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Original article

# Dietary intake, resting energy expenditure, and eating behavior in women with and without polycystic ovary syndrome

Ingrid Larsson [a], Lena Hulthén [b], Mikael Landén [c], Erik Pålsson [c], PerOlof Janson [d], Elisabet Stener-Victorin [e, f, *]

[a] Department of Endocrinology, Diabetology and Metabolism, Sahlgrenska University Hospital, 413 45 Gothenburg, Sweden
[b] Institute of Medicine, Department of Internal Medicine and Clinical Nutrition, Sahlgrenska Academy, University of Gothenburg, 40530 Gothenburg, Sweden
[c] Institute of Neuroscience and Physiology, Department of Psychiatry, Sahlgrenska Academy, University of Gothenburg, 40530 Gothenburg, Sweden
[d] Institute of Clinical Science, Department of Obstetrics and Gynecology, Sahlgrenska Academy, University of Gothenburg, 413 45 Gothenburg, Sweden
[e] Institute of Neuroscience and Physiology, Department of Physiology, Sahlgrenska Academy, University of Gothenburg, 40530 Gothenburg, Sweden
[f] Department of Physiology and Pharmacology, Karolinska Institutet, 171 77 Stockholm, Sweden

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SUMMARY

*Background:* Data on dietary intake, meal patterns, and eating attitudes from women with polycystic ovary syndrome (PCOS) is limited despite the fact that PCOS is associated with obesity. We aimed to test the hypothesis that women with PCOS display altered dietary intakes and eating behaviors compared to controls.

*Methods:* Women with PCOS (n = 72) as defined according to the modified Rotterdam criteria were compared with healthy controls (n = 30). Anthropometry included measurement of waist circumference and determination of the resting metabolic rate via indirect calorimetry. All women completed questionnaires regarding eating behavior; Three-Factor Eating Questionnaire (TFEQ-R21) and eating attitudes; Eating Attitudes Test (EAT). Group comparisons were done by Mann–Whitney U test and logistic regression analysis was used for adjustments of age and BMI in a non-parametric way.

*Results:* BMI was higher in women with PCOS compared to controls. Resting metabolic rate did not differ between women with women with and without PCOS after adjustment for age and BMI [1411 ± 229 kcal/day versus 1325 ± 193 kcal per day ($P = 0.07$)], whereas the respiratory exchange ratio was higher in women with PCOS than in controls [0.83 ± 0.07 versus 0.78 ± 0.08 ($P = 0.02$ after adjustments for age and BMI)]. Energy percent (E%) carbohydrates was higher in women with PCOS compared to controls ($P = 0.017$), but E% alcohol was lower ($P = 0.036$) after adjustment for age and BMI. The average total EAT scores and EAT dieting subscale scores were higher in women with PCOS compared with controls ($P = 0.001$ and $P = 0.024$, respectively) after adjustment for age and BMI. No difference was found for previous or current symptoms of bulimia nervosa.

*Conclusions:* Independent of BMI and age, the resting metabolic rate did not differ between women with and without PCOS indicating that women with PCOS should have equal abilities in terms of energy metabolism to lose weight as women without PCOS. Women with PCOS showed greater concerns about their weight and dieting, and this indicates that anxiety about weight is one of the psychological symptoms of PCOS.



## 1. Introduction

Polycystic ovary syndrome (PCOS) is the most common endocrine and metabolic disorder among women of reproductive age [1]. PCOS is characterized by hyperandrogenism, irregular menstrual cycles, infertility, and increased risk for pregnancy complications [2]. The most common metabolic features of PCOS are hyperinsulinemia and insulin resistance, and there is a strong

* Corresponding author. Department of Physiology and Pharmacology, Karolinska Institutet, Von Eulersväg 8, 171 77 Stockholm, Sweden. Tel.: +46 (0)705643655.
*E-mail address:* elisabet.stener-victorin@ki.se (E. Stener-Victorin).

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relationship between PCOS and obesity [1]. Both obesity and insulin resistance exacerbate the reproductive and psychological symptoms in women with PCOS [3,4].

