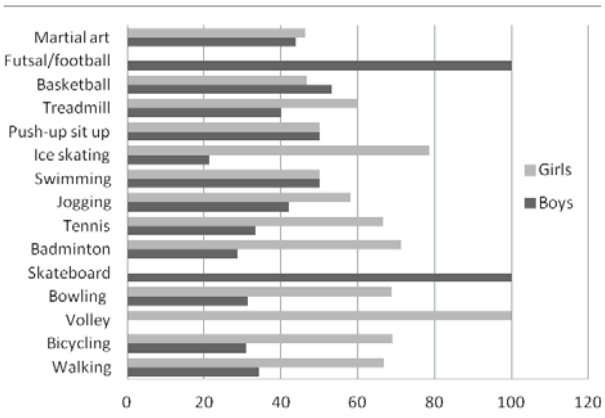

Figure 3. Comparison of physical activity between boys and girls

were overweight, and 35.5% were obese. There was no adolescent with moderate- vigorously intensity of physical activity, while 73.8% of adolescents had light intensity of physical activity. Most boys (66%) and girls (78%) engaged in light intensity of physical activity. Most adolescents (50.7%) engaged in length of screen time for >2 hours/day; 59% of boys spent >2 hours/day and 54% of girls spent <2 hours/day on screen time.

Mean nutritional intake of obese adolescents was higher than that of non-obese adolescents [1,695.7 (479.1) vs. 1,266.7 (410.3) kcal/day, respectively; (P<0.001)], with a mean difference of 429 kcal/day (95%CI: 297.4 to 560.6). Energy output did not differ between obese and non-obese adolescents, either on a school day with or without exercise or at holiday (**Table 2**). However, energy output on a school day with exercise was higher than on a school day without exercise in both obese and non-obese subjects (**Table 3**).

All non-obese adolescents engaged in light intensity of physical activity while 70.2% of obese adolescents engaged in sedentary intensity of physical activity (**Table 4**). Also, obese adolescents spent significantly less time in moderate-vigorously intensity of physical activity than non-obese adolescents (**Table 5**). Length of screen time for obese adolescents was significantly longer than for non-obese adolescents (**Table 6**). No adolescents met the recommended criteria for intensity and duration of physical activity, especially for moderate-vigorously intensity of physical activity. However, 15.5% of obese adolescents and 79.8% of non-obese adolescents fulfilled the screen time recommendation.

Table 2. Energy output of obese and non-obese adolescents

Day types	Obese	Non-obese	Mean difference (95% CI) kkal/day	P value
	Mean (SD)* kkal/day	Mean (SD)* kkal/day		
School day with exercise	2,581.8 (568.6)	2,380 (501.9)	201.8 (43.4-360.1)	0.260
School day without exercise	2,317.5 (484.8)	2,209.6 (492.3)	107.9 (36.9-252.7)	0.081
Holiday	2,464.5 (623.9)	2,308.1 (564.6)	156.4 (19.4-332.2)	0.081

*T-test

Table 3. Energy output of obese and non-obese adolescents on school days with and without exercise

Nutritional status	School day with exercise	School day without exercise	Mean difference (95%CI)	P value
	Mean (SD)*	Mean (SD)*		
Non-obese	2,380 (501.9)	2,209.6 (492.3)	2,473.7 (2,393.5 to 255.9)	0.000
Obese	2,581.8 (568.6)	2,317.5 (484.8)	2,258.9 (2186.4 to 2335.5)	0.000

*kcal/day; T-test

Table 4. Intensity of physical activity in obese and non-obese adolescents

Nutritional status	Median (range)*, METs	P value
Non-obese	2 (1.6-2.8)	<0.001
Obese	1.5 (0.8-1.8)	

*Mann-Whitney test

Table 5. Duration of moderate-vigorously intensity of physical activity in obese and non-obese adolescents

Nutritional status	Mean (SD) *, minutes	Mean difference (95%CI), minutes	P value
Non-obese	26.4 (3.4)	9.1 (8.5 to 10.7)	0.000
Obese	19.3 (6.9)		

*T-test

Table 6. Length of screen time for obese and non-obese adolescents

Nutritional status	Median (range)*, hours	P value
Non-obese	1.8 (0.3-6.1)	<0.001
Obese	2.8 (1-6.6)	

