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A CLINICO-EPIDEMIOLOGICAL STUDY OF OBESITY INPRIMARY SCHOOL STUDENTS IN TIKRIT PROVINCE

Ayid Tuma Hasan*, Nibras Othman Teek, Assist. Prof. Dr. Emad R. Al-Sadoon

Iraq.

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***Corresponding Author**
Ayid Tuma Hasan
Iraq.

ABSTRACT

Childhood obesity is a growing problem and an increasing public health concern in the developed countries. Even more worrying is the increasing prevalence of obesity in developing countries. Childhood obesity is a well-recognized problem all over the world. Obesity can cause other medical problems in childhood, adolescence and adulthood. The current study represents an observational, cross-sectional study by using a multistage-stratified random sampling technique which included six hundred and eleven students (girls and boys), from randomly chosen primary schools. The study was conducted in Tikrit province from February through May 2009 to assess the prevalence of overweight and obesity in primary school students between the ages from 7 to 13 years in Tikrit province and to identify some of their possible risk factors. Body mass index and midarm-arm circumference were measured and compared to standard tables using international cut-off points. Blood pressure and random blood sugar were measured for all students. Informations on possible risk factors were collected by questionnaire. The total number of cases was 5830 students. The prevalence of overweight and obesity was 41(16%) and 98(6.7%), respectively. Significant associations were found between overweight and age, residency (urban-rural), family history, social level and certain dietary practices. The study concluded that the prevalence of obesity and overweight is relatively high in students in Tikrit province, and that there is a significant association between overweight and obesity from one side and high blood pressure, high blood sugar on the other hand. Modern dietary habits are an important influence in the development of childhood obesity that should be watched carefully and controlled. Community awareness of children nutrition depending on the mass media in the form of: newspapers, television, satellite. More researches on this field should be done all over our

country in order to Make a comparison as well as assessment of the magnitude of the nutritional problems & find the suitable solution for it.

KEYWORDS: Obesity; Children; Determinants; Prevention; Genetics; Physical activity; Dietary pattern.

Genetics

Obesity tracks in families, and one of the strongest predictors of child overweight is the BMI of the mother and father. In recent years, progress was made in identifying genes that may contribute to this effect. A recent study showed for association with the FTO (fat mass and obesity-associated) gene and found strong associations with BMI and weight among children. Moreover, a defect in the melanocortin 4 receptor gene (MC4R) is associated with a severe and early form of monogenic obesity in children.[16]

Age and gender

Age and gender have been identified as key determinants for the development of obesity. A study conducted among 2-18 children in Nigeria and revealed that Males had higher BMI than females at age group 2-6 years, whereas females had higher BMI than males at age groups 11-14 years and 15-18 years.[17]

A study conducted among Sri Lankan children age between 5 and 14 found that fat free mass index (fat free mass/height2) was decreased from age 5 to 6 and after that adipose tissue was increased without much increment in fat free mass index. After that fat mass index (fat mass/ height2) remained relatively stable and fat free mass index increased a little for girls. However, adiposity was increased until 10 years of age and fat free mass index was also increased a little for boys.[18] It clearly showed that weight gain in Sri Lankan children is due to increase in adiposity rather than increase in non-fat tissue (Figure 1).

Birth weight

Rapid weight gain which was traditionally

Rapid weight gain which was traditionally considered as a healthy intervention for low birth weight infants is now recognized as a potential risk factor of increasing interest for obesity; In the geographically defined birth cohort of the Avon longitudinal study of pregnancy and childhood (ALSPAC), it showed that early postnatal catch-up growth, between birth and two

years, is a risk factor for childhood obesity and may therefore contribute to the greatest risk for disease in adulthood.[19]

Dietary pattern

Eating fast foods and snacks: Fast foods play as a key contributor to the rising prevalence of obesity among children because of fast food's poor nutritional quality, as fast foods have higher total energy, total fat, and saturated fat intakes; have refined carbohydrates and lower fiber intakes; and with higher energy density.[20,21] Further, fast food consumption is also associated with higher intake of sugarsweetened beverages and French fries and lower intake of milk, fruit, and vegetables.[22,23]

Skipping breakfast: Breakfast is a most important meal to start a day. Skipping breakfast leads to hunger and increases the amount of lunch. Therefore, it leads to play a key role in causing obesity in children.[24] Some studies showed the higher prevalence among students who skip breakfast than others.[25,26] Ortega et al., identified through 7 day food records that obese subject omit breakfast than normal person. It suggests that inadequate food choices contribute to poor food choices for rest of the day and it increases the risk of obesity in long term.[27]

BEHAVIORAL CHARACTERISTICS

Sedentary activities and screen viewing

Rapid increase in childhood obesity has also been attributed to a shift in the activity patterns from outdoor play to indoor entertainment: television viewing, internet, and computer games. A study suggested that decreasing any type of sedentary time is associated with lower health risk in youth aged 5-17 years. In particular, the evidence suggested that daily TV viewing in excess of 2 hours is associated upward in BMI.[28,29] Another study showed that Overweight and obese children were more sedentary and higher screen time than normal weight children.[30] Further, a European youth heart study conducted among 9-10 year old boys and girls found the significant positive relationships between TV viewing and adiposity after adjusting for gender, age group, study location, sexual maturity and birth weight.[31] Mitchell et al. studied the association of hours of objectively measured sedentary behavior and odds of being obese and confirmed that sedentary behavior was positively associated with obesity.

Physical activity pattern

Physical activity plays an important role in protection from obesity.

