

UNIVERSIDADE FEDERAL DE UBERLÂNDIA
FACULDADE DE MEDICINA
PROGRAMA DE RESIDÊNCIA EM ÁREA PROFISSIONAL DA SAÚDE
(UNI E MULTIPROFISSIONAL)

CATARINA MENDES SILVA

QUALIDADE DA DIETA DE MULHERES COM SÍNDROME DO OVÁRIO
POLICÍSTICO: UM ESTUDO CASO-CONTROLE

UBERLÂNDIA
2018

CATARINA MENDES SILVA

**QUALIDADE DA DIETA DE MULHERES COM SÍNDROME DO OVÁRIO
POLICÍSTICO: UM ESTUDO CASO-CONTROLE**

Trabalho de Conclusão de Residência apresentado ao Programa de Residência em Área Profissional da Saúde (Unidade Multiprofissional) da Faculdade de Medicina da Universidade Federal de Uberlândia, como pré-requisito para obtenção do título de especialista em Nutrição Clínica.

Orientador: Prof^a. Dr^a. Daurea Abadia de Souza

UBERLÂNDIA

2018

**DIET QUALITY OF WOMEN WITH POLYCYSTIC OVARY SYNDROME: A
CASE-CONTROL STUDY**

Catarina Mendes Silva^a, Camila Toffoli Ribeiro^b, Nayara Bernardes da Cunha^a,
Ana Carolina Japur de Sá Rosa e Silva^c, Daurea Abadia De-Souza^{d*}

^a Multidisciplinary Residency Program in Clinical Nutrition, Multidisciplinary
Residency in Health, Faculty of Medicine, Federal University of Uberlândia,
Uberlândia, Minas Gerais, Brazil.

^b Department of Gynecology and Obstetrics, Faculty of Medicine, Federal
University of Uberlândia, Uberlândia, Minas Gerais, Brazil.

^c Department of Gynecology and Obstetrics, Faculty of Medicine, University of
São Paulo, Ribeirão Preto, São Paulo, Brazil.

^d Department of Internal Medicine, Faculty of Medicine, Federal University of
Uberlândia, Uberlândia, Minas Gerais, Brazil.

*Corresponding author: Daurea Abadia De-Souza, Faculty of Medicine, Federal
University of Uberlândia. Av. Pará, 1720, Bloco 2H, Sala 16, 38405-320,
Uberlândia, Minas Gerais, Brazil.

Fax: +55-34-3225-8602. E-mail: daureas@ufu.br

Abbreviations: PCOS, Polycystic Ovary Syndrome; DXA, Dual-Energy X-ray
Absorptiometry; BIA, Bioelectrical Impedance Analysis; HEI, Healthy Eating
Index; AHEI, Adapted Healthy Eating Index; BMI: body mass index; WC: waist
circumference.

Abstract

Background & Aims: Food intake is one of the factors that contributes to overweight/obesity in women with PCOS. The aim of the present study was to investigate the food intake, nutritional status and body composition of women with and without PCOS.

Methods: Women with PCOS (n=34) according to Rotterdam criteria were compared to controls (n=29) matched by body mass index (BMI) and age. Anthropometric assessment included weight and height to calculate BMI, and waist and hip circumference. The body composition was evaluated by Bioelectrical Impedance Analysis (BIA) and Dual-Energy X-ray Absorptiometry (DXA) methods. The food intake was evaluated by 24-hour food recall, used to compare to recommendation of Adapted Food Pyramid and for calculate the Adapted Healthy Eating Index (AHEI).

Results: Obese PCOS women had lower fiber consumption when compared to healthy weight PCOS and healthy weight controls ($p = 0.011$). For the other food groups of the Adapted Food Pyramid there were not found significant differences. PCOS women presented lower score for the fruit group in the AHEI when compared to women in the control group ($p = 0.029$). For overall score, both groups were classified as diet that “need improvement”.

Conclusions: For PCOS patients the routine adoption of a balanced diet should be included in the primary treatment of the disease. Special emphasis should be given to the increase in the fiber and fruit consumption.

Keywords: Polycystic Ovary Syndrome; Food intake; Adapted Healthy Eating Index; Fiber consumption; Dual-Energy X-ray Absorptiometry; Body composition

1 Introduction

2 Polycystic ovary syndrome (PCOS) is the most common endocrine
3 disorder among women of reproductive age.¹ Although pathophysiological
4 changes and clinical manifestations of PCOS are well known, some researchers
5 have highlighted the importance of associated metabolic disorders, including the
6 risk of developing type 2 diabetes mellitus and cardiovascular diseases.²

7 Controversial results are identified in the literature about the prevalence of
8 overweight / obesity in women with PCOS when compared to women who do not
9 have the syndrome.³⁻⁵ However, in women with PCOS, the development of the
10 obesity aggravates the pathophysiological alterations and clinical manifestations
11 of the syndrome.

