Predictors of functional and exercise amenorrhoea among eating and exercise disordered patients

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BACKGROUND: The aim of this study was to investigate the predictors of amenorrhoea self-reported by patients who are suffering or recovering from eating or exercise disorders. METHODS: Menstrual status, eating and exercise behaviours and feelings, and weight history of 268 female patients, 16–40 years old and not taking oral contraception or hormone replacement, were assessed on admission to hospital or 12 months later. RESULTS: Most (134) had secondary amenorrhoea, 39 had oligomenorrhoea and 95 regular spontaneous menses. Amenorrhoea occurs in women with all types of eating disorder diagnoses including EDNOS (eating disorder not otherwise classified). The predictors of secondary amenorrhoea were: lower current BMI (odds ratio (OR) 0.59, confidence interval (CI) 0.50–0.68); a greater amount of body weight lost (OR 1.19, CI 1.06–1.33); exercising for mood, to burn up energy or for body image reasons (OR 1.50, CI 1.14–1.97); and younger age (OR 0.93, CI 0.87–1.00). Eating disorder patients with an exercise disorder were significantly more likely to report trying to reduce their food intake, to feel compelled to exercise and to have amenorrhoea/oligomenorrhoea than eating disorder patients without an exercise disorder.

CONCLUSION: The greater the self-report behaviours and feelings associated with energy debt, the more likely menstruation is to be disturbed. Energy balance needs to be assessed in all amenorrhoeic patients.

Key words: amenorrhoea/eating disorders/energy balance/BMI/exercise disorder/EDNOS

Introduction

Functional hypothalamic and athletic or exercise amenorrhoea receives scant attention in the eating disorder literature. Current amenorrhoeic research relates to athletes and the triad of amenorrhoea/oligomenorrhoea, disordered eating and decreased bone density (Papanek, 2003). More recently, energy balance has been added to this triad (Andrico et al., 2002; Harber, 2004).

There are few papers examining predictive factors for functional amenorrhoea. Possible predictors suggested are: energy balance; nutritional status; exercise intensity and training practices; body weight and body composition; disordered eating behaviours; and physical and emotional stress (Manore, 2002). Low BMI and excessive exercise are accepted predictors of secondary amenorrhoea but these do not explain why amenorrhoea may remain after these factors are reversed (Brambilla et al., 2003).

Predictors of recovery from functional hypothalamic amenorrhoea in women are: a history of and reversal of stress; weight loss; eating disordered behaviour (Perkins et al., 2001); and no continued mild nutritional deficit (Couzinet et al., 1999). LH, leptin and lower calorie intake were found to differentiate between women with amenorrhoeic anorexia nervosa and low weight menstruating women of equivalent BMI and fat mass (Di Carlo et al., 2002). Recently, it has been suggested that eating disorders reflect problems with energy balance irrespective of the behaviours and beliefs leading to the discrepancy in energy balance (Abraham, 2003).

We wished to look at the self-reported behaviours and beliefs associated with energy balance that are most likely to be associated with functional or exercise amenorrhoea. We studied eating and exercise disordered women admitted to hospital for treatment of their eating and exercise disorders, and women who had been admitted for the same treatment 12 months prior. The eating disorder diagnoses of the women were anorexia nervosa, bulimia nervosa, EDNOS (eating disorder not otherwise specified), or no eating disorder diagnosis.

Methods

Subjects

Female eating and exercise disordered patients (n = 242) with possible spontaneous menstrual cycles were studied on admission to a specialist, multidiscipline, inpatient program at the Eating Disorder Unit, Northside Clinic, University of Sydney or 12 months later. All had: expected levels of LH, FSH, estradiol (E₂) androgens; thyroid function tests; and no other chronic medical illnesses.

The minimum age for admission to the clinic is 14 years following referral by family physicians and psychiatrists. All patients had been an inpatient for an average of 45 days (range: 22–87 days). They included a broad spectrum of eating and exercise disordered patients.
Patients included: those with no previous treatment; those from country areas and interstate who may have responded to outpatient care if available; patients who had failed outpatient or day patient treatment programmes; and those who were at different stages of recovery. Approximately 60% had not received inpatient treatment previously.

Excluded from the analyses were: women aged <16 years or >40 years; those taking oral contraception or HRT; those with primary amenorrhoea; those that were pregnant, breastfeeding, hysterectomized or post-menopausal; and those with a history of polycystic ovarian syndrome, endometriosis and/or diabetes.

