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Nutritional status, dietary intake, physical activity and sleep among women with and without polycystic ovary syndrome

Estado nutricional, consumo alimentar, atividade física e sono entre mulheres com e sem síndrome do ovário policístico

Abstract

Introduction: Polycystic ovary syndrome (PCOS) is characterized by endocrine disorders associated with genetic and environmental factors. *Objective*: This study aimed to assess the nutritional status, food intake, physical activity level, and sleep quality in women with and without PCOS. *Methods*: Data were collected through a self-administered online questionnaire, which included sociodemographic data, body mass index (BMI), dietary intake, physical activity, and sleep quality. Data analysis was conducted using SPSS software, with a significance level set at $p < 0.05$. A total of 232 women participated, including 107 in the PCOS group and 125 in the control group, with a median age of 25.48 years; 46.3% self-identified as white, 76.3% reported not having a partner, 60.3% had education up to incomplete higher education, and 84.9% resided in southeastern Brazil. Additionally, 40.1% were irregularly active or sedentary, and 57.3% reported poor sleep quality. *Results*: When comparing women with and without PCOS, no statistically significant differences were observed regarding the consumption of different food groups, physical activity level, or sleep quality. However, women with PCOS had higher weight and BMI. When evaluating dietary intake only in women with the syndrome, it was found that eutrophic women consumed more protein than those who were overweight. *Conclusion*: Women with PCOS had higher weight and BMI compared to those without the syndrome. Moreover, a higher protein intake was observed in eutrophic women with PCOS.

Keywords: Polycystic Ovary Syndrome. Dietary Intake. Exercise. Sleep.

Resumo

Introdução: A síndrome do ovário policístico (SOP) é caracterizada por distúrbios endócrinos associados a fatores genéticos e ambientais. *Objetivo*: Objetivou-se avaliar o estado nutricional, consumo alimentar, nível de atividade física e qualidade do sono em mulheres com e sem SOP. *Métodos*: Os dados foram obtidos por questionário *on-line* autoaplicado com dados sociodemográficos, índice de massa corporal (IMC), consumo alimentar, prática de atividade física e qualidade do sono. A análise dos dados foi

realizada utilizando o *software* SPSS, com nível de significância das análises de $p < 0,05$. Participaram 232 mulheres, sendo 107 do grupo que tinha diagnóstico de SOP e 125 do grupo controle, com mediana de idade de 25,48 anos; 46,3% se autodeclararam brancas, 76,3% não possuíam companheiro(a), 60,3% tinham escolaridade em até nível superior incompleto e 84,9% residiam no sudeste do Brasil. Além disso, 40,1% eram irregularmente ativas ou sedentárias e 57,3% apresentaram qualidade ruim do sono. ***Resultados***: Ao comparar as mulheres com e sem SOP, não houve diferença estatística para o consumo de diferentes grupos de alimentos, nível de atividade física e qualidade do sono. No entanto, mulheres com SOP apresentavam maior peso e IMC. Ao avaliar somente o consumo alimentar de mulheres com síndrome, observou-se que as mulheres eutróficas consumiam mais proteínas do que as com excesso de peso. ***Conclusão:*** Conclui-se que mulheres com SOP apresentaram maior peso e IMC quando comparadas àquelas sem síndrome. E maior consumo de proteínas foi observado em mulheres eutróficas com SOP.

Palavras-chave: Síndrome do ovário policístico. Consumo alimentar. Atividade física. Hábitos do sono.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a heterogeneous and multifactorial endocrine disorder commonly found in women of reproductive age, influenced by genetic and environmental factors, and affecting approximately 6 to 16% of this population.[1,2] The alterations in PCOS arise from the secretion of gonadotropins, leading to an increase in luteinizing hormone (LH) and a decrease in follicle-stimulating hormone (FSH). This imbalance between LH and FSH stimulates androgen production, particularly testosterone, resulting in hyperandrogenism. Low levels of FSH prevent the maturation of follicles, which results in the formation of ovarian cysts.[3]

