**Original Article**

# STUDY OF LIFE STYLE FACTORS RELATED TO OVERWEIGHT AND OBESITY AMONG ADOLESCENTS IN MOSUL CITY

**[1*]Hind Amer Muhsen /M.B.Ch.B., [2]Ali Hilal Gendari/ M.B.Ch.B.**

[1]Higher Diploma in Family Medicine/Nineveh Health Directorate
[2]Clinical Master Radiation Oncology, AACME Clinical Nutrition/ Nineveh Health Directorate

**\*Corresponding Author: Hind Amer Muhsen /M.B.Ch.B.**

Higher Diploma in Family Medicine/Nineveh Health Directorate

## ABSTRACT

**Background:** Adolescence is considered as a critical period for abnormal weight gain since it is associated with dynamic physiological and psychological changes in both sexes. Several factors might be associated with weight gain during adolescence period like genetic, environmental, and behavioral factors. **Objectives:** To study life style factors among a group of adolescents. **Subjects and Methods:** The study was conducted in Mosul city, 513 students of 4 public intermediate and secondary schools were included. The data were collected through an interview with students who fill the questionnaire; their weight and height were measured following the standard procedures during an interview. **Results:** The mean Body Mass Index for the total sample was 20.0 kg/m2. The prevalence rates of overweight and obesity based on Centers for Diseases Control criteria were 13.7% and 8.5% respectively while the prevalence rates based on International Obesity Task Force were 17.4%, and 4.9% respectively. The main risk factors associated with overweight and obesity among adolescents were Mother's education (p=0.0005), number of the siblings (p=0.0006), physical education classes (p=0.044), number of the meals/daily (p=0.0003), regular weight measurement (p=0.0097) and district location inside Mosul city (p=0.0004). **Conclusions:** The prevalence of overweight and obesity among adolescents in Mosul city was high in compared to nearby countries. Family's socioeconomic characteristics, physical exercises, and extra meals may play an important role in weight problems of adolescents.

**KEYWORDS:** Adolescents, Overweight, Obesity, Mosul.

## INTRODUCTION

Adolescence is the time in a person's life when he or she develops from a child into an adult. In other words, it is the period between 10 to 19 years old according to World Health Organization (WHO), and roughly, adolescents make up 20% of the total world population.[1, 2] In Iraq over 40% of population is less than 15 years of age while the expected rate of those age15-24 years old will be around 20% in 2025.[2] Adolescence period is characterized by rapid physical, sexual growth, and changes in the body.[3] Youth including adolescents comprise an important population of interest regarding risky behaviors as physical inactivity, sedentary life style, unhealthy diet, overweight, and obesity trends.[4]

Overweight is a serious public health problem affecting all ages and both sexes around the world, with consequences for individuals and society. Early preventive programs to promote the health of people specifically during early years of life will be less costly for the individuals and society and have positive effects on the health for this group. In this study, it is tried to study life style factors among a group of adolescents since this issue had not been explored and up to my knowledge there were no studies about this topic in Mosul city which eventually leads to a better planning for preventive activities.

A standard definition was established during 2000 for overweight and obesity in children and adolescents based on the percentile values of body mass index (BMI) adjusted for age and sex corresponding to BMI of 25- 30 in Kilogram/meter$^2$ at the age of 18 years old.[5] Obesity among all age groups can be simply defined as an excess body fat.[6] World Health Organization (WHO) data show that the prevalence rate of overweight varies between different countries and regions from 5% in Africa and Asia to more than 20% in Europe and 30% in America.[7]

The mechanism of obesity is complex, and it is believed to be a disorder of multiple causes in which genetic factors together with the environmental and behavior factors influenced the susceptibility of a given child to develop obesity.[6]

Different types of studies show the impacts of several factors separately and together on body weight during adolescence period.[8-10] Some studies show that the prevalence of overweight is more among male adolescents[11-13], while other studies show the opposite.[14, 15] Rasmussen M et al. reviewed that there are also a gender differences in consumption of certain type of food that affect body weight like fruits and vegetables.[16] Age has a certain effect on BMI, in general BMI increase with age.[13, 15] There are three critical periods associated with risk for overweight and these are the prenatal period, 4-7 years old period and adolescence period.[17] Concerning the physical activities, most of the studies that explore adolescents` daily life show that they do not meet the recommended criteria of daily physical activities which is 30-60 minutes daily of mild to moderate physical activity.[18, 19] An important consequence is the association between overweight and low rate of physical activity which has been proved by several studies.[19, 20] Several factors are responsible for reducing the rate of physical activity in adolescents.[18, 20] On the top of the list are the changes in life style, socioeconomic status, with availability of cars and electrical appliances which make life more sedentary among all people in many countries.[20] Schools as places of learning and living have major effects on adolescents' different aspects of life.[21] Studies show that interventions in these places in order to raise the level of physical activity in children and adolescents are likely to be important in the fight against obesity.[22-26]

