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Research Article

THE EFFECTS OF PROFESSIONAL SPORTS ON MENSTRUAL IRREGULARITIES IN ELITE SWIMMERS

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ABSTRACT
Severe physical activities of professional female athletes can cause serious health problems. Researchers believe that physical exercise is an integral cause of irregularities in menstrual cycle. The present study attempted to investigate the effects of professional athleticism on menstrual irregularities of elite swimmers. Statistical population of the present study included 220 elite swimmers of East Azerbaijan province of Iran in the year 2014. 80 subjects were selected as convenient samples and filled out the questionnaire of physical characteristics and types of menstrual disorders along with the Sharkey physical activity index questionnaire. The data collected through these questionnaires were analyzed by SPSS 21 computer application. In order to evaluate naturalness of data distribution, the Kolmogorov–Smirnov test was conducted and the relationship between severity, length and amount of exercises with the age at which swimming activity began and the menstrual disorder, the Spearman Correlation coefficient was applied in the significance level of $P<0.05$. Findings revealed that there is a significant positive relationship between the age of beginning the activity and the beginning of menstrual period and amount of activity and menstrual disorders ($P<0.05$). However, the study failed to find a significant relationship between length of activity and menstrual disorders ($P>0.05$). In conclusion, it seems that sports exercises increase Prolactin dramatically and retards ovarian maturation by follicle stimulating hormone all of which result in late beginning of menstrual period.

Keywords: *Disruption; Menstrual Disorder; Exercise; Female Swimmers; Elite*

INTRODUCTION
Severe physical activities of professional female athletes can cause serious health problems (Tak *et al.*, 2010). It is estimated that 16% of female athletes suffer menstrual disorders of pituitary axis (Rahim *et al.*, 2014). Menstrual disorders are caused by changes in hormonal environment (Zarneshan *et al.*, 2010; Sharabiani and Tartibian, 2010). The change in hormone levels induced by physical activities is proven to be an essential reason for irregularities in menstrual cycle (Aminian-Far *et al.*, 2012). Constant mental and physical pressures stimulate the central incentive system of hypothalamus to release CRH Arginine and Vasopressin i.e. a neurotransmitter and urine reducing hormone and finally release cortisol (Mudd *et al.*, 2007). Researchers believe that constant pressures induced by exercising increases the level of cortisol in female athletes and this reduces and even disrupts gonadotropin release from hypothalamus. Lack of enough gonadotropin hinders Lutein (LH) and Follicle stimulating hormones and this causes insufficient estradiol and progesterone release (Rahim *et al.*, 2014). Therefore, stressful situations like intense sports exercises trouble the female reproductive system through pituitary axis. Studies have shown that catechol amines disrupt the reproductive system. Significant periodical increases in the amount of Norepinephrine released after intense exercising, hinder the pulsatile secretion of LH and later on disrupt the reproductive system (Fazel, 2011). A combination of physical, nutritional, hormonal, psychological and environmental parameters along with genetic factors affect irregularities in menstrual period (William *et al.*, 2006). Researchers believe that losing weight and body fat may induce irregularities in menstrual period of female athletes (Stockie *et al.*, 2005). In fact, a 22% level of fat is essential for proper functioning of pituitary axis and as a result regular menstrual cycle. Female athletes with lower than 22% fat will have problems with their ovarian estrogen and the menstrual cycle (Schatscherbynal *et al.*, 2012; Lagowska and Jeszka, 2011). Lower percentages of fat and intense physical training affect hypothalamus in female athletes and disrupt female sex hormone release and as a result, the pattern for the menstrual

cycle changes (Zarneshan *et al.,* 2010). Schatscherbynal (2012) reported that intense sports exercises with low levels of fat disrupts the pituitary axis function resulting in disrupted female hormone release and brings up menstrual cycle problems like Oligomenorrhea and Amenorrhea (Schatscherbynal *et al.,* 2012). On the other hand, several studies have found positive relationships between irregularities of menstrual period like Oligomenorrhea and Amenorrhea and the age of beginning menstrual period in elite sportspeople (Dadgostar *et al.,* 2009). Prevalence of Oligomenorrhea and Amenorrhea among sport champions is 6-79% higher than common people (Warren, 2001; Dusek, 2001). This disorder is more common among athletes of endurance sports and weight sports like martial arts and gymnastics (Barker *et al.,* 2007; Dadgostar *et al.,* 2009). Nikolas *et al.,* (2006) declared the prevalence of Oligomenorrhea and Amenorrhea among university sports champions to be 31% (Nikolas *et al.,* 2011). The reason for prevalence of Oligomenorrhea and Amenorrhea is weight loss, sudden sports exercises and mental and psychological stresses (Genazzani *et al.,* 2001). Moreover, intensity, length, frequency of exercise and receiving less energy with various types affect menstrual disorders in female athletes (Castelo-Branco *et al.,* 2006). The probability of Amenorrhea is higher in endurance sports like long haul runing and sports that need a low percentage of fat like gymnastics, skating and ballet (Ebrahimian and Kazemi, 2002). According to various studies conducted, athletes in sports like martial arts, swimming, weight lifting, field sports like football, basketball and handball, tennis and javelin throw, suffer irregularity of menstrual cycle as well (Sigridur *et al.,* 2011). Besides, the high level of competition in international and global levels cause stress and this stress is among the most important reasons of disruption in pituitary and adrenals axis and pituitary and ovary axis and cause Oligomenorrhea and Amenorrhea (Brundu *et al.,* 2006). Thus, considering the point that intense physical activities of professional and elite female athletes can cause damages to their health, observing principles and notifying them about these consequences is of an indispensible importance and may mitigate the damage. Since not enough research has been conducted in the field of menstrual irregularities in swimmers, and because of the increasing interest in swimming among female athletes and their use of various medicine to alleviate the problems caused, the present study was conducted in order to investigate the effects of exercising on disruption and irregularity of menstrual period in elite female swimmers.

