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Menarquia precoz y su asociación con parámetros antropométricos y de composición corporal en jóvenes universitarias

Early menarche and its association with anthropometric and body composition variables in young university students

ABSTRACT

Objective: Evaluate the association between early menarche and anthropometric/body composition variables in young female university students. **Methods:** Cross-sectional study involving female university students at a public university in northeastern Brazil. Anthropometric and body composition data were collected, along with a self-report of age at menarche. The conceptual model considered demographic, socioeconomic and lifestyle variables as well as the perception of weight in childhood and at menarche. **Results:** Among the 162 students analyzed, 62.3% were less than 20 years of age. The frequency of underweight and overweight was 8.6% and 22.3%, respectively. The frequency of above-average body fat and obesity was 32.1% and 14.8%, respectively. Early menarche was reported in 35.2%. The frequency of self-reported excess weight in childhood and at menarche was 31.3% and 25.9%, respectively. A statistically significant association was found between early menarche and height < 1st tertile (< 1.62 m). A tendency toward an association was found between early menarche and both weight, circumference in the risk range and the perception of excess weight in childhood and at menarche. **Conclusion:** Current excess weight was more associated with excess weight in childhood and at menarche than the occurrence of early menarche.

Keywords: Anthropometry; Body composition; Early menarche; Excess weight; University students.

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RESUMEN

Objetivo: Evaluar asociación entre menarquia precoz, parámetros antropométricos y de composición corporal en jóvenes universitarias. **Métodos:** Estudio transversal en 162 jóvenes universitarias del Nordeste brasileño. Se recogieron datos antropométricos, de composición corporal y relato sobre la edad de la menarquia. Se consideraron, además, variables demográficas, socioeconómicas, estilo de vida e histórico del peso. **Resultados:** De las 162 jóvenes el 62,3% tenía menos de 20 años de edad. Un 8,6% y 22,3% presentaron bajo peso, y exceso de peso respectivamente. La frecuencia de grasa corporal y obesidad por encima de la media fue de 32,1% y 14,8%, respectivamente. La me-

narquia temprana fue reportada en el 35,2% de los casos. El 31,3% y 25,9% reportaron tener exceso de peso en la infancia y en la menarquia respectivamente. Se verificó asociación estadísticamente significativa entre menarquia precoz y talla <1 tercil (<1,62cm). Además de una tendencia de asociación entre menarquia precoz, circunferencia de la cintura y exceso de peso, tanto en la infancia como en la edad de menarquia. **Conclusión:** el exceso de peso actual está, mas asociado con el exceso de peso en la infancia y la edad de la menarquia que con la menarquia precoz. **Palabras clave:** Antropometria; Composición corporal; Estudiantes universitarios; Exceso de peso; Menarquia precoz.

INTRODUCTION

The relationship between weight and sexual maturity, which is generally evaluated, in girls, by the age at menarche, is quite complex¹. Early menarche (EM) has been considered a marker for the risk of obesity in adolescence and adulthood. However, girls with EM tend to be overweight prior to puberty. Thus, the occurrence of EM may simply reflect the effect of rapid weight gain in childhood².

Depending on the study, EM is defined from 9 to less than 12 years of age^{3,4,5}. According to Gaudineau et al⁶, this variability can be explained by the age of menarche found in different populations. Therefore, there is no consensus on age limits for defining EM. Thus, menarche generally is considered early if it occurs before 12 years of age and late if it occurs at or after 15 years of age⁷.

Most studies conducted in Brazil that have explored the relationship between menarche and nutritional status are limited to the investigation of its effect during the period of adolescence^{3,8}. A study involving adult women in the southern region of the country found a protective effect of late menarche for obesity⁸. Pinheiro et al.⁹ found a 67.7% frequency of excess weight among women who had EM (< 13 years), whereas the frequency was 54.0% in the group with a later menarche. This association has also been found in studies conducted in other Brazilian states^{10,11,12}.

Therefore, the aim of the present study was to investigate whether EM is associated with anthropometric variables and body composition among young university women.

METHODS

A cross-sectional study was conducted involving students studying health majors at a public university in northeast Brazil in 2015. Students aged ≥ 30 years, pregnant women, those who already had children and those who were unable to undergo the anthropometric evaluation due to poor physical condition were excluded. This study received approval from the Human Research Ethics Committee of the Center for Health Sciences of Universidade Federal de Pernambuco (certificate number: 41423215.6.0000.5208).