Information about the dietary intakes and eating behaviors of women with PCOS is limited despite the fact that the syndrome is associated with obesity. Based on anecdotal evidence, women with PCOS appear to have difficulty with weight management. This could be explained by hyperinsulinemia and insulin resistance, which are common in both lean and overweight women with PCOS, that might predispose the women to weight gain via insulin's anabolic effects as well as from changes in energy expenditure and food intake [5]. In addition, high levels of androgens in women have been associated with more craving for carbohydrates [6], and this indicates the potential for increased energy intake in women with PCOS. This is supported by a study demonstrating that women with PCOS have higher energy intakes even though they have lower intakes of saturated fats and higher intakes of low glycemic index foods than women without PCOS [7]. Other studies have found no difference in carbohydrate intake between women with PCOS and controls but higher intakes of high glycemic index foods [8]. Contrary to these results, recent studies have demonstrated that the habitual dietary intakes of energy, fat, protein, and carbohydrates in overweight and obese women with PCOS do not differ from age-matched controls with somewhat lower BMIs [5]. Whether resting energy expenditure (REE) is altered in women with PCOS is unclear, and studies have shown both lower [9] and unaltered [10] REE in women with PCOS compared to healthy women.

Regular meal patterns have been shown to lead to higher postprandial energy expenditure, lower energy intake, and improved insulin sensitivity compared to irregular eating patterns in experimental studies of lean and obese women [11,12]. A recent study in premenopausal women concluded that meal pattern is an important factor that can explain the associations between eating behaviors and self-reported energy intake [13]. However, no previous study have investigated whether meal patterns of women with PCOS differ from those of healthy women. The one study that reported habitual meal patterns in women with PCOS did not include healthy women [14], thus the importance of the frequency of food intake in women with PCOS has yet not been determined. Eating attitudes might also be affected in women with PCOS, and it has been suggested that high androgen levels and polycystic ovaries might advance bulimic behavior by influencing food cravings and impulse control [15]. An increased frequency of PCOS among bulimic [16] and anorectic [17] women has been reported, although these associations have been questioned [18].

The lack of research indicates a clear need for further studies on dietary intakes, meal patterns, and eating attitudes in women with PCOS. In this work we explore these three associated areas in a case–control study of women with PCOS in Sweden. Our hypothesis was that women with PCOS display altered dietary intakes and eating behaviors compared to controls after adjustments for age and BMI.

## 2. Material and methods

This cross sectional case–control study was as conducted November 2005–September 2008 at the Sahlgrenska Academy, University of Gothenburg, Sweden. Participants were recruited by advertising in local newspapers and in frequently visited places in the community and have been described in detail elsewhere [19,20]. Potential participants for the study were asked to describe their medical histories and underwent a gynecological examination and a two-dimensional transvaginal ultrasonography (HDI 5000, ATL, Bothell, Washington) to determine ovarian morphology.

Modified Rotterdam criteria [21] was used to define women with PCOS. All women with PCOS should have ultrasound-verified polycystic ovaries (12 or more follicles 2–9 mm in diameter and/or ovarian volume $\geq$10 mL in at least on ovary) and/or clinical signs of hyperandrogenism (hirsutism, acne) and/or oligo/amenorrhea [21]. A Ferriman–Gallwey score $\geq$8 was used to define hirsutism. An confirmatory response to the question: *Do you have excessive acne*? defined acne. An intermenstrual interval >35 days or <8 menstrual bleedings in the past year defined oligoamenorrhea. Amenorrhea was defined as an absence of menstrual bleeding within the past 90 days. Women diagnosed with congenital adrenal hyperplasia, hypothyroidism, hyperprolactinemia, Cushing's syndrome, androgen secreting tumors, or other related disorders were excluded [21]. Control women were excluded if they had menstrual irregularities, evidence of polycystic ovarian morphology, or signs of hyperandrogenism. All women who reported pharmacological treatment within the past 12 weeks, breast-feeding within the past 24 weeks, or physical diseases such as hypertension or type 2 diabetes or ongoing medication for psychiatric disease, were also excluded. In total, 72 women with PCOS and 30 control women were included.