Procedures and measures

Height and body weight were measured on admission or 12 months later and BMI calculated. The information collected was: age; mother’s country of birth; marital status; parity; whether career involves exercise, e.g. dancer, athlete; whether in an athletic (or equivalent) training programme; whether exercise is limited for medical reasons; BMI (current, lowest ever, highest ever, desired kg/m²); amount of weight lost prior to current BMI (kg/m²); binge eating (days/previous month); objective binge eating (episode of overeating felt to be out of control; large amount of food; binges ≥8 in previous month); limiting food intake for any reason (mood or body image) (days/previous month); exercising for any reason (for mood or to burn up energy or body image) (days/previous month); self-induced vomiting (days/previous month); laxative abuse (days/previous month); purging (self-induced vomiting or laxative misuse ≥4 days in previous month); exercise (days/month); excessive exercise (amount in kcal and time >19 days in previous month); avoiding eating liked foods (days/previous month); trying to follow rules about eating (days/previous month); trying to follow rules about exercise (days/previous month); and a feeling you must exercise (days/previous month).

The Eating and Exercise Examination (EEE), a self-report computer program generated the questions and provided the above data ready for analysis. Days per month were recorded by patients as: 0 = no days; 1 = 1–7 days; 2 = 8–14 days; 3 = 15–21 days; and 4 = 22–28 days.

Eating disorder diagnoses were determined by an eating disorder specialist psychiatrist and psychologist, omitting amenorrhoea as a criterion. The criteria used for an exercise disorder are: (i) the person is exercising excessively and feels annoyed, angry or agitated if any episode of exercise is interrupted; (ii) would continue to exercise if they were ill or injured; and (iii) that exercising is of greater than average importance to them for psychological reasons or to affect energy expenditure, body weight or shape.

Those patients who were not participating in traditional types of exercise in the three months before admission would not be considered in this study to have an exercise disorder or disordered exercise.

Analysis

Menstrual status was divided into three groups: (i) secondary amenorrhoea (no periods for 3 months or more); (ii) oligomenorrhoea/irregular (one period in last 3 months); and (iii) regular (two or three periods in last 3 months). The eating diagnoses (previous 3 months) were divided into three groups: (i) anorexia nervosa; (ii) bulimia nervosa; and (iii) eating disorder not otherwise specified (EDNOS).

One way ANOVA (analysis of variance), Student t-test and non-parametric χ² Mann–Whitney and Kruskall–Wallis tests were used to compare the three menstrual groups, the oligomenorrhoea and regular groups, and the exercise and no exercise eating disorder groups as appropriate.

Logistic regression (Wald forward) was used to test the determinants of secondary amenorrhoea using the following variables (see above): age; BMI (kg/m²) (current, lowest ever, desired BMI); amount of weight loss to current weight (kg/m²); binge eating; objective binge eating; self-induced vomiting; and exercise for mood or to burn up energy. The choice of the 10 variables was based on comparison (significantly different between the two groups), correlation (Spearman) and clinical experience, i.e. current BMI and lowest ever BMI correlated 0.59, P <0.001 but both were kept in the regression analysis; similarly for binge eating and vomiting correlated 0.55, P<0.001. These variables are clinically independent. The number of events per variable for the secondary amenorrhoea group (n = 116) was >10 (minimum 14). To the best of our knowledge, the basic rules for logistic regression were adhered to (Concato et al., 1993). The patients with oligomenorrhoea and normal menstrual cycles were grouped together for this analysis.

Results

The characteristics and behaviours of the patients and differences between the menstrual status groups are shown in Table I. Most were Caucasian [112 (97%) amenorrhoea and 113 (90%) normal/irregular], had never been married [108 (93%) amenorrhoea and 112 (89%) normal/irregular] and not had children [112 (97%) amenorrhoea and 117 (93%) normal/irregular].

In the 28 days before the study, 15 of the women stated they were athletes or dancers, and a further 15 said they were in an athletic (or equivalent) training course. Ten women who reported having to limit their exercise for medical reasons in the 28 days before admission still managed to fulfill the criteria for an exercise disorder. Forty-three patients without an exercise disorder also stated they had to limit their exercise for medical reasons. Comparison of the oligomenorrhoea group and the regular group showed that the oligomenorrhoea group were more likely to have an exercise disorder (χ² = 10.76, df = 2, P<0.001).

