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THE EVALUATION OF EATING BEHAVIOUR AND NUTRITIONAL STATUS OF BALLET DANCERS WITH MENSTRUAL DISORDERS

Karolina Łagowska[A-G], Jan Jeszka[A]

Department of Human Nutrition and Hygiene, Sub-departments of Dietetics, University of Life Sciences, Poznań, Poland

Abstract

Introduction: It is known that ballet dancers are particularly at risk from eating disorders and consequents like menstrual disorders.

Objective: The aim of this study was to evaluate eating behavior and nutritional status in ballet dancers with menstrual disorders.

Methods: Twenty-three female ballet dancers with menstrual disorders (6 with *amenorrhea*, 17 with *oligomenorrhea*) of mean age 17.4±0.9 years from a Poznan ballet school, participated in the study. Nutritional status was evaluated by analyzing body composition using the BIA method (percentage of adipose tissue (FM%, kg), fat-free mass (FFM%, kg), and total body water (TBW %, l). Serum levels of leptin were also measured. Nutritional values were estimated by examining dietary records for seven consecutive days. Moreover, to describe eating behavior the Three-Factor Eating Questionnaire (TFEQ) was employed.

Results: The ballet dancers were characterized by low fat mass (18.4±3.2%), low serum leptin level (4.04±1.44ng/ml), and inadequately balanced daily diets. Furthermore, observed negative eating behaviors included cognitive restraint (12.1±5.4) and hunger (8.0±2.9). Disinhibition was rarely found (7.4±3.0), but was significantly (P<0.05) associated with increased body mass (r = 0.60), BMI (r = 0.41), amount of body fat (r = 0.45), waist circumference (r = 0.62), and hip circumference (r = 0.51). Also hunger was associated with increases in the body mass (r = 0.40), BMI (r = 0.34), fat mass (r = 0.40), hip circumference (r = 0.42) but decreases in fat-free body mass (r = -0.38) and total body water (r = -0.40).

Conclusions: The data show that the nutritional habits and nutritional status of ballet dancers with menstrual disorders are poor. These results suggested that dancers should be monitored with the aim of preventing serious medical consequences, such as oligomenorrhea or amenorrhea. These results may play a role in future education efforts to provide more accurate knowledge of nutritional habits and the medical consequences of unbalanced daily diets.

***Key words**: menstrual disorders, eating behavior, nutritional status, ballet dancers*

Introduction

The media and the Internet, which have immense influence on individuals' behavior, promote a slim figure as an ideal of beauty, health, and feeling good. Negative body image is a frequent reason for deciding to lose weight, but this unfortunately is not always undertaken using rational methods. Not infrequently serious eating disorders develop as a result. Female athletes are by no means safe from such disorders, a fact which is supported by the results of many studies [1,2]. According to Tanya et al. [3], inadequate eating behavior was observed in 75% of female athletes. The sports disciplines in which women show the highest incidences of eating disorders include especially "esthetic" disciplines, such as rhythmic gymnastics, synchronized swimming, and figure skating [4], because women who practice these disciplines, as Cyrak-Antosiak [5] suggests, are evaluated not only on the basis of their sport techniques, but also on the so-called artistic impression they make – a term which covers the elegance and grace of their movements, and also their figure. For similar reasons, ballet dancers are also particularly at risk from eating disorders. Inappropriate dietary habits – including fasting and the use of purgatives – can lead to serious health consequences, including not only generally feebleness, difficulty concentrating, and increased risk of anemia, but also disorders in the menstrual cycle and loss of bone mineral density [1,6,7].

With the above in mind, it seems justified to undertake an assessment of the eating behavior and nutritional status of young ballet dancers.

Methods

Twenty-three ballet dancers with menstrual disorders (6 with amenorrhea, 17 with oligomenorrhea) from a ballet school in Poznan participated in the study. Before beginning, the girls and their parents were informed of all aspects of the study, and gave their written consent in every case. The study was approved by the Poznan Medical Ethics Committee (no. 334/09).

