Comparision of diet in women of reproductive age with and without diagnosed polycystic ovary syndrome – pilot study

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Introduction

Polycystic Ovary Syndrome (PCOS) affects 6% to 21% of women of reproductive age and is considered a common endocrine disorder [1–3]. This disorder is characterised by endocrine (hyperandrogenism) and biochemical abnormalities, irregular menstrual cycles, lack of ovulation, enlarged ovaries with numerous cysts and infertility [4–8]. There is a correlation between PCOS and obesity, hyperinsulinaemia and insulin resistance [7]. Different women suffering from PCOS have different and specific combinations of symptoms [9, 10]. Approximately 65% to 70% of these women have insulin resistance [11]. Insulin resistance and PCOS symptoms are aggravated by obesity [3, 12–14]. However, not all women with PCOS and/or insulin resistance are obese [3]. Besides medications, the main treatments for PCOS are weight reduction and lifestyle management practices with equivalent...
Aims of this study were to 1) determine the prevalence of 
PCOS in Croatia, and 2) compare anthropometric and 
physiological characteristics of women with PCOS and 
healthy counterparts.

Methods

The inclusion criteria for women with PCOS were age (18 to 41 years) and a PCOS diagnosis based on Rotterdam Criteria made by the gynaecologist (Gynaecological Office Lončar, Karlovac, Croatia) [18]. The controls, the inclusion criteria were age (18 to 41 years), absence of PCOS and/or other diagnoses indicative of hormonal imbalance. A total of 12 women with PCOS and 20 healthy counterparts were recruited over a six-month period (October 2013 to March 2014). Pairing was done on the basis of the set criteria between 12 women with PCOS and 16 healthy women. Four of the healthy women did not fulfill the criteria between 12 women with PCOS and 16 healthy women. The prevalence of PCOS among women of reproductive age in Croatia is unknown [19]. The strength of the study was determined with the power analysis method based on the number of women with PCOS recruited for the study (12 women, minimum strength 80%, significance 0.05, two-sided, minimum detectable difference 0.899 units). The study protocol was approved by the Ethical Committee for the Research on People from the University of Osijek, Faculty of Food Technology. The study participants were informed in detail about the study and written consent was obtained from all of them.

After recruitment, each woman filled in a “24-Hour Diet Recall” and a “Survey on the Basic Data, Dietary Habits, and Physical Activity”. The women with PCOS had additional questions on their gynaecological health added to the “Survey on the Basic Data, Dietary Habits, and Physical Activity” and they also filled out a “Questionnaire on Polycystic Ovary Syndrome” (adapted according to Cronin et al.) [9]. The controls filled in a separate “Questionnaire on Gynaecological Health”.

The “Survey on the Basic Data, Dietary Habits, and Physical Activity” provided data on age, socio-economic information (work status, salary, living conditions, etc.), dietary habits (number of meals per day, place of consumption, desire to experiment with food, food preferences, eating after feeling satiety, eating breakfast, eating dinner, and the consumption of dairy products, fruits and vegetables, potatoes, meat, fish, salt, fast food, candy, water, juices, coffee, sugar, alcohol, and dietary supplements) and physical activity (physical activity at work, physical activity during free time and participation in sports). The “Questionnaire on Gynaecological Health” filled in by healthy women and questions related to gynaecological health in the “Survey on the Basic Data, Dietary Habits, and Physical Activity” filled in by the women with PCOS investigated menstrual cycle, pregnancies and general gynaecological health in both groups.

Research was conducted at the University of Osijek, Faculty of Food Technology, Department of Food and Nutrition Research laboratory. Medical documentation on the history and course of PCOS was provided by the gynaecologist (Gynaecological office Lončar, Karlovac, Croatia).

Both groups of women were measured for body weight with Tanita BC-601 (Tanita Corporation, Japan) scale (±0.1 kg), body height without shoes with the position of the head in the Frankfurt plane (±0.1 cm) with portable stadiometer Seca 123 (Seca, Germany) and waist and hip circumferences with measuring tape NCD Medical/Medical Prestige (Prestige Medical, USA). Body mass index (BMI) of participants was calculated with measured weight and height data. BMI was used to group women into the following categories: underweight (BMI<18.5 kg/m²), normal (18.5 to 24.9), overweight (25.0 to 29.9) and obese (30.0 to> 40.0) [20].