12 Besides that, obesity impairs PCOS treatment.^{3,6} Although, the
13 mechanisms are not completely addressed, recent data have suggested that
14 dietary management and physical exercise improve reproductive function
15 possibly via an insulin sensitivity-enhancing mechanism⁷ and may affect serum
16 anti-Müllerian hormone (AMH).⁷⁻⁸

17 Food intake is one of the factors that contributes to overweight / obesity.
18 Regardless there is no consensus in the literature, some researchers have shown
19 that PCOS women have excessive calorie intake from high-fat foods and / or
20 carbohydrates.^{3-4,6,9} However, other studies failed to detect any differences
21 between dietary habits of PCOS women and controls.¹⁰⁻¹²

22 The Healthy Eating Index (HEI) is a method used to assess food intake,
23 created by United States Department of Agriculture, Center for Nutrition Policy
24 and Promotion (CNPP) (USDA, 1989-1990). This index was adapted by Mota et
25 al., according to Adapted Brazilian Pyramid Food¹⁴, resulting in the Adapted

Healthy Eating Index (AHEI).¹³⁻¹⁴ The AHEI has been used to evaluate food intake of different populations, including women with PCOS⁴ and other situations.¹⁵⁻¹⁶

Thus, it is very important to investigate the factors related to overweight / obesity in PCOS women. The aim of the present study was to investigate, according with body mass index (BMI), the food intake, nutritional status and body composition of women, with and without PCOS, from the Gynecological Clinic at a public university hospital of high complexity in Brazil. We hypothesize that women with PCOS have worst food consumption compared to women without PCOS.

Methods

Subjects and ethics

Subjects and ethics

The present study is a case-control design and was developed with 63 women (34 PCOS cases and 29 controls), paired by age and BMI, from Gynecology Clinic of the Clinical Hospital of Uberlândia, Federal University of Uberlândia, Uberlândia, Minas Gerais, Brazil.

Recruitment consisted of folders distributed on campus, messages via email and verbal communication informing women about the research and inviting them to participate in the study. The inclusion criteria for cases were women aged between 18 and 35 years old, classified with PCOS according to Rotterdam consensus criteria¹⁷ and that accepted to participate in the research through the signature of the consent term. Inclusion criteria for the control group were women in the same age and BMI range ($BMI \pm 2\text{kg/m}^2$), presenting

spontaneous regular menstrual cycles, without history of infertility. Exclusion criteria were use of hormonal medication in the last 3 months prior the study; use of oral hypoglycemic or weight loss inducing medications; diagnosis of other endocrinopathies; pregnancy or lactation. The study was approved by the Ethics Committee of the Federal University of Uberlândia.

Evaluations

When anthropometric variables, body composition and energy and macronutrient consumption were evaluated, the participants were divided in four groups, according to BMI (healthy weight PCOS women; obese PCOS women; healthy weight control women; obese control women). For food consumption, comparisons were made between women with and without PCOS groups.

Preliminary questionnaire

It was developed and applied a structured questionnaire asking about weight history (including usual weight); previous nutritional care; use of supplements; diseases and previous surgical procedures; use of medications; practice of physical exercise; family background of diseases; sociodemographic characteristics (age); and personal information (schooling, profession, telephone).

Food intake evaluation

Food intake was determined through a 24-hour food recall, a retrospective method to assess past food consumption. It is considered a practical and easy-to-apply method, but due care must be taken by the interviewer to avoid

influencing and not having approval or disapproval of the interviewer.¹⁸ Through the food survey cited, the interviewer notes and quantifies everything that the individual consumed in the 24 hours prior to the interview. Portion sizes were estimated using common household measurements such cups, glasses, bowls, teaspoons and tablespoons, in addition to individual food items / units. For the evaluation of the 24-hour food recall, a database was created in the Excel program with foods usually consumed by the volunteers. Dietary data reported as home measures was converted to milliliters or grams to facilitate the assessment of the chemical composition, which was performed using the food composition chart, in addition to the manufacturers' nutritional labels and based on the number of servings.¹⁴

Quality of food intake

The AHEI was used to assess the diet quality of PCOS and control women. To this end, the reported foods were converted into portions according to the energy content of the food groups and the Adapted Food Pyramid.¹⁴ The AHEI assess 12 components of the diet. Eight components refer to the groups of the Adapted Food Pyramid. Three components refer to specific nutrients: total fat, saturated fat, and cholesterol. One component assesses diet variety. Each component receives a score ranging from 0 to 10 according to the adequacy of intake compared with the recommendation. As the intake becomes closer to the recommended amount, a higher score is given to the component. Intermediate scores were calculated proportionately. For the groups of the Adapted Food Pyramid, it was observed that the proper range per day with respect to cereals would be 5 to 9 servings; vegetables, 4 to 5 servings; fruits, 3 to 5 servings; meat

and eggs, 1 to 2 servings; milk and dairy products, 2 to 3 servings; beans, 1 serving; oils and fats, 1 to 2 servings; and sugars, 1 to 2 servings. Fat intakes less than or equal to 30% of the total calories were assigned a score of 10 points. The score declined to 0 when the proportion of fat to total calories reached 45%. A score of 10 points was assigned to saturated fat intakes of less than 10% of total calories. Zero points were assigned when the saturated fat intake reached a level of 15% of the total calories. The maximum point value for cholesterol was assigned when its intake was at a level of 300mg or less per day. Zero point was assigned when intake reached a level of 450mg or more of cholesterol per day. Intakes between 30% and 45% of fat to total calories, between 10% and 15% of saturated fat, and cholesterol between 300mg and 450mg were scored proportionately. For diet variety, a maximum score (10 points) was assigned if seven items or more different food items were consumed over a 1-day period. A score of 0 was given if four or fewer different items were eaten. From the sum of all components, the diets were classified as follows: good quality (over 100 points), needs improvement (71-100 points), and poor quality (under 71 points).¹³