The main features of PCOS include ovulatory dysfunction and infertility, the presence of ovarian cysts, and hyperandrogenism, manifested by clinical signs such as acne, alopecia, menstrual irregularities, and hirsutism.[4] Moreover, PCOS is associated with hyperinsulinemia, insulin resistance (IR), metabolic syndrome (MS), obesity due to decreased lipolysis, lipid profile abnormalities (decreased HDL-c and increased LDL-c), predisposition to type 2 diabetes (T2DM), cardiovascular disease (CVD), nonalcoholic fatty liver disease (NAFLD), and sleep apnea.[5,6]

Environmental factors can trigger endocrine changes and contribute to PCOS features, such as dietary habits (notably, high intake of simple carbohydrates and saturated fats), physical inactivity, poor sleep quality, and the consumption of tobacco and alcohol.[7-9]

Studies show a higher prevalence of overweight and obesity in women with PCOS, ranging from 50% to 80% of cases.[10,11] Additionally, women with this diagnosis exhibit more sedentary behavior, characterized by reduced physical activity and increased time spent sitting.[12]

Poor sleep is also a common pattern among women with PCOS, due to hormonal imbalances and metabolic disturbances. As a disorder characterized by endocrine dysfunction, PCOS is also associated with alterations in the circadian cycle. Therefore, changes in sleep duration, delayed sleep onset, difficulties in maintaining sleep or waking up are often observed, which result in mood changes, impaired well-being, attention deficits, metabolic alterations, and reduced performance in daily activities.[13]

Thus, studying lifestyle factors in women with and without PCOS is essential to better understand the possible metabolic alterations associated with this syndrome and, consequently, to guide clinical and nutritional strategies for treatment. Therefore, the aim of this study was to assess and compare nutritional status, dietary intake, physical activity level, and sleep quality in women with and without the syndrome.

METHODS

Study design and Data collection

This was a cross-sectional, quantitative study conducted with women of reproductive age who were divided into two groups: women with a diagnosis of PCOS (PCOS group- PCOSG) and women without a diagnosis of PCOS (control group-CG).

Data collection was performed using self-administered online questionnaires via Google Forms, between January and June 2022. Invitations to participate were disseminated through digital platforms (Instagram, Facebook, and WhatsApp). The structured questionnaire included questions on the diagnosis of PCOS (only for the PCOS group), sociodemographic data, nutritional assessment (self-reported weight and height), dietary intake, physical activity practice, and sleep quality.

Eligibility Criteria

The study included adult women of reproductive age (19–40 years old)[2] with a diagnosis of PCOS and healthy women without a PCOS diagnosis.

Exclusion criteria were pregnant or lactating women; women with a diagnosis of cancer or with clinical manifestations similar to PCOS (such as late-onset congenital adrenal hyperplasia, androgen-secreting tumors, thyroid dysfunction, hyperprolactinemia, Cushing's syndrome, ovarian insufficiency, and hypothalamic amenorrhea); and volunteers using exogenous androgens. Women in the control group who had metabolic alterations diagnosed as hypertension, diabetes mellitus (DM), or dyslipidemia were also excluded.

PCOS Diagnosis and Clinical Assessment

The Rotterdam criteria were used to assess the diagnosis of PCOS.[14] Initially, participants were asked whether they had the syndrome (self-reported), followed by questions to verify the Rotterdam criteria: polycystic ovaries detected by ultrasound (US), whether the participant had undergone the exam and whether she had follicles/cysts and increased ovarian volume; menstrual dysfunction through the presence of oligovulation (interval between two menstrual cycles longer than 35 days) and/or anovulation (absence of ovulation); and clinical hyperandrogenism, along with signs and symptoms (acne, oily skin, hair loss, and androgenic alopecia).

Hyperandrogenism was assessed by the presence or absence of self-reported hirsutism, using the Ferriman & Gallwey Index.[15] This index uses a scale of 1 to 4 in nine areas of the body, considering the size, pigmentation, and thickness of terminal hair.

For the clinical evaluation of women with PCOS, questions included the use of medications for glycemic control, hormonal contraceptives, antiandrogens, and supplements. These data were obtained along with the PCOS diagnosis questions.