There is no clear consensus on what are the reasonable cut offs for the amount of time spent with sedentary activities like watching T.V, playing video games, or computer usage although nowadays all youth spent more time than the two hours maximum recommended by American Academy of Pediatrics.[27] Researches show the positive association between these sedentary behaviors and overweight among adolescents due to reduced time spent in physical activity and also food consumption during performing these activities.[6] Adolescent's dietary habits and food choices have dramatically changed during the last decades.[28] Irregularity of daily meals, skipping breakfast, increased consumption of fast food with sweet beverages, decreased in consumption of healthy food as fruits and vegetables had became the commonest daily habits.[28, 29] These dietary patterns place adolescents at risk for obesity, micronutrient deficiency, and future chronic diseases.[29-31]

Daily eating habits and food choices are influenced by several factors and again on the top of list is the family social class which allows the availability of certain foods inside home[29], in addition to the effect of parental education and income on food choices of adolescents. The environment surrounding adolescents plays also an important role in building their eating pattern[6], and an important tool of this environment is the mass media as T.V. which acts as a motive factor for eating with advertisement programs for different types of food.[8] Eating disorder as binge eating is also an important cause for the severe obesity in 40% of adults and adolescents especially girls.[31]

## PATIENTS AND METHODS
Study design: A cross-sectional study design was adopted to achieve the study objective.
Setting of the Study: The study was conducted in Mosul city include Four public intermediate and secondary schools inside Mosul city were included in this survey; 2 schools for boys and 2 schools for girls, 2 of them were in the left coast and other 2 were in the right coast, each coast should include1 school for girls and 1 school for boys. The data collected during 16th -28th of February 2020 with multi-stage random sampling was used to choose the sample; the source population was 31961 students inside the governorate who met the study criteria. Sample size was 513students.
Inclusion and Exclusion Criteria: All morning public intermediate and secondary schools inside Mosul city were included in the selection procedure. Both sexes, age12years and above were included. Pupils who did not give informed consent were excluded.

Data collection and data collection tool: Based on a structured questionnaire, the data were collected by an interview with students who were included in the study with the measurement of their height and weight.

**Statistical Analysis:** SPSS was used for data entry and analysis. Tabular methods were used to describe data. Chi square test was used to test association between categorical variables. P≤0.05 was considered significant. Descriptive statistics for BMI described as mean, range, and standard deviation was calculated. Prevalence rates of underweight, normal, overweight and obesity was calculated based on the (CDC) reference to allow fair comparison with other countries.

## RESULTS
In this study, 548 pupils who met the study criteria were participated in this study. Out of the total number, 513 students were participated. This means that the response rate was 93.6%. The response rate was higher among girls, where 257 girls agreed to participate in the study out of 262 (98% response rate) while the figure for boys was 256 out of 286 (89.5% response rate). The mean age and standard deviations for the total sample were13.3+1.02 years, while the mean age and standard deviations for boys were 13.4+0.99 years and for girls were13.2+1.03 years. (Table1).

**Table (1): The sample distribution by school, sex, and age.**

| School type | | Mean age/years | ±SD | Range | Total |
|---|---|---|---|---|---|
| Girls | School 1 | 13.2 | 1.19 | 12.0-18.0 | 109 |
| | School 2 | 13.3 | 1.04 | 12.0-18.0 | 148 |
| Boys | School 1 | 13.6 | 1.00 | 12.0-18.0 | 129 |
| | School 2 | 13.0 | 0.92 | 12.0-18.0 | 127 |

The mean BMI is low at certain age groups (table 2). In boys, the mean BMI decreases at the ages of 16 years while the mean BMI in girls decreases at age of 15 years.

**Table (2): BMI in kg/m² for the sample stratified by age and sex.**

| Age/years | | BMI(kg/m²) | | | Total (N) |
|---|---|---|---|---|---|
| | | Mean | ±SD | Range | |
| Boys | 12 | 18.3 | 3.76 | 13.7-30.5 | 35 |
| | 13 | 19.5 | 4.08 | 12.8-35.0 | 125 |
| | 14 | 19.6 | 4.24 | 13.9-35.5 | 57 |
| | 15 | 20.6 | 3.43 | 14.5-32.9 | 28 |
| | 16 | 20.4 | 3.01 | 17.4-28.4 | 11 |
| | Total | 19.5 | 3.99 | 12.8-35.5 | 256 |
| Girls | 12 | 19.6 | 4.04 | 12.8-32.5 | 61 |
| | 13 | 19.8 | 3.74 | 12.7-34.1 | 117 |
| | 14 | 21.4 | 3.81 | 15.0-32.8 | 48 |
| | 15 | | 3.38 | 15.4-32.7 | 20 |
| | 16 | | 2.80 | 18.1-28.8 | 11 |
| | Total | | 3.85 | 12.7-34.1 | 257 |