Anthropometric evaluations

The body mass measurements were performed with a balance (Welmy® W300, 0.1kg precision). Each volunteer was weighed standing, barefoot, wearing light clothes, with arms at her side and eyes fixed on a point in front of woman. During measurements, individuals moved as little as possible, to avoid oscillations of the readings being obtained.¹⁹

A vertical stadiometer (Welmy® W300, accurate to 0.5cm) was used to measure height. Each volunteer was positioned on the base of the stadiometer,

barefoot, erect, with arms hanging freely and feet together, trying to make the back surfaces of the heels, pelvic waist, scapular waist and occipital region touch the measurement scale. By means of a cursor, the distance between the plantar region and the vertex, when holding the breath in an inspired position and with the head oriented parallel to the ground – the “Frankfurt plan” – was determined.¹⁹ Height and weight were used to calculate the BMI (kg/m^2). A BMI ≥ 18.5 and ≤ 24.9 was classified as “normal” and BMI $> 29.9 \text{ kg}/\text{m}^2$ was considered “obesity”.²⁰

For the measurement of waist circumference (WC) and hip circumference (HC) an inextensible anthropometric tape was used (Sanny Medical, SN-4010, 0.5 cm of precision). The measurement was made at the midpoint between the last rib and the iliac crest. The WC value used to indicate abdominal obesity is in accordance with the definitions of the World Health Organization ($> 80 \text{ cm}$).²⁰

Body composition

Bioelectrical Impedance Analysis (BIA)

For the measurement for body composition, it was used Biodynamics 310e, TBW©. During the experiment the individual should remain lie down, with the legs apart and the arms parallel, away from the trunk. The electrodes are placed in specific locations of the dominant hand and foot. An imperceptible current is introduced into the distal electrodes and is picked up by the proximal electrodes. The percentages of body water, lean body mass and body fat are calculated.²¹

Dual-energy X-ray absorptiometry (DXA)

DXA was made of full body using Lunar Prodigy DXA System, software version 11.20. The participants were asked to not use metallic objects during the exam. It was measured the quantity of body fat and lean mass and obtained information about body fat distribution in the android and gynoid compartments. Specifically, compartments related to android and gynoid fat were identified (for android fat - lower limit: horizontal line connecting the anterior superior iliac spines; upper limit: defined as 20% above the lower border; lateral boundaries: waist margins parallel to the chin line; for gynoid fat – upper limit: upper trochanter; lower limit: 96mm of the greater trochanter, lateral limits: delimited by the subcutaneous tissue of the hip.²¹

Statistics

The data was analyzed using SPSS 21.0 software (IBM SPSS Statistics 21). First, the normality of data was tested using the *Shapiro-Wilk test*. The values were presented as the means and standard deviation for normal data, or as median and interquartile range for non-normally distributed data. The *Student's t-tests* were used for normal distributed data when the comparison was made only between PCOS women and controls. For non-normally distributed data, the *Mann-Whitney* test was used. To compare women with PCOS and controls according with BMI, for normally distributed data, the ANOVA and *Tukey* post-hoc analysis were used. For non-normally distributed data, the *Kruskal-Wallis* with *Dunn's* post-hoc test was used. Statistical tests with $p < 0.05$ were accepted as significant.

Results

Anthropometric characteristics, and body composition according to the BMI, for participants with PCOS and controls were shown in Table 1. For anthropometric characteristics, obese PCOS presented higher values compared to healthy weight PCOS for current weight ($p<0.001$), WC ($p<0.001$), HP ($p<0.001$), and BMI ($p<0.001$). Similar results were identified to control group, i.e., significant differences were observed for obese controls versus healthy weight controls in relation to current weight ($p<0.001$), WC ($p<0.001$), HC ($p<0.001$), and BMI ($p<0.001$).

For body composition, obese PCOS presented higher values of body fat mass than healthy weight PCOS ($p=0.003$), and lower values for muscle mass ($p=0.003$). Lastly, obese PCOS women presented higher basal metabolic rate than healthy weight women with PCOS ($p<0.001$). Similar results were identified to control group, i.e., obese controls women presented higher values of body fat mass than healthy weight control ($p<0.001$), and lower values for muscle mass ($p<0.001$). In addition, obese control women presented higher basal metabolic rate than healthy weight control women ($p<0.001$).

In relation to composition evaluated by DXA for total fat mass, gynoid and android fat, obese PCOS had higher values compared to healthy weight PCOS ($p<0.001$ for all parameters). Obese controls also had higher values compared to healthy weight controls ($p<0.001$ for fat mass, gynoid and android fat).