All participants gave oral and written informed consent. The study was conducted at the Sahlgrenska Academy, University of Gothenburg, Sweden, in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board (IRB) and Regional Ethical Review Board of the University of Gothenburg.

### 2.1. Anthropometrics

After screening all participants with an initial examination, body weight (to the nearest 0.1 kg) and body height (to the nearest 0.5 cm) were measured with light clothing and without shoes. BMI was calculated as kg/m$^2$. Waist circumference (to the nearest 0.5 cm) was measured halfway between the lower rib and iliac crest, and hip circumference (to the nearest 0.5 cm) was measured at the widest point between the waist and thighs. The waist-to-hip ratio (WHR) was calculated as the ratio of the waist and hip circumferences.

### 2.2. Resting metabolic rate

After an overnight fast, the resting metabolic rate (RMR) was measured by indirect calorimetry using a Deltatrack™ II Metabolic Monitor ventilated hood system (Datex, Helsinki, Finland). Before measurement, the equipment was calibrated with Quick Cal™ calibration gas (Datex-Ohmeda, Helsinki, Finland) constituting of 95% $O_2$ and 5% $Co_2$ according to the manufacturer's instructions with gas mixtures of known $O_2$ and $CO_2$ concentrations. Participants were instructed to limit their physical activity the evening before the measurement. After 30 min of rest in a supine position, RMR was measured over the course of 30 min in a room with a temperature between 22 °C and 23 °C. The presented mean RMR for each participant is from the last 25 min of measurement. The respiratory exchange ratio (RER), also known as the respiratory quotient, is the ratio between volumes of released $CO_2$ and consumed $O_2$ from the oxidation of substrate. The size of the RER depends on what type of fuel (glucose, fatty acids, or protein) is being oxidized. The carbon and oxygen contents of these three substrates differ, and this affects the RER. There is a fourth fuel – alcohol – that is completely oxidized when consumed.

### 2.3. Dietary history including dietary intakes and meal patterns

This dietary assessment consisted of a detailed questionnaire that had previously been validated against the doubly labeled water technique, and this method of establishing a dietary history has been found to be a valid way to assess habitual energy intake [22]. All dietary data were collected at Sahlgrenska University Hospital.

**Table 1**
Characteristics of women with polycystic ovary syndrome and controls.

| | PCOS n = 72 | Controls n = 30 | *P*-value* |
|---|---|---|---|
| Age (years) | 30.2 ± 4.4 | 27.8 ± 3.6 | **0.005** |
| Height (cm) | 167.3 ± 6.8 | 169.0 ± 6.5 | 0.243 |
| Body weight (kg) | 79.6 ± 20.3 | 70.9 ± 17.1 | **0.029** |
| BMI (kg/m$^2$) | 28.5 ± 7.2 | 24.6 ± 5.0 | **0.003** |
| Waist circumference (cm) | 89.2 ± 14.9 | 83.8 ± 12.9 | 0.085 |
| WHR | 0.80 ± 0.07 | 0.80 ± 0.10 | 0.798 |

Mean ± SD. PCOS: polycystic ovary syndrome, BMI: body mass index, WHR: waist-to-hip ratio, SD: standard deviation. * = Mann–Whitney U test of PCOS versus Controls.
P value in bold defines signficant differences.

The three dieticians involved in the dietary collection during the three years data collection in the study were all specifically trained in order to collect the dietary data in the same way in order to limit differences in data collection that may affect the results. The dietary assessment consisted of a detailed food frequency questionnaire and an individual interview by trained dieticians [23]. Each participant was asked about habitual food intake and the numbers of meals eaten. Portion sizes of foods were described in terms of household measures, standard weights of food items, and photographs of proportions of known weights. Nutrient calculations were performed with the Diet 32 software package (Aivo, Solna, Sweden) that uses the Swedish Food Database of the Swedish National Food Agency [27]. Dietary intake data from 51 women with PCOS and 29 controls were available for the analysis.