Each subject filled out a medical questionnaire. The questions asked for the following personal data and information on menstrual cycle characteristics: age, age

at menarche, duration of menstrual cycle, duration of menstrual bleeding, non-appearance of menstruation, and painful menstruation. Menstrual disorders were classified according to Manore [6] and Skałba [8]. The criterion for recognizing *amenorrhea* was the absence of 3 consecutive menstrual cycles in the past year, while *oligomenorrhea* was considered to refer to menstrual cycles occurring at intervals of greater than 35 days, but less than 90 days, over the past year.

Nutritional status was evaluated based on anthropometrical indices (height and weight) using an anthropometer coupled to a WPT 200 OC verified medical scale (Rad Wag), with subsequent calculation of the body mass index (BMI) (kg/m^2). Participants were dressed in minimal clothing during the measurements, which were performed to the nearest 0.5 kg and 0.5 cm. Analysis of body-fat mass (FM) and fat-free mass (FFM) was performed using a BODYSTAT 1500, according to Heyward et al. [9], with the subjects lying in a supine position after an overnight fast.

Serum leptin levels were measured using commercial immunoassay kits for leptin. Hormone levels were determined in duplicate [10]. To evaluate of serum leptin level assumed the laboratory recommended norms given by manufacturer.

Body composition analysis and blood samples were taken in the morning (6.00–9.00) before the first meal. The subjects were instructed to abstain from caffeine and alcohol for 24 hours before blood sampling, and to refrain from strenuous exercise on the day of the body composition analysis and blood sampling.

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Dietary records from seven consecutive days were obtained under the supervision of dieticians. All meals (including recipes and item weight) and nonmeal foods, beverages, and fluids were recorded in diary form. In order to more precisely estimate the portions eaten by the dancers, a photographic album of products and meals was employed [11]. The energy and nutrient values of daily diets (DRP) were calculated using the *Dietetyk* computer software package, based on Polish food composition tables [12]. Corrections were made to account for the loss of nutrients in processing and cooking. In the case of energy and nutritional values from macronutrients, as well as most nutrients, loss was set at 10%, while the loss of vitamins B2 and C was estimated at 20% and 50%, respectively. The amounts of particular nutrients consumed were expressed as a percentage of the recommended dietary allowance for girls between 16 and 18 years of age presented by Jarosz et al. [13], with deviations of up to 10% from the norm considered acceptable. The energy values of the daily diets were compared with the predicted resting metabolic rate and physical activity level values [13].

In addition, the assessment of nutritional habits was supplemented with the results of a diagnostic test involving, firstly, a questionnaire for the appraisal of eating behaviors. This instrument, the Three-Factor Eating Questionnaire (TFEQ) [14], contains 36 items in a true or false response format. In the second part of the test, the dancers responded to 15 questions by choosing one of the descriptors *never*, *seldom*, *often*, and *always*. All item responses were dichotomized and aggregated into three scales: cognitive restraint (R), with 21 items, disinhibition (D), which had 16 items, and hunger (H), with 14 items. Cognitive restraint is intended to measure dietary restraint, that is, control over food intake for the purpose of influencing body weight and shape. Disinhibition refers to episodes of loss of control over eating, while the hunger scale concerns subjective feelings of hunger and food cravings [14].

Statistical analysis

The data thus obtained were expressed as average values with standard deviation, and the maximum and minimum values were also recorded. Next the normality of the distribution was calculated, and using the results obtained a statistical examination was performed by analyzing the correlation Spearman in StatSoft's STATISTICA™ 8.0 software package.

Results

The characteristics of the ballet dancers are presented in table 1, and include low body-fat percentages (18.4% ± 3.2%) and lower than recommended levels of serum leptin (4.04 ± 1.44 ng/ml). Delayed menarche was also typical of the dancers (14.6 ± 1.2).

The ballet dancers' daily diets were not properly balanced for energy (covering on average only 80% of the recommended dietary allowance (RDA)), and macronutrients (protein: 98% of RDA, carbohydrate: 75% of RDA). Among the micronutrients, calcium (with 56% of RDA), vitamin D (32% of RDA), and folate (42% of RDA) showed especially lower intake than recommended dietary allowances. The recommended levels were met only in regard to zinc (104% of RDA), vitamin A (125% of RDA), vitamin B_2 (136% of RDA), and vitamin B_{12} (108% of RDA) (table 2).