The prevalence rate of overweight and obesity together in the whole sample based on CDC cut off points were 22.2%. The prevalence rates of overweight and obesity separately in this study based on CDC cut off points were 13.7% and 8.5% respectively. The prevalence rate of overweight was higher in girls while the prevalence rate of obesity was higher in boys. The prevalence rate of underweight in girls was 5.8% while in boys was 11.8% based on CDC cut off criteria (Table 3).

**Table (3): Weight status classification for the total sample based on CDC cut off points.**

| Weight Status | CDC* | | |
|---|---|---|---|
| | Girls (%) | Boys (%) | Total N(%) |
| Underweight | 5.8 | 11.8 | 42(8.3) |
| Healthy weight | 70.9 | 67.5 | 357(69.5) |
| Overweight | 15.9 | 10.6 | 70(13.7) |
| Obesity | 7.4 | 10.1 | 44(8.5) |

*U.S. Centers for disease control and prevention cut off points for weight status.

The association between weight status and daily physical activities which included sports and walking into and from school for at least more than half an hour, physical education classes (2 classes/weekly), and sedentary behaviors like watching T.V was only statistically significant for physical education class (p=0.044).

Overweight prevalence rate was 12.7% in those reported as had regular sports or daily walking while the rate of those had a healthy weight is nearly equal in those who were practicing sports from those who were not (Table 4).

**Table (4): The association between daily physical activities, sedentary behaviors & adolescent's weight status.**

| Activity | | Under Weight % | Healthy Weight % | Over Weight % | Obesity % | Total N(%) | P-value |
|---|---|---|---|---|---|---|---|
| Daily sports and walking/daily | Yes | 9.3 | 67.9 | 12.7 | 10.1 | 238(46.4) | 0.202 |
| | No | 7.5 | 70.8 | 14.6 | 7.1 | 275(53.6) | |
| Physical Education classes/weekly | Yes | 9.8 | 68.8 | 12.0 | 9.4 | 299(58.4) | 0.044 |
| | No | 6.3 | 70.4 | 16.1 | 7.2 | 214(41.6) | |
| Watching T.V, using computer | <1hour | 7.8 | 71.3 | 12.8 | 8.1 | 216(42.6) | 0.980 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| & playing video games/daily | 1-3hours | 8.7 | 68.1 | 14.4 | 8.8 | 235(45.8) | |
| | >3hours | 8.3 | 68.6 | 14.0 | 9.1 | 62(12.1) | |
| Sleeping hours/daily | <6hours | 8.7 | 69.5 | 13.8 | 8.0 | 212(41.4) | 0.989 |
| | 6-9hours | 8.2 | 69.8 | 13.4 | 8.6 | 245(47.8) | |
| | >9hours | 7.4 | 67.6 | 14.8 | 10.2 | 56(10.8) | |
| Studying hours/daily | ≤3hours | 8.5 | 69.2 | 13.3 | 9.0 | 296(57.7) | 0.889 |
| | >3hours | 8.0 | 70.0 | 14.2 | 7.8 | 217(42.3) | |

Daily dietary habits like daily breakfast, eating green vegetables daily, weight checking at regular interval, and extra meals were significantly associated with weight status (Table 5).