Data on blood glucose and sex hormones (testosterone overall, estradiol - E2, follicle stimulating hormone - FSH and luteinizing hormone - LH) for women with PCOS were obtained from the patients’ medical documentation. All tests (hormones and blood glucose) were performed according to the standards of the good professional practice at an authorized Croatian medical biochemical laboratory [21]. Glucose levels were determined by the standard photometry UV and the hexokinase with glucose oxidase methods [22]. For the determination of hormones (testosterone overall, estradiol (E2), FSH and LH), blood samples were collected between the third and seventh day of the menstrual cycle as recommended by the PHSVP [23]. Sex hormones were measured according to the manufac-
The degree of physical activity was calculated from the “Survey on the Basic Data, Dietary Habits, and Physical Activity” for women with PCOS and the controls, adapted for Croatian language from Baecke et al. [26]. Three separate dimensions of physical activity were assessed: working time activity, sport activity, and free time activity (details in the original reference work) and converted into indices [28].

The statistical analysis was performed with the Statistica software system (version 12.0, StatSoft Inc., USA) to the chosen level of significance at p=0.05. The categorical variables were presented as the absolute and relative frequencies while the numerical data were presented with the use of descriptive statistical methods (mean and standard deviation).

A Chi-square test was used to compare categorical variables within and between the groups. The differences between the two dependent groups were tested with the t-test for dependent measurements, that is, using the t-test for independent measurements in the groups and the variables. An analysis of variance was performed with ANOVA. The Pearson correlation test was used for calculating the correlation of the numerical data.

### Results and Discussion

The mean BMI was $27.4 \pm 8.5\, \text{kg/m}^2$ and $23.1 \pm 3.1\, \text{kg/m}^2$ in the women with PCOS and in the controls, respectively. The difference between these two BMI values is statistically significant ($p = 0.046$). This is in accordance with the findings of a 13-year research conducted by Moran et al. [4] stating that the mean BMI in women with PCOS is higher. The mean waste hip ratio (WHR) was $0.9 \pm 0.2$ and $0.8 \pm 0.1$ in the women with PCOS and in the controls, respectively, which is not statistically significant.

The collected biochemical data showed the typical PCOS phenotype for the women with PCOS (41.7% high LH, 41.7% high testosterone, 16.7% elevated glucose, 16.7% glucose on the upper level, 100% polycystic ovaries on ultrasound). The women with high LH did not have high testosterone and vice versa. Pavičić Baldani has shown that Croatian women with PCOS have poly-
cystic ovaries on ultrasound, elevated LH, elevated total and free testosterone, elevated insulin, low sex hormone-binding globulin (SHGB) and FSH [19]. Radulović et al. [29] in their retrospective study on 39 women with PCOS found that 43% of overweight/obese women with PCOS found that 43% of overweight/obese women with PCOS had eating habits similar to those of healthy women except that the women with the typical PCOS phenotype ate foods associated with higher GI [2]. After further analysis of the responses to the “Survey on the Basic Data, Dietary Habits, and Physical Activity” it was evident that the analysed women with PCOS showed a tendency towards higher GI foods (e.g., 33.3% of the women with PCOS vs 0% of the controls ate cakes/sweets every day, 33.3% of the women with PCOS vs 18.8% of the controls ate bakery products for dinner, 16.6% of the women with PCOS vs 31.3% of controls never put additional sugar in their food/beverage), which contributed to their lower score on dietary habits.

The total energy intake of both groups of women was calculated as the percentage of the RDA intake based on the nutritional requirements of 2,333 kcal. The results showed that women with PCOS had a slightly higher average energy intake (82.25%±39.41%) than the controls (69.97%±26.33%). This difference did not prove to be statistically significant in multivariate analysis together with socio-economic data and anthropometry. However, Graff et al. and Moran et al. found that the women with PCOS had a higher calorie intake than the healthy ones [2, 4].

The macronutrient intake for both groups has been expressed as a percentage of total daily energy intake. The average energy intake from carbohydrates (CHO) was 43.48%±8.69% and 40.85±11.91% for the women with PCOS and for the controls, respectively. In addition, the average energy intake of protein was 17.67%±4.68% and 16.56±4.44 for the women with PCOS and for the controls, respectively, while the average energy intake from fat was
Table 3. Correlation of selected variables with energy intake and macronutrient intake based on the “24-hour diet recall” – controls (n = 16)