Dietary pattern of women with and without PCOS were shown on Table 2. It was observed that obese PCOS presented lower values of energy in kilocalories per kilo than healthy weight PCOS ($p=0.017$). However, it was not found significant difference between obese control and healthy weight control

($p=0.092$). For carbohydrate in grams per kilo, obese PCOS had lower values compared to healthy weight PCOS ($p=0.009$), while there was no significant difference between obese control and healthy weight control ($p=0.001$). About protein consumption, also in grams per kilo, no significant difference was found between obese PCOS and healthy weight PCOS, but obese control presented lower consumption of protein compared to healthy weight control ($p=0.015$). At least, the fiber intake in grams per kilo was lower in obese PCOS women than in healthy weight PCOS women ($p=0.031$). It was also found significant difference between obese controls and healthy weight controls ($p=0.013$).

The results of food intake of PCOS women and control women according to food groups of Adapted Food Pyramid were shown in Table 3. There were made comparisons of food intake for each group with the food groups recommended by Phillipi et al.¹⁴ When the consumption by food groups was compared to the recommendation, for both PCOS and controls, the consumption of cereals, bread and pasta, and vegetables, milk and dairy products and beans groups were below recommended (Table 3). However, the consumption of meat and eggs group, was above the recommendation for PCOS ($p<0.001$) and controls women ($p<0.001$). The PCOS women had lower consumption of portions of fruit group when compared to controls (0.00 portions vs. 0.78 portions, respectively; $p=0.029$). However, both groups presented consumption below the recommended for this group.

The components and global score for AHEI of PCOS women and controls were shown on Table 4. There was a significant difference of fruits score between PCOS women and controls (0.00 point versus 2.61 points, respectively; $p=0.028$). For the other scores, there were not significant differences between groups.

Discussion

In the present study were identified that obese PCOS women had lower fiber consumption when compared to healthy weight PCOS and healthy weight controls. It is not yet established consensus in relation to dietary fiber intake in obese PCOS patients, healthy weight PCOS, healthy controls weight, and obese controls. In only study found comparing overweight / obese PCOS (n = 100) and healthy weight PCOS (n = 80), matched by age and BMI and using 7-day food registry, there were no differences in dietary fiber consumption between groups (p = 0.09).²²

Other localized studies compared PCOS and controls groups only. A recent study, that evaluated PCOS patients (n = 280) and controls (n = 472), matched by age and using a food frequency questionnaire, it was identified that PCOS women had lower whole grains consumption than controls (p = 0.004).⁹ At least, in the study developed by Moran et al., investigating the contribution of diet to BMI in women with (n = 409) and without (n = 7466) PCOS, using a food frequency questionnaire, it was demonstrated that PCOS group had higher fiber consumption compared to control group (p = 0.001).²² Although the results of the present study and that obtained by Eslamian et al. and Moran et al.^{9,23}, most of the studies identified in the literature did not find significant differences in fiber consumption between PCOS women and controls.^{11-12,24-25}

The lower fiber intake observed for obese PCOS women in the present study is related to fruits and fruit juices group (servings/day) consumption identified by 24-hour food recall. It was observed that PCOS women presented lower score for the fruit group in the AHEI when compared to women in the control group. Fruits are important foods because they are sources of fiber, vitamins and

minerals. In addition, several fruits have been classified as functional foods, i.e., present in their composition antioxidants, phytoestrogens and anti-inflammatory agents, that prevent the development of several diseases, and improve health for different mechanisms.²⁶⁻²⁷ Adequate fruit consumption is a prominent topic in the healthy eating practices of all people, including women with PCOS.

Nybacka, Hellström and Hirschberg evaluated the interventional effects of dietary management of PCOS women (n = 57) for 16 weeks.⁷ The investigators identified that the strongest predictor of reduced BMI was increased fiber intake ($r = -0.44$, $p = 0.03$). According to the authors, low saturated fat and trans fatty acids consumption also contributed to improve BMI values. Thus, though it is recommended for all individuals, women with PCOS in dietary regimens must increase fiber intake and decrease fat consumption according to Dietary Reference Intakes (DRIs).²⁸ It is necessary to clarify that it is sufficiently demonstrated in the literature the benefits of fiber intake for several diseases, especially coronary heart disease, hypertension, diabetes, obesity and certain gastrointestinal disorders.^{26,29-30}

In the present study, it was identified that obese PCOS consumed less energy, with special attention for lower carbohydrate consumption, compared to healthy weight PCOS and healthy weight controls. In addition, was demonstrated that protein consumption in grams per kg was lower in obese PCOS women and obese controls compared to healthy weight controls. Similar results were demonstrated by Zhang et al., which observed that PCOS group had lower carbohydrate consumption than controls ($p=0.01$, respectively).³¹ About food consumption, the results found in literature are controversial. While PCOS women consumed more energy and fat in some studies^{3,9,23,31}, in others no

significant difference in food intake was found.^{10-12,24} However, it is possible that obese subject, independent of PCOS, underreported their food intake.³²