MATERIALS AND METHODS

The present survey type and field study was conducted in 2014. The statistical population of the study included 220 elite swimmers of East Azerbaijan province of Iran. From among all of them, 80 swimmers with at least 2 years of continuous swimming experience were selected through convenience sampling. The subjects included 26 teenagers (age: 15±3 years, weight: 57.154± 8.422 kg, height: 168.3± 4.147 cm, BMI: 20.127± 2.515), 18 young people (age: 20± 2 years, weight: 55.056± 4.731 kg, height: 162.72± 3.392 cm, BMI: 20.616± 1.907) and 36 middle aged individuals (age: 25± 3 years, weight: 61.28±10.199 kg, height: 165.83± 4.925 cm, BMI: 22.203± 2.942). The subjects had average physical activity with intensity of 3.68± 0.312 m/s, time of 58.6± 16.81 months and volume of 6.08± 1.74 hours.

The criterion for entering the study was having at least two years of experience and the criterion for removal was going on diet, weight loss trainings, using hormonal drugs, depression, and mental stress and having uterine mass.

In the present study, considering the purposes of the study, three questionnaires were used. The first one was the questionnaire of physical and health characteristics. The next one was the menstrual features questionnaire and the third one was the Sharkey body activity index questionnaire. These questionnaires were filled out by subjects and then were collected. The first questionnaire asked about personal information including weight, height, age, the age of beginning of menstrual period, and the age of entering games along with information on the history of health problems like depression, thyroid problems, uterine mass and using diet to lose weight or hormone therapy. In order to investigate menstrual period, the lengths shorter than twenty days and more than thirty-five days, volume of bleeding in more than seven days, irregular bleeding in menstrual cycles like blood spotting, amount of bleeding, spot bleeding and bleeding in low amounts along with the length and frequency of bleeding, the menstrual

features questionnaire was filled out and collected. This questionnaire had three options of have not had, sometimes and always to test different kinds of menstrual disorders. The "have not had" option received 1, "sometimes" received 2 and "always" received 3 scores. Zarneshan *et al.,* (2013) determined the reliability of the questionnaire through Cronbach's alpha to be 0.81. The Sharkey Body Activity Index questionnaire was also used to determine physical activity indices like intensity, length and volume. This questionnaire determined the intensity of physical activity with light, average, above-average and high scales, the length of activity with 24 to 30 months, 31 to 37 months, 38 to 47 months, 48 to 57 months, and more than 57 months scales and finally the volume of activity with scales of 1 to 2 hours, 2 to 3 hours, 3 to 4 hours, 4 to 5 hours, and more than 5 hours in a week. The scale started from 1 to the lowest to 5 as the highest (Takfallah *et al.,* 2010). Sharabiani and Tartibian calculated Cronbach's alpha coefficient of the questionnaire to be 0.82.

The data collected were then analyzed through inferential and descriptive statistics using SPSS 21 computer application. First, the normality of data was tested and verified via Kolmogorov–Smirnov test. Then, Spearman correlation coefficient with significance level of $P<0.05$ was used to find the relationship between intensity, length and volume of activities and the age of beginning swimming and menstrual disorders.

