Nutrition, Fruits and Vegetable Intake and Lipid Profile of Obese and Non-Obese Schoolchildren in Bandar Lampung Indonesia: A Cross-Sectional Study

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1. Introduction

Bandar Lampung is the capital city of Lampung Province of Indonesia. The city is situated in the transit area for economic and business activities between Sumatra and Java islands. The prevalence of obesity for school children in Lampung Province reached 28.5%, significantly higher than the national prevalence (18.8%) [1], but current data for obesity prevalence in the capital city was lacking. The risk factors for obesity among children in Bandar Lampung are supposed to be similar to those in developing countries [2].

Increased energy intake and decreased energy expenditure are common causes of childhood obesity [3]. Eating habits, such as high intake of high glycemic index food [4], low intake of fresh fruits and vegetables and sedentary lifestyle [5] have a positive correlation with the incidence of obesity in school children. The systematic review of the current evidence indicates that habits are not only the causes of obesity in children but also predispose young people to be overweight and obese in adult life [6].

Obese children mostly develop into obese adults who carry a high risk of chronic diseases [7]. Research has shown that overweight and obese children had higher TG [8], TC [9] and non-HDL concentration and lower HDL [10] compared with non-obese children indicating they were at increased risk of cardiovascular disease [11]. In one study, Shirisawa *et al*. found data collected from more than 5000 schoolchildren supporting the evidence (increased risk of cardiovascular disease), whereas the obese children had higher LDL-C regardless of sex [12].

There is no current data on the prevalence of obesity and lipid profile of elementary school children in Bandar Lampung city. The aim of this study was to investigate overweight and obesity prevalence and to identify dyslipidemia in obese children who attended grade 4 of elementary schools in Bandar Lampung. As it is suggested that BMI and lipid profiles are affected by children's lifestyles, especially their nutrition and food intake, as well as physical activity, data on these factors were included in the assessment.

2. Methods

Study Design, Place and Time

A cross-sectional survey has been conducted from September to December 2014 among grade 4 students of elementary schools in Bandar Lampung. Ethical approval of the study was granted from the Faculty of Medicine, University of Lampung, Indonesia (No. 1924/UN26/8/DT/2014).

Recruitment and Sample Size

According to the Educational Service of Bandar Lampung, in 2012 there were 206 state primary schools with 84,008 students and 39 private primary schools with 16,880 students [13]. Of these 245 primary schools, 2 state and 3 private elementary schools which met the inclusion criteria (being non-boarding schools with an obesity incidence rate of about 10%) were eligible to participate in the study. An invitation letter to participate in this study was delivered to all parents of grade 4 student from 5 elementary schools under the permission of the school management, and signed letters of consent were collected from the parent before starting the survey.

Estimating that the obesity incidence rate to be within 10% of the true value with 95% confidence, the minimal sample size was derived by using the formula [14]

$$n = \left[Z_{1-\alpha/2}/e\right]^2$$

where:

n = minimal sample size of school children and Z = 1.96.

Therefore:

$$n = (1.96/0.1)\ 2 = 384.16 \approx 385$$

To take account of drop-outs, we have added 10% to the sample; therefore, the total recruited samples were 425 schoolchildren. For some reason, 32 of the 425 recruited students refused to have blood sampling, so we finally had 392 schoolchildren to be eligible samples of this study. Table 1 shows the sample size by schools.

Data Collection and Analysis

Children and family characteristics, food intake and physical activities, body mass index (BMI) and lipid profile were collected from 392 children of grade 4 of five elementary schools in Bandar Lampung. The food frequency questionnaire (FFQ) and a self-reported questionnaire were used to collect data. Data collection in each school was conducted for two days. On the first day, the children

Table 1. Samples distribution according to school and gender.

Sex	Public School			Private School		Total
	A	B	C	D	E	
Boys	53	17	80	31	14	195
Girls	50	23	70	43	11	197
Total	103	40	150	74	25	392

completed the questionnaires in their classrooms assisted by research assistants and the classroom teachers. The students were asked to take the completed questionnaires home and showed them to their parents to crosscheck whether the data that has been filled was correct. The parentally confirmed and completed questionnaires were returned to the research assistants on the following day.