### 2.4. Eating behavior

The 21-item Three-Factor Eating Questionnaire (TFEQ-R21) [24] is a self-administered instrument measuring eating behavior. It originates from the 51-item TFEQ that was translated, adapted, and validated in Swedish [25] and later revised to an 18-item version [26]. Development of the construct validity of the short form resulted in the 21-item version, TFEQ-R21, consisting of the following three scales that cover different eating behavior domains: the cognitive restraint scale (6 items), the emotional eating scale (6 items), and the uncontrolled eating scale (9 items). Higher scores indicate greater cognitive restraint, uncontrolled eating, or emotional eating.

### 2.5. Eating attitudes

The Eating Attitudes Test (EAT-40) is a self-reported questionnaire of 40 items that assesses the range of symptoms of anorexia nervosa and bulimia nervosa [27]. Each item is a 6-point Likert scale ranging from never to always. Total EAT scores, the sums of all 40 items, were calculated and the clinical cut-off for eating disturbances was a score of >29 [28]. Such scores indicate serious eating disturbances and weight concerns of potential clinical relevance. Twenty-six of the items make up the following three subscales: 1) Dieting – the avoidance of fatty foods and a fixation on losing weight, 2) bulimia and food fixation or an indication of bulimia, and 3) the perceived external pressure to gain weight and self-control over eating.

### 2.6. Psychiatric questionnaire

Psychiatric illness was assessed with a self-reporting questionnaire based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) [29] that has previously been described [30]. The questionnaire aimed to detect bulimia nervosa and five additional related psychiatric conditions (social anxiety disorder, depressed mood, anxiety attacks, obsessive-compulsive disorder, and premenstrual dysphoric disorder). The questions regarding bulimia nervosa read: “Have you ever had eating binges, i.e., times when you ate a very large amount of food within a short period of time, and then compensated this by vomiting or took other measures to prevent weight gain?”, and “Do you currently have eating binges, i.e., times when you eat a very large amount of food within a short period of time, and then compensate this by vomiting or take other measures to prevent weight gain?”. A ‘yes’ on the first question counted towards ‘Previous bulimia nervosa’, and a ‘yes’ to the second question counted towards ‘Current bulimia nervosa’ (Table 4).

## 3. Statistical analysis

Frequencies and descriptive statistics were generated using Prediction Application Software (PASW) Statistics 21 (formerly SPSS Statistics). Data are presented as means ± SD or number and percent. Differences in characteristics and eating behaviors between women with PCOS and controls were analyzed with the Mann–Whitney U-test or $\chi^2$ test (crude) and by logistic regression analysis for adjustment of age and BMI (adjusted).

An EAT score of >29 indicated an anorexia symptom burden of potential clinical relevance based on previous clinical reports suggesting that a score of 29 or less corresponds to a broadly defined state of remission. Results were considered statistically significant at $P < 0.05$. Bonferroni correction for multiple comparisons was done by multiplying significant $P$ value with number of variables and for the corrected $P$ value is given in Tables 2, 3, 5.

**Table 2**
Energy and macronutrient intake in women with PCOS and controls.

| | PCOS n = 51 | Controls n = 29 | Crude *P*-value* | Adjusted *P*-value** | Bonferroni x 8*** |
|---|---|---|---|---|---|
| Energy (kcal) | 2019 ± 727 | 2059 ± 779 | 0.657 | n.s. | |
| Protein (E%) | 18 ± 3 | 17 ± 6 | 0.548 | n.s. | |
| Fat (E%) | 31 ± 6 | 33 ± 7 | 0.059 | n.s. | |
| Saturated fatty acids (E%) | 12 ± 3 | 12 ± 3 | 0.727 | n.s. | |
| Unsaturated fatty acids (E%) | 17 ± 5 | 18 ± 4 | 0.191 | n.s. | |
| Carbohydrates (E%) | 49 ± 6 | 44 ± 9 | 0.008 | **0.017** | 0.136 |
| Dietary fiber (g) | 23 ± 7 | 22 ± 8 | 0.678 | n.s. | |
| Alcohol (E%) | 2.4 ± 3.0 | 4.1 ± 3.8 | 0.022 | **0.036** | 0.288 |

Values are mean ± SD.
E%: Energy percent.
PCOS: polycystic ovary syndrome.
n.s.: not significant, SD: standard deviation.
*Mann–Whitney U-test of PCOS versus controls.
** Logistic Regression analysis for adjustment of age and BMI.
*** Bonferroni correction with 8 variables.
P value in bold defines signficant differences.