*Mann-Whitney test

Discussion

Subjects in this study were obese and non-obese adolescents aged 10-15 years. Obese adolescents in this age range are thought to be at greatest risk for adult obesity. As such, early intervention could reduce the risk of obesity in adulthood. The prevalence of obesity in this study was 37%. This prevalence was higher than those reported by the National Health and Nutrition Examination Survey (NHANES) on obese adolescents in 2000 and in 2009-2010 (15.3% vs 17%, respectively),[13] as well as Hady in 2011 (22.5%).[14]

Types of physical activity varied by age and sex, with boys participating in soccer, futsal, or skateboarding, and girls engaging in badminton, volleyball, bicycling, swimming, ice skating, tennis, and bowling. The limited amount of moderate-vigorously intensity of physical activity and the >2 hours/day screen time indicates that longer screen times diminish the time for physical activity. An Australian study showed that children and adolescents who spent >2 hours per day on electronic media tended to not meet physical activity recommendations.[15] Several studies in the United States, Canada, Finland, and the Netherlands have consistently suggested that physical activity decreases dramatically during adolescence.[16-19] The decline may indicate that was normal. Decreased activity may be due to more mature adolescents' interest in new things such as gadget and technology and the demands of life (education demand), thereby reducing the time to perform physical activity.[15] We also observed that girls were more active than boys. More girls engaged in light intensity of physical activity than boys; most girls spent < 2 hours/day on screen time, and more girls exercised outside of lesson time.

The mean energy output on a school day with or without exercise and at holiday in obese adolescents was higher than non-obese adolescents, but these differences were not statistically and clinically significant. In contrast, studies in Hong Kong in obese children aged 6-18 years in 2011 and in China in obese adolescents aged 10-12 years in 2008 suggested that total energy output was higher in obese children compared to non-obese children and the differences were statistically and clinically significant. Studies in Hong Kong and China showed that the energy output was higher in obese children in absolute terms but it would be lower when divided by kilograms of body weight.[20,21] Energy output of obese adolescents in this study were also higher in kcal/day, but lower in the units of kcal/kgBW/day.

Energy ouput by both obese and non-obese adolescents was higher on school days with exercise. This data suggests that school is a good medium for providing health education and supporting intervention through a health education curriculum. The World Health Organization recommends that school or community-based physical activity promote health in every state.[23]

The intensity of physical activity is the key for health and body composition. In our study, obese adolescents engaged in lower intensity of physical activity than the non-obese adolescents. Possible reasons for this observation are that obese adolescents have higher weight in their lower limbs than non-obese adolescents so more effort is required to move or that the self-esteem of obese adolescents is lower than that of non-obese adolescents such that they are embarrassed to engage in physical activities. A Canadian study in 2007 on 5,890 adolescents aged 11-18 years also found that obese adolescents' physical activity intensity was lower than non-obese adolescents.[16] Similar results were reported by the Caspian study stating that both boys and girls with sedentary intensity physical activity are at risk for being overweight/obese (OR=0.7; 95%CI 0.6 to 0.8).[23] However, the cutoff for sedentary classification in the Caspian study (<3 METs) was higher compared to our study (≤1.5 METs).

A Finland study in 2000 suggested that obese adolescents spent 2.5% of their time (18 minutes/day) for moderate-vigorously intensity of physical activity.[18] Our data showed that the duration of moderate-vigorously intensity of physical activity in obese adolescents was lower than that of non-obese adolescents. None of our subjects met the recommended duration of moderate-vigorously intensity of physical activity of 30-60 minutes each day.

