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A Study of Body Mass Index in Relation to Menarche in Adolescent Females at Tikrit District

Suha K. Jameel, (1)

Ruqaya S. Tawfeeq (2)

Nissren M Ibrahim (3)

(1) Community medicine specialist – Tikrit health directorate. Iraq
(2) Community medicine specialist –, College of Medicine, Al-Iraqia University. Iraq
(3) Community medicine specialist –College of Medicine, Tikrit University. Iraq

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A R T I C L E I N F O

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ABSTRACT

Background:

Anthropometric indices have been known to be associated with age at menarche.

Objective:

this study an attempt to determine the relation between menarche & nutritional status in adolescent's student. regarding the effect of menstrual cycle,

Subjects and methods:

cross-sectional study was conducted during the period extended from first of October 2018 to the end of March 2019. Females of secondary school in Tikrit district were be chosen from urban & rural areas Official permission to carry out this study was obtained from educational directorate of Tikrit district & the head masters of each school before the study. In addition approval permission & consent were obtained from all study students by using a multistage-stratified random sampling technique which includes(536) female adolescent students from secondary school of Tikrit district,

Results:

There was a highly significant difference between pre & postmenarcheal adolescent student. A higher percentage of underweight (30.9%) & normal weight (60.3%) were in premenarcheal students while higher overweight (31.2%) & obesity (12.6%) in postmenarcheal students. Menarcheal age appear to be associated with the change of nutritional status of adolescent students as they increase or decrease according the number of years of menstrual cycles. Underweight was recorded in adolescents students who were menstruating for less than 6 years while not present in adolescent with more than 6 years menstrual time while normal weight, overweight & obesity were fluctuating in increase & decrease along the menstrual cycle.

Conclusion:

The menstrual cycle had a highly significant effect on the distribution of nutritional status.

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*Corresponding author E mail :suhakj@tu.edu.iq

Introduction:

Menarche is a milestone for adolescent girls. The timing of menarche is influenced by genetics, social status and nutritional status (e.g ,height, weight, and body mass index(BMI) and impact future health (e.g, obesity and breast cancer).(1). Menarche is affected by genetic factors, race, environmental conditions, nutrition, physical activity, geographic location, urban or rural residence, health status, psychological factors, blindness, body mass index(BMI), family size, socioeconomic status, parental educational level, occupation of parents, loss of parents, child sexual abuse, physical stress, tea consumption and passive smoking.(2).

Rapid changes in anthropometric measurements occur during sexual development, for example, during the adolescent growth spurt, the highest rate of weight gain follows the highest rate of height gain. This lead to acceleration in the rise of BMI shortly after reaching the peak high velocity & this rise is more related to pubertal development than chronologic age. (3-5) Moreover, sexual development occurs at different ages in different populations. Chronic under nutrition delay sexual maturity & adolescent growth spurt, this delay can exaggerated differences in age of sexual maturation & the growth spurt between under nutrition survey population & well nourished reference populations. (6-7)

The single maturational landmark which might be easily being collected in field is age of menarche. In all populations where adolescents know their age of menarche can be recalled by girls & women & has been measured successfully in many survey. (7,8) Improve nutrition

may accelerate maturation in adolescence, but this may also result in greater obesity in adulthood, observed in Amsterdam growth study. (9,10) Simpler methods of determining pubertal stage, may in future, allow adjustment for this complicating factor. Such methods include appropriate line drawings or photographs of different Tanner stages. In contrast, it may be easier & more accurate when assessing adolescents to consider pre-pubertal & post-pubertal adolescents separately. (11)

Method:

A cross-sectional study was conducted during the period extended from first of October 2018 to the end of March 2019. Females of secondary school is in Tikrit district were be chosen from urban & rural areas. Official permission to carry out this study was obtained from research committee in Tikrit medical college regarding the ethical points of view also from educational directorate of Tikrit district & the head masters of each school before the study. In addition approval permission & consent were obtained from all study students

This is a multi-stage stratified random sampling technique has been used to collect a (536) females students sample in three main stage. In first stage, all the schools have been divided according to its location. The second stage includes 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 every tenth students from each class to complete the sample size.

BMI was calculated as weight (kg) divided by height

squared (m^2). Data were analysed using Pearson correlation coefficient to examine the correlation between variables when analysis of proportion was needed, chi-square test were performed.

The questionnaire was developed to collect all data relevant to socio-demographic factors. Checking on data entry is done on regular basis.

- Age: it include 3 age groups: Early adolescent (12-<15 years old), mid adolescent (15-<17 years old) & late adolescent (≥17 years old).

- Menstrual history: adolescent students asked whether they had ever had menstrual period, & if necessary, the term `menstrual period` was explained. Post-menarcheal girls were asked to identify the year of their first period, with help question such as, ″ Do you remember what grade you were in when started having period ″

- 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 & routinely before recording the weighment of each student.