A study revealed that Prevalence of overweight and obese was higher among children who travel to school in motor vehicle than children who travel by cycle or walk.[32] Another study done in Iran reported significant difference in physical activity among obese and non-obese children. Non-obese children engaged with more physical activities like running, football, and travel to school by foot than obese children did.[33] A study conducted in Bangladesh reported that physical activity more than 30 minutes have protective effect on obesity in 10-15 year old school children.[28]

Sleeping hours

In school-age children, several studies have consistently reported that short sleep duration was an independent risk factor for obesity.[34] A cross-sectional study conducted among 229 Mexican American 8-10-year-olds and concluded that children who slept less were more likely to have a higher BMI Z-Score.[35] A cohort study done in Japan observed positive relationship between decreased sleeping hours and obesity after adjusting for potential confounding factors.[36]

Strategies for Childhood Obesity Prevention

Obesity prevention is not simply an issue of individual responsibility and prevention strategies seem to be more effective in children than in adults. Therefore, Successful strategies for obesity prevention among children should be targeted and implemented in natural settings for influencing the diet and physical activities at home, in preschool institutions, schools, or after-school care services.

1. INTRODUCTION

1.1. Introduction

Obesity in children is now one of the most widespread medical problems. Obese children are more likely to be obese adults. Increasing prevalence of overweight and obesity is an important public health problem contributing to significant excess in morbidity and mortality.[1]

Obesity generally is defined as an excess amount of body fat. That means the body mass index (BMI) is above 30 for adults. Modified BMI for age was used to define obesity in children, BMI >85 percentiles is considered as overweight, BMI > 95 percentiles is considered as obese, where as the normal weight range is between 5 percentiles - >85 percentiles and under weight is below 5 percentiles.[2]

Obesity during childhood is associated with a number of cardiovascular risk factors, including hyperinsulinism and insulin resistance, hypercholesterolemia, hypertriglyceridemia, reduced levels of high density lipoprotein (HDL), and hypertension.[3]

Many different factors contribute to the development of obesity mainly the imbalance between calorie intake or consumption, and energy expenditure beside the genetic factors. Obese parents may have obese children due to shared genes and environment such as availability of certain energy rich food and decreased exercise and physical activities.[4]

The tendency towards obesity is fostered by lack of physical activity combined with high-calorie, low-cost foods. Low activity levels and excessive television watching were strongly related to overweight status. Possible causes of obesity include diet composition, physical activity level, feeding behaviour, endocrine and genetic factors, psychological traits, and exposure to broader environmental factors.[5]

Factors contributing to the problem include eating food away from home, consuming large or excessive quantities of soft drinks and snack foods, and large portion sizes.[6]

Increases in energy intake are observed in genetic syndromes, such as Prader- Willi syndrome, Cushing syndrome, drug-induced obesity, and certain mutations in genes that control appetite. Reductions in energy expenditure characterize hormonal deficiency states, including hypothyroidism and growth hormone deficiency.[7]

The Global Strategy on Diet, Physical Activity and Health

The *Global Strategy on Diet, Physical Activity and Health (DPAS)* was developed by the World Health Organization (WHO) in 2004 to address the increasing prevalence and burden of NCDs *(13)*. More specifically, the strategy focuses on improving global diet and physical activity patterns, two of the main risk factors for NCDs.

The four main objectives addressed by DPAS are:

1. To encourage the implementation of public health action and preventative intervention to reduce the risk factors which result from unhealthy diet and physical inactivity.
2. To increase recognition of the implications of unhealthy diet and inadequate physical activity levels and knowledge of preventative measures.
3. To promote policies and action plans at all levels to address diet and physical activity behaviours.

4. To encourage monitoring, evaluation and further research.

The priority-setting process

A number of approaches exist for setting priority areas for action in obesity prevention. As, the following steps are common to all approaches:

- Problem identification and needs analysis
- Identification of potential solutions
- Assessment and prioritization of potential solutions
- Strategy development

1.2. Aim

This study aims at identifying the prevalence of obesity in primary school students in Tikrit district and some of its possible risk factors.

1.3. Objectives

The objectives of this study are to:

1. Assess the nutritional status of primary school children**.**
2. Recognize the prevalence of obesity among this age group.
3. Identify some of the risk factors of obesity.
4. Identify the main complications of obesity.
5. Evaluate the efficacy of midarm circumference in the diagnosis of obesity.

Childhood obesity is a global epidemic and rising trends in overweight and obesity are apparent in both developed and developing countries. Obesity has a profound effect on a child's life. It increases the child's risk of numerous health problems, and it also can create emotional and social problems. Obese children are also more likely to be obese adults, increasing their risk of serious health problems such as heart disease and stroke.[8]

2.1. Definition of Obesity

Defining obesity in children has been difficult as assessing body fat is expensive and impractical. Body mass index, derived from weight and height, is used as an indicator in adults. Obesity means an excess amount of body fat. No general agreement exists on the definition of obesity in children as it does in adults. (9) Most professionals use published obesity guidelines that use the body mass index or a modified BMI for age adopted by National Center for Health Statistics (NCHS) and Communicable Disease Control (CDC), as

a measure of obesity for children.[10] The body mass index calculated by the following equation.[11]

= weight (kg)/Height (m)

= Weight (lbs) – (Height (inch) X 704.5)

Others define obesity in children as body weight at least 20% higher than a healthy weight for a child of that height or a body fat percentage of more than 25% in boys and 32% in girls. In children, the consensus is to use BMI percentiles statistically derived from a reference population.[12]

The body mass index is a continuous, though imperfect, measure of body fatness. The BMI correlates closely with total body fat (TBF), estimated by dual-energy x-ray absorptiometry (DEXA) scan in children who are overweight and obese. In the united State of America(USA), using the National Health and Nutrition Examination Surveys of 1988-1994, the normal values (between 5t h and 85t h) of BMI if >85 percentiles is considered as overweight, > 95 percentiles is considered as obese, where underweight below 5%.[13]

2.2. Epidemiology of Obesity

Childhood obesity has reached epidemic levels in developed countries. Twenty five percent of children in the USA are overweight and 11% are obese. Obesity is a disease that affects nearly one-third of the adult American population. The number of overweight and obese Americans has continued to increase since 1960, a trend that is not slowing down.[14]

A cross-sectional, sample of 4722 children from birth through 19 years of age with weight and height measurements of the USA population. Overweight among those aged 2 through 19 years was defined as at or above the 95th percentile of the sex-specific body mass index for age growth charts. Their data showed that, the prevalence of overweight was 15.5% among 12- through 19-year-olds, 15.3% among 6- through 11 -year-olds, and 10.4% among 2- through 5-year-olds.[15]

