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AGE AT MENARCHE IN GREEK COMPETITIVE SWIMMERS

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ABSTRACT. *Introduction*: We determined the age at menarche in Greek swimmers compared to a sample of age matched non athletic controls in 1986 and in 2006. *Methods*: The cross sectional sample in both studies included 12-15 year old Greek female swimmers and age matched non athletic controls. The first study, conducted in 1986, included 354 swimmers and 350 non athletic controls. The second study, conducted in 2006, included 459 swimmers and 350 non athletic controls. Data were collected from a self administered structured questionnaire was delivered to the study participants in 1986 and 2006. *Results*: Menarche age occurred earlier in swimmers (12.69±1.15 years in 1986; 11.31±0.93 years in 2006) than in controls, but this difference was not statistically significant. In 1986, BMI was statistically higher that in controls, but this was not the case in 2006, when swimmers reported higher BMI values (20.84) compared to the 1986 study (19.86). There was evidence of a statistically significant association between age at menarche and subject's height weight and body mass index. *Conclusion:* There is a tendency for earlier onset of menstruation in swimmers, but the age at menarche in swimmers is not significantly different from non athletic controls.

Keywords: menarche, swimmers, training.

Introduction

Menarche, the onset of menstruation is regulated by a variety of genetic and environmental factors especially nutritional factors or environmental exposure to chemicals that mimic estrogen (Malina, 1983; Speroff & Fritz, 2005). The determinants of the timing of menarche are many, and it is difficult to isolate a

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single factor which may delay or accelerate this event. Menarche, on average, occurs later in athletes. With few exceptions, the data are consistent across several countries. According to some authors, swimmers are also an exception to the tendency towards later menarche in athletes (Malina, 1983; Baxter-Jones & Maffulli, 2002). However, university-level swimmers in the United States in the mid 1980s and early 1990s had mean ages at menarche of 14.3 and 14.4 years (Malina, 1996).

Several studies in the literature document the late menarche in athletes compared to non athletic individuals (Malina, 1983; Brooks, Sanborn, Albrecht & Wagner, 1984; Krawczyk, Sklad & Majle, 1994). In addition, other surveys report sport specific differences in menarcheal age, with gymnasts reaching menarche later than swimmers or tennis players (Baxter-Jones & Maffulli, 2002; Sambanis et al., 2003). The type of sport exerted a significant influence on subject's age of menarche (Baxter-Jones & Maffulli, 2002). Late onset of menstruation also occurs more often in those starting sport specific training before reaching menarche (Stager, Robertshaw & Miescher, 1984; Skierska, 1998). However a limited number of studies support that no significant difference exists in the menarcheal age between girls that participated and those that did not participate in sporting activities (Papadimitriou et al., 2008).

The aim of this study was to determine the age at menarche in Greek swimmers compared to a sample of age matched controls with normal daily non athletic activity in two different time periods in 1986 and 2006.

Methods

The current study consists of two cross sectional analyses. The cross sectional sample in both studies included 12-15 years old Greek female swimmers and age matched non athletic control youngsters (n=350). The 1986 study included 354 swimmers and 350 controls, while the 2006 survey included 459 swimmers and 350 controls (Table 1).

Table 1. Anthropometric data presented for swimmers and controls.

	N	Age (years)	Height (cm)	Weight (kgr)	BMI
SWIMMERS 1986	354	13.14±1.45	165.12±8.25	63.21±5.62	19.86
CONTROLS 1986	350	13.45±1.13	159.10±10.35	66.10±5.90	20.51
CONTROLS 2006	350	12.60±0.89	160.60±9.57	64.8±6.30	21.35
SWIMMERS 2006	459	12.08±1.83	167.45±8.57	62.8±6.43	20.84

All participants in both studies were Caucasian from middle class families, from all over Greece. Middle class was defined according to the annual income. The procedures were approved by Aristotle's University ethics committee, and informed consent was obtained both by the participants and their parents, prior to participation in the study.

The questionnaires were self-derived and preliminarily validated in the Greek population (Karademas, Peppa & Fotiou, 2008) including questions regarding birth date, age at menarche, regularity of menses and duration of menstrual cycle. Regular menstrual cycles range from 26 to 32 days. In addition, inquiries on premenstrual and menstrual complaints were also added in the battery of questions.

Finally, questions regarding physical activity for controls and sporting history for swimmers (training volume, onset of swimming and onset of systematic training) were included. Training volume was defined as the total hours of training a week, while physical activity among controls was defined as the total hours of physical activity a week including physical education lessons and daily living walking. The questionnaires were completed by the participants with parental help.

Additionally, anthropometric characteristics (height and weight) measurements were recorded by the first author with the use of a metal tape and a digital scale. Body Mass Index (BMI) was also calculated for each participant. The BMI was calculated from an individual's weight divided by the square of the height multiplied (Marker, 1981).

All analyses were performed using SPSS software version 16.0 *(SPSS, Evanstron, llinois USA)* results are expressed as mean (SD). Comparisons between swimmers and controls were carried out using Student's T–test for continuous data. Differences were considered significant for p values equal to or less than 0.05. Pearson correlation analysis was used to analyze continuous variables.