Sociodemographic data

Data were collected on age, self-reported skin color, marital status, state of residence, and educational level. Education was classified according to the economic classification criteria of the Brazilian Association of Research Companies (ABEP), which distributes it into five categories: Illiterate/Incomplete Primary I; Complete Primary I/Incomplete Primary II; Complete Primary II/Incomplete Secondary; Complete Secondary/Incomplete Higher; and Complete Higher Education.[16]

Nutritional status

Nutritional status was assessed using the body mass index (BMI), calculated from self-reported weight and height. BMI classification followed the recommendations of the World Health Organization.[17]

Dietary intake

Dietary intake was assessed using a Food Frequency Questionnaire (FFQ) based on the food list from the Surveillance of Risk and Protective Factors for Chronic Diseases through Telephone Interviews (VIGITEL) study by the Ministry of Health.[18]

The questionnaire covered the intake of ultra-processed foods (Group 1: soda, boxed/canned fruit juice, powdered drink mix, chocolate drinks, flavored yogurt, packaged snacks (chips), salty crackers, sweet biscuits, stuffed cookies, packaged cake, chocolate, ice cream, gelatin, flan or other industrial desserts, sausage, hot dog, mortadella or ham, sliced bread, hot dog or hamburger buns, mayonnaise, ketchup,

mustard, margarine, instant noodles, packaged soup, frozen lasagna or other ready-to-eat frozen meals); animal and plant protein sources (Group 2: beans, peas, lentils, chickpeas, beef, pork, chicken or fish, fried, boiled or scrambled eggs, milk); vegetables, fruits, and nuts (Group 3: lettuce, kale, broccoli, watercress, spinach, pumpkin, carrot, sweet potato, okra, papaya, mango, yellow melon, pequi, tomato, cucumber, zucchini, eggplant, chayote, beetroot, orange, banana, apple, pineapple, peanuts, cashew nuts, Brazil nuts); and cereals, roots, and tubers (Group 4: rice, pasta, polenta, couscous or corn, potato, cassava, yam). Frequencies were categorized as: rarely or never, 1–3 times/month, once/week, 2–4 times/week, 5–6 times/week, once/day, twice or more/day.

Dietary intake assessment followed the methodology of Fornés et al.,[19] in which consumption frequencies were converted into scores. Frequencies reported in the FFQ were converted into daily frequencies using the value of 1 for "once a day." For "rarely or never," the daily value was 0; for "1–3 times/month," 0.066 (2X/30); for "once/week," 0.142 (1X/7); for "2–4 times/week," 0.428 (3X/7); for "5–6 times/week," 0.786 (5.5X/7); and for "twice or more/day," it was equal to 2.

Physical Activity Level

To obtain data on physical activity, the short version of the International Physical Activity Questionnaire (IPAQ) was used, following the methodology of Matsudo et al.[20] The questions assessed the level and intensity of physical activity, classifying them as very active, active, irregularly active, or sedentary.

Sleep Quality

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI),[21] which consists of 10 questions categorized into seven components: subjective sleep quality, latency, duration, habitual efficiency, disturbances, use of sleep medications, and daytime dysfunction. Each component is scored from zero (no difficulty) to three (severe difficulty). The sum of the points ranges from 0 to 21, considered good if 0–4, poor if 5–10, and indicative of sleep disorder if higher than 10.[21]

Statistical Analysis

Data were analyzed using SPSS statistical software version 20.0 for Windows. Continuous variables were initially tested for normality using the Kolmogorov-Smirnov test. Nonparametric continuous variables are described by median and interquartile range (25th and 75th percentiles). Categorical data were represented using descriptive statistics with frequencies and percentages. For statistical analyses, education was grouped into: without higher education and with higher education. Marital status was also categorized as with partner (married/other) and without partner (separated/divorced/widowed). Physical activity level was regrouped as: very active, active, and irregularly active/sedentary.

Comparisons between variables with non-normal distribution were performed using the Mann-Whitney U test. Food frequency consumption scores, as ordinal variables, were described as median and percentiles (25–75), and their relationship with explanatory variables was also evaluated using the Mann-Whitney U test. The chi-square or Fisher's exact test was used to test differences in categorical data between the PCOS group and the control group. The significance level for all analyses was set at $p < 0.05$.

Ethical Aspects

This study was approved by the Research Ethics Committee for Human Beings of the Universidade Federal de Ouro Preto, in accordance with Resolution No. 466/2012 of the National Health Council, under the opinion number CAAE: 67051817.9.0000.5192.