**Table (5): The association between daily dietary habits and adolescent's weight status.**

| Dietary habit | | Under Weight % | Healthy Weight % | Over Weight % | Obesity | Total N(%) | P-value |
|---|---|---|---|---|---|---|---|
| Daily breakfast | Yes | 8.3 | 71.1 | 13.8 | 6.8 | 408(79.5) | 0.0021 |
| | No | 8.3 | 63.4 | 13.2 | 15.1 | 105(20.5) | |
| Fruits/daily | Yes | 8.3 | 70.0 | 13.6 | 8.1 | 490(95.6) | 0.1203 |
| | No | 8.9 | 59.1 | 13.7 | 18.3 | 23(4.4) | |
| Green Vegetables /daily | Yes | 8.4 | 71.0 | 13.7 | 6.9 | 379(73.8) | 0.0253 |
| | No | 8.0 | 65.3 | 13.7 | 13.0 | 134(26.2) | |
| Chocolate/daily | Yes | 8.7 | 69.5 | 13.2 | 8.6 | 353(68.9) | 0.8380 |
| | No | 7.4 | 69.5 | 14.7 | 8.4 | 160(31.1) | |
| Eating meals in front of T.V. | Yes | 8.8 | 66.2 | 13.4 | 11.6 | 146(28.4) | 0.1502 |
| | No | 8.1 | 70.8 | 13.8 | 7.3 | 367(71.6) | |
| Fast food/daily | Yes | 8.5 | 69.0 | 14.3 | 8.2 | 194(37.8) | 0.9684 |
| | No | 8.2 | 69.8 | 13.3 | 8.7 | 319(62.2) | |
| Weight checking regularly | Yes | 6.2 | 69.3 | 14.7 | 9.8 | 300(58.4) | 0.0097 |
| | No | 11.3 | 69.7 | 12.3 | 6.7 | 213(41.6) | |
| Soft drink/daily | Yes | 7.7 | 68.8 | 14.8 | 8.7 | 212(41.3) | 0.8159 |
| | No | 8.7 | 70.0 | 12.9 | 8.4 | 301(58.7) | |
| Extra meals/daily | Yes | 10.4 | 74.9 | 8.9 | 5.8 | 179(34.8) | 0.0003 |
| | No | 7.2 | 66.6 | 16.2 | 10.0 | 334(65.2) | |
| Snacks | Yes | 8.5 | 69.0 | 12.3 | 10.2 | 190(37.0) | 0.9832 |
| | No | 8.2 | 69.8 | 13.3 | 8.7 | 323(63.0) | |

## DISCUSSION

The higher response rate in girls was due to the better organization of schools for girls and girls` desire to participate in this study. Another important factor that might had an important effect on the total response rate was the socioeconomic characteristics of the adolescents` families that could be the cause of a high response rate in certain regions especially in families with middle and high socioeconomic characteristics.

In this study the majority of adolescents were aged 13 years old because these were the most common age group attended 7th grade. The prevalence rate of both overweight and obesity was higher during early than later years of adolescence period which was similar to other studies involving the same age groups during the last two years.[32, 33] These studies show that the prevalence rate of overweight had an inverse relationship with age which could be explained by physiological changes during adolescence period and by the effects of lifestyle changes which may affect early age more than older ages. Another possible explanation could be the

issue of selection bias which could not be totally eliminated from any study.

In this study the prevalence rate of overweight in girls was higher than boys. Mikki N et al. show the same result regarding high rate of overweight in girls and explain the sex differences and its effect on adolescent's weight by the social habits and environment which surround girls in communities making them less active than boys and more vulnerable to weight problems.[14] The same finding and differences were observed in recent studies in different countries in South America and Middle East.[34] In this study, the rate of obesity in boys was higher than girls who might be explained by the high rate of sedentary behaviors like playing video games and using computer among boys, another explanation for that might be the modern trend of girls of seeking beauty and body shape perfection. Lissau I et al show a different result in a study involving 13 European countries and United States, in which boys were more overweight and obese than girls which they explained by boys` over reporting for their weight and height since

this study was depended on self measurements.[15] In this study, boys had a low BMI at the age of 16 years old and girls had a low BMI at the age of 15 years. This growth deficit might be due to the political and socioeconomic changes that happened during the last few years after ISIS occupation in Mosul city that may have affected different aspects of the psychological, social, health environments surrounding adolescents and as consequence affected their health, lifestyle, feeding & physical practices. While the improvement in both height and weight could be observed later on due to the general improvement in the socioeconomic conditions and the stability of the local region general condition after ISIS civil war era. This finding was similar to the results of other study that was carried out in Iran during 2007[35] which discussed the growth improvement among children in post war period.

In this study, the mean BMI in boys was 19.5 kg/m$^2$ while that of girls was 20.3 kg/m$^2$ which were similar to that of adolescents in European countries.[36] These means were higher than those reported by studies in the nearby countries like Iran and Turkey[3, 37] and at same time they were lower than that of United State.[38]

Till now up to our knowledge this study is the first one in Mosul city that shows the prevalence of overweight, obesity, underweight and normal weight and the prevalence rate of overweight in the total sample based on CDC criteria was similar to that of Nordic countries (Denmark, Finland, Norway, and Sweden) regarding overweight prevalence rate in youth (10%-15%).[39] Also the prevalence rate of obesity in this study was almost similar to that of Iran (7.8%) based on the same criteria but it was less than that of other countries in the region like Saudi Arabia which had20.5% obesity prevalence rate and this might be due to both genetic, socioeconomic status and life style differences.[7, 34]

The prevalence rates of overweight and obesity were higher when compared with the results of a study done in the middle part of Iraq (Babel governorate) involving 13 years old adolescents (6%, and 1.3% for overweight and obesity respectively).[40] This might be explained by the different socioeconomic nature of the sample.