The sample size was calculated using the Statcalc program of EPI-INFO, version 6.04, considering a 95% significance level ($1-\alpha$), 80% power ($1-\beta$), 1:1 proportion, exposure (obesity) and relative risk of 1.6. A sample of 120 university students was determined. A convenience sample was used of women who agreed to adhere to the study.

The students were evaluated at the beginning of the school year. Age at menarche was defined as the self-reported age at which the first menstrual cycle occurred. Menarche was considered early when it occurred at a younger age than the median of its occurrence among the university students analyzed (12 years).

The anthropometric variables collected were weight, height and waist circumference (WC). Weight was determined using a digital scale (Plena) with a 150 kg capacity and 100 g precision. Height was determined using a portable stadiometer (Ghrum Polar, Switzerland) with 1 mm precision. Both weight and height

were measured using the methods proposed by Lohman et al.¹³ and served as the basis for the calculation of the body mass index (BMI). For students up to 19 years of age, the BMI was classified using the cutoff points for adolescents recommended by the World Health Organization (WHO)¹⁴. For those aged 20 years or older, cutoff points for adults were used¹⁵.

WC was measured at the midpoint between the last rib and iliac crest using a non-elastic metric tape. Abdominal obesity was evaluated using both WC and the waist-to-height ratio (WHtR= WC in cm/height in cm). For adolescents, we used the cutoff points for the classification of WC recommended by Taylor et al.¹⁶ For adults, the cutoff points proposed by the WHO were used¹⁷. For WHtR, we used the cutoff points proposed by Li et al.¹⁸

Body composition was evaluated using bioimpedance analysis. For such, the Maltron BF-906 device (Maltron, United Kingdom) was employed, with a 50-Hz frequency in alternating current and four electrodes. Readings were made with the students lying on a non-conductive surface in the supine position with the limbs bent at 45° and the volunteer free of any accessories or metallic objects. To ensure the accuracy of the readings, participants were instructed to follow the following procedures: four hours of absolute fasting; no rigorous physical exercise in the previous 12 hours; refrain from ingesting alcoholic beverages in the previous 48 hours; no use of medications that affect the hydroelectrolytic balance in the previous seven days; and urinate at least 30 minutes prior to the reading. The cutoff points for above average body weight and obesity were $\geq 24\%$ and $\geq 32\%$, respectively¹³.

The conceptual model considered demographic, socioeconomic and lifestyle variables as well as perceptions of weight in childhood and at menarche. Socioeconomic status was categorized using the Economic Classification Criteria of Brazil established by the Brazilian Association of Research Companies¹⁹. Age was stratified into two groups: adolescents (<20 years) and adults (20 years). The lifestyle variables were physical activity level, sedentary behavior, alcohol consumption and smoking.

The short version of the International Physical Activity Questionnaire (IPAQ) was used for the determination of physical activity level²⁰. Sedentary behavior was determined by the time spent on activities such as watching television and using a computer, considering two hours per day for each activity was considered excessive²¹. Alcohol consumption was dichotomized as "drinks" or "does not drink" based on intake frequency (number of times per week). Students who reported having smoked one or more days in the previous 30 days were classified as smokers²². To identify the occurrence of excess weight in childhood and at menarche, students were asked about their perceptions of their own weight and given four response options: underweight, normal, a little overweight and very overweight²³.

The statistical analysis was performed with the SPSS version 13.0. The chi-square test was used to determine associations between variables. Continuous variables were tested for the normality of distribution using the Kolmogorov-Smirnov test.

Variables with normal distribution were expressed as mean and standard deviation and those with non-Gaussian distribution were expressed as median and interquartile range. Means were compared using the Student's t-test for unpaired variables and medians were compared using the Mann-Whitney U test. For all analyses, the 5% significance level was adopted, with p-values between 0.06 to 0.10 considered indicative of borderline significance.

RESULTS

A total of 162 university students were evaluated, among whom 35.2% reported the occurrence of menarche prior to

12 years of age (EM). A total of 62.3% of the sample were adolescents and more than half were middle class. Regarding physical activity, 42.6% were classified as insufficiently active or sedentary; 63.9% spent more than two hours a day on the Internet and 18.8% reported spending more than two hours a day watching television (Table 1).

The anthropometric characteristics and body composition according to the occurrence of EM are displayed in table 2.

In the overall sample, the frequency of excess weight based on the BMI was 22.2% (14.8% prevalence of overweight + 7.4% prevalence of obesity). However, the frequency of the above average percentage of body

Table 1. Occurrence of early menarche and socioeconomic, demographic and lifestyle characteristics of young university women. Recife, Brazil 2015.