Table II shows the comparison between the exercise and no exercise disorder eating disorder patients. Thirty (16.5%) eating disorder patients had an exercise disorder and no patient without an eating disorder (n = 30) had an exercise disorder. Most patients (n = 182) had an eating disorder but not an exercise disorder. There were no significant differences between the eating disorder sufferer with and without an eating disorder for: age; current BMI; highest BMI; lowest BMI; amount of weight lost (BMI); purging behaviour; and objective binge eating (Table II.).

The variables associated with secondary amenorrhoea are shown in Table III; the value of the Cox and Snell R² was 0.38. These variables predicted 81% of cases of amenorrhoea and 82% of non-cases with no amenorrhoea. Being older and having a higher current BMI was associated with a lower likelihood of amenorrhoea while losing more weight and exercising for mood, body image or to utilise energy was associated with a greater likelihood of amenorrhoea. Amenorrhoea occurred at higher body weights when the weight loss was greater.

Discussion

To our knowledge, this is the largest group of carefully selected eating disorder women not taking oral contraception or other hormones to be studied. Amenorrhoea was associated with all eating disorder diagnoses; anorexia nervosa, bulimia nervosa and EDNOS (eating disorder not otherwise classified).
The menstrual status of women with a diagnosis of EDNOS had not been studied previously; the majority in this study had irregular cycles or secondary amenorrhoea. We had expected to find a greater prevalence of women with exercise disorders, particularly among the group of women who had been in hospital 12 months previously. It is possible that women who have exercise disorders may be less likely to accept inpatient treatment as exercise is limited, and be more likely to take oral contraception if they have a menstrual disturbance. Despite these possible biases in the patient group studied, a clear indication of the variables associated with secondary amenorrhoea emerged. These were: current BMI; 

Table I. Comparison of the eating and exercise disorder patients aged 16 to 40 years of different menstrual status

<table>
<thead>
<tr>
<th>Age and weight</th>
<th>Secondary amenorrhoea</th>
<th>Irregular</th>
<th>Regular</th>
<th>F (df = 2)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>F (df = 2)</td>
<td>P</td>
</tr>
<tr>
<td>Current BMI (kg/m²)</td>
<td>20.6 ± 4.7</td>
<td>20.7 ± 4.6</td>
<td>21.2 ± 5.7</td>
<td>0.41</td>
<td>ns</td>
</tr>
<tr>
<td>Lowest ever BMI (kg/m²)</td>
<td>16.3 ± 2.7</td>
<td>19.5 ± 2.8</td>
<td>20.5 ± 4.3</td>
<td>39.86</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Highest ever BMI (kg/m²)</td>
<td>14.8 ± 2.0</td>
<td>16.6 ± 2.8</td>
<td>16.6 ± 3.0</td>
<td>14.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Desired BMI (kg/m²)</td>
<td>22.6 ± 3.9</td>
<td>23.8 ± 4.3</td>
<td>23.8 ± 4.9</td>
<td>2.36</td>
<td>ns</td>
</tr>
<tr>
<td>Weight loss (kg/m²)</td>
<td>16.8 ± 2.5</td>
<td>17.5 ± 2.1</td>
<td>18.3 ± 2.3</td>
<td>9.75</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table II. Comparison of eating disorder patients with and without an exercise disorder

<table>
<thead>
<tr>
<th>Behaviour (previous 28 days)</th>
<th>Exercise and eating disorder</th>
<th>Eating disorder but NO exercise disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age and weight</td>
<td>n = 30</td>
<td>n = 182</td>
</tr>
<tr>
<td>Current BMI (kg/m²)</td>
<td>3.80 ± 0.41</td>
<td>3.11 ± 1.33</td>
</tr>
<tr>
<td>Lowest ever BMI (kg/m²)</td>
<td>3.60 ± 0.81</td>
<td>2.65 ± 1.45</td>
</tr>
<tr>
<td>Highest ever BMI (kg/m²)</td>
<td>3.80 ± 0.48</td>
<td>3.11 ± 1.30</td>
</tr>
<tr>
<td>Desired BMI (kg/m²)</td>
<td>3.43 ± 0.71</td>
<td>1.61 ± 1.60</td>
</tr>
<tr>
<td>Weight loss (kg/m²)</td>
<td>3.37 ± 0.72</td>
<td>1.78 ± 1.55</td>
</tr>
</tbody>
</table>

EDNOS eating disorder not otherwise specified. Ns = not significant.