FFQ are dietary assessment tools which were designed to retrospectively assess habitual food consumption of school children during the last month preceding the study. FFQ contained a list of foods that commonly consumed by school children and their family in Bandar Lampung. Foods were classified as foods prepared by family and foods prepared by the restaurant, food court or franchise. The schoolchildren should answer how many times they consumed every single food (listed in the questionnaire) per day, week, or month [15].

Anthropometric Assessments and Dietary Intake

On the second day, the medical staff of the health laboratory took the children's blood samples in the school clinic room for plasma lipid profiles analysis.

The children's food consumption was collected through 24 hours recall and converted into nutrient contents (energy, protein, carbohydrate, and fat) by using the nutritional content of food template [14]. Considering that vegetable and fruits are important factors affecting the BMI, so in this study, these foods were included.

The children's body weight status was assessed by body mass index (BMI), calculated as body weight in kg divided by the squared height (H) of body (kg/m^2). Body weight status based on BMI per age standard is categorized according to WHO recommendations [15] [16]. BMI/age standard was derived from the population by Z score or mean ± standard deviation (SD) as wasting (−3 SD to <−2 SD), normal (−2 SD to +1 SD), overweight (>+1 SD to +2 SD), and obese (>+2 SD).

The lipid profiles were measured as blood total cholesterol (TC), Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL) were assayed using CHOD-PAP method and Triglyceride (TG) was assayed using GPO-PAP method, and then Non-HDL was calculated as TC-HDL (Paramesh *et al.*, 2011) [17].

The levels of these lipid parameters were categorized in (**Table 2**) as followed:

Table 2. The parameter level of lipid categories.

Category	Acceptable	Borderline High	High
TC (mg/dL)a	<170	170 - 199	≥200
LDL-C (mg/dL) a	<110	110 - 129	≥130
Non-HDL-C (mg/dL) a	<120	120 - 144	≥145
TG (9 - 10 year) (mg/dL) a	<90	90 - 129	≥130
HDL-C (mg/dL) a	>45	40 - 45	<40

[a]Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents [16].

Levels of physical activity were obtained from the data filled out by students on their regular daily activities during the normal school day. Activities were classified as sleeping, sedentary (such as eating and drinking, personal activities, going to and come back from the school, studying at school or home, playing in their room, watching TV, helping parent, course) and active (such as playing in the schoolyard, playing outdoors and sports).

Statistical Analysis

Statistical analysis was run using Minitab version 17 for windows. The predictions of means and standard deviation values were calculated for all quantitative variables. The prediction of proportion was conducted for categorized variables and the prevalence of obesity among school children was calculated. One-way ANOVA was applied, and significantly different group means were then separated using a Fisher's least significant difference (LSD) method and the groups were considered statistically different if $p < 0.05$. Moreover, correlation analysis was carried out with the dependent variable lipid profiles and BMI, whereas the independent variables were nutrient, vegetable and fruit intakes and time spent in physical activities.

3. Results

General Description of the Research Location and Characteristics of the Subject

The Bandar Lampung school day started at 12.00pm and finished at 17.00pm for public schools, while in private schools the day started at 7.15am and finished at 12.15pm. All schools had canteens located on the food stall area of the schools or in a separate area close to the school. Common food types sold in school canteens were similar and can be categorized as heavy wheat -flour based food flour such as instant noodles and donuts, tapioca-flour based food such as somay, mpek-mpek, and cireng, as well as sweet drinks and some snacks (traditional or modern). All of the children involved were aged between 9 - 11 years, of whom 197 (50.3%) were girls and 195 (49.7%) boys. The children's BMI was considered as normal (−2 SD - +1 SD). Mean girls BMI was 16.77 kg/cm^2, not statistically different with boys BMI (17.27 kg/cm^2) ($p = 0.190$). Boys consumed more energy, protein and fat daily than girls (p = 0.026, 0.018 and 0.001, respectively). Girls consumed 429.1 g and boys 393.1 g carbohydrates daily, but these intakes were not statistically significant ($p = 580$). Girls spent more time than boys enjoying sedentary lifestyles ($p = 0.000$), whereas boys were more active than girls ($p = 0.020$). In both genders, TC, LDL-C, HDL-C, and Non-HDL-C were relatively similar ($p>0.05$), whereas mean of TC, HDL-C, LDL-C, and Non-HDL-C of the boys children were 161.1 mg/dL, 84.9 mg/dL, 55.1 mg/dL and 106.0 mg/dL respectively and respective mean of TC, LDL-C, HDL-C and Non-HDL-C of the girls children were 164.0 mg/dL, 84.5 mg/dL, 56.3 mg/dL, and 107.8 mg/dL. Girls had higher TG levels than boys, 118.7 mg/dL and 105.5 mg/dL respectively (p=0.022). Table 3 summarizes the general characteristics of the study participants.

