Relation of Age at Menarche to Physical Activity

Egreta Peja
Sports University of Tirana, Faculty of Recreation and Physical Activity, Tirana, Albania
Ela Tase
Sports University of Tirana, Institute for Sport Research, Tirana, Albania

A B S T R A C T

The aim of this study is to determine whether regular physical activity during early puberty is influential in preventing early menarche. This cross sectional study was carried out on 102 post-menarcheal girls aged 11–20 (14.79±0.33). 51 of them were already engaged in competitive sport activities prior to the onset of menstruation (group 1), while the others got engaged in such activities after the onset of menstruation (group 2). All participants provided the year and the month of their first menstrual period. First, we estimated the equality of dispersion between the two groups, by conducting Two Samples for Variances F-test. Second, because no homogeneity of variances between groups was found, they were compared by using Two Samples Assuming Unequal Variances t-test. The difference between groups is statistically significant, as the t statistics (=2.883) is greater than both critical t statistics (one-tail=1.664 two-tail=1.990) and the p value less than 0.05 in both cases (one-tail=0.002 two-tail=0.005). None of the girls in the first group starts to menstruate before 11 years of age and 90% of them are menstruating by age 14, with a median age of 12.95±0.35 years. Age of menarche is lower in the second group with a median age of 12.25±0.31 years, thus approximately 8 months lower than median age for the first group. 11.76% of the girls in the second group start to menstruate before 11 years of age and 90% of them are menstruating by age 13. It is rather, the decline in early matures among those engaged in regular physical activity prior to the onset of menses, that makes the statistically significant correlation between physical activity and age at menarche practically meaningful. Relatively early matures (<11 years) have been found to be slightly shorter but up to 5.5 kg heavier in adulthood than are late matures. In addition, a relatively young age at menarche has been associated with an increased risk for breast cancer and spontaneous abortion.

Key words: exercise, health, lifestyle, age at menarche

Introduction

Menarche is the first menstrual cycle in female humans. The age at menarche is clinically valuable, since it may have important health implications in later life. For example, relatively early matures (<11 years) have been found to be slightly shorter but up to 5.5 kg heavier in adulthood than are late matures (van Lenthe et al., 1996; Biro, 2001; Garn et al., 1986). In addition, a relatively young age at menarche has been associated with an increased risk for breast cancer (Petridou et al., 1996; Titus-Ernstoff, 1998) and spontaneous abortion (Liestol et al., 1980).

The age at menarche is reportedly 12.9 years in Europe, 12.5–12.9 in different regions of India and 13.3 years in Africa (Anderson et al., 2003; Bektas, 2008). It appears that the level of development of a society is inversely related to the age of first menstruation which is higher in underdeveloped regions. An example is illustrated by girls from the very poor Bundi region of New Guinea whose average age of first menstruation is 18.8 years, comparable to Europeans of one century ago (Bayat et al., 2012). However reports from different regions of Europe such as Germany (14 years), Czech Republic (14.6 years), Italy (12.2 years) and Greece (12 years) convinces us that the age at menarche cannot be accounted for solely by level of development (Thomas et al., 2001). As a matter of fact, researchers have reported genetic factor as the most influential factor on the time of first menses (Chumlea et al., 2003).

As for Albanian girls, updated studies on the average age at menarche are lacking. Due to remarkable lifestyle changes, during the last decade, there has been a marked increase in the number of Albanian girls of all ages undertaking physical activity at both competitive and recreational levels. This is a comparative study regarding menarche in Albanian girls engaged in competitive sport activities prior to the onset of menstruation versus those engaged in such activities after the onset of menstruation. The aim of this study is to determine whether regular physical activity during early puberty is influential in preventing early menarche.

Methods

Participants

This cross sectional study was carried out on 102 post-menarcheal girls aged 11–20 years. The mean age of the girls was 14.79±0.33 years. All the girls, who were recruited in this study, were active in team sports like volleyball and basketball or in speed and power sports like sprint and middle distance run. Girls were categorized in two groups. The first group consisted of 51 girls, who were active members of sport clubs prior to the onset of menstruation, while the second group was composed by 51 girls, who had become active members of their respective sport clubs after the onset of menstruation. The average duration of time girls of the first group had spent undertaking sport activities, prior to the onset of menstruation was 1.67±0.82 years.