Characteristics	N	%	CI _{95%}
Early menarche			
• Yes (< 12 years)	57	35.2	28.0 – 43.1
• No (≥ 12 years)	105	64.8	56.9 – 72.0
• Total	162	100.0	
Age			
• Adolescent (< 20 years)	101	62.3	54.3 – 69.7
• Adult (≥ 20 years)	61	37.7	30.2 – 45.6
• Total	162	100.0	
Socioeconomic level			
• Upper class	47	29.0	22.3 – 36.7
• Middle class	89	54.9	46.9 – 62.7
• Lower class	26	16.1	10.9 – 22.8
• Total	162	100.0	
Physical activity			
• Very active	25	15.4	10.4 – 22.1
• Active	68	42.0	34.3 – 50.0
• Insufficiently active/sedentary	69	42.6	34.9 – 50.6
• Total	162	100.0	
Hours of TV/day			
• < 2 hours	108	81.2	73.3 – 87.2
• ≥ 2 hours	25	18.8	12.7 – 27.0
• Total	133	100.0	
Hours of Internet/day			
• < 2 hours	48	36.1	28.1 – 44.9
• ≥ 2 hours	85	63.9	55.1 – 72.9
• Total	133	100.0	
Consumption of alcoholic beverages			
• Yes	46	28.6	21.9 – 36.3
• No	115	71.4	63.7 – 78.1
• Total	161	100.0	
Smoking			
• Yes	02	1.3	0.2 – 5.0
• No	156	98.7	95.0 – 99.8
• Total	158	100.0	

% = percentage; CI_{95%} = 95% confidence interval.

fat and obesity measured using bioimpedance analysis was 32.1% and 14.8%, respectively. A total of 31.2% reported excess weight in childhood and 25.9% reported that excess weight continued at menarche. EM was significantly associated with height < 1st tertile (< 1.62 m) and tendencies (borderline p-values) were found between EM and both WC and WHtR in the risk range as well as perceptions of excess weight in childhood and at menarche.

No statistically significant differences were found between the students with and without EM regarding the

anthropometric variables and body composition, except WHtR, which had a tendency to be higher in the group with EM (Table 3). Analyzing the situation in terms of means and medians (Table 4), no statistically significant differences were found between the students with and without EM regarding the anthropometric variables and composition, except WHtR, which had a tendency to be higher in the group with EM.

In correlation analysis between age at menarche and the anthropometric variables, inverse correlations were found with BMI, lean mass and WHtR (Figure 1).

Table 2. Anthropometric characteristics and body composition of university women according to occurrence of early menarche. Recife, Brazil 2015.

Variables	Early Menarche								p*
	TOTAL		Yes			No			
	n	%	n	%	CI _{95%}	n	%	CI _{95%}	
BMI classification									0.418
• Underweight	14	8.6	03	21.4	5.7-51.2	11	78.6	48.8-94.3	
• Ideal weight	112	69.1	38	33.9	25.4-43.6	74	66.1	56.4-74.6	
• Overweight	24	14.8	10	41.7	22.8-63.1	14	58.3	36.9-77.2	
• Obesity	12	7.4	06	50.0	22.3-77.7	06	50.0	22.3-77.7	
• Total	162	100.0	57	-			-		
WC in risk range									0.077
Yes	35	22.0	17	48.6	31.7-65.7	18	51.4	34.3-68.3	
No	124	78.0	38	30.6	22.8-39.7	86	69.4	60.3-77.1	
Total	159	100.0	55	-		104	-		
% body fat **									0.767
• Normal	86	53.1	29	33.7	23.6-44.6	57	66.3	55.4-76.3	
• Above average	52	32.1	18	34.6	22.4-49.2	34	65.4	50.8-77.7	
• Obesity	24	14.8	10	41.7	22.8-63.1	14	14.8	36.9-77.2	
• Total	162	100.0	57	-		105	-		
WHtR in risk range									0.079
Yes	37	22.8	18	48.6	32.3-65.3	19	51.4	34.7-67.8	
No	125	77.2	39	31.2	23.4-40.2	86	68.8	59.8-76.6	
Total	162	100.0	57	-		105	-		
Height									0.016
< 1st tertile (< 1.62m)	69	42.6	32	46.4	34.4-58.7	37	53.6	41.3-65.6	
≥ 1st tertile (≥ 1.62m)	93	57.4	25	26.9	18.5-37.2	68	73.1	62.8-81.5	
Total	162	100.0	57	-		105	-		

BMI: body mass index; WC: waist circumference; WHtR: waist-to-height ratio; CI 95% = 95% confidence interval; % = percentage; *chi-square test with Yates correction; **linear trend chi-square test.