It was not found significant difference in the overall AHEI score for PCOS and controls groups. Regardless of PCOS, it was identified by AHEI score that participants need to promote major changes in dietary pattern, i.e., both groups need improvements in dietary intake. For PCOS groups, the highest scores obtained were for meat and eggs group, oils and fats group, sugar and sweets group, cholesterol and diversity groups. Similar results, i.e., "needs improvements" and "inadequate diet" evaluation for PCOS women (n = 100), were also identified by Rodrigues et al., using the Brazilian Healthy Index – Revised (BHEI-R), to assess dietary patterns. The highest scores were for oil, total vegetables and dark green and orange vegetables.⁴

When food intake was evaluated according to food groups of Adapted Food Pyramid, were identified in the present study that independent of PCOS, for cereals, bread and pasta, vegetables, fruit and fruit juices, milk and dairy products and beans groups, the consumption were below recommended. In addition, for meat and eggs group the consumption for PCOS and controls was above the recommended. In a pooled analysis of these results, it is possible to conclude that PCOS participants and controls presented inadequate AHEI score, i.e., both groups of women need to improve food intake. Moreover, the results of AHEI have failed in the demonstration that food consumption is a prominent factor for obesity / overweight in PCOS patients.

There are some limitations in study. The study design was cross-sectional, and the results are based on only 63 women, i.e., the generalization of the results to all women with PCOS is not possible. Some evaluations were performed using

questionnaires, which are subjective and depend of the memory and motivation of the participant.

In conclusion, for fruit group and fiber, PCOS women presented lower levels of consumption compared to controls. For the other food groups, PCOS women and controls need to improve food intake. Surprisingly, obese women with and without PCOS presented lower carbohydrate consumption compared with healthy weight women with and without PCOS. Further studies with women with PCOS should be developed to better understand this issue.

Acknowledgements

We express our appreciation to the participants of study for their collaboration.

Statement of Authorship

N.B.C., C.T.R. and C.M.S. participated in the study design, statistical analyses, interpretation of data, and manuscript drafting. D.A.D.S. participated in the study design, interpretation of data, and critical revision of the manuscript for important intellectual content. A.C.J.R.S. participated in the study design, and critical revision of the final version of the manuscript. All authors approved the final version for submission.

Conflict of interest and Funding sources

None of the authors had any personal or financial conflict of interest.

References

1. Sirmans SM, Pate KA. Epidemiology, diagnosis, and management of polycystic ovary syndrome. *Clin Epidemiol*. 2013;6:1-13.
2. Goodarzi MO, Dumesic DA, Chazenbalk G, Azziz R. Polycystic ovary syndrome: etiology, pathogenesis and diagnosis. *Nat Rev Endocrinol*. 2011;7(4):219-31.
3. Ahmadi A, Akbarzadeh M, Mohammadi F, Akbari M, Jafari B, Tolide-le HR. Anthropometric characteristics and dietary pattern of women with polycystic ovary syndrome. *Indian J Endocrinol Metab*. 2013;17(4):672-76.
4. Rodrigues AM, Martins LB, Franklin AM, Candido AL, dos Santos LC, Ferreira AV. Poor quality diet is associated with overweight status and obesity in patients with polycystic ovary syndrome. *J Hum Nutr Diet*. 2015;Suppl 2:94-101.
5. Messinis IE, Messini CI, Anifandis G, Dafopoulos K. Polycystic ovaries and obesity. *Best Pract Res Clin Obstet Gynaecol*. 2015;29(4):479-88.
6. Altieri P, Cavazza C, Pasqui F, Morsellii AM, Gambineri A, Pasquali R. Dietary habits and their relationship with hormones and metabolism in overweight and obese women with polycystic ovary syndrome. *Clin Endocrinol (Oxf)*. 2013;78(1):52-9.
7. Nybacka A, Hellström PM, Hirschberg AL. Increased fiber and reduced trans fatty acid intake are primary predictors of metabolic improvement in overweight polycystic ovary syndrome-Substudy of randomized trial between diet, exercise and diet plus exercise for weight control. *Clin Endocrinol (Oxf)*. 2017;87(6):680-88.

8. Vosnakis C, Georgopoulos NA, Rousso D, Mavromatidis G, Katsikis I, Roupas ND, Mamali I, Panidis D. Diet, physical exercise and Orlistat administration increase serum anti-Müllerian hormone (AMH) levels in women with polycystic ovary syndrome (PCOS). *Gynecol Endocrinol.* 2013;29(3):242-5.
9. Eslamian G, Baghestani AR, Eghtesad S, Hekmatdoost A. Dietary carbohydrate composition is associated with polycystic ovary syndrome: a case-control study. *J Hum Nutr Diet.* 2017;30(1):90-97.
10. Wright CE, Zborowski JV, Talbott EO, McHugh-Pemu K, Youk A. Dietary intake, physical activity, and obesity in women with polycystic ovary syndrome. *Int J Obes Relat Metab Disord.* 2004;28(8):1026-32.
11. Douglas CC, Norris LE, Oster RA, Darnell BE, Azziz R, Gower BA. Difference in dietary intake between women with polycystic ovary syndrome and healthy controls. *Fertil Steril.* 2006;86(2):411-17.
12. Larsson I, Hulthén L, Landén M, Palsson E, Janson P, Stener-Victorin E. Dietary intake, resting energy expenditure, and eating behavior in women with and without polycystic ovary syndrome. *Clin Nutr.* 2016;35(1):213-8.
13. Mota JF, Rinaldi AEM, Pereira AF, Maestá N, Scarpin MM, Burini RC. Adaptation of the healthy eating index to the food guide of the Brazilian population. *Rev. Nutr.* 2008;21(5):545-52.
14. Philippi ST, Latterza AR, Cruz ATR, Ribeiro LC. Adapted food pyramid: a guide for a right food choice. *Rev. Nutr.* 1999;12(1):65-80.
15. Rauber F, da Costa Louzada ML, Vitolo MR. Healthy eating index measures diet quality of Brazilian children of low socioeconomic status. *J Am Coll Nutr.* (2014);33(1):26-31.