All participants in this study were living in Tirana, had no medical problems in personal menstrual cycle histories and/or family menstrual cycle histories and conducted similar lifestyles regarding diet and exercise.

The study protocol was approved by the Sports University of Tirana and informed consent was obtained from all participants and their coaches. This study was conducted in Tirana during June 2014.

Data Collection

A questionnaire was designed and verified for validity and reliability by researchers. The questionnaire contained questions about the following issues: date of birth, city of residence, age of first menstruation as well as weight and height during first menstruation, personal menstruation cycle history, family menstruation cycle history and retrospective exercise histories regarding duration, frequency, type of sport activities engaged in.

Median time between menarche and study interview was 2.25 years. Anyway, correlations between recalled and recorded menarcheal ages have generally been high (r>0.75) over periods of up to 10 years (Koprowski et al., 2001), with 60% of girls being able to recall the month and year of menarche over short periods (Koo et al., 1997).

Cluster sampling was performed in sport clubs based on the number of girls of the desired range. All girls, that were eligible for enrollment in the study, provided the year and the month of their first menstrual period. Age at menarche was then calculated.

Statistical Analysis

As above mentioned, participants in the first group were active members of sport clubs prior to the onset of menstruation, while those in the second group had become active members of their respective sport clubs after the onset of menstruation. In order to statistically estimate any correlation between the age at menarche and regular physical activity a two step statistical analysis was conducted. First, we estimated the equality of dispersion between the two groups, by conducting Two Samples for Variances F-test (Table 1).

Table 1. F-Test Two Sample for Variances

	Group 1	Group 2
Mean	12,94944	12,25451
Variance	1,16252	1,314605
Observations	51	51
df	35	50
F	0,884311	
P(F<=f) one-tail	0,354873	
F Critical one-tail	0,587134	

It results that the hypothesis on the equality of dispersions between groups is not true because the F statistics (=0.884311) is greater than the F critical one-tail (=0.587134), thus the second group owns a greater variance. Second, because the above mentioned F-test showed no homogeneity of variances between groups, we compared mean menarcheal ages between these groups by using Two Samples Assuming Unequal Variances t-test (Table 2).

Table 2. t-test Two-Sample Assuming Unequal Variances

	Group 1	Group 2
Mean	12,94944	12,25451
Variance	1,16252	1,314605
Observations	51	51
Hypothesized Mean Difference	0	
df	78	
t Stat	2,883849	
P(T<=t) one-tail	0,002538	
t Critical one-tail	1,664625	
P(T<=t) two-tail	0,005075	
t Critical two-tail	1,990847	

It results that the difference between mean menarcheal age from the two groups is statistically significant, as the t statistics (=2.883849) is greater than both critical t statistics (one-tail=1.664625 and two-tail=1.990847). Another important index is the p value which in both cases (one-tail=0.002538 and two-tail =0.005075) is less than 0.05. In other words, girls in group 1 experience a later menarche than girls in group 2.

fore 11 years of age and 90% of them are menstruating by age 14, with a median age of 12.95±0.35 years. Age of menarche is lower in the second group with a median age of 12.25±0.31 years, thus approximately 8 months lower than median age for the first group. 11.76% of the girls in the second group start to menstruate before 11 years of age and 90% of them are menstruating by age 13 (Table 3).

Results

Figure 1 shows the cumulative distribution of menarche by age among girls of both groups. The points represent the proportion of postmenarcheal girls within age intervals of approximately 1 year.

None of the girls in the first group starts to menstruate be-

Discussion

On average, girls who are competitive in sport activities prior to the onset of menstruation undergo menarche approximately 8 months later than girls who become competitive in sport activities after the onset of menstruation. It is rather, the decline in early matures among those engaged in regular physi-

cal activity prior to the onset of menses, that makes the statistically significant correlation between physical activity and age at menarche practically meaningful. Relatively early matures (<11 years) have been found to be slightly shorter but up to 5.5 kg heavier in adulthood than are late matures (Van Lenthe et al., 1996; Biro, 2001; Garn et al., 1986). In addition, a relatively young age at menarche has been associated with an increased risk for breast cancer (Petridou et al., 1996; Titus-Ernstoff, 1998) and spontaneous abortion (Liestol et al., 1980).