## 4. Results

The characteristics of the women with and without PCOS are presented in Table 1. Women with PCOS were older and heavier compared with controls. Women with PCOS had a somewhat larger waist circumference, although not statistically significant, compared with controls ($P = 0.085$).

### 4.1. Energy and macronutrient intake

(Table 2). Women with PCOS reported significantly higher intakes of energy percent (E%) carbohydrates ($P = 0.017$) and lower E % alcohol ($P = 0.036$) compared with controls after adjustment for age and BMI, but not after Bonferroni correction. Number of meals per day in women with PCOS was (3.8 ± 1.7) reported compared with controls (4.4 ± 1.0 meals) and did not differ ($P = 0.07$). No other differences between specific meal patterns during the day were found.

### 4.2. Resting metabolic rate and respiratory exchange ratio

The measured RMR did not differ between women with and without PCOS [1411 ± 229 kcal/day and 1325 ± 193 kcal/day, respectively ($P = 0.07$)]. The RER was higher (0.83 ± 0.07) in women with PCOS than in controls (0.78 ± 0.08) ($P = 0.02$) and remained significant after adjustment for age and BMI ($P = 0.02$, CI = 0.00–0.20). In Table 3, the RMR and RER are presented divided by weight status of the women. As expected, overweight/obese women had higher RMR and RER compared with normal weight women. In overweight/obese women only, RER was higher in those women with PCOS compared with controls (Table 3). All observations remained significant after Bonferroni corrections.

### 4.3. Eating behaviors and eating attitudes

There were no significant differences between women with PCOS and controls regarding scores for cognitive restraint, uncontrolled eating, or emotional eating (Table 4). The mean total EAT score was higher in women with PCOS compared with controls before and after adjustment for age and BMI and after Bonferroni correction ($P = 0.001$) (Table 5). Using a cut-off score >29, six women with PCOS and one control woman were identified as having symptoms of anorexia of potential clinical relevance with no difference between the groups *($P = 0.360$)*. Scores on the EAT dieting subscale were higher in women with PCOS compared with controls after adjustment for age and BMI ($P = 0.024$) but not after Bonferroni correction, with no differences were seen in the bulimia and food fixation ($P = 0.270$) or the oral control ($P = 0.085$) subscales (Table 5).

### 4.4. Psychiatric questionnaire based on DSM-IV

The frequency of positive scores for previous symptoms of bulimia nervosa was similar between the PCOS and control groups ($P = 0.78$). Neither women with PCOS nor the control group scored positive for current symptoms of bulimia nervosa.

## 5. Discussion

We here found that women with PCOS had similar RMR and higher RER compared to controls after controlling for age and BMI. Reported energy intake was similar, but reported E% carbohydrate was higher and alcohol was lower among women with PCOS. Women with PCOS scored higher for dieting but were otherwise similar to controls with respect to eating attitudes. The higher total

**Table 3**
Resting metabolic rate and the respiratory exchange ratio in women with and without PCOS.

| | PCOS | | Normal weight *vs* overweight/obese* | Bonferroni x 2** | Controls | | Normal weight *vs* overweight/obese* | PCOS *vs* Controls Normal weight* | PCOS *vs* Controls Overweight/obese* | Bonferroni x 2** |
|---|---|---|---|---|---|---|---|---|---|---|
| | Normal weight (n = 23) | Overweight/obese (n = 23) | | | Normal weight (n = 19) | Overweight/obese (n = 11) | | | | |
| RMR, kcal/24 h | 1266 ± 116 | 1558 ± 222 | <0.001 | **0.002** | 1252 ± 115 | 1451 ± 236 | 0.009 | 0.723 | 0.114 | |
| RER | 0.82 ± 0.07 | 0.84 ± 0.09 | 0.286 | | 0.81 ± 0.07 | 0.74 ± 0.09 | 0.018 | 0.578 | **0.002** | **0.004** |