Based on the same criteria, overweight prevalence rate was similar to that of USA 17% and Sweden 18% and obesity prevalence rate was similar to that of Wales 4.8% and Canada 4.1%. Furthermore this can be explained by adopted western life style by the people in our region.[7, 39]

More than half of the adolescents were not practicing any organized physical activity and about two thirds of girls were not practicing sports outside schools. This low rate was common in many Mediterranean and Asian countries[18, 19] and it was associated with multiple factors like low educational level of the parents and parents` occupation[33, 37, 41], safety of district and availability of facilities within the district to practice physical activity.[42, 43]

There was an association between physical education classes and adolescent's weight status, the risk for overweight will be lower for those who were receiving these classes. At the same time the association between playing sports outside school and weight status of the adolescents was not statistically significant and this was similar to the result of a study done by UK researchers which shows that physical activity can significantly improve motor skills but did not reduce BMI.[44] There were other researches that disagree with the results of this study and emphasize on the importance of regular physical activity in reducing weight and improving health.[45-47]

Physical education classes were more organized in schools for boys. but these classes were not reaching to the international recommendation of mild to moderate physical activities which is 30-60minutesdailyforatleast5days during a week.[39, 48] The rates of sedentary behaviors like watching T.V, using computer, and playing video games were high in adolescents and the higher rate were in boys and this might be considered as a factor added to the physiological changes which could make boys more obese than girls in this study but it was not statistically significant. This result agreed with other recent studies during the last three years.[45, 49] These studies show the unhealthy effects of these behaviors on weight status especially watching T.V because it can decrease the time spent performing physical activity and sports and had also associated with increased food consumption during viewing or as a result of food advertisements. At the same time Giammattei J et al. found that there was no association between using computer and playing video games with overweight including obesity and explained that by the occupied both hands and this accompanied by fewer and less-graphic food advertisements, and therefore less conducive to being accompanied by snack.[50]

Sleeping hours in this study was positively associated with weight (weight will increases when sleeping hours increase) but this association was not statistically significant and this was consistent with the results of a Japanese study involving the same age groups.[45] About 90% of the adolescents were not reaching to the recommended sleeping hours especially boys which could be explained by irregular school time (morning/and afternoon) and late hours of going to sleep especially among boys.[45, 51]

Four important daily habits in this study affect weight status and were statistically significant; daily breakfast, eating more than three meals, green vegetables eating/ daily, and weight checking at regular interval. Daily breakfast was a regular dietary habit among normal weight adolescents reflecting the importance of this habit

in keeping a healthy weight of adolescents because consumption of fiber-rich food like breads and cereal may improve glucose and insulin parameters and lead to increased satiety in addition to lowering body weight.[45, 52] Extra meals might be associated with extra calories that might increase weight but at the same time snacks may play a role in reducing the amount of food eaten during essential meal time and this could be explained by the high percentage of extra-meals among healthy weight adolescents.[11, 53] Underreporting for the number of essential meals could not be excluded as another cause for the above result.

The daily habit of eating green vegetables was associated with low rate of overweight including obesity among adolescents in this study and this was consistent with the recommendations of Irene A. in her guidelines for adolescent's daily nutrition plan for preventing overweight.[54]

In this study weight control behavior by measuring weight regularly was common in adolescents, although it was statistically significant but the rate was high among overweight and obese adolescents. Lombard C et al. explained this result in their study during 2009 by the ineffective of peoples self measurements for their weight alone without intervention programs involve diet and physical activity to maintain healthy weight and to prevent overweight including obesity.[55] However, people's perception for having weight problems is not fully correct till now and this is also the same for other parts of the world.[56] Fruits, chocolate eating, and soft drink in this study were not associated with weight status and this is consistent with several studies regarding these types of food[39, 53, 57] and a negative association between chocolate eating and overweight had been reported in other study.[39]

### Study Limitations
A limited number of schools & sample size due to the Health & security situation in Mosul has been selected. However, the sample has been drawn randomly. There is always a possibility of recall bias which might affect the association between certain variables. Regarding dietary questionnaire, recall bias about the food quantity couldn't be avoided. The sample was only from Mosul city and it is representative for an urban population.

### CONCLUSIONS
The means of height and weight in this study were lower than that of CDC growth references; the mean BMI was low at certain age groups. In boys; the mean BMI decreases at the age of 16 years while the mean BMI in girls decreases at age of 15 years. The prevalence of overweight was higher in girls while the prevalence rate of obesity was higher in boys. Sedentary life style was apparent among boys. < 2 physical education classes weekly, regular weight checking and extra meal during the day were independently significant risk factors after taken in account the effect of confounders. Healthy

dietary habits like daily breakfast, daily eating fruits and vegetables were apparent among girls.