Results

Anthropometric data and menstruation characteristics for study participants and control subjects in both trials are outlined on Table 1 and Figure 1 respectively.

The swimmers reported lower BMI values than controls in both studies (Table 1). Regarding the 1986 survey, the difference in BMI was statistically significant compared to that in controls ($p<0.05$). With regard to the 2006 survey, there was no statistically significant difference in BMI. The swimmers in the 2006 survey showed higher BMI values (mean=20.84) and were almost of the same height (mean=167.45±8.57 cm) with the ones in the 1986 study BMI values (mean=19.86) and were of the same height (mean=165.12±8.25 cm) respectively. The difference in BMI was statistically significant ($p<0.05$). Moreover, swimmers were significantly taller than controls in both surveys ($p<0.05$).

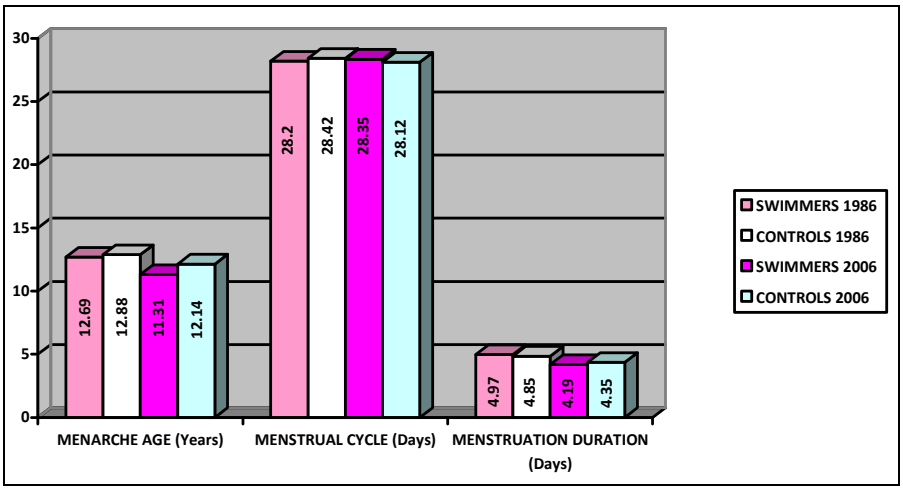

Figure 1. Menstruation characteristics reported for swimmers and controls

The athletes trained on average 12±1 hours per week in the 1986 study, and 14±1.5 hours per week in the 2006 survey. The controls reported being physically active 4.8±2.6 hours weekly.

Age at menarche occurred earlier in swimmers (mean=12.69±1.15 years in 1986 participants, and mean=11.31±0.93 years in 2006) than in controls, a difference which was statistically no significant. In both studies, all athletes started sport specific training before reaching menarche (mean=10.73±1.88 years, for 1986 swimmers and mean=6.83±1.50 years, for 2006 athletes). Menstrual cycles were normal in both swimmers and controls ($p>0.05$). Duration of menses did not differ significantly between athletes and controls ($p>0.05$).

There was evidence of a statistically significant association between age at menarche and subject's height ($r=0.388$, $p=0.001$). Weight and BMI were also associated with menarche age ($r=0.392$, $p=0.001$; $r=0.578$, $p=0.000$). Moreover, training hours and age of sport specific training were not associated with onset of menstruation ($r=0.122$, $p=0.307$; $r=-0.051$, $p=0.666$).

Discussion

We report on the age of menarche in Greek swimmers. The main purpose of the present study was to determine the age of menarche and to identify possible influencing factors. The mean menarche age decreased from 12.69 years and 12.88 years (1986 survey data for swimmers and control) to 11.31 years and 12.14 years respectively (2006 survey outcome for swimmers and control). This decreasing trend conforms to the well described decline in menarcheal age over the past several years (Speroff & Fritz, 2005).

Several studies document the late menarche in athletes compared to non athletic individuals (Marker, 1981; Malina, 1983; Brooks, Sanborn, Albrecht & Wagner, 1984; Stager, Robertshaw & Miescher, 1984; Stager & Halter, 1988; Malina, 1994; Krawczyk, Sklad & Majle, 1994; Baxter-Jones & Helms, 1996; Skierska, 1998; Fujii & Demura, 2005). Menarche, on average, occurs later in athletes (Malina, 1996). With few exceptions (Claessens et al., 2003), the data are consistent across several countries. According to some authors, swimmers are also an exception to the tendency towards later menarche in athletes. Menarche in swimmers tends to approximate the average for the general population (Malina, 1983; Baxter-Jones, Helms, Baines-Preece & Preece, 1994; Erlandson, Sherar, Mirwald, Maffulli & Baxter-Jones, 2008). On the contrary, other studies documented the later onset of menarche in swimmers starting training before age at menarche, than those starting training after menarche (Stager, Robertshaw & Miescher, 1984; Stager, Wigglesworth & Halter, 1990; Skierska, 1998). According to our results, onset of menarche in Greek swimmers, was earlier compared to the one reported in the literature, and approximated the average for the general Greek population In the study, 750 senior Greek high school girls were asked through a questionnaire to report their date of menarche, participation in physical activities and their weight at menarche in two different time periods (Papadimitriou et al., 2008). According to the authors, the mean age at menarche was 12.29±1.19 years in 2006 and 12.27±1.13 in 1996. In our 1986 cohort, onset of menstruation tended to approximate the average for non-sporting controls. In the 2006 survey, although menarche age occurred earlier in swimmers than in controls this difference was not statistically significant. Additionally, our menarche outcome is consistent with previous data of swimmers, starting training after menarche (Skierska, 1998), whereas all our swimmers, in both study cohorts, started training before menarche.