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 & care was taken to see that

there were no folds or tilting to any side. Contact point includes head, shoulder, buttocks, knee & feet. During the examination also the scale was repeatedly checked for loosing of adhesive tapes or tilting of the scale.

3.**Mid Upper Arm Circumference (MUAC):** Using non-stretchable tapes, MUAC 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) & olecranon process of ulna (in elbow joint) with arm & forearm hanging loosely by the side. The tape was placed gently but firmly around the arm to avoid compression of the soft tissues.

Results:

Regarding menstrual history of student in the sample studied, post-menarcheal students were 468 (87.3%) while pre-menarcheal students were 68 (12.7%) of the total sample in the research.

The age group has been divided into three age groups according to WHO/UNICEF subdivision which include: early adolescent between 12-<15 years was 217 (40.5) students ; mid adolescent between 15-<17 years was 164 (30.6%) students & late adolescent equal & more than 17 years was 155 (28.9%) students of the total sample in the research. Table 1.

Table 1: Distribution of the sample size according to general information

Sample	No.	%
Age		
Early adolescent(12-<15)	217	40.5
Mid adolescent(15-<17)	164	30.6
Late adolescent ≥17	155	28.9
Total	536	100.0
Menstrual history		
postmenarcheal	468	87.3
premenarcheal	68	12.7
Total	536	100.0

The anthropometric parameters were significantly

correlated with each other and with age as a total. Studying the correlation of age with anthropometric parameters showed a significant relation with MUAC(r 0.96, 0.027), highly significant relation with BMI(r 0.147, 0.001) & highly significant relation with menarche time (r0.850, 0.000). Correlation of MUAC has shown a highly significant relation with menarche time(r 0.220, 0.000), & highly significant correlation with BMI (0.896, 0.000). For correlation of menarche time has shown a highly significant correlation with BMI (0.251, 0.000) & also with other variables. Studying the correlation of BMI has shown a highly significant correlation with the three variables as explained. Table 2.

Table 2: Correlation between age, MUAC, BMI & menarche time.

Measurement	Correlation	Age	MUAC	Menarche time	BMI
Age	r p	1	0.96* 0.027	0.850** 0.000	0.147** 0.001
MUAC	r p		1	0.220** 0.000	0.896** 0.000
Menarche Time	r p			1	0.251** 0.000
BMI	r				1

*correlation is significant at the 0.05 level (2-tailed)
**correlation is significant at the 0.01 level (2-tailed)
p(p value) r(regression)

The effect of menstrual cycle the on the distribution of different nutritional status of adolescent students was studied. There were(468) postmenarcheal students 14 (3%) of them were underweight, 249 (53.2%) were normal weight, 146 (31.2%) were overweight & 59 (12.6%) were obese. premenarcheal adolescents which were(68)students, 21 (30.9%) of them were

underweight, 41 (60.3%) were normal weight, 4 (5.9%) were overweight & 2 (2.9) were obese. There was a highly significant association between menstrual cycle & distribution of nutritional status (89.752) at P value (<0.0001). Table.3.

Table 3: Distribution of nutritional status before & after menarche in adolescent students.

Nutritional status	Menstruated		Not-menstruated	
	No	%	No	%
Underweight	14	3	21	30.9
Normal	249	53.2	41	60.3
Overweight	146	31.2	4	5.9
Obesity	59	12.6	2	2.9
Total	468	100.0	68	100.0

Chi square = 89.752 Degree of freedom = 3 P value = <0.0001

The study showed that the prevalence of nutritional problems has been different between post & premenarcheal adolescent students. Underweight was (3.9%) in postmenarcheal while (2.6%) in premenarcheal students. Overweight were (27.2%) in postmenarcheal while (o.8%) in premenarcheal students. Obesity were (11.0%) in postmenarcheal while (o.4%) in premenarcheal students. Figure (1).