Available estimates for the period between the 1980s and 1990s show the prevalence of overweight and obesity in children increased by a magnitude of two to five times in developed countries (e.g. from 11 % to over 30% in boys in Canada), and up to almost four times in developing countries (e.g. from 4% to 14% in Brazil).[16]

2.3. Diagnosis of Obesity

2.3.1. Body Mass Index

Which is simply weight adjusted for height, is a more practical and widely used method to screen for obesity. Calculated as weight (kg) divided by height (m), BMI corrects for body size and can be quantified readily and reliably in clinical settings.[17]

Body mass index in childhood changes substantially with age, at birth the median is as low as 13 kg/ m, increases to 15.5 kg/ m2 at age of 6 year, then increases to 21 kg/ m at age of 20 year. To diagnose obesity in children scientists and physicians should relate the BMI charts according to age and sex, if the BMI >95 percentiles the child is diagnosed as obese.[18]

A number of other techniques, such as bioelectrical impedance, dual-energy x-ray absorptiometry, and total body water, can measure body fat, but it is impractical to use them routinely. Clinicians may use the waist circumference as a measure of central adiposity.(19)

2.3.2. (MAC) Mid- Arm Circumference

Mid- Arm Circumference measurements are a good predictor of immediate risk of death. It is an initial screening tool in feeding programs as it is simple and fast to use. It is useful when access to population is difficult, resources limited or when weight for height measurements is not possible. In carrying out a rapid nutritional assessment MAC is commonly used screening tool in measuring malnutrition levels especially in emergencies.[20]

2.3.2.2. Procedure

Request to uncover the left arm as far as the shoulder. Bend the arm and place the lower arm across the stomach. Find the tip of the bone at the back of elbow joint (olecranon process) and top of the shoulder (acromion process) with finger tips and mark it with a pen. Measure the distance between the two marked spots while standing behind the child and divide this measurement by two. Using a triple color tape measure, warp the tape around the marked midpoint. The tape should be comfortably crossed over from 0 marks. Take the measurement to the nearest of 0.1 to 0.5 centimeter where the tape crosses at 0 then record the number or data.[20,21]**(Appendix III)**

2.3.2.3. Advantage of MAC

It is useful for assessment of nutritional status.[20,21] It is good at predicting mortality and in some studies, MAC alone,[20,23] or MAC for age, predicted death in children better than any

other anthropometric indicator. This advantage of MAC was greatest when the period of follow up was short.[23] The MAC measurement requires little equipment and easy to perform even on the most debilitated individuals, although it is important to give worker training in how to take measurement in order to reduce inter and intra observer errors, the technique can be taught to minimally trained health workers.[24] It is thus potentially suited to screening admissions to feeding centers during emergencies. The use of MAC in emergencies is still controversial and disagreement over the preferential selection of younger children, the levels of cut-off points used, the efficiency of a two-phase screening process and poor reproducibility in the measurements continue.[25,26]

At present in emergency, MAC is only recommended for use with children between one and five years of age.[27,28] It is, however, increasingly being used to assess adult under nutrition during famine Measurement of adult MAC have long been known to reflect changes in adult body weight and the major determinant of MAC, arm muscle and subcutaneous fat are both important determinants of survival in starvation.[29,30]

Mid- Arm Circumference is less affected than BMI by local accumulation of excess fluid (pedal edema, per orbital edema, ascitis) common in famine; is likely to prove to be more sensitive index of tissue atrophy than low body weight. It is also relatively independent of height.

2.3.2.4. Classification of MAC

Mid- Arm Circumference cut-off points which are use in screening of adult under nutrition base on extrapolation from more normally nourished populations in developing countries, without reference to data from acutely under nourished adult during famine. (32) It is likely, therefore, that in populations suffering from famine, MAC cut-off points denoting moderate to severe under nutrition should be adjusted. Values of 185mm denoting moderate under nutrition and 160mm denoting severe malnutrition in both sexes have been proposed and used in famine.[33] Given that there are different cross-sectional humerus bone area in men versus women. It is unclear whether common cut-off points for both sexes will prove appropriate Table 2.2.[34,35]

Table 2.2: Midarm circumference cut-off points for moderate and sever adult acute under nutrition.[34,35]

Level of under nutrition	MAC (mm)
Moderate	< 185
Severe	< 160

There is another classification of under nutrition using MAC to measure wasting in children and adults.[36]

Table (2.3): Classification of under nutrition using MAC.[36]

MAC levels(cm)	Definition
Adult Male > 22 **< 22**	Normal malnourished
Adult Female > 22 **< 22**	Normal malnourished
Children > 12.5 **11-12.5** **< 11**	Normal Mild/Moderate Severe malnourished

2.4. The etiology of Obesity

During childhood and adolescence, excess fat accumulates when total energy intake exceeds total energy expenditure. This energy imbalance can result from excessive energy intake and/or reduced energy expenditure for body metabolism, thermoregulation, and physical activity. Children who regularly consume food rich in calories more than their body need will gain weight, and the child will become obese over time. Certain medical conditions can cause obesity, but these are very rare. They include hormone or other chemical imbalances and inherited disorders of metabolism. Lastly certain medications can cause weight gain by altering how the body processes food or stores fat.[37] Changes in dietary constituents including higher derivation of energy from nutritionally poor and energy dense foods, increased sweetened drink consumption, excessive sugar intake by soft drink, larger portion sizes, and more frequent intake of food outside the home have been associated with poorer diets and higher weights.[38] Many different factors contribute to this imbalance between calorie intake and consumption such as:

2.4.1. Dietary Factors

Dietary habits of children have shifted away from healthy foods such as fruits, vegetables, and whole grains to a much greater reliance on fast food, processed snack foods, and sugary drinks. These foods tend to be high in fat and/or calories and low in many other nutrients

especially vitamins, minerals and fibers. Some eating patterns that have been associated with this behavior are eating when not hungry and eating while watching TV or doing homework.[39]Authors reported that, the determinants of food intake are affected by health, sex, age groups, seasons and sometimes communities and other factors such as employment status, level of education, household size, occupation and main source of income.[40] Results of a cluster randomized controlled trial involving six schools in southwest England, constitute 644 children aged 7-11 years, showed that, a targeted, school based education program produced a modest reduction in the number of carbonated drinks consumed, which was associated with a reduction in the number of overweight and obese children.[41]

The amounts of lipids and carbohydrates in the daily diet of overweight and obese individuals are frequently excessive and physical activity is inappropriate.[42]

Eating too much snacks disrupts the physiological rhythm of the digestive economy. The carbonated soft beverages are used instead of water, affording large amounts of inapparent sugars. Ice creams are often too rich in carbohydrates and lipids. Fruits and vegetable fibers fail in the diet.[43]

2.4.2. Socioeconomic Factors

Low family incomes and nonworking parents are associated with greater calorie intake. Overweight and obesity in childhood are known to have significant impact on both physical and psychological health. The mechanism of obesity development is not fully understood and it is believed to be a disorder with multiple causes. Environmental factors, lifestyle preferences, and cultural environment play pivotal roles in the rising prevalence of obesity worldwide.[44]

In Western Europe and United State of America, people usually view obesity as undesirable. In the upper socioeconomic strata in these countries, the high prevalence of eating disorder (such as bulimia) may be due to social pressures. Overweight and obesity are frequently encountered in Saudi females of childbearing age. The prevalence of overweight and obesity was higher amongst a group of married women than among a group of single women.[45]

Those in the lower social classes at birth had significantly higher body mass index and percentage body fat at 50. The choices and the amount of foods eaten at any meal are likely to be determined by the time of day and social context.[46]

2.4.3. Genetic Factors

Obesity tends to run in families. A child with an obese Parent, brother, or sister is more likely to become obese. Genetics alone does not cause obesity. Obesity occurs only when a child eats more calories than he or she uses.[47] Genetic syndromes associated with childhood obesity include Prader-Willi syndrome, Pseudohypoparathyroidism, Down syndrome and Turner syndrome.[48]

2.4.4. Other Rare Factors

Such as hormonal disorders associated with childhood obesity include the growth hormone deficiency, hypothyroidism and glucocorticoid excess (Cushing syndrome). Medications that may cause weight gain in children and adolescents such as Cortisol and tricyclic antidepressants.[49]

2.5. Complications of Obesity

Acute medical complications of obesity are less common in children and adolescents than in adults, and because longitudinal data on the relation between childhood weight and adult morbidity and mortality are more difficult to interpret.[50]

The accumulation of body fat, particularly in a visceral distribution, reduces the sensitivity to insulin in skeletal muscle, liver tissue, and adipose tissue; this "insulin resistance" predisposes to glucose intolerance and hypertriglyceridemia.[51]

2.5.1. Short term Complications of Childhood Obesity

They include Diabetes Mellitus type 2, hypertension, hyperlipidaemia, accelerated growth and bone maturation, gynecomastia, cholecystitis and pancreatitis. Fatty liver is common; rare patients develop cirrhosis. Sleep apnea and sleep-disordered breathing are common in children with obesity and excess weight in young children can cause some bowing of the tibia and femurs; the resulting overgrowth of the proximal tibial metaphysis is called Blount disease.(52) Evidence of liver dysfunction, with elevated plasma concentrations of transaminases, is observed in 20% of children with obesity. Emotional and psychosocial squeal are widespread among obese. Social isolation, peer problems, and lower self-esteem are frequently observed among these patients.[53]

2.5.2. Long-term Complications of Obesity

A number of observational studies showed that, obesity during childhood is associated with an increased risk of obesity during adulthood, with its attendant long-term health risks.[54]

The long-term complications of obesity during infancy and early childhood on subsequent health are less clear than elderly children and adolescent. In general, the proportion of children with obesity who have obesity as adults increases with increased age at the onset of obesity, such that 26-41% of preschoolers with obesity have obesity as adults, compared to 42-63% of school aged children.[55] Additionally, the higher the degree of obesity during childhood, the higher the risk of adulthood obesity.[53]

2.6. Prevention of Obesity

Research priorities to inform the development of best practice recommendations will reduce obesity and chronic disease risk in children and youth.[56]

Schools were found to be a critical setting for programming where health status indicators, such as body composition, chronic disease risk factors and fitness, can all be positively impacted. Engagement in physical activity emerged as a critical intervention in obesity prevention and reduction programs. While many programs had the potential to integrate chronic disease prevention, few did; therefore efforts could be directed towards better integration of chronic disease prevention programs to minimize duplication and optimize resources.[57]

Physical activity has reduced with decreases in school physical education classes and organized sports, fewer opportunities to expend energy for daily living activity due to more mechanization, lower frequency of walking and biking, and greater use of sedentary activities for leisure. Television watching remains the most common activity for children.[58]

Children should be considered the priority population for intervention strategies. Prevention may be achieved through a variety of interventions targeting built environment, physical activity, and diet.[59,60]

3.1: PATIENTS AND METHODS

3.1.1: Administration and Ethical considerations

Official permission to carry out this study was obtained from Educational Directorate of Tikrit province and the headmasters of each school before the study. In addition, apprPoval

permission and consent were obtained from all study students to carry out this study on them. Arm exposure required sociable as well as friendly dealing with the students to obtain accurate information and measure as this subject very sensitive for students. (**Appendix II**)

3.1.2: Socio-Demographic Characteristic

The study has been conducted in primary schools in Tikrit province which consist of 118 schools in different areas in the province (urban and rural areas). Tikrit province has an estimated number of primary schools students of (5830).

3.1.3: Design of Study

The current work represented an observational cross-sectional study which was conducted during the period extending from the first of February 2009 to the end of May 2009, with regular working hours.