This data discordance suggests that sport training per se may not be a causative factor for later menarche in female athletes. Our outcome, that training hours were not associated with early onset of menstruation in both of our surveys, favors this hypothesis. Papadimitriou et al. concluded that there was no significant difference in menarche age between Greek girls who participated and those who did not participate in sport. However, training for sport is considered as the factor responsible for later mean age at menarche in female athletes (Malina, 1994; Baxter-Jones & Helms, 1996; Vadocz, Siegel & Malina, 2002). Petridou et al. (1996) stated that various measures of moderate physical activity were associated with a delay in age at menarche. The authors postulated that an alteration of energy balance in early life through increased physical activity could delay age at menarche (Petridou et al., 1996). However, most surveys do not take into consideration other confounding factors known to influence menarche (Baxter-Jones & Maffulli, 2002). In addition, data were mainly based on cross sectional studies or retrospective menarcheal data (Claessens et al., 2003). Inferences about possible effects of training have to be based on prospective longitudinal studies (Beunen & Malina, 1996; Malina, 2000).

The standing height of young female swimmers equals or exceeds the median for the control non athletic population. Female basketball players, volleyball players, tennis players, rowers, and swimmers have mean standing height above the 50th centile of the reference populations from 10 years onwards (Malina, 1994). An epidemiologic study in Greece to ascertain whether anthro-pometric variables are predictors of age at menarche concluded that increased height and body mass index accelerate the occurrence of menarche (Petridou et al., 1996). Kato, Tominaga & Suzuki, (1988) investigated the underlying factors of early menarche and analyzed the relationship between menarcheal age and environmental or physical factors. The authors conducted a population based survey in Aichi prefecture in Japan. Kato et al. concluded that residence in a metropolitan area, weight and daily intakes of bread, milk and green-yellow vegetables were positively associated with early menarche. In addition, women with early menarche were taller and had higher body mass index (Kato et al., 1988). An early age of menarche is positively associated with post-menarche BMI, and negatively associated with post-menarche height Girls with a younger age of menarche experience accelerated growth and tend to be taller and heavier when compared to later maturing girls of the same chronological age (Adair & Gordon-Larsen, 2001; Wang, 2002; Anderson, Dellal & Must, 2003; Freedman et al., 2003). Higher BMIs in childhood are associated with early ages of menarche. This is of particular concern for African-American girls, as they have higher BMIs at younger ages and experience menarche at earlier ages than Caucasian girls (Salsberry, Reagan & Pajer, 2009). According to Papadimitriou et al. (2008) there was a significant difference in the age at menarche according to the schoolgirls' perceived weight. Menarcheal age in obese girls occurred at age 11.73±1.21 years, in normal weight girls at 12.29±1.21 years, and in lean girls at 12.42±1.14 years. Our swimmers were significantly taller than controls in both in 1986 and 2006. Additionally, a significant correlation existed between age at menarche and subject's postmenarche height, postmenarche weight and postmenarche BMI. The fact that onset of menarche in Greek swimmers, was earlier compared to the one reported in the literature could be attributed to their increased height and BMI at that time, which was probably above the critical limit for menstruation to commence. In addition, the earlier age at menarche could be a recall bias (Koo & Rohan, 1997) or could reflect the selection of early matures into the sport (Claessens et al., 2003); in the case of swimming taller athletes are typically preferred.

This study has several limitations. Its cross-sectional design is vulnerable to information bias due to recall inaccuracies, since age at menarche was self-reported. However, great care was taken, and only those girls who could easily recall their exact age of menarche were included in the study. Moreover, recalled age at menarche is accurate enough for anthropological and epidemiologic purposes involving group comparisons (Damon, Damon, Reed & Valadian, 1969). In addition,

we did not collect information regarding maternal menarcheal age or dietary intake, and consequently we were not able to assess the impact of these factors on the onset of menstruation in the participants in the present study.

Conclusion

Despite the above limitations, a tendency for earlier onset of menstruation in swimmers could be documented. In addition, Greek swimmers were significantly taller than controls both in 1986 and in 2006, and a positive correlation existed between menarcheal age and subject's height. The relationship of other environmental factors, such as athletes' dietary intake, to onset of menstruation has to be investigated (Malina, 1994). In conclusion, there is a tendency for earlier onset of menstruation in Greek swimmers, but the age at menarche in swimmers is not significantly different from non-athletic controls (11.31 years and 12.14 years respectively).

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