Prevalence of overnutrition (overweight and obese) was higher in boys (15.6%) than in girls (10.7%) but the level of undernutrition (wasting) was not relatively different (4.3% and 3.3%, respectively). The incidence of undernutrition in Bandar Lampung city was much lower than the incidence of overnutrition, whereas undernutrition only occurred in 7.7% of students and overnutrition occurred in 26.3% (Table 4).

Nutrient, Fruits and Vegetable Daily Intakes, Daily Activities and Lipid Profiles of Schoolchildren Based on Their BMI Categories

The schoolchildren's body weight status was examined based on BMI and classified into four categories: wasting, normal, overweight and obese. Energy, protein and fat daily intake were significantly higher when the children have higher BMI, but, even though daily carbohydrate intake increased with increasing of BMI, carbohydrate consumed daily by students was not significantly depend on BMI (Table 5). Vegetable consumption levels of obese student reached 90.5 g/day,

Table 3. Summarizes the general characteristics of study participants.

Characteristics	Boys	Girls	P*
N/%	195/49.7	197/50.3	
Age (years)	9.64 ± 0.46	9.59 ± 0.44	0.285
Anthropometric			
BMI (kg/m^2)	17.27 ± 3.73	16.77 ± 3.80	0.190
Nutrients and food daily intake			
Energy (kcal)	1726 ± 519.2	1613 ± 481.9	0.026*
Protein (g)	59.41 ± 27.57	53.16 ± 24.58	0.018*
Fat (g)	65.20 ± 29.24	55.70 ± 24.54	0.001*
Charbohydrate (g)	393.9 ± 488.4	429.1 ± 741.6	0.580
Vegetable (g)	75.21 ± 83.93	72.44 ± 82.07	0,742
Fruits (g)	56.70 ± 82.67	92.89 ± 132.91	0.001*
Physical activities			
Sleeping (hr)	9.06± 1.21	8.86 ± 0.91	0.069
Sendentary (hr)	13.07 ± 1.60	13.62 ± 1.23	0.000*
Active (hr)	1.72 ± 0.97	1.49 ± 1.02	0.020*
Lipid profile			
Total Cholesterol (mg/dL)	161.1 ± 25.32	164.0 ± 164.0	0.248
LDL-Chol (mg/dL)	84.9 ± 22.48	84.5 ± 22.56	0.848
HDL-Chol (mg/dL)	55.09 ± 7.15	56.3 ± 7.51	0.119
Non-HDL-Chol (mg/dL)	106.0 ± 23.52	107.8 ± 23.71	0.447
Trygliceride (mg/dL)	105.5 ± 53.29	118.7 ± 60.84	0.022*

*The data represent the mean ± SD Differentiation is considered significant when p < 0.05.

Table 4. Schoolchildren's nutritional status by gender.

Nutritional status	Gender		Total
	Girls (n/%)	Boys (n/%)	
Wasting	13 (3.3)	17 (4.3)	30 (7.7)
Normal	142 (36.2)	117 (29.8)	259 (66.1)
Overweight	20 (5.1)	18 (4.6)	38 (9.7)
Obese	22 (5.6)	43 (11.0)	65 (16.6)
Total	197 (50.3)	195 (49.7)	392 (100)

Table 5. Nutrient daily intake, lipid profiles, and duration of daily activities of schoolchildren by BMI categories.