Based on the data from the TFEQ questionnaire, the ballet dancers frequently show cognitive restraint (12.1 ± 5.4) and hunger (8.0 ± 2.9). Disinhibition was found significantly more rarely (7.4 ± 3.0) (table 3).

Analysis of the influence of eating behaviour on anthropometric parameters and body composition showed that disinhibition may significantly (P<0.05) increased body mass (r = 0.60), BMI (r = 0.41), fat mass (r = 0.45), waist circumference (r = 0.62), and hip circumference (r = 0.51) but decreased fat-free

Table 1. *Characteristics of ballet dancers*

Parameters	Mean ± standard deviation (min–max)
Age (years)	17.4 ± 0.9 (16–21)
Body mass (kg)	52.4 ± 5.2 (44–66)
Body height (cm)	167.1 ± 4.5 (159–176)
BMI (kg/m2)	18.8 ± 1.6 (16.7–23.1)
Fat mass FM (22.0 – 24.0%)*	18.4 ± 3.2 (9.6–22.7)
Fat mass FM (kg)	9.6 ± 2.0 (15.1–13.9)
Fat-free mass FFM (%)	81.6 ± 3.2 (77.3–90.4)
Fat-free mass FFM (kg)	42.6 ± 4.5 (36.7–52.1)
Total body water TBW (%)	56.7 ± 3.5 (50.6–63.3)
Total body water TBW (l)	29.6 ± 2.6 (26.1–34.6)
Circumference of waists (cm)	63.5 ± 1.7 (60–66)
Circumference of hip (cm)	80.2 ± 3.8 (81–98)
Age of menarche (years)	14.6 ± 1.2 (12–16)
Serum leptin level (6.80–8.20ng/ml)	4.04 ± 1.44 (2.14–6.53)

* recommended value according to Frish et al [17]

Table 2. *Energy and nutritional value of ballet dancers' daily diets, compared with recommended values*

Energy and nutrients	Supply in daily diets Mean ± SD (min–max)	RDA* [13]	Percentage of RDA covered (%)
Energy (kcal)	1950 ± 408 (1510–2997)	2430	80
Protein (g)	65 ± 19 (44–122)	73–91	89
Percentage of energy from protein	14.7	12–15	
Fat (g)	75 ± 12 (56– 98)	67–810	100
Percentage of energy from fat	32.9	25–3	
Carbohydrate (g)	252 ± 64 (189–410)	min 334	75
Percentage of energy from carbohydrates	56.8	min 55	
Dietary fiber (g)	16.4 ± 7.3 (10.4–39.8)		
Calcium (mg)	728 ± 292 (295–1277)	1300–1500	56
Potassium (mg)	1077 ± 351 (564–1912)	1250	86
Magnesium (mg)	250 ± 88 (128–496)	360	69
Iron (mg)	9.9 ± 4.0 (5.2–18.8)	15	66
Zinc (μg)	9.4 ± 4.3 (4.8–19.7)	9	104
Vitamin A (μg)	873 ± 355 (436–1629)	700	125
Vitamin D (μg)	1.6 ± 1.1 (0.6–5.1)	5	32
Vitamin E (μg)	6.3 ± 3.0 (2.8–13.0)	10	63
Vitamin B1 (mg)	0.9 ± 0.4 (0.3–1.6)	1.1	82
Vitamin B2 (mg)	1.5 ± 0.5 (0.7–2.4)	1.1	136
Niacin (mg)	11.0 ± 5.7 (4.8–24.8)	14	79
Vitamin B6 (mg)	1.5 ± 0.6 (0.7–2.7)	1.2	125
Folate (μg)	168 ± 63 (85–305)	400	42
Vitamin B12 (mg)	2.6 ± 0.8 (1.1–4.0)	2.4	108
Vitamin C (mg)	55.4 ± 29.2 (17.1–103.4)	65	85

*RDA: recommended dietary allowance, according to Jarosz et al. [13]