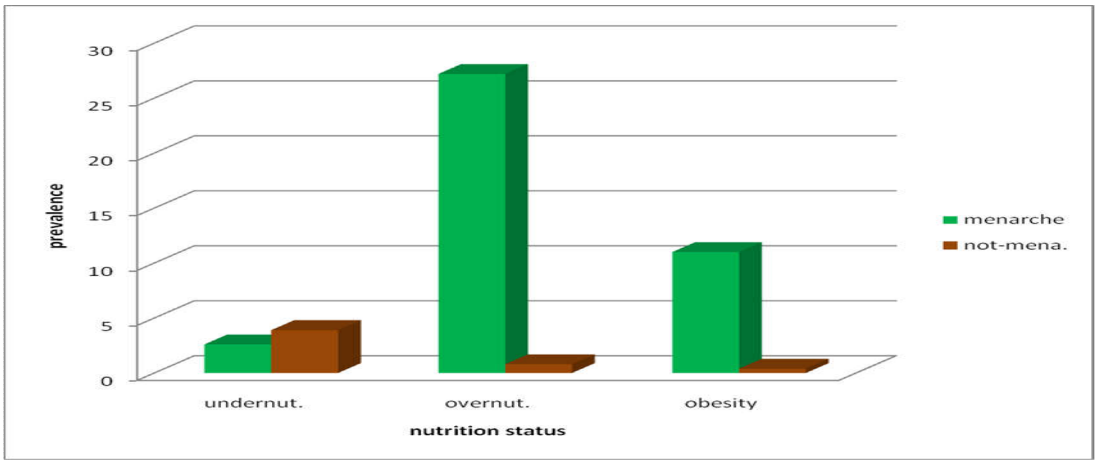

Figure (1): Prevalence of nutritional problems according in pre & postmenarcheal adolescent students.

Furthermore the study showed the effect of menstrual age (menstrual time) on each nutritional status. For underweight, it was started (60%) in premenarcheal adolescent students than sudden decrease after starting the menstrual cycle to reach (14.3%) at adolescent students who are menstruated for one year then continue to decrease till reaching (5.7%) at 5 years then disappear at 6 & 7 years menstrual time. For normal weight, it started as (14.1%) at premenarcheal students then increased gradually to reach (16.9%)& (17.2%) at students who starting menstruation for1 & 2 years menstrual time then at 5 years menstrual time the percentage of normal weight would decrease from (12%) to (0.7%) in students who had7 years menstrual time. For overweight, it started at(2.7%) in premenarcheal students than increased in the students who starting menstruation for one year to reach (15.3%) then continued to increase till reaching (24%) at students who menstruated for 2 years. The overweight fluctuated between (14.7%) & (16.7%) at students who were menstruated from 3 to 5 years duration then start to decrease till reaching (1.3%) at students with 7 years menstrual time. For obesity, it started at (3.3%) in premenarcheal adolescent students then it increased & fluctuated between (14.8%) & (29.5%) when the students started menstruation between 1 & 5 years menstrual time then decreased till reached (3.3%) at 7 years menstruated students. Figure (2)

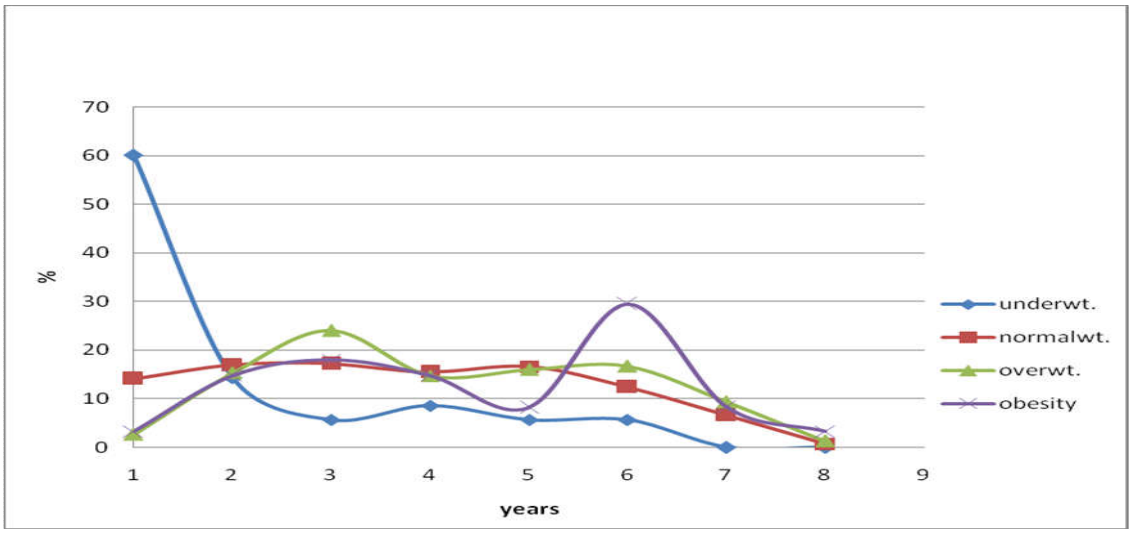

Figure (2): Distribution of nutritional status according to menstrual age (per years) in adolescent students.

Discussion:

A highly significant relation of MUAC with BMI & menarche age (P <0.0001) & significant relation with age (P 0.027), this result agreed with (Khadizadeh T.) who showed a significant relation between MUAC & BMI, weight, height, age & calf circumference [11]. 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.