Values are mean ± SD.
RMR; resting metabolic rate, RER; respiratory exchange ratio.
* *P-value:* Mann–Whitney U test for group comparisons.
** Bonferroni correction with 2 variables.
P value in bold defines signficant differences.

**Table 4**
Eating behavior assessed by the TFEQ-R21 in women with PCOS and controls.

| | PCOS n = 72 | Controls n = 30 | Crude *P*-value* | Adjusted *P*-value** |
|---|---|---|---|---|
| Cognitive restraint | 41 ± 23 | 37 ± 23 | 0.30 | 0.30 |
| Uncontrolled eating | 42 ± 20 | 39 ± 15 | 0.68 | 0.63 |
| Emotional eating | 44 ± 28 | 37 ± 19 | 0.28 | 0.28 |

PCOS: polycystic ovary syndrome.
Values are Mean ± SD.
*Mann–Whitney U-test comparing PCOS *vs.* controls.
** Logistic Regression analysis for adjustment of age and BMI.

EAT-score among women with PCOS indicate altered eating attituds towards eating, specifically with respect to dieting. This may mean the women with PCOS struggle more with weight loss attempts and weight control.

Although a large proportion of women with PCOS are overweight or obese [32], weight management programs specifically designed for these women are sparse. Treatment with metformin is common resulting in increased insulin sensitivity and weight loss of a few kilograms at the beginning of the treatment. The weight loss management offered to obese women with and without PCOS is similar and basically includes dietary energy restriction and increased physical activity. To our knowledge, it has not previously been shown whether obese women with PCOS have different RMR compared with obese women without PCOS. If they do, this could be a physiological impairment making it more difficult for obese women with PCOS to lose weight. However, we found no difference in measured RMR between women with PCOS and controls which is in agreement with another small size studies reporting no differences in RMR [10]. On the contrary – RMR in a group of younger, non-obese women was lower in women with PCOS than in control women [9], and even lower in women with both PCOS and insulin resistance compared to women with only PCOS [9].

Previous studies on reported dietary intake provide no clear evidence for a specific relationship between dietary intake and PCOS. A higher self-reported intake of energy [8] and a higher intake of high glycemic index foods [8] have been found among women with PCOS, but others have found similar energy and macronutrient intakes between women with and without PCOS [7]. This indicates that women with PCOS might not report a different dietary intake than healthy women or that there are other factors that confound potential associations between dietary intake and PCOS, especially differences in terms of dietary assessment methodology. Here women with PCOS reported similar energy intakes but higher carbohydrate and lower alcohol intakes compared to controls. Although RER does not reflect macronutrient intake it does reflect macronutrient and alcohol oxidation. A higher carbohydrate intake and lower alcohol intake will give a higher RER compared with lower carbohydrate and higher alcohol intake. Others have reported low alcohol consumption but found no differences between women with PCOS and controls [7]. The fact that women with PCOS report a higher carbohydrate intake, and that overweight/obese women with PCOS have higher RER than overweight/obese controls, together with previous publications demonstrating that women with PCOS are insulin resistant and have larger adipocytes [19] suggests ongoing higher lipogenesis. However, without longitudinal data we cannot draw any conclusion from this.

A lack of clear differences between the groups in terms of eating behaviors could be because PCOS is not a main determinant of cognitive restraint, uncontrolled eating and emotional eating. On the other hand, the total EAT scores and the scores on the dieting subscale were higher in women with PCOS indicating altered eating behavior related to body weight. One possible explanation for lack of difference in eating behavior might be that the sample size was too small to detect differences.