	BMI categories			
	Wasting	Normal	Overweight	Obese
N (%)	30 (7.7)	259 (65.8)	38 (9.7)	65 (16.6)
	Nutrient daily intake			
Energy (kcal)	1364 ± 195c	1450 ± 264c	1892 ± 372b	2535 ± 386a
Protein (g)	47.3 ± 18.2c	47.0 ± 24.7c	65.7 ± 22.8b	91.2 ± 28.8a
Fat (g)	52.6 ± 13.7c	50.8 ± 17.9c	70.8 ± 25.5b	95.4 ± 31.1a
Carbohydrate (g)	290.9 ± 450.3a	391.0 ± 695a	428.3 ± 313.9a	537.6 ± 430.3a
Vegetable (g)	35.2 ± 45.2b	73.9 ± 80.6ab	74.5 ± 79.5a	90.5 ± 101.0a
Fruits (g)	22.7 ± 77.2c	74.2 ± 106.8b	119.1 ± 167.3a	76.2 ± 97.7ab
	Duration of daily activities (hr)			
Sleeping	9.04 ± 0.90a	8.91 ± 1.09a	8.92 ± 1.13a	9.20 ± 1.08a
Sendentary	13.23 ± 1.08a	13.31 ± 1.53a	13.56 ± 1.47a	13.44 ± 1.27a
Active	1.67 ± 0.81ab	1.68 ± 1.06a	1.52 ± 0.99ab	1.36 ± 0.82b

*The data represent the mean ± SD. Data points denoted by different superscripts differ significantly when $p < 0.05$.

making it the highest in comparison with the other groups. The vegetable and fruit daily intakes of wasting students were lower than that normal weight and obese categories. Obese students spent 30 minutes less on activities than normal weight children.

The lipid plasma of schoolchildren in all category nutritional status was considered as accepted or borderline high according to American guidelines [18] except the TG of the obese student was the high category (>130 mg/dL). TC, LDL, and Non-HDL were not dependants on BMI. Obese students had lower HDL concentration than wasting students, but the level was similar to those of normal and overweight students. Obese students had high TG category (142.6 mg/dL) whereas this level was higher than TG of normal weight students (103.4 mg/dL) (**Table 6**).

To elucidate the correlation between BMI and lipid profiles (HDL and TG levels) with nutrition, fruit and vegetable intakes as well as daily activity levels, we conducted Pearson correlation analysis (**Table 7**). BMI was significantly correlated with energy, protein, fat, and vegetable daily intakes and daily activity. Increases in energy, protein and fat daily intakes will increase BMI levels, but when students spend more time on an activity, their BMI will be reduced. Meanwhile, increasing the intake of energy and fat will reduce the HDL level. Concomitant with BMI, TG concentration was positively correlated with energy, protein and fat daily intake but was negatively correlated with the duration of the activity. Daily vegetable consumption was positively correlated with BMI but not correlated with HDL and TG. Daily fruit intake was not correlated with BMI or HDL concentration but was positively correlated with TG level (**Table 7**).

4. Discussion

The increase of childhood obesity prevalence rate worldwide is greater than the

Table 6. Lipid profiles of school children by BMI categories.

	BMI categories			
	Wasting	Normal	Overweight	Obese
N (%)	30 (7.7)	259 (65.8))	38 (9.7)	65 (16.6)
Total-Chol (mg/dL)	165.4 ± 24.0a	161.9 ± 23.4a	165.0 ± 30.5a	162.4 ± 30.7a
LDL-Chol (mg/dL)	84.9 ± 21.9a	85.86 ± 21.4a	85.05 ± 27.1a	79.91 ± 24.0a
HDL-Chol (mg/dL)	57.9 ± 5.2a	55.9 ± 7.1ab	55.4 ± 8.0ab	54.0 ± 8.5b
Non-HDL-Chol (mg/dL)	107.4 ± 23.9a	106.0 ± 21.7a	109.6 ± 27.9a	108.4 ± 27.8a
Trygliceride (mg/dL)	107.3 ± 50.9bc	103.4 ± 47.3c	122.8 ± 75.9ab	142.6 ± 73.2a

*The data represent the mean ± SD. Data points denoted by different superscripts differ significantly when $p < 0.05$.