Table 3. Descriptive Statistics of Age at Menarche for Both Groups

Age at Menarche (years)	Group 1		Group 2	
	Absolute frequency	Cumulative frequency	Absolute frequency	Cumulative frequency
8	0,00%	0,00%	1,96%	1.96%
9	0,00%	0,00%	1,96%	3,92%
10	0,00%	0,00%	7,84%	11,76%
11	22,22%	22,22%	23,53%	35,29%
12	27,78%	50,00%	37,25%	72,55%
13	27,78%	77,78%	23,53%	96,08%
14	19,44%	97,22%	3,92%	100,00%
15	2,78%	100,00%	0,00%	100,00%

The numerous physiological and psychological changes that occur in the years preceding menarche, make it difficult to determine which (if any) factor is causative (Forbes, 1992). However, the participants that we chose were living in the same city, were conducting similar lifestyles regarding diet and exercise and had no medical problems in personal menstrual cycle histories and/or family menstrual cycle histories. Having done so, various characteristics that have been suggested to influence pubertal development such as the secretion of hormones by the hypothalamus, anterior pituary and ovary (Apter, 1997), social stress (Wierson et al., 1993) and organic pollutants (Colon et al., 2000) were intended as alike among participants. In these terms, the most important limitation of the current study may be the lack of evidence regarding anthropometric characteristics, such as weight and height during menarche, as our interpretation of results is focused mainly on Frisch's theory. According to Frisch's theory, menstruation occurs when body fat increases from 16% to 23% (Speroff et al., 1999). The reduction in adiposity through participating in physical activity results in a suppression of reproductive function (Zimmet et al., 1996). It has been proposed that declining leptin levels (a hormone secreted from adipose tissue) may be an evolutionary mechanism that turns off reproduction function when adipose tissue is inadequate (Wade & Jones, 2004). With regard to physical activity, however, research indicates that activity per se has little influence upon leptin levels (Zimmet et al., 1996), thus the later menarche among athletes is mainly due to the reduction in adiposity.
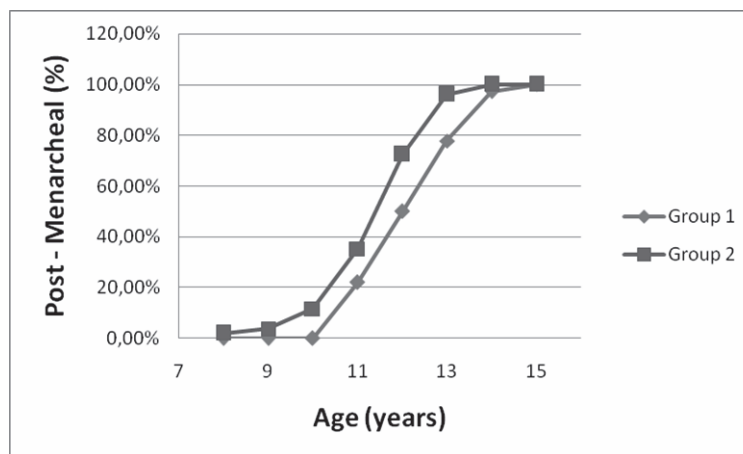

Figure 1. Cumulative distribution of menarche by age among girls of both groups

In conclusion, our pattern of age at menarche among girls who are competitive in sport activities, during early puberty, differs from the pattern of age at menarche among girls who started sport activities after the onset of menstruation. Regular physical activity during early puberty may decline the proportion of girls who undergo a relatively early menarche (<11 years) and as a consequence prevent undesirable health outcomes, associated with an early menstrual cycle, in later life.

REFERENCES

Anderson, S. E., Dallal, G. E., & Must, A. (2003). Relative weight and race influence average age at menarche: results from two nationally representative surveys of US girls studied 25 years apart. *Pediatrics, 111*(1), 844-50.