Regarding the effect of menstrual history on the distribution of nutritional status, the study shows that there was a highly significant relation between sexual maturity in the form of menstrual cycle & nutritional status in adolescent students in which (60.3%) of premenarcheal students were normal weight while in postmenarcheal students it was (53.2%). Premenarcheal students had higher underweight (30.9%) with low overweight (5.9%) & obesity (2.9%). In postmenarcheal students there

was a higher level of overweight (31.2%) & obesity (12.6%) with very low underweight (3%). This result agreed with (Bhadra M. et al) which indicated that there were significant differences in body composition as well as BMI between pre & postmenarcheal adolescent girls in **India** [12]. It also agreed with (Lassek WD et al) who reported that menarche is more related to fat distribution than skeletal maturity [13]. This result can be explained by the growth spurt which occurs during puberty due to interaction between adipocytokines (as the adipose tissue is endocrinologically sensitive) and the sex steroid hormones such as FSH(follicular stimulating hormones), Estrone(E_1),Estradiol (E_2) & androstendione secreted by the ovaries after starting menstrual cycle together with non-sex steroid hormones such as growth hormones (GH) & insulin-like growth factor (IGF-1), this will lead to accumulation & redistribution of fatty tissues in the body after menarche.[14]

The prevalence of nutritional problems differs in pre & postmenarcheal adolescent students. The prevalence of underweight was higher in premenarcheal adolescents which was (3.9%) than postmenarcheal students (2.6%) while the prevalence of overweight &obesity were higher in postmenarcheal students (27.2%) & (11.0%) than that in premenarcheal students (0.8%) & (0.4%). This result agreed with (Wang Y. et al) which showed that early sexual maturation was positively associated with overweight & obesity, which shows the prevalence of overweight was (31.6%) & obesity (15.6%) [15],in Western China ,the timing of menarche is influenced by many factors, and a trend towards earlier onset of menarche has been observed.

This study investigated associations between height, weight, BMI and menarche among adolescent girls, and found that BMI is an important indicator of the timing of menarche [16]. This difference in the nutritional status between pre & postmenarcheal adolescents occur due to approximately half of adult body weight is gained during adolescence. Peak weight gain follows the linear growth spurt by 3 to 6 months in females. Girls will gain (8.5kg) per year during peak rate of weight gain (12.5years of age on average). Average weight gain during puberty among females is between (7-25kg) with mean gain of (17.5kg) weight slows around the time of menarche, but will continue into late adolescents who gain (6.3kg) [17]. Also the difference in the prevalence of nutritional status can be explained by a complex interplay of biological, psychological, social influences, genes, environmental factors & nutritional habits within the same population or in comparison with other population.

The relation between menstrual time (menstrual age) & the distribution of nutritional status shows that the underweight in premenarcheal students was (60%) then there was a greater & sudden reduction in it with postmenarcheal students who were menstruated for 1 year to reach (14.3%) which continue to reduce till it disappears in the students with 6 & 7 menstrual time. Normal weight was (14.1%) in premenarcheal students then it increases to reach (17.2%) in the students with 2 years menstrual time & after 5 years menstrual time, it starts to reduce to (0.7%). Overweight was (2.7%) in premenarcheal students then it had a peak (24%) in the students with 2 years menstrual time then fluctuating

till it is reduced to (1.3%) at 7 years menstrual time. Obesity was (3.3%) in premenarcheal then it increased to reach (29.5%) in the students with 5 years menstrual time. So the underweight not present in the student with early sexual maturation (longer menstrual time) while the overweight & obesity fluctuating by increase & decrease but do not disappear. This can be explained by the fact that early menstruating females had a high estradiol/ dehydroepiandrosterone ratio which has a great effect on fat deposition & distribution & this concentration remains higher than girls having late menarche which occurs because early menarche had more profound decrease in the sensitivity of hypothalamus-pituitary unit to the negative feed-back circulating steroid.[1,18] This result agreed with (Afkhamzadeh A,. et al) that in girls with higher BMI, the menarche age was lower.[19]This also agreed with (freedman DS. et al) which shows that the girls who undergo early menarche have been found to be more obese in adulthood. However, most (60-70%) of apparent effect of menarcheal age is due to faster maturation in girls who are relatively heavier for their age. [20-23]

Conclusions:

There was a highly significant relation between anthropometric measurements including: weight, height & BMI with age of female adolescent students but MUAC had no significant relation with age.

Menstrual cycle had a highly significant effect on the distribution of nutritional status. Postmenarcheal adolescent students had a higher prevalence of overweight & obesity while underweight prevalence was

higher in premenarcheal adolescent students.

Menarcheal age (menstrual time) had a greater effect on the nutritional status, higher reduction & disappearance of underweight & fluctuation of normal weight, overweight & obesity with its persistence to adulthood

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