16. Malta MB, Papini SJ, Corrente JE. Assessment of the diets of elderly people in a city in São Paulo state: application of the Healthy Eating Index. *Cien Saude Colet.* (2013);18(2):377-84.
17. Rotterdam ESHRE/ASRM-Sponsored PCOS consensus workshop group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). *Hum Reprod.* 2004;19(1):41-7.
18. Fisberg RM, Marchioni DML, Colucci ACA. Assessment of food intake consumption and nutrient intake in clinical practice. *Arq Bras Endocrinol Metab.* 2009;53(5):617-24.
19. Lohman TG, ROCHE AF, Martorrel R. Anthropometrics standardization reference manual. Champaign, Illion: Human Knectis, 1988.
20. WORLD HEALTH ORGANIZATION (WHO). Obesity: preventing and managing the global epidemic. (Technical Report Series, 894). Geneva, 2000.
21. Fosbol MO, Zerahn B. Contemporary methods of body composition measurement. *Clin Physiol Funct Imaging.* 2015;35(2):81-97.
22. Barr S, Hart K, Reeves S, Sharp K, Jeanes YM. Habitual dietary intake, eating pattern and physical activity of women with polycystic ovary syndrome. *Eur J Clin Nutr.* 2011;65(10):1126-32.
23. Moran LJ, Ranasinha S, Zoungas S, McNaughton SA, Brown WJ Teede HJ. The contribution of diet, physical activity and sedentary behavior to body mass index in women with and without polycystic ovary syndrome. *Hum Reprod.* 2013;28(8):2276-83.

24. Mazloomi S, Alizadeh N, Aminzare M, Niroomand S, Mousavi SN. Serum zinc and adiponectin levels in patients with polycystic ovary syndrome, adjusted for anthropometric, biochemical, dietary intake, and physical activity measures. *Biol Trace Elem Res*. 2017. doi: 10.1007/s12011-017-0951-0. [Epub ahead of print]
25. Shishehgar F, Ramezani Tehrani F, Mirmiran P, Hajian S, Baghestani AR, Moslehi N. Comparison of dietary intake between polycystic ovary syndrome women and controls. *Glob J Health Sci*. 2016;8(9):54801.
26. Slavin JL, Lloyd B. Health benefits of fruits and vegetables. *Adv Nutr*. 2012;3(4):506-16.
27. Liu RH. Health-promoting components of fruits and vegetables in the diet. *Adv Nutr*. 2013;4(3):384S-92S.
28. Institute of Medicine (IOM). Food and Nutrition Board. Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. Washington DC, 2002.
29. Anderson JW, Baird P, Davis RH Jr, Ferreri S, Knudtson M, Koraym A et al. Health benefits of dietary fiber. *Nutr Rev*. 2009;67(4):188-205.
30. Lattimer JM, Haub MD. Effects of dietary fiber and its components on metabolic health. *Nutrients*. 2010;2(12):1266-89.
31. Zhang J, Liu Y, Liu X, Xu L, Zhou L, Tang L et al. High intake of energy and fat in southwest chinese women with PCOS: a population based case-control study. *PLoS One*. 2015;10(5):e0127094.
32. Fricker J, Baelde D, Igoin-Apfelbaum L, Huet JM, Apfelbaum M. Underreporting of food intake in obese "small eaters". *Appetite*. 1992;19(3):273-83.

Table 1. Anthropometric characteristics, and Body composition according to the BMI of women with PCOS and controls.

Variable	PCOS (n=34)		Controls (n=29)		p
	Healthy weight (n=20)	Obese (n=14)	Healthy weight (n=19)	Obese (n=10)	
Age	23.75±3.75	26.50±3.36	24.21±3.91	28.50±4.69	0.023
Anthropometric characteristics					
Height (m)	1.61±0.05	1.57±0.04	1.60±0.05	1.61±0.06	0.131
Habitual weight (kg)	55.30±6.45 ^a	81.83±11.74 ^b	55.74±6.70 ^a	91.40±20.73 ^b	0.001
Current weight (kg)	55.60±6.18 ^a	87.47±8.76 ^b	56.23±6.58 ^a	94.39±19.44 ^b	0.001
BMI (kg/m ²)	21.35±2.02 ^a	35.20±3.37 ^b	21.71±1.82 ^a	36.04±5.04 ^b	0.001
WC (cm)	73.67±5.86 ^a	104.85±10.49 ^b	73.73±5.92 ^a	104.85±12.64 ^b	0.001
HC (cm)	95.62±4.82 ^a	118.92±7.07 ^b	95.44±5.78 ^a	123.45±12.11 ^b	0.001
Body composition					
BIA					
TBW (L)	29.65 (27.37-32.42) ^a	36.50 (34.50-40.05) ^b	29.80 (27.90-32.20) ^a	38.05 (34.65-47.07) ^b	0.001
IW (L)	16.55 (15.02-19.12) ^a	20.50 (20.02-23.12) ^b	16.90 (16.60-17.80) ^a	21.30 (19.50-25.25) ^b	0.001
IW (%)	57.20 (53.75-60.20)	56.45 (54.30-60.27)	57.70 (54.80-60.30)	56.95 (52.00-61.45)	0.912