3.1.4: The Study Group and Sampling

A multi-stage stratified random sampling technique which has been used to collect a (611) students sample in three main stages. In the first stage, all the schools have been divided according to their location in Tikrit province into urban and rural schools which were 118 schools and 20 schools were visited representing more than 10% of schools. In the second stage, more than 10% of students in each class have been examined according to the total number of the visited schools. In the third stage, a systemic random sampling has been applied by choosing the tenth of the students of each class to complete the sample size. The total sample size chosen is suspected to be suitable to this study for showing the expected degree of differences regarding different variables.

3.1.5: Development of questionnaire

The questionnaire was developed to collect all data relevant to socio-demographic factors. (**Appendix I**)

3.1.6: Pilot Study

A pilot study was carried out to set up the data collection before finally applied to study sample and the real benefit in this research as it is usefulness as a pre test measure, done on small scale.

The pilot study sample was collected on January 2009; it consists of 40 students selected from 4 schools on a non-randomized basis. This pilot study was done two weeks before the

study was lunched. The students were tested for the clarity of language and to give an idea about the acceptability of errors and trying to correct them from the beginning as part of quality control measures thus quality checks will be applied at each state of data collection.

3.1.7: Data Collection

The study includes two components: interviewer administration of questionnaire and anthropometric measurements. Prior to the interview, the purpose of data collection was explained and consent was obtained. The students were interviewed and examined at their educational classes during official study period in sport sections.

3.1.8: Inclusion and Exclusion Criteria

1 Inclusion criteria

Primary school's students with the age of 7 and above years old had been included in the sample without any limitations for their presence in any class

2. Exclusion Criteria students diagnosed to have a medical condition that may cause overweight or obesity like nephrotic syndrome or those who are taking drugs like steroids had been excluded from the study.

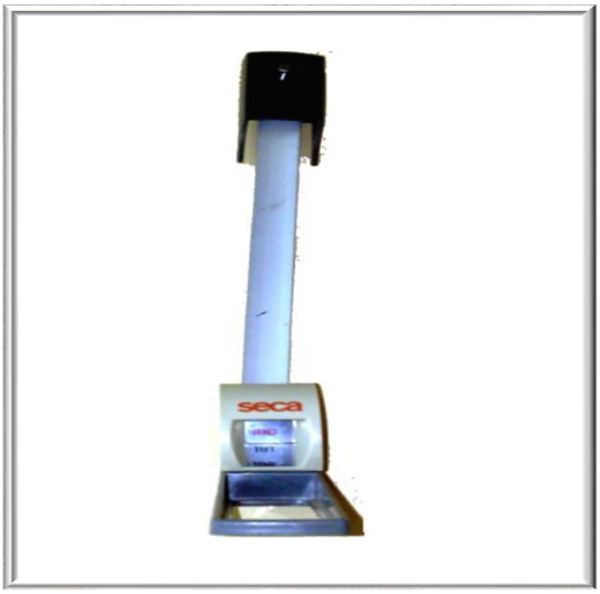
3.1.9: Examination

1. Weight

All student were weighed wearing minimal clothing without shoes to the nearest of 100g using UNICEF Seca personal scales that are checked regularly and routinely before recording the weight of each student and the pointer was adjusted to zero.[6]

2. Height

Height was measured with the student standing at ground level without footwear to the nearest of 0.1 cm against the wall as a vertical tape fixed perpendicular to the ground on the wall was used as scale. This tape was of non-stretchable fibreglass. It was fixed with transparent tape and care was taken to see that there were no folds or tilting to any side. Contact point includes head, shoulder, buttocks, knee and feet. During the examination also the scale was repeatedly checked for loosing of adhesive tapes or tilting of the scale.[6]



3. Midarm-Circumference Measurement

Using non-stretchable tapes, MAC were measured to the nearest of 0.1 to 0.5 millimetres. Left mid-upper arm was measured at the mid-point between the acromion process (in shoulder) and olecranon process of ulna (in elbow joint) with arm and forearm hanging loosely by the side. The tape was placed gently but firmly around the arm to avoid compression of the soft tissues.[61]

4. Blood Pressure

Blood pressure was measured using standardized sphygmomanometer when the student was sitting comfortable after explaining that the procedure is not harmful to them and the device at the level of heart.

Blood pressure was checked 2 times for each student and readings were recorded and classified into normal, prehypertensive and hypertensive according to standard tables. (**Appendix VI**)

5. Random Blood Sugar

Blood sugar was measured using ACCU-CHEK® Active meter system after assuring the students that the procedure is not harmful and brief.

Readings were recorded and measurements repeated for each student in the next day to validate the results.

Readings were classified into two groups, below 200 mg/dl and above 200 mg/dl.[62]

3.1.9: Data Interpretation

BMI was calculated as weight (kg) divided by height squared (m).[63,64] The classification of nutritional status depending on BMI cut-off points into four groups: underweight, normal, overweight and obesity following the recommendation cut-off point of WHO.[64] This cut-off points are:, BMI < 18.5 for underweight, BMI 18.5 to 24.9 for normal weight, BMI 25 to 29.9 for overweight and BMI ≥ 30 for obesity. There is no specific cut-off point of MAC as reported by WHO.[63]

Prevalence of underweight, overweight and obesity was calculated, validity of MAC as a screening tool of nutritional status was calculated as sensitivity, specificity, positive predictive values, negative predictive values, false positive percentage and false negative percentage.

3.2: Statistical Analysis

The statistical analysis was done with the use of SSPS software, version 7.5.

4.1. Demographic characteristics of the study

The total sample studied in this research was (611) of the total of (5830) students registered for the year 2008-2009 in the Education Directorate of Tikrit district representing more than 10% of the total number. The age group was taken from 7 years and above considering those who might fail in certain classes. The residence was recorded in the data collection of the sample in which (304) of the students has been living in urban areas representing 49.8% of

the total sample, (307) students have been living in rural areas representing 50.2% of the total sample in the research. The sex of students was also recorded, male students were 322(52.7%), and female students were 289 (47.3%).