### Recommendations
1. More research should be done to investigate other aspects of adolescents' life. Conducting longitudinal and follow up studies regarding overweight and obesity.
2. Availability of special youth centers for practicing sports and different types of physical activities in each district. In addition to application of organized programs to increase the public awareness of overweight and obesity complications through the use of mass media.

### REFERENCES
1. Organization WH. Nutrition in adolescence: issues and challenges for the health sector: issues in adolescent health and development.2005.
2. Assaad R, Roudi- Fahimi F. Youth in the Middle East and North Africa: Demographic Opportunityor Challenge. 2010; 12.
3. Oner N, Vatansever U, Sari A, Ekuklu E, Guzel A, Karasalihoglu S, et al. Prevalence of underweight, overweight and obesity in Turkish adolescents. Swiss Med Wkly. 2004Sep4; 134(35-36): 529-533.
4. Plotnikoff RC, Bercovitz K, Loucaides CA. Physical activity, smoking, and obesity among Canadian school youth. Comparison between urban and rural schools.Can J Public Health. 2004 Nov-Dec; 95(6): 413-418.
5. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000 May6; 320(7244): 1240-1243.
6. Dehghan M, Akhtar-Danesh N, Merchant AT. Childhood obesity, prevalence and prevention. NutrJ. 2005Sep 2; 4: 24-2891-4-24.
7. ShieldJ SC. Obesity in Childhood. In: William GFG, editor. Obesity Scienceto Practice. first ed.UK: iley-Blackwell; 2009: 509-533.
8. Krueger PM, Coleman-Minahan K, Rooks RN. Race/ ethnicity, nativity and trends in BMI among U.S. adults. J Obesity. 2014April; 22: 1739–1746.
9. White MA, O'Neil PM, Kolotkin RL, Byrne TK. Gender, race, and obesity-related quality of life at extreme levels of obesity. Obes Res. 2004Jun; 12(6): 949-955.
10. Apfelbacher CJ, Loerbroks A, Cairns J, Behrendt H, Ring J, Kramer U. Predictorsof overweight and obesity in five to seven-year-old children in Germany: results from cross-sectional studies.BMC Public Health. 2008 May 21; 8:171-2458-8-171.
11. Murer SB, Saarsalu S, Zimmermann J, Herter-Aeberli I. Risk factors for overweight and obesity in Swiss primary school children: results from a representative national survey. EurJNutr. 2016 Mar; 55(2): 621-629.
12. CarvalhoFrancescantonio Menezes IH, Borges Neutzling M, AguiarCarrazedo Taddei JA. Risk

factors for overweight and obesity in adolescents of a Brazilian University: a case-control study. Nutr Hosp. 2009Jan-Feb; 24(1): 17-24.

13. Tanzil S and Jamali T. Obesity, An Emerging Epidemic In Pakistan-A Review Of Evidence. J Ayub Med Coll Abbottabad. Jul-Sep2016; 28(3): 597-600.

14. Mikki N, Abdul-Rahim HF, Awartani F, Holmboe-Ottesen G. Prevalence and sociodemographic correlates of stunting, underweight, and overweight among Palestinian school adolescents (13-15 years) in two major governorates in the West Bank. BMC Public Health. 2009 Dec23; 9: 485-2458-9-485.

15. Lissau I, Overpeck MD, Ruan WJ, Due P, Holstein BE, Hediger ML, et al. Body mass index and overweight in adolescents in 13 European countries, Israel, and the United States. Arch Pediatr Adolesc Med. 2004 Jan; 158(1): 27-33.

16. Rasmussen M, Krolner R, Klepp KI, Lytle L, Brug J,Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: Quantitative studies. Int J Behav Nutr Phys Act 2006 Aug 11; 3: 22-5868-3-22.

17. Sherry B DW. Pediatric Obesity: An Overview. In: Bray G BC, editor. Hand Book of Obesity: Etiology and Path Physiology. 2nd edition.. NewYork: Marcel Deckker, Inc; 2000: 117-148.

18. Pate RR, Stevens J, Pratt C, Sallis JF, Schmitz KH, Webber LS, et al. Objectivelymeasured physical activity in sixth-grade girls. Arch Pediatr Adolesc Med., 2006Dec; 160(12): 1262-1268.

19. Smith BJ, Phongsavan P, Havea D, Halavatau V, Chey T. Body mass index, physical activity and dietary behaviours among adolescents in the Kingdom of Tonga. Public Health Nutr. 2007 Feb; 10(2): 137-144.