Table 1: Mean and standard deviation of features related to weight, height, the age of beginning swimming and the age of beginning menstrual period

Groups	Number	Height (cm)		Weight (kg)		Age of menstrual period		Age of swimming (years)		BMI	
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Teenager	26	168.35	4.147	57.154	8.422	13.85	1.384	8.92	3.019	20.127	2.515
Young	28	162.72	3.392	55.56	4.731	14.08	1.309	8.06	3.438	20.616	1.907
Middle-aged	36	165.83	4.925	61.28	10.199	12.46	1.795	11.08	7.189	22.203	2.942

67.43% of swimmers suffered menstrual disorders 29.23 % of which were middle-aged, 14.98% were young and 21.04% were teenagers. The most prevalent forms of disorders were Menorrhagia (31.6%), metrorrhagia (10.03%), Hypermenorrhea (4.78%), Oligomenorrhea (7.19%), Polymenorrhea (7.25%) and the most infrequent one was Hypo menorrhea (3.58%) (Table 2).

Table 2: The percentage of prevalence of different forms of menstrual period in the teenager, young and middle-aged

Age-based disorder	Menorrhagia	Metrorrhagia	Hypermenorrhea	Hypomenorrhea	Oligomenorrhea	Polymenorrhea
Teenager	10.27%	3.21%	1.55%	1.16%	2.56%	2.35%
Young	6.11%	3.12%	1%	0.5%	1.34%	2.82%
Middle-aged	15.22%	3.53%	2.22%	1.91%	3.29%	3.06%

According to the findings of this study, there is a significant relationship between exercise intensity, age of beginning exercise, and volume of activities with menstrual disorders (P<0.05) (Table 3) so as the increase in activity age, volume of activities and exercise intensity, menstrual disorders increase.

Table 3: Test of finding the relationship between sports activity and menstrual disorders in elite female athletes of East Azerbaijan

	Exercise intensity	**Length of exercise**	**Volume of activity**	**Age of beginning exercise**
correlation coefficient of menstrual disorders	0.842	0.954	0.039	0.870
Level of significance	0.007	0.003	0.733	0.006
Number	80	80	80	80

The level of significance in Spearman correlation test of the relationship between exercise intensity and menstrual disorders was 0.007, the relationship between volume of sport activity and menstrual disorder was 0.003 and the relationship between age of beginning sport activities and menstrual disorders was calculated to be 0.006 (table 3). These levels are clearly less than the level of significance of the study (P<0.05). Therefore, there is a significant relationship between exercise intensity, volume and age of activities and level of menstrual disorders in elite swimmers of East Azerbaijan province. Considering the calculated amount for the Spearman correlation coefficient to be 0.842, it could be concluded that the relationship between these four parameters is positive and somehow strong. Furthermore, it could be concluded that the relationship between the parameter of length of activity and menstrual disorder is 0.733. Thus, there is no significant relationship between length of exercising and level of menstrual disorders in elite swimmers.

RESULTS AND DISCUSSION

Discussion

Considering findings from this study, there is a significant rlationship between menstrual disorders and intensity of exercises in elite swimmers. These finding concord with the findings from studies on luteal phase disorders of female athletes by Lee *et al.,* (2004); Branco *et al.,* (2006); Zoodfekr *et al.,* (2012) and Rahim Zadeh *et al.,* (2003). They believe that intense sports decreases the serum progesterone level, causes failure in luteal phase and in conclusion menstrual disorders and infertility (Lee *et al.,* 2004; Branco *et al.,* 2006; Zoodfekr *et al.,* 2012; Rahim *et al.,* 2003). Moreover, other studies have shown that women ought to avoid sports competitions in the day's from20 to 24 of their menstrual cycle in which the level of estrogen is in its highest and avoid physical activities on the days 3 to 9 of their menstrual cycles for there is a great risk of severe muscular damages (Aminian *et al.,* 2012). Doing intense long-haul exercises in women ends in menstrual disorders, nutritional problems and osteoporosis. They also experience more menstrual irregularities (Beckvid *et al.,* 2000). However, this finding does not agree with the results from studies conducted by Noorbakhsh *et al.,* (2012). The reason for this disagreement in the result could be the level of skills in athletes (Noorbakhsh *et al.,* 2012). Extremely high level of important games and the stress induced by them is one of the reasons for disruption in pituitary-ovary and pituitary-adrenal axes and finally disorders in menstrual cycle (Brundu *et al.,* 2006). Besides, long-haul sports activities decrease insulin and increase insulin sensitivity and this reduces androgen synthesis in adrenal and serum plasma. This eventually helps protect ovarian follicles (Harrison *et al.,* 2011).