Table 4.1: Distribution of the sample size according to general information.

Sample	No. of Students	%
Residence		
Urban	304	49.8%
Rural	307	50.2%
Total	611	100%
Sex		
Male	322	52.7%
Female	289	47.3%
Total	611	100%

4.2. Relationship between B.M.I and Residence

The prevalence of nutritional status was distributed differently according to the residence.

Table (4.2) shows that urban areas have more cases of overweight 86(87.8%) and obesity 30(73 %) than rural areas in which overweight students were12(12.2%) and obese students were 11(26.8) respectively .

Table (4.2): Distribution of the Cases According to the BMI and Residency.

B.M.I	Residency					
	Urban		Rural		Total	
	No	%	No.	%	No.	%
Underweight	12	24.5	37	75.5	49	8
normal weight	176	41.6	247	58.4	423	69.3
overweight	86	87.8	12	12.2	98	16
obese	30	73.2	11	26.8	41	6.7
Total	304	49.8	307	50.2	611	100

X^2= 89.3, *P* value =0.00 <0.05, df = 3 (significant)

4.3. Relationship between B.M.I and Age

Concerning the age of students and its relations to B.M.I the study found that obesity and overweight weight tend to be more prevalent with increasing age as shown in table (4.3).

Table (4.3): Distribution of the Cases According to the BMI and Age Groups.

BMI	Age(years)									
	6-<7		<8->9		<10->11		≥12		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Underweight	0	0	0	0	39	79.6	10	20.4	49	8
normal weight	118	27.9	142	33.6	71	16.8	92	21.7	423	69.3
overweight	29	29.6	7	7.1	30	30.6	32	32.7	98	16
obese	6	14.6	6	14.6	11	26.8	18	43.9	41	6.7
Total	153	25	155	25.4	151	24.7	152	24.9	611	100

x^2(chi square) = 136.9, *P* value =0.00 <0.05, df = 9 (significant)

4.4. Relationship between B.M.I and Sex

Regarding sex of students overweight and obesity were found to be more prevalent among female students. For overweight there were 79cases (80.6%) and19 cases (19.4 %) for females and males respectively. Meanwhile obesity accounts for 25 cases (52**%)** and **20 cases (**48%) for females and males respectively as shown in table (4.4)

Table (4.4): Distribution of the Cases According to the BMI and Sex.

BMI	Sex					
	Male		Female		Total	
	No.	%	No.	%	No.	%
Underweight	18	36.7	31	63.3	49	8
normal weight	246	62.4	159	37.6	423	69.3
overweight	19	19.4	79	80.6	98	16
obese	20	48%	25	52%	41	6.7
Total	322	52.7	289	47.3	611	100

X^2= 64.6, *P* value =0.00 <0.05, df = 3 (NOT significant)

4.5. Relationship Between B.M.I and Social Class

Regarding social class and it's to relation nutritional status; the following table shows that obesity and overweight are more common in high social level 18 cases (43.9%) and 61cases (62.2%) respectively.

Table (4.5): Distribution of the Cases According to the BMI and social class.

BMI	Social class							
	High		Middle		Low		Total	
	No.	%	No.	%	No.	%	No.	%
Underweight	5	10.2	30	61.2	14	28.6	49	8
normal weight	90	21.3	172	40.7	161	38.1	423	69.3
Overweight	61	62.2	14	14.3	23	23.5	98	16
obese	18	43.9	14	34.1	9	22	41	6.7
Total	147	28.5	230	37.6	207	33.9	611	100

x^2= 86.1, *P* value =0.00 <0.05, df = 6 (significant)

4.6. Relationship between B.M.I and Family History

Regarding the nutritional and it's relation to obesity and overweight the following table shows that overweight counts for 71 (72.4%) of those with positive family history and obesity counts (%90.2)37 of them. While those with a negative family history count for (%27.6) and 4(9.8) for overweight and obesity respectively. as showed in table (4.6).

Table (4.6): Distribution of the Cases According To the BMI and Family History.

BMI			Family history			
	+vet		-ve		Total	
	No.	%	No.	%	No.	%
Underweight	0	0	49	100	49	8
normal weight	52	12.3	371	87.7	423	69.3
overweight	71	72.4	27	27.6	98	16
obese	37	90.2	4	9.8	41	6.7
Total	160	26.2	451	73.8	611	100

x^2= 255.1, *P* value =0.00 <0.05, df = 3 (significant)

4.7. Relationship between B.M.I and Type of Diet

Table (4.8) show that students who eat meals and snacks are liable to be obese or overweight, it show that the number of overweight students who eat meals and snacks is66 cases (65%) and obese students is 30(73.2%) which is more than those who only eat 3 meals per day.

Table (4.7): Distribution of the Cases According to the BMI and diet.

BMI			Diet			
	Just meals		Meals &snacks		Total	
	No.	%	No.	%	No.	%
Underweight	46	93.9	3	6.1	49	8
normal weight	386	91.3	37	8.7	423	69.3
overweight	33	33.7	65	66.3	98	16
obese	11	26.8	30	73.2	41	6.7
Total	476	77.9	135	22.1	611	100

x^2=224.5, *P* value =0.00 <0.05, df = 3 (significant)

4.8. Relationship between B.M.I and Blood Pressure

This table shows that prehypertensive and hypertensive children are as follow 13 cases (13.2%) and 23 cases (56.1%) for overweight and obese children respectively which was higher than those who are normal or underweight.

Table (4.8): Distribution of the Cases According To the BMI and Blood Pressure.

BMI			Hypertension					
	Normal		Prehypertension		Hypertension		Total	
	No.	%	No.	%	No.	%	No.	%
Underweight	49	100	0	0	0	0	49	8
normal weight	416	98.4	6	1.4	1	0.2	423	69.3
overweight	73	13.3	12	12.2	13	13.2	98	16
obese	11	26.8	7	17.1	23	56.1	41	6.7
Total	549	89.9	25	4	37	6.1	611	100

x^2=271.4, *P* value =0.00 <0.05, df = 6 (significant)

4.9. Relationship between B.M.I and Random Blood Sugar Measurement

This table shows increased number of children having high random blood sugar measurement among those who are considered to be obese or overweight 7 cases (17%) and 5 cases (5.1 %) respectively.