EW (L)	12.80 (11.22-14.25) ^a	16.15 (14.90-17.02) ^b	13.00 (11.10-14.00) ^a	15.85 (14.42-20.90) ^b	0.001
EW (%)	42.80 (39.80-46.25)	43.55 (39.72-45.70)	42.30 (39.70-45.20)	43.05 (38.55-48.00)	0.912
PA (degree)	7.0 (5.92-7.60) ^a	7.9 (7.2-8.52) ^b	7.1 (6.5-7.6) ^{a,b}	8.05 (6.52-9.45) ^{a,b}	0.023
TBF (%)	27.05 (25.47-30.10) ^a	39.80 (37.42-41.72) ^b	25.60 (23.00-29.70) ^a	40.90 (36.22-41.72) ^b	0.001
MM (%)	72.95 (69.90-74.52) ^a	60.20 (58.27-62.57) ^b	74.20 (69.70-76.40) ^a	59.10 (58.27-63.77) ^b	0.001
BMR (kcal)	1258.50 (1127.00-1412.50) ^a	1594.00 (1491.25-1760.00) ^b	1267.00 (1148.00-1432.00) ^a	1659.50 (1518.00-2028.65) ^b	0.001
DXA					
Total fat mass	33.80 (28.37-37.32) ^a	49.45 (47.55-52.82) ^b	36.50 (32.30-41.10) ^a	52.60 (47.15-57.70) ^b	0.001
Trunk fat	32.75±6.16 ^a	52.43±3.83 ^b	35.34±6.26 ^a	53.13±5.17 ^b	0.001
Total trunk fat	0.47±0.04 ^a	0.54±0.06 ^b	0.47±0.02 ^a	0.49±0.04 ^{a,b}	0.005
Gynoid fat	43.34±5.68 ^a	55.34±3.11 ^b	46.15±5.58 ^a	58.03±5.43 ^b	0.001
Android fat	35.02±8.50 ^a	55.91±3.11 ^b	37.87±7.83 ^a	56.20±5.50 ^b	0.001
Legs fat	36.65±6.06 ^a	50.89±4.09 ^b	40.22±6.20 ^a	55.53±7.32 ^{a,b}	0.001
Total legs fat	0.40±0.04 ^a	0.35±0.06 ^b	0.40±0.02 ^a	0.39±0.04 ^{a,b}	0.022
Arms, legs and trunk fat	1.05±0.20 ^a	0.83±0.20 ^b	1.05±0.12 ^a	1.00±0.19 ^{a,b}	0.013

Values expressed in means and standard deviation or median and interquartile range. For normally distributed data, ANOVA was performed and for non-normally distributed data, it was used the Kruskal-Wallis test.

BMI = body mass index; PCOS = polycystic ovary syndrome; WC = waist circumference; HC = hip circumference; TBW = total body water; IW = intracellular water;

EW = extracellular water; PA = phase angle; TBF = Total body fat; MM = muscle mass; BMR = basal metabolic rate.

Table 2. Dietary pattern of women with PCOS and controls, according to the body mass index.

Variable	PCOS (n=34)		Controls (n=29)		P
	Healthy weight	Obese	Healthy weight	Obese	
	(n=20)	(n=14)	(n=19)	(n=10)	
Total energy (kcal)	1520.49 (1117.15-1800.96)	1486.57 (952.29-1722.40)	1704.98 (1134.64-2590.98)	1526.28 (1452.24-2445.91)	0.678
Energy (kcal/kg)	26.56 (21.15-34.83) ^a	16.86 (10.84-21.70) ^b	31.42 (20.98-43.88) ^a	18.92 (16.68-24.52) ^{a,b}	0.001
Carbohydrate intake (kcal)	685.61 (443.53-976.64)	581.96 (435.73-801.19)	720.73 (538.99-947.20)	947.06 (601.22-1153.52)	0.280
Carbohydrate intake (g/kg)	2.94 (2.18-4.56) ^a	1.71 (1.25-2.46) ^b	3.32 (2.07-4.37) ^a	2.30 (1.87-3.04) ^{a,b}	0.004
Carbohydrate intake (%)	46.55 (40.80-57.54)	42.27 (36.60-48.40)	42.45 (39.88-49.64)	44.37 (40.87-61.51)	0.368
Protein intake (kcal)	277.50 (197.67-388.76)	279.53 (225.45-346.76)	289.05 (273.17-475.94)	319.14 (251.56-364.32)	0.599
Protein intake (g/kg)	1.32 (0.82-1.88) ^{a,b}	0.78 (0.64-1.07) ^a	1.37 (1.06-2.29) ^a	0.92 (0.61-1.13) ^b	0.001
Protein intake (%)	19.81±7.01	21.53±6.99	22.18±9.87	19.84±7.28	0.789
Fat intake (kcal)	462.52 (348.67-892.44)	506.27 (227.27-741.86)	597.24 (332.63-885.77)	601.04 (284.39-1163.38)	0.840
Fat intake (g/kg)	0.96 (0.74-1.75)	0.67 (0.30-0.93)	1.23 (0.60-1.87)	0.87 (0.28-1.22)	0.101
Total fat intake (%)	33.98 (24.99-42.12)	35.55 (22.20-43.43)	33.99 (28.26-42.22)	36.92 (20.65-55.38)	0.980