Table 7. Correlation coefficients between nutrient and food intake and daily activities with BMI, HDL-C, and TG of school children.

	BMI		HDL		TG	
	Pearson correlation	P-value	Pearson correlation	P-value	Pearson correlation	P-value
Energy	0.789	0.000*	−0.108	0.032*	0.210	0.000*
Protein	0.592	0.000*	−0.081	0.111	0.166	0.001*
Fat	0.580	0.000*	−0.108	0.033*	0.166	0.000*
Carbohydrate	0.076	0.133	0.004	0.935	0.029	0.572
Vegetable	0.118	0.019*	0.054	0.287	0.013	0.799
Fruits	0.062	0.218	0.009	0.863	0.111	0.028*
Sleeping	0.042	0.408	0.037	0.468	0.042	0.406
Sendentary	0.033	0.510	−0.008	0.876	0.078	0.125
Active	−0.109	0.032*	−0.021	0.675	−0.144	0.004*

*Correlation is considered significant when $p < 0.05$.

rate of increase in adult obesity [19]. Obesity prevalence of children aged under 10 years reached 10% in northern Europe, it was much lower than the incidence in southern Europe (40%) [20]. Based on the Welsh Health Survey 2008 to 2012 in 2013, the prevalence of childhood obesity in Wales was estimated at around 20% [21]. Meanwhile, in most ASEAN countries, the combined prevalence of overweight or obesity based on Global School-based Student Health Survey (GSHS) between 2007 and 2013 was 9.9%, significantly higher in boys (11.5%) than in girls (8.3%) [22]. Basic health research conducted in 2012 indicates that the prevalence of obesity in 5 - 12-year-old children in Indonesia was around 18.8% lower than those found in Brunei Darussalam (36.1%) or Malaysia (23.7%) [1]. Recent reports from Taiwan show that the prevalence of obesity has reached 19.69% in boys and 18.70% in girls [5]. In our study, the prevalence of overweight and obesity of schoolchildren in Bandar Lampung reached 26.3%, which is significantly high in comparison with the incidences in other countries, including Indonesia.

BMI of schoolchildren in Bandar Lampung city was mostly determined by nutrition and food intake as well as physical activity (**Table 5**). Previous research has shown multiple risk factors of obesity such as diet and physical activity], psychosocial [23] medical (e.g., parent smoking, maternal health, child health) [24], environment [25] and socioeconomic [26]. High nutrition intake especially energy, protein or fat also have been reported as risk factors of childhood obesity [27].

Rice and flour-based foods were the main sources of carbohydrate in the Indonesian diet. As the carbohydrate daily intake is not statistically different between the groups (**Table 5**), its correlation with BMI was not observed. Effect of carbohydrate daily intake on childhood obesity was not consistent [28]. McGloin *et al.* found that carbohydrate was one of macronutrient that did not affect the body fatness in children [29]. Other research indicated that when carbohydrate contribution to energy intake was low, childhood obesity incidence was high, however, opposite results have also been reported which statistically positively correlatecarbohydrate intake with childhood obesity [30]. Heinza and Qi suggested that the effect of carbohydrate intake on BMI interacts with genetic variants related to obesity, metabolic status, and preference to nutrients [31].