Table (4.9): Distribution of the Cases According to the BMI and DM.

BMI			DM			
	<200		>200		Total	
	No.	%	No.	%	No.	%
Underweight	49	100	0	0	49	8
normal weight	420	99.3	3	0.7	423	69.3
overweight	93	94.9	5	5.1	98	16
obese	34	82.9	7	17.1	41	6.7
Total	596	97.5	15	2.5	611	100

x^2=43, *P* value =0.00 <0.05, df = 3 (significant)

4.10. Relationship between B.M.I and midarm circumference measurement in the evaluation of nutritional status

The following tables show the numbers of children by their midarm circumference in relation to their B.M.I. table(4.11) crosstabulate B.M.I. and mid-arm Circumference and it shows that midarm Circumference increases with the increase in B.M.I.

Table (4.11): Distribution of the Cases According to the MAC and B.M.I.

BMI * M.A.C cross tabulation

Count

		Midarm circumference				
		12-15cm	15-20cm	20-25cm	>25cm	Total
BMI	Underweight	3	45		1	49
	Normal	29	247	25	122	423
	Overweight		8	52	38	98
	Obese			11	30	41
Total		32	300	88	191	611

x^2=262.4, *P* value =0.00 <0.05, df = 9 (significant)

Applying a least significant test (LSD) to measure the significant association between the MAC & the four nutritional status classified according to BMI through entering the MAC as a dependent variable & the nutritional status as independent to make a multiple comparison between the mean of MAC of the four nutritional status has shown that there was a highly significant association (P value < 0.000) at the 0.01 level. Table 4.12

Table (4-12) correlations between B.M.I and midarm circumference.

Correlations

		BMI	Midarm circumfer
Pearson Correlation	BMI	1.000	.441 **
	Mac	.441 **	1.000
Sig. (2-tailed)	BMI	.	.000
	Mac	.000	.
N	BMI	611	611
	Mac	611	611

**. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The use of BMI for assessing nutritional status is now being applied worldwide. Body mass index cut off points was linked to adult cut off points to measure the nutritional problems.

The present study was the first carried out in Tikrit University College of Medicine & Tikrit city to assess the prevalence of obesity among school students in Tikrit province. Therefore, the methods & results developed would be useful as basic information in further studies among this age group. The present study had several strengths including a sociodemographic sample (urban & rural), validated MAC cut-off points, accurate & simple anthropometric measurements in addition, the results has been adjusted for age.

5.1. Distribution of different Nutritional Status in The Study

By comparison, the prevalence of overweight and obesity in the current study were higher than that reported from K.S.A, where over weight and obesity for age group 6-18 years were 11.0 % and 5.9% respectively.[65] The prevalence of obesity in this study was more than in Qatar, they reported that, 3.2% and 8.8% were overweight, and 1.6% and 5.4% of both boys and girls were obese, respectively. The prevalence of obesity was less than in Kuwait. The BMI of Kuwaiti children at higher percentiles and was higher than that of Saudi taking into consideration the difference in developmental habits and prosperity between Iraq and these countries and this difference again can be explained by the change in social, economic, number of population within the country together with genetic susceptibility, change in body image & availability of energy dense diet as important differences between developing & industrialized countries.[66]

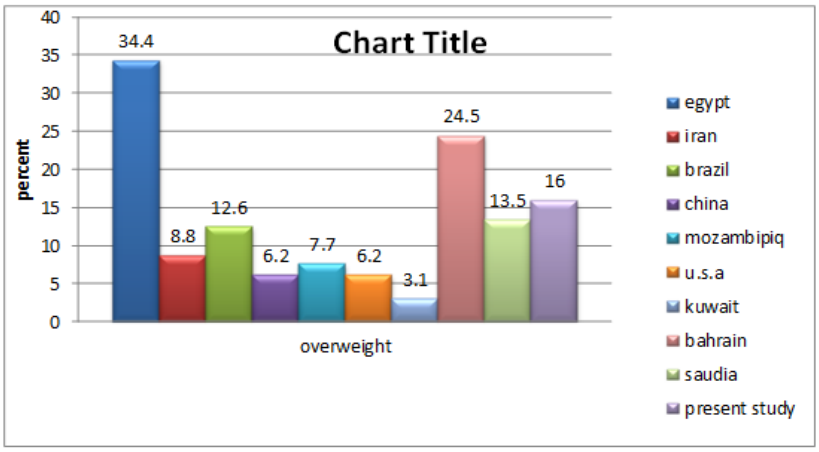


Figure (1): Comparison of the current study Result in Overweight Prevalence with Other Countries.

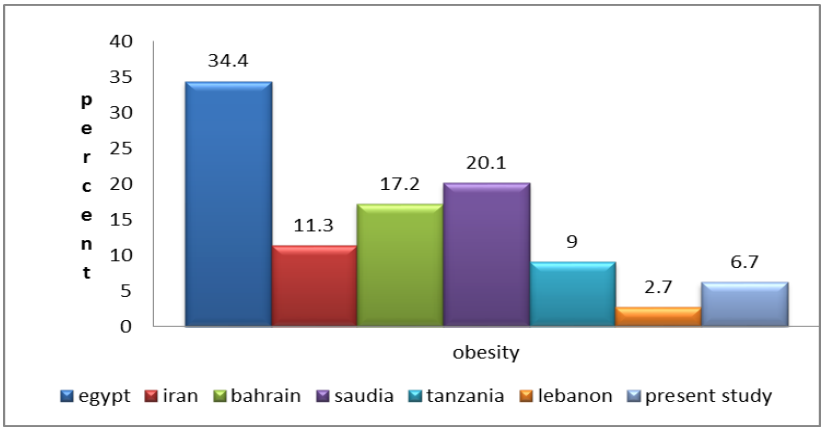


Figure (2): comparison of the current study result in obesity prevalence with other countries.