20. Musaiger AO. Overweight and obesity in the Eastern Mediterranean Region: can we control it? East Mediterr Health J. 2004Nov; 10(6): 789-793.

21. Carrel AL, Clark RR, Peterson SE, Nemeth BA, Sullivan J, Allen DB. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: a randomized, controlled study. Arch Pediatr Adolesc Med. 2005Oct; 159(10): 963-968.

22. Young DR, Phillips JA, Yu T, Haythornthwaite JA. Effects of a life skills intervention for increasing physical activity in adolescent girls. Arch Pediatr Adolesc Med. 2006Dec; 160(12): 1255-1261.

23. Riddoch CJ, Leary SD, Ness AR, Blair SN, Deere K, Mattocks C, et al. Prospective associations between objective measures of physical activity and fat mass in 12-14 year old children: the Avon Longitudinal Study of Parents and Children (ALSPAC).BMJ2009 Nov26; 339: b4544.

24. Loth KA, MacLehose R, Crow S, Neumark-Sztainer D. Predictors of Dieting and Disordered Eating Behaviors From Adolescence to Young Adulthood. Journal of Adolescent Health. November 2014;

55(5): 705-712

25. Neumark-Sztainer D, Story M, Hannan PJ, Tharp T, Rex J. Factors associated with changes in physical activity: a cohort study of inactive adolescent girls. Arch Pediatr Adolesc Med 2003Aug; 157(8): 803-810.

26. Allen ML, Elliott MN, Morales LS, Diamant AL, Hambarsoomian K, SchusterMA. Adolescent participation in preventive health behaviors, physical activity, and nutrition: differences across immigrant generations for Asians and Latinos compared with Whites. Am J Public Health. 2007Feb; 97(2): 337-343.

27. Bes-Rastrollo M, Sanchez-Villegas A, Gomez-Gracia E, Martinez JA, PajaresRM, Martinez-Gonzalez MA. Predictors of weight gain in a Mediterranean cohort: theSeguimiento Universidad de Navarra Study 1. Am J Clin Nutr., 2006 Feb; 83(2): 362-70;quiz394-5.

28. Hunt ET, Brazendale K, Dunn C, Boutté AK, Liu J, JamesHardin, Beets MW, Weaver RG. Income, Race and its association with Obesogenic Behaviors of U.S. Children and Adolescents, NHANES2003-2006. JCommunity Health. .2019 Jun; 44(3): 507-518.

29. Hanson N, Neumark-Sztainer D, Eisenberg M, Story M, Wall M. Hanson NI,Neumark-SztainerD, Eisenberg ME, Story M, Wall M. Associations between parental report of the home food environment and adolescent intakes of fruit, vegetables and dairy foods. Public Health Nutr. 2005; 8: 77-85.

30. Isganaitis E, Lustig RH. Fast food, central nervous system insulin resistance, and obesity. Arterioscler Thromb VascBiol. 2005 Dec; 25(12): 2451-2462.

31. Pinhas-Hamiel O, Doron-Panush N, Reichman B, Nitzan-Kaluski D, Shalitin S,Geva-Lerner L. Obese children and adolescents: a risk group for low vitamin B12concentration.ArchPediatrAdolescMed 2006Sep; 160(9): 933-936.

32. Taheri F, Kazemi T. Prevalence of Overweight and Obesity in 7 to 18 Year-Old Children in Birj and/Iran. Iranian Journal of Pediatrics. 2008; 19(11): 19.

33. Amna Umer, George A. Kelley, Lesley E. Cottrell, Peter Giacobbi Jr, Kim E. Innes & Christa L. Lilly. Childhood obesity and adult cardiovascular disease risk factors: a systematic review with meta-analysis. BMC Public Health. Articlenumber, 2017; 17: 683.

34. Kelishadi R. Childhood overweight, obesity, and the metabolic syndrome in developing countries. Epidemiol Rev. 2007; 29: 62-76.

35. Baker E, Balistreri KS, Van Hook J. Maternal employment and overweight among Hispanic children of immigrants and children of natives. J Immigr Minor Health. 2009Jun; 11(3): 158-167.

36. Moreno LA, Blay MG, Rodriguez G, Blay VA, Mesana MI, Olivares JL, et al. Screening performances of the International Obesity Task Force body mass index cut-off values in adolescents.

J Am Coll Nutr. 2006Oct; 25(5): 403-408.

37. James J, Thomas P, Kerr D. Preventing childhood obesity: two year follow-up results from the Christchurch obesity prevention programme in schools (CHOPPS).BMJ2007Oct13;335(7623):762.