The recommended daily vegetable and fruits intake of Indonesian primary schoolchildren is 300 - 400 g [32]. Even though vegetable intake had a significant positive relationship with BMI (**Table 7**), the number of vegetable fruits consumed by the schoolchildren in Bandar Lampung was low, less than half the daily recommended level. This finding is concomitant with the previously reported figure that 95% of Indonesian people did not eat the recommended level of vegetables and fruit. [1]. Low intake of fruits and vegetables has also been reported in several countries such as Nakhon Pathom Thailand [33], the Nordic island [34], Saudi Arabia [35] and West Midlands UK [36]. Some research indicated that the consumption of fruit, beans, and cereals reduced body mass index

[37] [38] [39] [40]. However, our research does not support this beneficial finding. It is suggested that because the portions consumed by schoolchildren in Bandar Lampung are small the benefit of consuming these plant foods was not observed. The effect of an excess of energy, protein and fat intakes were more pronounced than the beneficial effect of consuming fruits and vegetables.

Addressing physically activity is an important strategy of both prevention and treatment of childhood obesity [41]. Our result indicates that all the children, whichever category of nutritional status, spent similar time-durations in sleeping and enjoying a sedentary lifestyle but obese students spent less time on physical activity. Positive energy balance due to high energy intake and low energy expenditure causes fat accumulation, and when children are obese, some metabolic disorder affecting the ability of the children to be physically active occurred [42], as a consequence, obese children spent less time and energy to exhibit moderate and vigorous physical activities [43]. Previous research on the effect of sleeping, sedentary and physical activity was not consistent depend on several factors such as genetic [44] as well as duration and level of activities [45].

CVD risk increase with increasing BMI level which has indicated that obese students were more likely to have higher TG and lower HDL (**Table 6**). Dyslipidemia disorders due to increasing BMI previously also has been reported in school children aged 7 - 17 years [46] [47]. Obesity causes the development of insulin resistance in peripheral tissues leading to an enhanced hepatic flux of fatty acids from dietary sources, intravascular lipolysis and from adipose tissue [48]. Obese children might have hypertriglyceridemia, hypercholesterolemia, and HDL, hypertriglyceridemia and low HDL or only hypertriglyceridemia [49].

Our research indicates that risk factors of overweight and obesity of schoolchildren in Bandar Lampung such as energy, protein and fat intakes as well as daily activities were modifiable, therefore, childhood obesity in Bandar Lampung is considered as preventable and the prevalence might be reduced through reducing energy, protein and fat intake as well as increasing the duration of physical activity. It is suggested that BMI reduction in children causes significant changes in lipid profiles such as decreasing TG and increasing HDL [50] [51]. Moreover, due to energy and fat intakes having a negative correlation with TG plasma, reducing these nutrient intakes will normalize the TG level of the obese children and keep their HDL level with the range of accepted concentration.

Research with a bigger sample of children involving all of the grades in elementary school is urgently needed to improve the sensitivity and specificity of the results. Moreover, several limitations in this study need to be addressed. First, the food and activity questionnaires were based on self-reported data and the student recall was only for one day in the school week. There were no data or recall for food intake and activities of students at weekends. In addition, for those young children aged <10 years, information reported by parents may be more reliable. In our case parents only gave confirmation to what their children reported.

5. Conclusion

Prevalence of overweight and obesity was considered to be high (26.3%) in grade 4 of elementary schoolchildren in Bandar Lampung city. The lifestyles of obese students were characterized by high intakes of energy, protein and fat and lower physical activities. Obese children had higher TG plasma concentration but tended to have lower HDL than those with normal body weight. Decreased daily energy, protein and fat intakes or increased duration of physical activities will reduce BMI and TG level and increase HDL level. Daily vegetable and fruit intake were very low compared with the recommended daily intake, therefore, their beneficial effect on BMI and lipid profiles were not observed. Lifestyle modification through reducing of energy, protein and fat intake or increasing vegetable and fruit intake as well as spending more time for physical activity is recommended to improve nutrition and health status of the schoolchildren.

Strengths and Limitations of This Study

- There is currently no data on the prevalence of obesity and lipid profile, nutrition and food intake of elementary schoolchildren in Bandar Lampung city, so this study is the first to collect this data and hereby adding new literature on the topic.
- As well as physical activity, sedentary data such as sleeping, watching TV, eating and drinking, personal activities were included in the assessment.
- There are several limitations to this study. First, the food and activity questionnaires were based on self-reported data and the student recall was only for one day in the school week.