Apter, D. (1997). Development of the hypothalamic-pituitary-ovarian axis. *Ann N Y Acad Sci., 816*, 9–21

Bayat, P., Ghanbari, A., Khazaei, M., Ghorbani, R., & Amiri, S. (2012). Age at menarche and related factors in girls of urban areas of Markazi (Central) Province of Iran. *Int. J. Morphol., 30*(1), 15-18.

Bektas, Y. (2008). Age at menarche in Ankara, Turkey. *Anthropologiai Közlemények, 49*, 51-59.

Biro, F. M., McMahon, R. P., & Striegel-Moore, R., (2001). Impact of timing of pubertal maturation on growth in black and white female adolescents: The National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr., 138*, 636–643.

Chumlea, W. C.; Schubert, C. M.; Roche, A. F.; Kulin, H. E.; Lee, P.A.; Himes, J. H., & Sun, S. S. (2003). Age at menarche and racial comparisons in US girls. *Pediatrics, 111*(1), 110-3.

Colon, I., Caro, D., Bourdony, C. J., & Rosario, O. (200). Identification of phthalate esters in the serum of young Puerto Rican girls with premature breast development. *Environ Health Perspect., 108*, 895–900.

Garn, S. M., LaVelle, M., Rosenberg, K. R., & Hawthorne, V. M. (1986). Maturational timing as a factor in female fatness and obesity. *Am J Clin Nutr., 43,* 879–883.

Koprowski, C., Coates, R. J., & Bernstein, L. (2001). Ability of young women to recall past body size and age at menarche. *Obes Res, 9*, 478–485.

Koo, M. M., & Rohan, T. E. (1980). Accuracy of short-term recall of age at menarche. *Ann Hum Biol., 24,* 61–64.

Liestol, K. (1980). Menarcheal age and spontaneous abortion: a causal connection? *Am J Epidemiol., 111*, 753–758.

Petridou, E., Syrigou, E., Toupadaki, N., Zavitsanos, X., Willett, W., & Trichopoulos, D. (1996). Determinants of age at menarche as early life predictors of breast cancer risk. *Int J Cancer., 68*, 193–198.

Speroff, L.; Glass, R. H., & Kase, N. G. (1999). Clinical Gynecologic Endocrinology and Infertility. *6th Ed. Philadelphia,* Lippincott, Williams & Wilkins.

Thomas, F.; Renaud, F.; Benefice, E.; de Meeüs, T., & Guegan, J. F. (2001). International variability of ages at and menopause: Patterns and main determinants Menarche. *Hum. Biol., 73(2)*, 271-90.

Titus-Ernstoff, L., Longnecker, M. P., & Newcomb, P. A., (1998). Menstrual factors in relation to breast cancer risk. *Cancer Epidemiol Biomarkers Prev.*, 7, 783–789.

Van Lenthe, F. J., Kemper, C. G., & Van Mechelen, W. (1996). Rapid maturation in adolescence results in greater obesity in adulthood: the Amsterdam Growth and Health Study. *Am J Clin Nutr.*, 64. 18–24.

Wade, G. N., & Jones, J. E. (2004), ''Neuroendocrinology of nutritional infertility'', *American Journal of Physiology, Regulatory Integrative Comparative Physiology, 287,* 1277-1296.

Wierson, M., Long, P. J., & Forehand, R. L. (1993). Toward a new understanding of early menarche: the role of environmental stress in pubertal timing. *Adolescence., 28,* 913–924.

Zimmet, P., Hodge, A., Nicolson, M., Staten, M., De Courten, M., Moore, J., Morawiecki, A., Lubina, J., Collier, G., Alberti, G., & Dowse, G. (1996), ''Serum leptin concentration, obesity, and insulin resistance in Western Samoans: cross sectional study'', *British Medical Journal, 313*(7063), 965-969.

E. Peja

Sports University of Tirana, Faculty of Recreation and Physical Activity, Rruga "Muhamet Gjollesha" 1001, Tirana, Albania
e-mail: gretapeja@yahoo.com