<table>
<thead>
<tr>
<th>Selected variable</th>
<th>kcal</th>
<th>Protein kcal</th>
<th>Plant protein kcal</th>
<th>Animal protein kcal</th>
<th>Fat total kcal</th>
<th>SF(^\text{§§}) MUFA(^<em>) (\text{PUFA}^</em>)</th>
<th>Chol(^<em>) SF(^</em>) MUFA(^<em>) (\text{PUFA}^</em>) acid Linoleic acid (\text{Hol.}^*)</th>
<th>Chol(^*) total</th>
<th>CHO(^*) simple complex</th>
<th>CHO(^*) fibre</th>
<th>CHO(^*)</th>
<th>CHO(^*)</th>
<th>CHO(^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age/Godine</td>
<td>0.63(^*)</td>
<td>0.33</td>
<td>0.40</td>
<td>0.19</td>
<td>0.59(^*)</td>
<td>0.55(^*)</td>
<td>0.51(^*)</td>
<td>0.53(^*)</td>
<td>0.52(^*)</td>
<td>0.51(^*)</td>
<td>0.21</td>
<td>-0.04</td>
<td>-0.00</td>
</tr>
<tr>
<td>Household members/U/kacant</td>
<td>-0.23</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.21</td>
<td>-0.24</td>
<td>-0.10</td>
<td>-0.26</td>
<td>-0.26</td>
<td>0.04</td>
<td>-0.08</td>
<td>-0.10</td>
<td>0.22</td>
</tr>
<tr>
<td>Smoking/Pasjenje</td>
<td>-0.34</td>
<td>-0.23</td>
<td>-0.38</td>
<td>-0.04</td>
<td>-0.15</td>
<td>-0.15</td>
<td>-0.16</td>
<td>0.04</td>
<td>0.11</td>
<td>0.02</td>
<td>-0.37</td>
<td>-0.55(^*)</td>
<td>-0.17</td>
</tr>
<tr>
<td>BMI(^<em>)/ITM(^</em>)</td>
<td>0.14</td>
<td>0.11</td>
<td>0.12</td>
<td>0.09</td>
<td>0.16</td>
<td>0.10</td>
<td>0.14</td>
<td>0.31</td>
<td>0.34</td>
<td>-0.14</td>
<td>-0.01</td>
<td>-0.10</td>
<td>0.04</td>
</tr>
<tr>
<td>Waist/Struk (W)</td>
<td>0.14</td>
<td>0.28</td>
<td>0.30</td>
<td>0.19</td>
<td>0.04</td>
<td>-0.00</td>
<td>0.05</td>
<td>0.12</td>
<td>0.13</td>
<td>-0.15</td>
<td>0.16</td>
<td>0.00</td>
<td>0.28</td>
</tr>
<tr>
<td>Hips/Kukovi (H)</td>
<td>0.42</td>
<td>0.61(^*)</td>
<td>0.51(^*)</td>
<td>0.50</td>
<td>0.14</td>
<td>0.07</td>
<td>0.08</td>
<td>0.27</td>
<td>0.31</td>
<td>0.29</td>
<td>0.47</td>
<td>0.05</td>
<td>0.36</td>
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<tr>
<td>W/H/WH</td>
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<td>-0.02</td>
<td>0.09</td>
<td>-0.07</td>
<td>-0.02</td>
<td>-0.02</td>
<td>0.04</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.38</td>
<td>-0.08</td>
<td>-0.01</td>
<td>0.13</td>
</tr>
<tr>
<td>Sum points</td>
<td>0.04</td>
<td>0.03</td>
<td>0.08</td>
<td>-0.01</td>
<td>0.04</td>
<td>-0.08</td>
<td>0.18</td>
<td>-0.11</td>
<td>-0.16</td>
<td>0.02</td>
<td>-0.02</td>
<td>0.37</td>
<td>-0.37</td>
</tr>
<tr>
<td>Sama poena</td>
<td>0.05</td>
<td>0.08</td>
<td>0.37</td>
<td>-0.16</td>
<td>-0.09</td>
<td>-0.11</td>
<td>0.00</td>
<td>-0.25</td>
<td>-0.24</td>
<td>-0.15</td>
<td>0.27</td>
<td>0.10</td>
<td>0.47</td>
</tr>
<tr>
<td>Work index</td>
<td>0.19</td>
<td>0.20</td>
<td>-0.19</td>
<td>0.40</td>
<td>-0.18</td>
<td>-0.20</td>
<td>-0.07</td>
<td>-0.21</td>
<td>-0.20</td>
<td>-0.01</td>
<td>-0.16</td>
<td>-0.26</td>
<td>-0.25</td>
</tr>
<tr>
<td>Indeks posta</td>
<td>-0.09</td>
<td>0.32</td>
<td>0.13</td>
<td>0.34</td>
<td>-0.39</td>
<td>-0.44</td>
<td>-0.34</td>
<td>-0.46</td>
<td>-0.43</td>
<td>0.45</td>
<td>0.36</td>
<td>0.27</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* statistical significance at p<0.05, the Pearson correlation test/statistička signifikantnost pri p < 0,05, Pirsonov test korelacije; §§ – saturated fats/zašičene masti; § – monounsaturated fats/mononezasićene masti; † – polyunsaturated fats/polinezasićene masti; ‡ – cholesterol/colesterol; ¶ – carbohydrates/ugfjerni hridati; ¶¶ – Body Mass Index/index telesne mase

Intake of fibre proved to be slightly higher in the women with PCOS compared to the controls (Table 1), which corresponds to the findings of Altieri et al. [17].