There were no data or recall for food intake and activities of students at weekends. In addition, for those young children aged < 10 years, information reported by parents may be more reliable. In our case parents only gave confirmation to what their children reported.

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Author Contributions

Study concept and design: SUN, YI. Data collection: SUN, YI, RI. Data analysis: SUN, MI, YI Drafting: SUN, MI, YI. Manuscript critical revision: SUN, MI. All the authors read and approved the final manuscript.

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Availability of Data and Materials

The data that support the findings of this study are available from BASF South East Asia Pte Ltd. but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of BASF South East Asia Pte Ltd.

Ethics Approval and Consent to Participate

This study received ethical approval from the Faculty of Medicine, University of Lampung, Indonesia (No. 1924/UN26/8/DT/2014). We obtained written informed consent from parents for the participation of their children preceeding of study.

Conflicts of Interest

The authors declare no conflicts of interest.

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demographic correlates among urban Ethiopian women: evidence from the 2011 EDHS", BMC Public Health, 2016.
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---

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Crossref
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---

16 Gigih Forda Nama, Melvi Ulvan, Ardian Ulvan, Abdul Munif Hanafi. "Design and implementation web based geographic information system for public services in Bandar Lampung City — Indonesia", 2015 International Conference on Science in Information Technology (ICSITech), 2015
Crossref
13 words — < 1%

---

17 S Hayes, P S W Davies, T Parker, J Bashford, B Newman. "Quality of life changes following peripheral blood stem cell transplantation and participation in a mixed-type, moderate-intensity, exercise program", Bone Marrow Transplantation, 2004
Crossref
12 words — < 1%

---

18 "Dyslipidemias", Springer Science and Business Media LLC, 2015
Crossref
12 words — < 1%

---

19 Farya Mubarik, Janet Warren, Marieke Abrahamse, Jonathan E.

Brown, Leilani Muhardi. "Methodological Considerations for the Design of Food Frequency Questionnaires for Toddlers", Pakistan Journal of Nutrition, 2018
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24 Valentine Charlton-Menys, Jelena Chobotova, Paul N. Durrington. "Use of the TLX ultracentrifuge for the isolation of different density lipoproteins and effects of freeze/thawing of human plasma before ultracentrifugation", Clinical Chemistry and Laboratory Medicine, 2008
Crossref
10 words — < 1%

25 bmcresnotes.biomedcentral.com
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10 words — < 1%

26 Binghua Xue, Xiuxiao Xiao, Tingting Yu, Xinhua Xiao et al. "Mesenchymal stem cells modified by FGF21 and GLP1 ameliorate lipid metabolism while reducing blood glucose in type 2 diabetic mice", Research Square, 2020
Crossref Posted Content
9 words — < 1%

27 Donald L. Chi, Monique Luu, Frances Chu. "A scoping review of epidemiologic risk factors for pediatric obesity: Implications for future childhood obesity and dental caries prevention research", Journal of Public Health Dentistry, 2017
Crossref
9 words — < 1%

28 Yan-Ping LI, Xiao-Qi HU, Evert G. SCHOUTEN, Ai-Ling LIU et al.

"Report on Childhood Obesity in China (8): Effects and Sustainability of Physical Activity Intervention on Body Composition of Chinese Youth", Biomedical and Environmental Sciences, 2010
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29 www.tctmd.com
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30 www.researchsquare.com
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31 Alev E. Altinova, Fusun Toruner, Nuray Bozkurt, Neslihan Bukan et al. "Circulating concentrations of adiponectin and tumor necrosis factor-α in gestational diabetes mellitus", Gynecological Endocrinology, 2009
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32 pediatrics.aappublications.org
Internet

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33 intra.tai.ee
Internet

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34 "IUNS. 21st International Congress of Nutrition. Buenos Aires, Argentina, October 15-20, 2017: Abstracts", Annals of Nutrition and Metabolism, 2017
Crossref

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35 Rihul Husnul Juliyatmi, Lina Handayani. "Nutritional Status and Age at Menarche on Female Students of Junior High School", International Journal of Evaluation and Research in Education (IJERE), 2015
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