Table 3. Perception of weight and lifestyle of university women according to occurrence of early menarche. Recife, Brazil 2015.

Variables	Early Menarche								p*
	TOTAL		Yes		CI _{95%}	No		CI _{95%}	
	n	%	n	%		n	%		
Perception of weight at menarche **									0.088
Excess weight	42	25.9	17	40.5	26.0-56.6	25	59.5	43.3-74.0	
Ideal weight	59	36.4	25	42.4	29.8-55.9	34	57.6	44.1-70.1	
Underweight	61	37.6	15	24.6	14.8-37.6	46	75.4	62.4-85.1	
Total	162	100.0	57	-		105	-		
Perception of weight in childhood**									0.072
Excess weight	50	31.2	21	42.0	28.5-56.7	29	58.0	43.3-71.5	
Ideal weight	54	33.8	21	38.9	26.3-53.1	33	61.1	48.9-73.8	
Underweight	56	35.0	14	25.0	14.8-38.6	42	75.0	61.3-85.2	
Total	160	100.0	56	-		104	-		
Current perception of weight **									0.499
Excess weight	64	39.5	24	37.5	26.0-50.5	40	62.5	49.5-74.0	
Ideal weight	65	40.1	23	35.4	24.2-48.3	42	64.6	51.7-75.8	
Underweight	33	20.4	10	30.3	16.2-48.9	23	69.7	51.1-83.8	
Total	162	100.0	57	-		105	-		
History of dieting to lose weight									0.741
Yes	74	46.2	29	39.2	28.3-51.2	45	60.8	48.8-71.7	
No	86	53.8	28	32.6	23.1-43.6	58	67.4	56.4-77.0	

CI_{95%} = 95% confidence interval; % = percentage; *chi-square test with Yates correction; **linear trend chi-square test.

Table 4. Anthropometric variables and body composition according to occurrence of early menarche in university women. Recife, Brazil 2015.

Variables	Early Menarche		p
	Yes	No	
BMI (Kg/m ²)	*23.5 ± 4.1	*22.5 ± 3.9	0.123
WC (cm)	*76.1 ± 10.8	*74.0 ± 9.3	0.213
WHtR	*0.47 ± 0.06	*0.45 ± 0.06	0.096
Height (m)	*1.61 ± 0.05	*1.63 ± 0.06	0.116
Lean mass (kg)	*45.4 ± 6.8	*44.2 ± 5.3	0.246
Lean mass (%)	°75.5 (70.1-80.9)	°76.5 (70.9-81.2)	0.458
Fat mass (kg)	°13.5 (10.2-21.0)	°14.1 (9.6-18.4)	0.449
Fat (%)	*24.9 ± 7.4	*23.9 ± 7.4	0.449

BMI: body mass index; WC: waist circumference; WHtR: waist-to-height ratio. *Mean (standard deviation) and Student's t-test; °Median (p25-p75) and Mann-Whitney U test.

DISCUSSION

In recent years, age at menarche has been the focus of attention in the literature due to its possible association with health status in adulthood²⁴. In addition, with the influence of economic and social development of populations, there has been a trend toward earlier occurrence in recent decades^{25,26}. However, there is no standardization in the literature on what is considered early. The most widely accepted definition is that which considers EM as occurring before 12 years of age²⁴. In the present study, EM was considered as occurring prior to the median in the sample (12 years), which is in line with the most cited age in the literature. Despite methodological differences in the comparison of studies, the age that characterizes EM does not fluctuate much in the literature, with mean values ranging from 11.0 to 13.0 years^{24,27,28}.

The frequency of EM in the present study was 35.2%. In a study involving adolescents in the city of Porto Alegre (southern Brazil), Spinola et al.²⁷ found a much higher frequency of EM (73.3), but considered a cutoff point of < 13 years. According to Carvalho et al.²⁹, age at menarche seems to continue to diminish throughout the world, but apparently at a much slower pace in recent years when compared to that observed at the beginning of 20th century. However, if this trend continues, menarche will likely occur at nine or ten years of age in the near future, which is in childhood. This could cause a set of problems, such as a reduction in height gain and the occurrence of excess weight and body fat in adulthood, which are aspects investigated in the present study.

Although menarche is an intrinsic biological factor for each individual, the age at which it occurs may be related to environmental factors, eating habits and hormonal characteristics. Therefore, studies indicate the possibility that factors such as excess weight in childhood may contribute to early sexual maturity²⁷.