The correlation analysis results for variables from the questionnaires for the women with PCOS (Table 2) show statistically significant positive correlations between work index and intake of polysaccharides (p=0.68) and plant protein (p=0.64). A higher sport index has a statistically significant negative correlation with CHO intake from fibre (p=-0.70) and plant protein (p=-0.61). Due to the small number of women with PCOS who reported practicing sports, these results should be taken with caution. There is a statistically significant positive correlation between the total fat intakes and waist circumference (p=0.62) and WHR (p=0.59). In addition, a statistically significant correlation was found between the age and the intake of total CHO (p=0.61) and plant proteins (p=0.61).

For the women with PCOS, the number of household occupants, smoking and sports are negatively correlated with the intake of macronutrients, although not statistically significant (Table 2). Inclusion of a larger number of women with PCOS might have resulted in a statistical significance for some or all of the identified parameters. For the controls, this negative correlation (without statistical significance) was established only for some macronutrients.

40.09%±7.70% and 43.60±11.97 for the women with PCOS and for the controls, respectively. It should be noted that one woman from the control group was on a low CHO diet and her energy intake from fat (79.6%) was high; thus, it can be concluded that without her data the average energy intake from fat for the controls would be slightly lower while CHO intake would be slightly higher. The results show minor differences in macronutrient intake when the women with PCOS consume slightly more CHO and protein and slightly less fat than the controls, but these differences have not proved to be statistically significant after the multivariate analysis with the socio-economic data and anthropometry (Table 1). Altieri et al. also found that the women with PCOS consume less energy from fats and eat more cheese, desserts high in GI, fibre and oil [17]. In addition, Altieri et al. have not determined the differences in intakes of macronutrients and energy between the healthy women and the women with PCOS, while Douglas et al. found similar macronutrient intake in the women with PCOS and those who did not have PCOS, noting that women with PCOS consumed large amounts of high GI foods [15, 17]. Douglas et al. concluded that this difference should be explored together with all the factors affecting glycaemic characteristics of the diet consumed by the women with PCOS [15].
The correlation analysis for the controls showed a statistically significant correlation between the following variables (Table 3): age and energy (p=0.63), age and total fat (p=0.59), age and saturated fats (SF) (p=0.55), and age and monounsaturated fats (MUFAs) (p=0.51), age and polyunsaturated fats (PUFAs) (p=0.53), age and linoleic acid (p=0.52), age and cholesterol (p=0.51), smoking and monosaccharides (p=0.55), hips and total protein (p=0.61), and hip and plant protein (p=0.51).

The correlations in the controls for the age and nutrient intake were similar in the women with PCOS. However, as they aged, the women from the control group increased fat intake and total energy intake while the women with PCOS increased intake of total CHO and plant protein. These results suggest that as they get older women with PCOS should focus on reducing total CHO and plant protein when trying to lose weight in an attempt to manage PCOS symptoms.

The “Questionnaire on the Polycystic Ovary Syndrome” showed that the patients with PCOS exhibit all the relevant PCOS symptoms (excessive body weight, growth of visible body hair, visible facial hair, upper lip hair, beard, irregular menstrual periods, delayed menstruation, menstrual cramps, abdominal bloating and headaches during menstruation) [9]. The responses to the “Questionnaire on the Gynecological Health” showed that the controls generally reported regular and mostly regular menstrual periods that were not very painful with pain lasting one to three days and periods with low or medium bleeding.

Physical activity levels showed a statistically significant difference (t-test: p=0.043 and ANOVA: p=0.004) only for the index of free time in favour of the controls who were more active (Table 4). This corresponds with the results obtained by Moran et al. who found that the women with PCOS spent more time sitting and had a lower degree of physical activity [4].

Conclusion

This study has shown that in Croatia the women with polycystic ovary syndrome compared to the controls have significantly poorer dietary habits with characteristics of a diet high in glycaemic index; statistically non-significant higher energy intake from carbohydrates and protein with lower energy intake from fat; positive significant correlation between age and carbohydrates intake (the controls have a positive significant correlation between age and fat intake); statistically non-significant higher average energy intake; as well as more problems with irregular menstrual cycles and other polycystic ovary syndrome symptoms and they are significantly less physical active during free time.

A weakness of the study is the small sample size. However, the strength of the study was sufficient to identify potentially relevant differences in dietary and lifestyle habits of women with polycystic ovary syndrome as compared to controls.

References


23. Committee for harmonization of specialists and highly differential tests (PHSVP). Harmonization of specialists and highly differential tests in the area of medical biochemistry, laboratory immunology and analytical toxicology, Croatian Chamber of Medical Biochemists. Zagreb: PHSVP; 2005.