An association between higher prevalence of obesity and watching TV have been reported in several studies. Mendoza *et al.* stated that watching TV or playing video games >2 hours per day were at risk of overweight.[24] We found that 84.5% of obese

adolescents spent >2 hours per day for screen time, while 79.8% of non-obese adolescents spent <2 hours per day for screen time. Similarly, a Japanese study in 2011 reported that TV viewing was lower in non-obese adolescents compared to obese ones and time spent playing games was also lower in the non-obese adolescents [mean 0.1 (SD 0.3) vs. 0.4 (SD 0.8) hours; P <0.05]. [25]

The American Academy of Pediatrics, WHO, AHA, and CDC recommend at least moderate intensity of physical activity for 30-60 minutes daily.[22] None of our subjects met this recommendation. In contrast, studies from other countries reported that some obese and non-obese adolescents engage in moderate-vigorously intensity of physical activity for 30-60 minutes each day. A study in the Finland found that 22.2% of adolescents aged 12-19 years did moderate-vigorously intensity of physical activity for 60 minutes each day.[18] This finding was consistent with CDC data showing that only 20% of children meet their physical activity recommendations.[26] Sedentary behavior data in our study showed that only 79.8% of non-obese adolescents and 15.5% of obese adolescents limited their screen time to <2 hours each day. Drummond *et al.* suggested that most adolescents who watched TV >2 hours daily do not meet physical activity recommendations.[15]

As physical activity undertaken early in life determines physical activity in adulthood, the lack of adolescents who met the physical activity recommendations in this study is concerning. Larsen *et al*.[27] showed that few adolescents maintain an active lifestyle into adulthood. Of adolescents who engaged in moderate-vigorously intensity of physical activity ≥5 times per week and screen time of ≤14 hours per week, only 4.4% continued moderate-vigorously intensity of physical activity as adults, and 37% continued similar screen time as adults.

A limitation of our study was that assessment of physical activity using the Bouchard diary may lead to self-reporting recall bias. Energy output, intensity of physical activity, duration of moderate-vigorously intensity of physical activity, and screen time in our study could not be determined with objective certainty given the cross-sectional design of the study and the subjective input. In addition, the actual physical activity performed by the subjects could not be verified. To date, in Indonesia there has been no study on physical activity patterns, differences in nutritional intake, energy output, intensity and duration of physical activity and screen time between obese and non-obese adolescents aged 10-15 years. Studies conducted by Girsang[11] in 2003 and Kurniawan[12] in 2011 classified the intensity of physical activity into active or inactive. In addition, the age limit in those both studies differed from our study.

Physical activity varies in type, intensity, duration, and screen time among adolescents aged 10-15 years. We find no difference in mean energy output between obese and non-obese subjects. However, there are differences in intensity of physical activity, duration of moderate-vigorously intensity of physical activity, and screen time between obese and non-obese adolecents. Adolescents' physical activity did not meet published recommendations.

Conflict of interest

None declared

References

1. World Health Organization. Global Strategy on diet, physical activity, and health. Geneva: WHO; 2003 [cited 2011 September 1]. Available from http://www. www.who.int/dietphysicalactivity/media/en/gsfs_obesity.pdf.
2. Onis DM, Blossner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. Am J Clin Nutr. 2010;92:1257-64.
3. American Obesity Association. Childhood obesity. Georgia avenue, 2010. [cited 2011 February 29]. Available from http://www.obesity.org/subs/childhood/prevalence.shtml
4. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI. Riset Kesehatan Dasar 2007. Jakarta: Balitbang Depkes RI; 2008. [cited 2012 November 5]. Available from file:///C:/Users/user/Downloads/22-99Z_Book%20Manuscript-29-2-10-20130605%20(1).pdf .
5. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI. Riset Kesehatan Dasar 2010. Jakarta: Balitbang Depkes RI; 2010. [cited 2012 November 5]. Available from http://www.litbang.depkes.go.id/sites/download/buku_laporan/lapnas_riskesdas2010/Laporan_riskesdas_2010.pdf.
6. Reilly JJ, McDowell ZC. Physical activity interventions in the prevention and treatment of paediatric obesity: systematic

