CROATIAN MEDICAL JOURNAL

42(1):79-82,2001

STUDENT CMJ

Influence of High Intensity Training on Menstrual Cycle Disorders in Athletes

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Aim. To estimate the influence of intensive training on menstrual cycles in female athletes.

Method. The questionnaire was used to determine the time of menarche, and the prevalence of primary and secondary amenorrhea and dysmenorrhea in 72 active female athletes from Zagreb (10 volleyball players, 18 basketball players, 10 ballet dancers, and 34 runners) aged between 15 and 21. The control group comprised 96 girls of the same age not engaged in any sports activity.

Results. The prevalence of secondary amenorrhea was three times higher in athletes than in the control group ($p=0.037$). The prevalence of primary amenorrhea was substantially higher in athletes than in the control group (6/72 vs. 0/96, $p=0.014$), whereas the prevalence of dysmenorrhea was twofold lower in athletes than in the control group ($p<0.001$). The highest prevalence of secondary amenorrhea was recorded in runners (14/31), particularly long-distance runners (11/17), whereas there was only one case of secondary amenorrhea among basketball players. Menarche was significantly delayed in the athletes who started physical activities before the onset of menstruation (13.8±1.4 vs. 12.6±1.0 years, $p<0.001$).

Conclusion. High-intensity training before menarche postpones its onset. Type of training may be related to a significantly higher prevalence of secondary amenorrhea in runners than in basketball players.

Key words: adipose tissue; amenorrhea; body weight; dysmenorrhea; exercise; menarche; sports; women's health

The popularity of competitive sports and the number of women participating in sports and big competitions have lately seen a substantial increase (1). This is accompanied by constantly rising levels of competition and more demanding physical preparations. Unfortunately, occasional lack of professional coaches, as well as high ambitions of parents and athletes, often cause sport activities to depart from their essential purpose. Adverse consequences of highly intense training are reflected in the athletes' health. An increasingly high incidence of secondary amenorrhea and other menstrual cycle disorders has been recorded among female athletes (2). Whereas 90% of women athletes participating in the Tokyo Olympic Games in 1964 had a regular menstrual cycle, at the Olympic Games in Montreal only 12 years later 57% of women reported irregular cycles (3,4). High intensity training, specific type and amount of training, reduced body weight, lower percentage of fat tissue, and psychological stress have been put forward as potential factors responsible for menstrual irregularities in female athletes (5-7). The aim of this study was to: (a) evaluate the time of menarche occurrence, the prevalence of primary and secondary amenorrhea and dysmenorrhea in female athletes and in the control group; (b) establish possible differences in the values of these parameters between the group of athletes and control group; (c) establish possible differences in the prevalence of secondary amenorrhea between the groups of athletes and find out which group has the greatest risk for the appearance of secondary amenorrhea; (d) compare the training load (duration of training sessions per week) in different groups of athletes; and (e) find out whether intensive training before menarche affects the age at which menarche occurs.

Subjects and Methods

Subjects

The study involved female athletes from three Zagreb sports clubs registered as competitors with the Croatian Sports Association, as well as ballet dancers from the School of Classical Ballet in Zagreb. Although ballet is not a sports discipline, ballerinas were included in the study because of the nature of their training. The group of 72 athletes, 15 to 21 years of age, comprised 34 runners, 10 volleyball players, 18 basketball players, and 10 ballet dancers. The group of runners consisted of two subgroups: short distance and long distance runners. Short-distance runners were defined as those who run

races up to 400 meters long. Long-distance runners were defined as those who run races longer than 400 meters.

The control group comprised 96 high schoolgirls (3rd and 4th grade) from the School of Textile Design in Zagreb. None of them took part in any kind of out-of-school sports activities or physical recreation.

The study included a total of 168 subjects, aged 15 to 21. The average age of athletes was 17.9±2.1 years, and that of the control group 17.0±1.1 years (Table 1).