38. Bharati DR, Deshmukh PR, Garg BS. Correlates of overweight & obesity among school going children of Wardha city, Central India. Indian J Med Res 2008Jun; 127(6): 539-543.

39. Janssen I, Katzmarzyk PT, Boyce WF, Vereecken C, Mulvihill C, Roberts C, et al. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. Obes Rev. 2005 May; 6(2): 123-132.

40. Lafta RK, Kadhim MJ. Childhood obesity in Iraq: prevalence and possible risk factors. Ann Saudi Med. 2005 Sep-Oct; 25(5): 389-393.

41. Donkor HM, Grundt JH, Júlíusson PB, et al. Social and somatic determinants ofunderweight, overweight and obesity at 5 years of age: a Norwegian regional cohort study. BMJ Open. 2017; 0: e014548 .doi:10.1136/bmjopen-2016-014548.

42. Lamerz A, Kuepper-Nybelen J, Wehle C, Bruning N, Trost-Brinkhues G, Brenner H, et al. Social class, parental education, and obesity prevalence in a study of six-year-old children in Germany. Int J Obes (Lond). 2005 Apr; 29(4): 373-380.

43. Nelson MC, Gordon-Larsen P, Song Y, Popkin BM. Built and social environments associations with adolescent overweight and activity. Am J Prev Med. 2006 Aug; 31(2): 109-117.

44. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity and trends in body mass index among US children andadolescents,1999-2010,JAMA.2012Feb 1; 307(5): 483-90.

45. Ghazi HF, Mustafa J, Aljunid S, Isa Z, Abdalqader MA. Malnutrition among 3 to5 years old children in Baghdad city, Iraq: a cross-sectional study. J Health Popul Nutr. 2013 Sep; 31(3): 350-355.

46. Ayatollahi SM, Pourahmad S, Shayan Z. Trend in physical growth among children in southern Iran,1988-2003.Ann Hum Biol. 2006Jul-Aug; 33(4): 510-514.

47. Cole TJ. Secular trends in growth. Proc Nutr Soc. 2000 May; 59(2): 317-324.

48. Martínez-Vizcaíno V, Martínez MS, Pacheco BN, López MS, García-Prieto JC, Niño CT, et al. Trends in excess of weight, underweight and adiposity among Spanishchildren from 2004 to 2010: the Cuenca Study. Public Health Nutr. 2012Dec; 15(12): 2170-4.

49. Reilly JJ, Kelly L, Montgomery C, Williamson A, Fisher A, McColl JH, et al. Physical activity to prevent obesity in young children: cluster randomized controlled trial. BMJ, 2006Nov18; 333(7577): 1041.

50. Boardman JD, Saint Onge JM, Rogers RG, Denney JT. Race differentials in obesity: the impact of place.

J Health Soc Behav. 2005Sep; 46(3): 229-243.

51. Shirasawa T, Ochiai H, Nanri H, Nishimura R, Ohtsu T, Hoshino H, et al .The relationship between distorted body image and lifestyle among Japanese adolescents: a population-based study. Archives of Public Health. 2015; 73: 32

52. Patrick K, Norman GJ, Calfas KJ, Sallis JF, Zabinski MF, Rupp J, et al. Diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. Arch Pediatr Adolesc Med. 2004 Apr; 158(4): 385-390.

53. Kosti RI, Panagiotakos DB, Mihas CC, Alevizos A, Zampelas A, Mariolis A, et al. Dietary habits, physical activity and prevalence of overweight/obesity among adolescents in Greece: the Vyronas study. Med Sci Monit. 2007Oct; 13(10): CR437-44.

54. Stang J SM. Nutrition Needs of Adolescents. In: Stang JSM, editor. Guidelines for Adolescent Nutrition Services Minneapolis, MN: University of Minnesota; 2005: 21-34.

55. Fasting MH, Nilsen TI, Holmen TL, Vik T. Life style related to blood pressure and body weight in adolescence: cross sectional data from the Young-HUNT study, Norway. BMC Public Health. 2008Apr 9; 8: 111-2458-8-111.

56. Riddoch CJ, Leary SD, Ness AR, Blair SN, Deere K, Mattocks C, et al. Prospective associations between objective measures of physical activity and fat mass in12-14 year old children: the Avon Longitudinal Study of Parents and Children (ALSPAC). BMJ. 2009 Nov26; 339: b4544.

57. Williams W, Li K, Haynie D, Simons-Morton B. Physical activity and sedentary behavior of US immigrant versus non-immigrant adolescents: findings from the NEXT Generation Health Study data. Ethn Health. 2018 Apr; 23(3): 329-338.