Analyzing the anthropometric characteristics according to the occurrence of EM, an association was found with height < 1st tertile. According to Vitale et al.³⁰, the post-menarche period is characterized by a diminishing in the increase in height and a characteristic increase in weight. Lago et al.³¹ also found that age at menarche is directly associated with final height in younger generations. The authors found that a later menarche was associated with a taller height, with gains in stature on the order of 0.4 to 0.9 cm for each additional year in the age at menarche. As the majority of girls have reached 95% of their final height at the time of their first menstrual cycle, a later menarche would tend to be associated with a greater final height³¹.

Due to hormonal issues, obesity is believed to exert an influence on maturity in girls, making them menstruate at an earlier age³². In a study involving adolescents, Castilho & Nucci⁸ found that among girls recruited at private schools, those with excess weight menstruated earlier (11.6 years) than those without excess weight (12.3 years). Results published by Mumby et al.³³ lend support to a causal relationship between

Figure 1: Pearson's correlations between age at menarche and body mass index (BMI), lean mass in kg and waist-to-height ratio (WHtR).

a high BMI in childhood and a younger age at menarche, suggesting that the greater prevalence of childhood obesity leads to premature sexual maturity.

In the present study, perceptions of excess weight in childhood and at menarche demonstrated a tendency toward an association with early sexual maturity. This association has biological plausibility, as body fat may be a precursor of the onset of puberty due to the synthesis of leptin by adipocytes, thereby accelerating the maturation of the tissue and reproductive function³⁴. Moreover, changes in adipose tissue and its distribution during adolescence are strongly influenced by sexual maturity, which, in turn, is marked by human biological variability that originates from the interaction between genetic and environmental factors³⁵. There is a growing body of evidence that sexual maturity constitutes a risk factor for a greater percentage of body fat. On the other hand, individuals with a greater percentage of body fat have a greater chance of early maturity³⁶.

Pinheiro et al.⁹ concluded that the prevalence of excess weight in adulthood was higher among women who reached menarche prior to 13 years of age. Mueller et al.³⁷ found an association between younger age at menarche and higher BMI at 20 years of age in a study involving more than 8000 women in Brazil. The literature also reports that early puberty onset is an important risk factor for obesity among women who had their first menstrual cycle prior to 12 years of age, with a 59% higher risk of obesity when compared to those who had their menarche after 12 years of age¹.

In the present sample, we found an association between EM and shorter height as well as a tendency toward an association with past of excess weight and both current WC and WHtR. In other words, our data imply that excess weight in childhood contributed to EM and was perpetuated in the form of abdominal obesity.

In a five-year longitudinal study with girls in the ideal weight range at the time of menarche, Araújo et al.³ found no statistically significant differences between girls with and without EM in terms of excess weight, abdominal obesity or abnormal serum lipid levels at the end of sexual maturity. Likewise, Must et al.²⁸ conducted a longitudinal study and found that nutritional status in childhood exerted a greater influence on the occurrence of excess weight in adulthood than EM.

The present data also showed weak, but significant inverse correlations between age at menarche and current BMI and WC. Ibanez et al.³⁸ found that, independent of BMI, measures that reflect abdominal obesity were significantly more frequent among women who had EM. Mueller et al.³⁹ also found that EM was associated with visceral and subcutaneous abdominal fat deposits in adulthood.

Few studies in the literature have discussed the association between lean mass and EM. In 2000, Castilho & Barros Filho⁴⁰ found that peak weight gain velocity and growth in stature differs considerably among girls who mature early, those who reach menarche at an average age and those who mature later, but menarche nearly always coincides

with or occurs a few months after the peak weight gain velocity. Moreover, the authors report that peak gain in muscle mass occurs at menarche in girls and begins to decelerate thereafter.

In the present study, a statistically significant inverse correlation was found between age at menarche and the amount of muscle mass in adulthood. One may therefore conclude that an earlier occurrence of sexual maturity leads to more physiologically mature women (greater lean mass) at the end of adolescence and the onset of adulthood.

The present study has limitations that should be considered. Age at menarche was not collected in real time and this variable may have been subject to recall bias. The perception of excess weight in childhood and at menarche was self-reported by the students and may therefore have been underestimated, especially when one considers that the sample was composed of young women. However, self-reported weight and height have been used in epidemiological studies due to the cost effectiveness and simplification of the fieldwork and have presented acceptable levels of validity, even among individuals with obesity, who may have a greater tendency to underestimate their weight¹⁵.

CONCLUSION

The findings of the present study reveal that excess weight at the onset of adulthood in young university women may be more associated with excess weight in childhood and at menarche than EM. This study also discusses a finding that is addressed little in the literature, which is the association between EM and muscle mass in early adulthood.

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