The menstrual status of women with a diagnosis of EDNOS had not been studied previously; the majority in this study had irregular cycles or secondary amenorrhoea. We had expected to find a greater prevalence of women with exercise disorders, particularly among the group of women who had been in hospital 12 months previously. It is possible that women who have exercise disorders may be less likely to accept inpatient treatment as exercise is limited, and be more likely to take oral contraception if they have a menstrual disturbance. Despite these possible biases in the patient group studied, a clear indication of the variables associated with secondary amenorrhoea emerged. These were: current BMI;
the amount of weight lost to current BMI; exercising for any reason (to utilize energy, for body weight or shape and to improve mood); and age.

The amount of body weight lost has not been shown previously as a factor. Whether the rate in addition to the amount of weight lost is important is not known. Clinically, we know weight loss is associated with menstrual disturbances (Oats and Abraham, 2004), but the amount of weight lost is not a measure used when athletes and eating disordered women are studied. The finding that both BMI and amount of weight lost predicts amenorrhoea indicates that, irrespective of body weight, the greater the negative energy balance a person is in, the more likely menstruation is to be disturbed. This explains loss of menses at high and normal body weights and the return of menses, if the body weight is not low, when weight loss has ceased (Louks, 2003). Current BMI emerges as a predictor of amenorrhoea in all studies of athletes and eating disorder patients, and recovery of regular menses is associated with no further loss of body weight and usually a gain in weight (Perkins and Martin, 2001).

The finding that leptin is lower and nutritional status is poorer in same weight women with and without amenorrhoea (Di Carlo et al., 2002) is in keeping with the concept of amenorrhoea reflecting energy balance (Abraham, 2003). This is also supported by the recent association of energy balance with the triad of oligomenorrhoea/amenorrhoea, disordered eating, and loss of bone density in athletes.

Binge eating and or vomiting did not predict amenorrhoea. Current BMI and the amount of weight lost were better measures of amenorrhoea than binge eating, although there was a significant difference in the incidence of binge eating between the menstrual categories. Similarly, differences in self-induced vomiting reflect the strong relationship between binge eating and inducing vomiting.

Age was also a weak indicator of secondary amenorrhoea. This has not been found before in women 16 years and above. This may be a measure of maturation of the reproductive system or the ability of women’s bodies to adapt to chronic energy restriction. Whether this maturation occurs in the late teenage years or extends into the 20s or 30s is unknown. It also may suggest that the return of menses may not be a good measure of recovery as women become older.

Exercise is known to be associated with amenorrhoea, but the quantitative self-reported measures of amount and days of exercise are not good predictors. Reasons for exercising and rules about exercising are better self-report measures. The greater these self-reported behaviours and feelings, irrespective of actual BMI and weight loss, the more likely is the menstrual cycle disturbance. Those women with a concurrent exercise disorder who felt compelled to exercise had a greater likelihood of a menstrual disturbance. A woman with an exercise disorder will be in greater energy debt than other women who undertake formal exercise because they do not report the continual incidental activity as exercise.

This paper would have been improved if the number of exercise disorder patients had been greater and the study longitudinal in order to test if the variables do predict secondary amenorrhoea in the same group of patients after 12 months. The variables also need to be examined in other groups of women who increase their exercise or change their body weight.

The strengths of this paper are the selection of patients to ensure they were of reproductive age, with no medical or hormonal problems. The exercise status and eating behaviour status of the women were both known; this has not been achieved in previous studies of amenorrhoea. Women with all eating disorder diagnoses were included, which also has not been done previously. Inclusion of women who were at different stages of recovery, 12 months after inpatient treatment provided greater numbers of regularly menstruating women and a greater representation of eating and exercise subjects for analysis. Only women aged 16 to 40 years were included, as menstrual irregularities before this age are common and changes associated with menopause begin after 40 years (Oats and Abraham, 2004).

Education about energy balance may help healthy, active women avoid disordered eating and exercise patterns as well as help young women to prevent episodes of menstrual disturbance in their late teens and twenties when they appear to be more susceptible. Exercise should not be seen as healthy if it results in a woman being in a mild but chronic energy debt. Finding measures of chronic energy balance over the previous 3 to 6 months or more may be useful in the assessment of amenorrhoea in young women. Leptin may be a candidate (Di Carlo et al., 2002).

### References


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