Saturated fat intake (%)	9.38 (7.56-13.33)	11.93 (7.69-14.10)	10.87 (8.29-12.57)	13.52 (5.99-20.28)	0.718
Total fiber (g)	8.86 (6.78-17.07)	8.81 (8.05-10.62)	10.98 (6.72-12.63)	12.14 (7.90-18.21)	0.314
Fiber intake (g/kg)	0.17 (0.11-0.33) ^a	0.10 (0.08-0.11) ^b	0.20 (0.11-0.24) ^a	0.12 (0.08-0.18) ^{a,b}	0.011
Cholesterol intake (mg)	154.52 (107.95-245.41)	168.94 (118.69-255.94)	215.75 (131.92-428.00)	195.26 (141.41-640.17)	0.366

Values expressed in means and standard deviation or median and interquartile range. For normally distributed data, ANOVA was performed and for non-normally distributed data, it was used the Kruskal-Wallis test.

PCOS = polycystic ovary syndrome.

Table 3. Food intake according food groups of Adapted Food Pyramid.

Food group	PCOS (n=34)	p*	Controls (n=29)	p*	Recommendation*	p**
Cereals, bread and pasta (servings/day)	2.69 (2.28-4.67)	< 0.001	3.22 (1.76-4.54)	< 0.001	6 servings/day	0.581
Vegetables (servings/day)	1.87 (0.94-2.68)	< 0.001	1.22 (0.73-2.24)	< 0.001	3 servings/day	0.255
Fruits and fruit juices (servings/day)	0.00 (0.00-1.45)	< 0.001	0.78 (0.14-2.20)	0.004	3 servings/day	0.029
Meat and eggs (servings/day)	1.97 (1.16-2.69)	< 0.001	1.86 (1.48-2.75)	< 0.001	1 serving/day	0.951
Milk and dairy products (servings/day)	0.51 (0.00-1.69)	< 0.001	0.95 (0.44-1.75)	< 0.001	3 servings/day	0.227
Beans (servings/day)	0.41 (0.00-0.94)	0.003	0.75 (0.20-1.10)	0.024	1 serving/day	0.545
Oils and fats (servings/day)	1.21 (0.00-2.71)	0.338	1.49 (0.00-4.81)	0.060	1 serving/day	0.292
Sugar and sweets (servings/day)	0.86 (0.31-2.74)	0.130	1.14 (0.30-3.88)	0.098	1 serving/day	0.730

Values expressed in median and interquartile range (25% and 75%). Comparisons between groups were made using the Mann-Whitney test.

*Comparisons according to the Adapted Food Pyramid (PHILIPPI et al., 1999). The number of servings is based on a diet of 2000kcal.

**Comparisons between PCOS and controls.

PCOS = polycystic ovary syndrome.

Table 4. Components and global score for Adjusted Healthy Eating Index (AHEI) of PCOS women and controls.

Component	PCOS (n=34)	Controls (n=29)	P
Cereals, breads and pasta	5.38 (4.56-9.21)	6.44 (3.52-9.08)	0.551
Vegetables	4.68 (2.36-6.70)	3.06 (1.82-5.60)	0.261
Fruits and fruit juices	0.00 (0.00-4.83)	2.61 (0.47-7.35)	0.028
Meat and eggs	10.00 (10.00-10.00)	10.00 (10.00-10.00)	0.174
Milk and dairy products	1.71 (0.00-5.65)	3.18 (1.49-5.85)	0.206
Beans	4.12 (0.00-9.42)	7.54 (2.05-10.00)	0.484
Oils and fats	10.00 (5.00-10.00)	10.00 (0.00-10.00)	0.221
Sugar and sweets	10.00 (5.00-10.00)	10.00 (2.50-10.00)	0.793
Total fat (%)	5.00 (5.00-10.00)	5.00 (5.00-10.00)	0.857
Saturated fat (%)	5.00 (5.00-10.00)	5.00 (0.00-10.00)	0.688
Cholesterol (mg)	10.00 (10.00-10.00)	10.00 (5.00-10.00)	0.415
Diversity	10.00 (10.00-10.00)	10.00 (10.00-10.00)	0.188
Overall score	77.32 (69.51-85.60)	79.53 (67.59-84.57)	0.720

Values expressed in median and interquartile range (25% and 75%). Comparisons between groups were made using the Mann-Whitney test.

PCOS = polycystic ovary syndrome.