Independent of BMI, women with PCOS had more concerns about their weight and about dieting. Health-related quality of life measurements indicates that menstrual problems and hirsutism are the two features that bothered women with PCOS the most. Thus it might be important for women with PCOS to discuss weight matters and to be offered help with this in the clinical setting. Importantly, overweight/obese women with PCOS in the present study have no more difficulties to reduce weight compared to controls. Regarding specific counseling, the relatively higher carbohydrate intake among women with PCOS requires more information of what type of carbohydrates. If women with PCOS eat or drink sugar-sweetened beverages on a regular basis, the dietary counseling should focus on decreasing these drinks and intake of energy dense foods with low nutrient density and on increasing intake of complex carbohydrates in terms of nutrient dense wholegrains and fiber-rich foods.

### 5.1. Methodological issues

The main strength of this study is that the dietary intake data are based on detailed dietary history interviews performed by a trained dietician. Also, RMR and RER were measured according to suggested standardized methods. Importantly, post-hoc power calculations demonstrate that the number of participants in the present study is sufficient to detect a difference in RMR and RER. If

**Table 5**
The Eating Attitudes Test (EAT-40) and the items of having bulimia now or in the past based on questions 15–18 from the psychiatric questionnaire.

| | PCOS n = 72 | Controls n = 30 | Crude *P*-value* | Adjusted *P*-value** | Bonferroni x 3*** |
|---|---|---|---|---|---|
| Total EAT score | 16.4 ± 10.1 | 7.8 ± 6.7 | **<0.001** | **0.001** | **0.003** |
| EAT score >29 | 6 [8]. | 1 [3]. | 0.36 | 0.55 | |
| Subscales of EAT | | | | | |
| Dieting | 7.3 ± 6.2 | 3.5 ± 4.0 | **0.001** | **0.024** | 0.072 |
| Bulimia and food fixation | 1.2 ± 2.3 | 0.5 ± 1.7 | 0.14 | 0.27 | |
| Oral control | 1.1 ± 1.9 | 0.4 ± 0.7 | 0.13 | 0.085 | |
| Bulimia questions 13–14 | | | | | |
| Bulimia now | 0 | 0 | – | – | |
| Bulimia before | 4 [6] | 2 [7] | 0.81 | 0.78 | |

Total EAT scores and subscale scores are given as mean ± SD.
EAT scores >29 and answers to current or previous bulimia are given as n (%).
PCOS; polycystic ovary syndrome.
*Mann–Whitney U-test or $\chi^2$ test comparing PCOS *vs.* controls.
** Logistic Regression analysis for adjustment of age and BMI.
*** Bonferroni correction with 3 variables.
P value in bold defines signficant differences.

the anticipated difference in mean of RMR is 90 and standard deviation (SD) 100, the samples size required for and Alpha of 0.05 and a power of 90% are 27 cases per group. For RER, if the anticipated difference in mean is 0.15 and SD 0.2, the samples size required for and Alpha of 0.05 and a power of 90% are 39 cases per group.

Limitations are that the two groups were unbalanced with respect to age and BMI. This selection bias may have affected the results although we tried to minimize that through adjustments in the statistical analyses. Further, for logistical reasons, we were not able to do dietary interviews or indirect calorimetry in all women that might affect the results. Dietary methodology always suffers from different mis-reporting that may affect the results. Both women with PCOS and controls were in relatively good health as potential participants and had no self-reported current physical/psychiatric disease or medication use. In addition, women with ongoing hormonal or other similar treatments were excluded. Thus, the results and conclusions in the present study cannot directly be generalized to those who are receiving pharmacological treatments.

In conclusion, women with PCOS do not appear to have a lower RMR than women without PCOS indicating that the ability to lose weight should not be any worse than for women without PCOS, at least not from an energy metabolism perspective.

## Author's contributions

LH, ML, POJ, and ESV conceived and designed the trial. LH, POJ, and ESV performed the trial. IL and EP analyzed the data. IL, LH, ML, EP, and ESV wrote the paper.

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## Conflict of interest

Authors have nothing to disclose.

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