review and critical appraisal. Proc Nutr Soc. 2003;62:611-9.
7. Esparza J, Fox C, Harper IT, Bennett PH, Schulz LO, Valencia ME, et al. Daily energy expenditure in Mexican and USA Pima indians: low physical activity as a possible cause of obesity. Int J Obes Relat Metab Disord. 2000;24:55-9.
8. Eisenmann J, Bartee RT, Wang MQ. Physical activity, TV viewing, and weight in US youth: 1999 youth risk behavior survey. Obes Res. 2002;10:379-85.
9. Hughes AR, Henderson A, Ortiz-Rodriguez V, Artinou ML, Reilly JJ. Habitual physical activity and sedentary behaviour in a clinical sample of obese children. Int J Obes. 2006;30:1494-500.
10. Page A, Cooper AR, Stamatakis E, Foster LJ, Crowne EC, Sabin M, *et al.* Physical activity patterns in nonobese and obese children assessed using minute-by-minute accelerometry. Int J Obes. 2005;29:1070-6.
11. Girsang R. Hubungan antara pola makan dan aktivitas fisis dengan profil lemak darah pada anak remaja obese primer [master's thesis]. Bandung: Universitas Padjajaran; 2003.
12. Kurniawan AA. Perbedaan tingkat aktivitas fisis dan kebugaran jantung paru antara remaja dini (usia 10-12 tahun) dengan indeks massa tubuh di bawah persentil 85 dan di atas persentil 85 [master's thesis]. Jakarta: Universitas Indonesia; 2011.
13. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity in the United States, 2009–2010. NCHS data brief, no 82. Hyattsville, MD: National Center for Health Statistics; 2012 [cited 2012 June 25]. Available from: http://www.cdc.gov/nchs/data/databriefs/db82.pdf.
14. Hady I. Efek terapi suplementasi air putih terhadap keberhasilan program modifikasi perilaku pada remaja dengan obesitas [master's thesis]. Jakarta: Universitas Indonesia; 2011.
15. Drummond MJN, Drummond CE, Dollman J, Abery L. Physical activity from early childhood to adolescence: a literature review of issues and interventions in disadvantaged populations. J Student Wellbeing. 2010;4:17–31.
16. Allison KR, Adlaf EM, Dwyer JJ, Lysy DC, Irving HM. The decline in physical activity among adolescent students: a cross-national comparison. Can J Public Health. 2007;98:97-100.
17. Caspersen CJ, Pereira MA, Curran KM. Changes in physical activity patterns in the United States, by sex and cross-sectional age. Med Sci Sports Exerc. 2000;32:1601-9.
18. Telama R, Yang X. Decline of physical activity from youth to young adulthood in Finland. Med Sci Sports Exerc. 2000;32:1617-22.
19. Van Mechelen W, Twisk JW, Post GB, Snel J, Kemper HC. Physical activity of young people: the Amsterdam Longitudinal Growth and Health Study. Med Sci Sports Exerc. 2000;32:1610-6.
20. Hsu YW, Belcher BR, Ventura EE, Byrd-Williams CE, Weigensberg MJ, Davis JN, *et al*. Physical activity, sedentary behavior, and the metabolic syndrome in minority youth. Med Sci Sports Exerc. 2011;43:2307-13.
21. Zhang CX, Chen YM, Chen WQ, Deng XQ, Jiang ZQ. Energy expenditure and energy intake in 10-12 years obese and non-obese Chinese children in a Guangzhou boarding school. Asia Pac J Clin Nutr. 2008;17:235-42.
22. World Health Organization. Global recommendation on physical activity for health. Geneva, 2002. [cited 2011 August 5]. Available from http://www.who.int/dietphysicalactivity/factsheet_recommendations/en/.
23. Kelishadi R, Ardalan G, Gheiratmand R, Gouya MM, Razaghi EM, Delavari A, *et al*. Association of physical activity and dietary behaviours in relation to the body mass index in a national sample of Iranian children and adolescents: CASPIAN Study. Bull World Health Organ. 2007;85:19-26.
24. Mendoza JA, Zimmerman FJ, Christakis DA. Television viewing, computer use, obesity, and adiposity in US preschool children. Int J Behav Nutr Physc Act. 2007;4:44.
25. Satoh A, Fujita S, Menzawa K, Lee S, Miyamoto M, Sasaki H. Diets of obese and non-obese children. Health. 2011;3:487-9.
26. Physical activity and good nutrition essential elements to prevent chronic diseases and obesity 2007. [cited 2011 September 16]. Available from: http://www.cdc.gov/nccdphp/dnpa.
27. Gordon-Larsen P, Nelson MC, Popkin BM. Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood. Am J Prev Med. 2004;27:277–83.