Data Acquisition

Two-part questionnaire was used for data collection. Questions in the first part asked for personal data and data on the characteristics of the menstrual cycle: age, age at menarche, duration of menstrual cycle, duration of menstrual bleeding, non-appearance of menstruation, and painful menstruation. Questions in the second part of the questionnaire were intended for athletes only and referred to their sports activities: age at which the girl started training, type of sport, sports discipline, and training load per day and week. None of the girls in the study used oral contraceptives. The questionnaire was anonymous.

Outcome Measures

Primary amenorrhea was defined as non-appearance of menarche up to 16 years of age, and secondary amenorrhea as the absence of menstruation for more than 3 months in the post-menarche period (8).

Statistics

MedCalc for MS WINDOWS was used for statistical data processing on PC. Chi-square test was used for the analysis of the difference in the prevalence of primary and secondary amenorrhea and dysmenorrhea between the study groups. Wilcoxon test was used for the analysis of the difference in the age, age at menarche, and duration of secondary amenorrhea between the athletes and controls. Comparison of proportions test was used for the analysis of difference in the prevalence of secondary amenorrhea between the group of runners and the group of basketball players. The alpha level was set at 0.05.

Results

In athletes who started training at least one year before menarche (n=34) the average age at menarche was 13.8±1.4 years (median=13.5 years, interquartile range: 13.0-15.1). In athletes who started training after menarche (n=33), irrespective of their age, the average age at menarche was 12.6±1.0 years (median=12.5, interquartile range: 12.0-13.2, Wilcoxon test, z=-3.53, p<0.001).

Out of the 72 athletes, 6 had primary amenorrhea. Five of them did not start menstruating by the time of the survey. In contrast, not a single case of primary amenorrhea was recorded in the control group (chi-square=6.053, df=1, p=0.014; Table 2).

Secondary amenorrhea was found in 20 out of 67 athletes who passed menarche and in one eighth (12/96) of the girls in the control group (Chi-square test=8.833, df=2, p=0.037). The median duration of secondary amenorrhea was 6 months in athletes (interquartile range: 4.5-10.0) and 4 months in the control group (interquartile range: 3.5-4.5; Wilcoxon test, p<0.05). The highest prevalence of secondary amenorrhea was found in runners (in 14 out of 31). Only 1 out of 18 basketball players had secondary amenorrhea (comparison of proportions test, chi-square test=6.650, df=1, p=0.010; Table 2). The average training load of athletes with secondary amenorrhea was not significantly different from that of athletes without secondary amenorrhea.

Secondary amenorrhea was recorded in 11 out of 17 long-distance runners, in contrast to short-distance runners in whom 3 out of 14 had secondary amenorrhea (chi-square test=8.240, df=2, p=0.039; Table 3).

Table 1. Present age (Age I), age at the beginning of sports career (Age II) (years, mean±SD), and the training load (h/week) of the study subjects

Groups	n	Age I	Age II	Training load
Control	96	17.0±1.1		
All athletes	72	17.9±2.1		
Volleyball players	10	17.4±1.4	10.7±1.1	19±3
Basketball players	18	18.8±1.1	12.6±1.3	18±0
Ballet dancers	10	17.4±0.9	6.0±0.5	18±4
Runners	34	17.9±2.5	12.6±2.0	18±4

Painful menstruation was reported by 18 out of 67 athletes and 55 out of 96 control group girls (chi-square test=14.770, df=1, p<0.001).

Discussion

This study showed that athletes who started training before menarche had delayed onset of menstruation for almost a whole year, as opposed to the athletes who already had menstrual periods when they started training. This finding indicates that intensive sport training before menarche delays menarche. The possible reasons for delayed menarche in athletes could be the small amount of fat tissue, as well as physical and mental stress to which athletes are exposed (9-15).