Findings from this study also failed to reveal a significant relationship between menstrual disorders and length of physical activities and this concord with findings from the study conducted by Zarneshan *et al.,* (2013) on the effects of frequency and length of physical activities with menstrual disorders. They believe that there is no significant relationship between frequency and length of physical activities with menstrual disorders (Zarneshan *et al.,* 2013). Other researchers like Takfallah *et al.,* (2010), Gudmundsdottir *et al.,* (2011), and Sharabiani and Tartibian (2010) however, does not accept finding from this study. The reason

for this is that they think there is a statistical relationship between length of sport activities and menstrual disorders (Tak *et al.,* 2010; Gudmundsdottir *et al.,* 2011; Sharabiani and Tartibian, 2010). Furthermore, two months of aerobic physical activity reduces physical and emotional effects of premenstrual syndrome (Mosalla *et al.,* 2007). The reason for this must be the low intensity of aerobic exercises and as a result lower effect on neural system and decrease in stress hormones affecting menstrual disorders. Besides, aerobic exercises affect some physical and hormonal factors and improve metabolic condition of the body. This may improve infertility and metabolic disorders coming along with Polycystic Ovarian Syndrome (Attarzadeh *et al.,* 2012).

Results from this study demonstrated that there is also a significant relationship between menstrual disorders and increased volume of activities which concord with findings of Zarneshan *et al.,* (2013); Schtscherbynal *et al.,* (2012); Gudmundsdottir *et al.,* (2011); and Miller *et al.,* (2012). They believe that prevalence of menstrual disorders in sports with high volumes is more than sports with low volumes (Zarneshan *et al.,* 2013; Schtscherbynal *et al.,* 2012; Gudmundsdottir *et al.,* 2011; Miller *et al.,* 2012). This study also proved the disorders induced by high intensity of sports activities (Table 2). Moreover, higher intensities of exercises caused irregular uterine bleeding including Menorrhagia, metrorrhagia and Polymenorrhea. This does not concords with findings of Noorbakhsh *et al.,* (2012) who found a positive effect from sport activities on bleeding amount and length in female academicians. It seems as if the reason for this conflict in results comes from the volume of exercises on menstrual disorders and the use of low intensity exercises with lower volumes for two months for in this study, the subjects had at least two years of experince in sports and had an average of 6.08± 1.74 hours of weekly physical activities (Noorbakhsh *et al.,* 20012). The pressure form trainings affect uterine bleeding. Intense exercises disrupt the hormonal balance of estrogen and progesterone and cause abnormal bleedings (Nikolas *et al.,* 2011). Therefore, constant pressure from intense exercises increases cortisol level in female athletes (Eshe *et al.,* 2011). The increase in cortisol level hinders Gonadotropin release from hypothalamus and the insufficient Gonadotropin hinders releasing Lutein and Follicle stimulating hormones. The decrease in follicle stimulating hormone and lutein reduces the release of estradiol and progesterone eventually (Amy *et al.,* 2009). Since levels of cortisol is affected by the intensity and length of exercises (Naseh *et al.,* 2008), decreasing the volume of exercises (number of exercising hours) will reduce intensity of the exercises. This is because cortisol level increases in exercises that take longer than 40 to 62 minutes (Amy *et al.,* 2009). Findings from this study also demonstrated that there is a significant relationship between age of beginning swimming and age of beginning menstrual period. This concords with results of the studies conducted by Dadgosttar *et al.,* (2009); Constantine *et al.,* (1995); and Warren *et al.,* (2001). They revealed that beginning age of menstrual period among swimmers (13.8±0.2 years) was significantly more than the control group (13±0.1 years). Moreover, Brundu *et al.,* (2006) showed that beginning intense exercises in younger ages retards beginning of menstrual period and prevalence of Oligomenorrhea and Amenorrhea is much higher in female athletes compared to non-athletes (Brundu *et al.,* 2006). Dusek (2001) demonstrated that female athletes beginning sports in early ages experienced menstrual cycle in older ages (Dusek, 2001; Mosallanejad *et al.,* 2007). These finding concords fully with the findings from the present study. However, studies have shown that playing sports does not affect the age of menopause and the age of beginning menstrual period and volume of sports activities have nothing to do with menopause. Yet, in individuals having regular menstrual cycles, playing sports delays menopause (Ebrahimian and Kazemi, 2002). It seems as if sports activities increase prolactin as a pituitary hormone. In case of adult female athletes, this hormone affects ovary in its adulthood (Attarzadeh *et al.,* 2012). The delay of ovary maturity is induced by another hormone named follicle-stimulating hormone. These two acts increase the age of beginning menstrual period in professional swimmers (Aminianfar *et al.,* 2012).

Conclusion

The results from this study demonstrated that highly intense physical activities in elite swimmers without taking breaks and continuously induces menstrual disorders. In this case, there is a significant relationship between intensity and volume of sport activities and menstrual disorders. Besides, beginning exercises

with high intensity and volume delays beginning of menstrual period. Therefore, in order to reduce the negative side effects of menstrual disorders, offering solutions by health practitioners seems to be inevitable.

Suggestions

Menstrual disorders of professional swimmers must not be a reason for not doing regular exercises. Compiling a training plan with low intensity and or high intensity exercises with breaks in between along with solutions for reducing the effects of disorder by healthcare practitioners seems to be of utmost importance.

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