5.2. B.M.I and Age

The current study demonstrated that the prevalence of overweight and obesity significantly increased with age.

The proportion of overweight and obesity increased from (29.6%) and (14.6%) at age 7 reaching (32.7%) and (43.9%), respectively, at the age of 12 years and above. This may give the impression that obesity is a progressing phenomenon that once present, tends to increase with time. This is consistent with a study of children in primary schools in Leeds, which found a significant increase in the proportion of overweight and obese children at age.[67] It is also in agreement with Sanjay et al, who found in 20 973 children aged 5–14 years that the prevalence of obesity increases with age, being almost double in the oldest age quarter, compared with youngest age quarter.[68]

5.3. B.M.I and Sex

In the current study, although the prevalence of overweight was higher in girls than in boys, it was statistically not significant (52% vs. 48%).

This finding does not coincide with Nicolas et al in their cohort study of African Americans, which concluded that female sex is an independent risk factor.[69]

5.4. B.M.I and Residence

The prevalence of overweight was significantly higher in urban areas than in rural areas (73.2% vs. 26.8%) in current study. This was in agreement with Zuguo et al in the USA, who observed an increase in the prevalence of overweight among both urban and rural children[70], although trends were more marked and consistent in the urban areas. Our results also agree with Fredrik et al,[71] a study in the Netherlands, who concluded that obesity is more prominent in urban than rural areas. This observation may be due to more food and less physical activity in urban areas.

5.6. B.M.I and Dietary Habits

Eating more than three meals per day was significantly related to the BMI, the study demonstrated that the percentage of obese and overweight children (eating more than three meals per day) was 66.3%, 73.2% more than those with normal weight (73.2% vs. 8.7%).

The high BMI associated with these dietary habits in our sample does not agree with some studies, which concluded that obese children do not eat differently than their peers. Eating between meals was significantly related to high BMI.

5.7. B.M.I And Social Level

The study showed a significant association between BMI and social level. Increased BMI in children seems to be associated with a high social level of the parents. This result is in disagreement with Fredrik et al, who found increased BMI values in children with lowest social level,[71] but agree with a study done by Mihaela et al[72] in the USA where mothers of obese children were not different from mothers of non-obese children in education. This may attribute also to the fact that higher social levels in Iraq never mean that they have the sound medical awareness and knowledge like those in developed countries.

5.9. B.M.I And Blood Pressure

The current study shows a significant association between high B.M.I and elevated blood pressure when (56%) of obese children are considered to be hypertensive and (17.1%) were prehypertensive and this result agrees with (Muntner P. etal.) Who found a strong association between high blood pressure and obesity among children.[73] The prevalence of HT in the current study study ranks less than those reported in Arabian countries. Meanwhile, it is less than those reported in foreign.

Countries.[74] These differences may be attributed to variations in study design, definition of HT, methods of BP recording, observer effect, age range, sample size and social class.

5.10. B.M.I and Blood Sugar

The current study shows that overweight children having increased random blood sugar measurement. This result signifies that overweight and obesity are considered to be important risk factors for diabetes mellitus in children. This result agreed with (Eric Ravussin and Boyd A. Swindurn) who found that Overweight children and adolescents are now being diagnosed with impaired glucose tolerance and type2 diabetes, and they show early signs of the insulin resistance syndrome and cardiovascular risk.[75]

Ranjana Sinha, M.D concluded that Childhood obesity,which is epidemic in the United States, has been accompanied by an increase in the prevalence of type 2 diabetes among

children and adolescents and that impaired glucose tolerance is highly prevalent among children and adolescents with severe obesity, irrespective of ethnic group.[76]

5.11. Comparison between B.M.I and Midarm Circumference in Evaluation of Overweight and Obesity

This study shows that there is a significant association between B.M.I and use of midarm circumference in the assessment of nutritional status in school age children. This result is in agreement with (Khadizadeh T.) who showed a significant relation between MAC & BMI, weight, height, age & calf circumference.[77] This result agreed also with (Tawfeek H. et al) which show that there was a highly significant correlation of about +o.88 between weight & height ($P < 0.001$). Weight, height & MUAC were positively correlated ($r= 0.61$; $P < 0.05$)[78] and also agreed with (James WP.) who demonstrated an excellent relationship between MAC & BMI. (79)A high strength of relationship between anthropometric measures that were proved by correlation test indicates that each measure can be used as an indicator of nutritional status separately or with each other. Simple linear regression analysis revealed significant association between MAC and BMI.[80]

CONCLUSIONS AND RECOMMENDATIONS

6.1: Conclusions

6.1.1. The prevalence of overweight and obesity among primary school students in Tikrit province was (16%) and (6.7%), respectively.

6.1.2. Over weight and obesity were more common in females (86.2,52%) than males (19.4%,48%).

6.1.3. All the kinds of nutritional status were higher in urban than rural areas.

6.1.4. The associated risk factors in this study were: dietary habits, family history, and social level.

6.1.5. Complications of obesity and overweight were high blood sugar and high blood pressure.

6.1.6.. Midarm-Circumference had significant correlation with BMI so it can be used together with or as a substitute to BMI in nutritional assessment programs.

6.2: Recommendations

6.2.1. To Ministry of health, to introduce a nutritional education programmes for:

- Family: should include education about the quality care of children nutrition in this age 7-12years and its importance in this age group together with promoting healthy life styles practice for their health.
- Schools: it is considered as a supporting part for students to become healthy adult. Teaching students to use the scientific knowledge of nutrition when handling food to improve their health and promoting the lessons of sports in schools.
- Community: community awareness of children nutrition depending on the mass media in the form of: newspapers, television, satellite.

6.2.2. To Ministry of education, to re introduces the nutritional program to the schools.

6.2.3. To ministry of higher education to do more researches on this field all over our country in order to:

- Make a comparison as well as assessment of the magnitude of the nutritional problems & find the suitable solution for it.

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