Table 3. *Characteristics of eating behavior in ballet dancers*

	Mean ± SD (min–max)	INTERPRETATION OF SCORING		
		Low	High	Clinical
Cognitive restraint	12.1 ± 5.4[a] (2–20)	0–10	11–13	>14
Disinhibition	7.4 ± 3.0[b] (2–12)	0–8	9–11	>12
Hunger	8.0 ± 2.9[a] (1–13)	0–7	8–10	>11

[a, b] values with different letter superscripts are significantly different

Table 4. *Relationship between eating behavior, anthropometric parameters, body composition and serum leptin levels in ballet dancers*

Parameters	Restraint	Disinhibition	Hunger
Body mass (kg)	0.01	0.60*	0.40*
BMI (kg/m2)	-0.02	0.41*	0.34*
Fat mass FM (%)	0.13	0.23	0.04
Fat mass FM (kg)	0.06	0.45*	0.40*
Fat-free mass FFM (%)	-0.13	-0.23	-0.04
Fat-free mass FFM (kg)	-0.13	-0.47*	-0.38*
Total body water TBW (%)	-0.16	-0.54*	-0.22
Total body water TBW (l)	-0.27	-0.26	-0.40*
Circumference of waists (cm)	0.24	0.62*	0.30
Circumference of hip (cm)	-0.05	0.51*	0.42*
Serum leptin levels (μg/ml)	0.41*	0.16	-0.11

*$P<0.05$

Table 5. *Relationship between energy and nutritional value of daily diets and eating behaviour in ballet dancers with menstrual disorders*

Energy and nutrients	Restraint	Disinhibition	Hunger
Energy (kcal)	-0.31*	0.07	0.08
Protein (g)	-0.36*	0.09	0.15
Fat (g)	-0.06	-0.09	0.14
Carbohydrate (g)	0.16	0.05	0.09
Dietary fiber (g)	0.16	-0.12	0.01
Potassium (mg)	-0.71*	0.23	-0.01
Calcium (mg)	-0.56*	0.09	0.02
Magnesium (mg)	-0.54*	0.12	-0.01
Iron (mg)	-0.43*	0.15	0.03
Zinc (μg)	0.51*	0.14	0.03
Vitamin A (μg)	-0.03	-0.16	-0.08
Vitamin D (μg)	0.03	-0.16	-0.14
Vitamin E (μg)	0.02	-0.05	-0.03
Vitamin B1 (mg)	0.40	0.09	0.01
Vitamin B2 (mg)	-0.53*	0.18	0.07
Niacin (mg)	-0.31*	-0.03	-0.14
Vitamin B6 (mg)	0.24	0.16	0.03
Folate (μg)	-0.41*	-0.07	-0.21
Vitamin B12 (mg)	-0.53*	0.20	0.16
Vitamin C (mg)	-0.16	-0.57*	-0.32*

*$P<0.05$

body mass (r = -0.47) and total body water (r = -0.54). Also hunger may significantly (P<0.05) increased body mass (r = 0.40), BMI (r = 0.34), fat mass (r = 0.40), hip circumference (r = 0.42) but decreased fat-free body mass (r = -0.38) and total body water (r = -0.40).

Furthermore, it was observed that the serum leptin level increased in the dancers (r = 0.41) who showed higher cognitive restraint in food intake (table 4).

Furthermore, correlation analysis showed that increases in the frequency of cognitive restraint were associated with decreases in the energy (r = -0.31), protein intake (r = -0.36) and level of a number of nutrients (potassium: r = -0.71; calcium: r = -0.56; magnesium: r =-0.54; iron: r = -0.43; vitamin B_2: r = -0.53; niacin: r = -0.31; folate: r = -0.41; vitamin B_{12}: r = -0.53). In the cases of disinhibition and hunger, a similar relationship was observed only in relation to vitamin C (D r = -0.57, H r = -0.32) (table 5).