This study also confirmed the findings of other studies (16-19) that the prevalence of secondary amenorrhea

Table 2. Age at menarche (years, mean±SD), prevalence of primary amenorrhea (No/total), and prevalence (No./total) and duration (months) of secondary amenorrhea in the study groups

Groups	Age at menarche	No. of girls with amenorrhea/total		Duration (median)[a]
		primary	secondary	
Control	13.0±1.2	0/96	12/96	4
All athletes	13.2±1.4	6/72[b]	20/67[c]	6[d]
Volleyball players	13.3±1.5	0/10	3/10	
Basketball players	12.7±1.1	0/18	1/18	
Ballet dancers	13.8±1.6	2/10	2/8	
Runners	13.3±1.4	4/34	14/31[e]	

[a]Duration of secondary amenorrhea in the study groups.
[b]Chi-square test, p=0.014.
[c]Chi-square test, p=0.037.
[d]Wilcoxon test, p<0.05.
[e]Comparison of proportions test, p=0.010.

Table 3. Menstrual pattern and training schedule of short-distance (n=14) and long-distance (n=20) runners

Parameter (mean±SD)	Short-distance runners	Long-distance runners
Age at menarche (years)	13.1 0.8	13.5 1.7
Prevalence of primary amenorrhea	0/14	4/20
Prevalence of secondary amenorrhea	3/14	11/17[a]
Training load (h/week)	19 3	18 4

[a]Chi-square test, p=0.039.

was substantially higher among athletes than in other girls. We found the highest prevalence of secondary amenorrhea in runners and the lowest in basketball players, of whom only one had secondary amenorrhea. These two groups of athletes started intensive training at approximately same age, having roughly the same training schedule per week. The difference could be explained the fact that these two sports require different skills, which also specifies the concept and goals of training.

We also found that secondary amenorrhea was more common in the long-distance runners than in the short-distance runners, although there was no significant differences in the training load between these two subgroups. Training of short-distance runners involves intensive, quick, anaerobic exercises (laps) of short duration with many repetitions and long intervals between them (20). Muscle stretching and exercises with weights are another important component of their training. Training of long-distance runners is characterized by longer, continuous, aerobic exercises of somewhat lower intensity (20). Short-distance runners are more muscular and heavier, whereas long-distance runners have a slighter muscular structure and lower body weight. The differences in constitution, body weight, and training pattern may explain the difference in prevalence of secondary amenorrhea in long-distance and short-distance runners (20).

Painful menstruation was also one of the studied parameters in this research. Most girls in the control group reported having problems with painful menstruation. This was in contrast to athletes, of whom less than one third suffered from the same condition. Although evaluation of painful menstruation is subjective and of little clinical importance, the results point to the advantages of regular physical exercise as one of the possible ways of eliminating this unpleasant phenomenon that affects most girls (21).

Possible limitations to this study could be the lack of data on body dimension and composition of the surveyed female athletes.

The results obtained in this study should prompt female athletes, their coaches, and parents to learn about the changes that might accompany intensive sports training. Long-lasting secondary amenorrhea increases the risk of stress fracture formation at a younger age and osteoporosis in adult years (22,23). Amenorrhea, low body weight, and osteoporosis, the so-called ”female athlete triad”, are the focus of research of many authors (24-26). Prevention, early recognition, and treatment of secondary amenorrhea should reduce the risk (27).

The higher prevalence of secondary amenorrhea in runners than in other athletes, especially basketball players, makes the runners the group of greater risk for the appearance of secondary amenorrhea.

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Received: October 18, 2000
Accepted: December 11, 2000

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42(1):82,2001

POETRY

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The Dead End

It is hard to walk through a dense fog
With not any hall-mark of a road
It is hard to bear a still-bigger load
On the wounded shoulders is a heavy log.

Nowhere is a sign of light
There is no trace to show the way
There is no place to stay
Clammy is the dark of night.

Through a hazy castle of sand
Blind hangings obstacle is not lower
The last game is almost over
A trembling candle flame showing the end.