Discussion

The etiology of disorders in the menstrual cycle among physically active women is not clearly understood [7,15]. However, most data to date suggest that menstrual disorders arise only as a result of increased physical activity, with such activity frequently beginning before girls enter puberty [7]. Another very significant factor favoring the appearance of these disorders is to lower energy availability which can cause inadequate nutritional status. This affects above all women who practice disciplines which demand a slim figure and low body mass [16]. The ballet dancers who took part in the present study were characterized by a low percentage of fat mass, with an average value of 18.4%, which according to Frish et al. [17] is an insufficient amount for maintaining the regular menstrual cycle, since low levels of fat mass may be one of the causes leading to inhibition of the hypothalamus-pituitary-ovary axis. Apart from that, many authors draw attention to the key role that may be played in the mechanism of menstrual disorders in female athletes by the impairment of the endocrine function of adipose tissue connected with decreased secretion of leptin. It is thought that leptin is the hormone responsible for passing information to the brain concerning the appropriate amount of adipose tissue necessary for the secretion of gonadotropin hormones, and for initiating the activity of the hypothalamus-pituitary-ovary axis, as well as for maintaining its correct functioning [18]. Leptin is considered to be the link between nutritional status and reproductive function [18]. In studies involving female athletes and ballet dancers, it has been demonstrated that women with amenorrhea show characteristically lower leptin level in comparison to women with eumenorrhea [18,19]. This thesis also finds support in our research, as the serum leptin level of the ballet dancers turned out to be significantly lower than the expected norm.

Taking into account the fact that eating disorders are seen unusually frequently among ballet dancers, this study determined the energy and nutritional values of dancers' daily diets, and analyzed the eating behaviours of the dancers. It has been shown that the ballet dancers do not balanced their daily diets, especially in relation to energy and nutrition intake. The results of this study are similar to the results of other authors, also in the case of specific sport disciplines [1,2,20]. The low intake of calcium and vitamin D are particularly disturbing, as these nutrients play key roles in reaching optimal bone mineral density, and thus in protecting against osteoporosis, for which amenorrheic and oligomenorrheic ballet dancers are especially at risk – which has been repeatedly demonstrated in studies [7,15,16,21]. In the literature it is emphasized that during prepubescence girls BMD reaches about 50%–63% of its peak value. The rest of the BMD (37%–50%) is added during puberty. In the case of the ballet dancers suffering from menstrual disorders, the achievement of optimal BMD is made more difficult, as a result of which the BMD of these girls may turn out to be significantly lower than that of normally menstruating young women. The consequences of this are especially dangerous, as the results of inappropriate eating habits and menstrual disturbances at a young age are at least partially irreversible [7,15,22].

What's more, the influence of eating behaviour on anthropomorphic parameters and body composition, it can be supposed that those ballet dancers who are aware of the dangerous effects of such habits may try to avoid eating for emotional reasons. Other authors, emphasize that inadequate eating behavior such as restrictions in energy intake may be one of the causes of the decrease resting metabolic rate, occurring even in cases of high fat-free body mass – which is regarded as the main determinant of high metabolic rate [23]. What is more, it has also been observed that leptin levels were higher the more frequent the dancers showed dietary restraint. We could guess that this mechanism may explain the defensive reaction in which the body increases the synthesis of leptin, in order to restrain the appetite but this statement need further researches.

The results point to the need to monitor eating habits and behaviors of ballet dancers, as they may lead to menstrual disorders. The results of this study may be crucial in developing dietary recommendations for this group of women, and also in introducing educational programs which have as their aim the improvement of knowledge of appropriate eating habits, and of the health consequences which may result from an unbalanced diet.

Conclusion

Ballet dancers with menstrual disorders demonstrated low amounts of fat mass, low serum leptin levels, unbalanced daily diets and inadequate eating behavior.

Disinhibition was associated with increases in the BMI and in fat mass, but not in levels of leptin.

Hunger was associated with increases in the body mass, BMI, fat mass, hip circumference and decreases in fat-free body mass and total body water.

These results point to the need to undertake educational activities to improve the understanding of how to balance daily diets as a treatment of menstrual disorders.

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Declaration of interest

The author reports no conflicts of interest.

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Address for correspondence:
Karolina Łagowska
University of Life Sciences
Department of Human Nutrition and Hygiene,
Sub-departments of Dietetics,
ul Wojska Polskiego 31,
60-624 Poznań, Poland
tel: 061 848 7338
fax: 061 848 7332
karolina @up.poznan.pl

Jan Jeszka: jeszkaj@up.poznan.pl