RESULTADOS

A total of 275 online questionnaires were collected, of which 43 were excluded: 6 due to being outside the study's age range; 18 from women with PCOS who were pregnant, lactating, or had thyroid dysfunction; and 19 from women without PCOS who had a diagnosis of hypertension, diabetes, or dyslipidemia. Ultimately, 232 participants were included in the final analysis, with 107 in the PCOSG group and 125 in the CG.

The median age of the women was 25.48 years (range: 19–40), with no statistically significant difference between women with and without PCOS (p=0.765). Of these, 46.3% self-identified as white, 76.3% reported not having a partner, 60.3% had incomplete higher education, and 84.9% lived in southeastern Brazil. There was an association between higher education and the presence of PCOS (Table 1).

Table 1. Sociodemographic characteristics of women with and without polycystic ovary syndrome. Ouro Preto, MG, 2021.

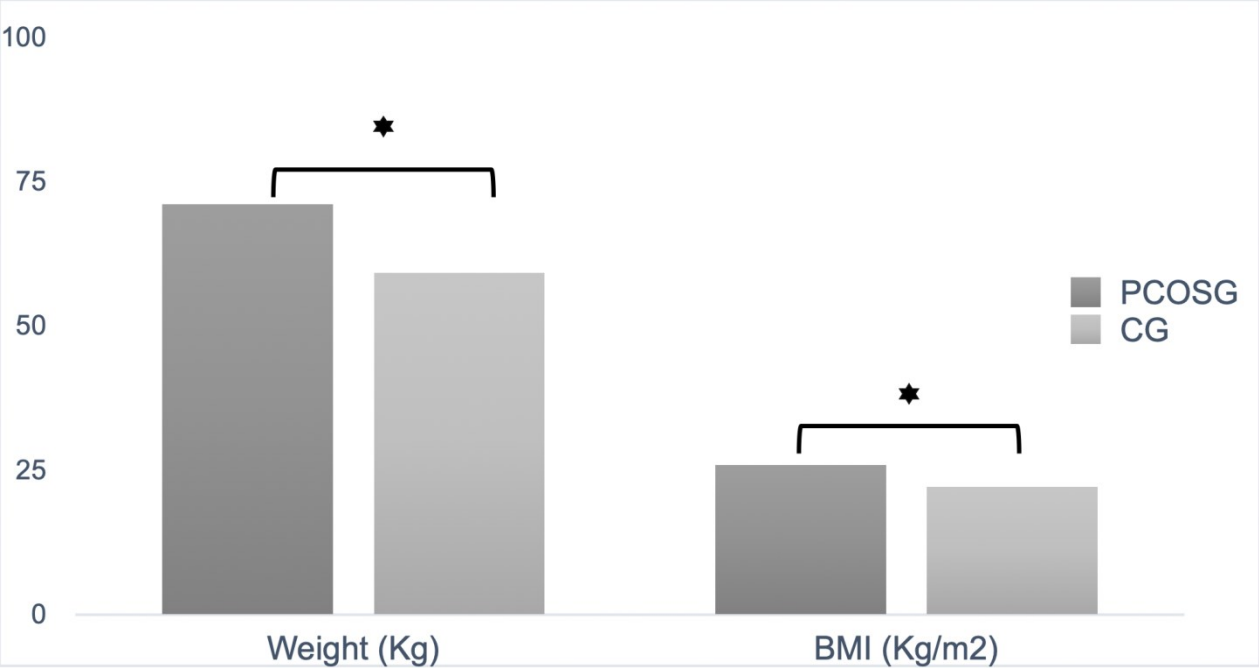
Variables	PCOSG %(n)	CG %(n)	Total %(n)	p-value
Skin color**				0.848
Yellow	1.0 (1)	0.8 (1)	0.9 (2)	
White	44.7 (47)	47.5 (58)	46.3 (105)	
Brown	42.9 (45)	37.8 (46)	40.1 (91)	
Black	11.4 (12)	13.9 (17)	12.7 (29)	
Marital Status*				0.260
with partner	72.9 (78)	79.2 (99)	76.3 (177)	
without partner	27.1 (29)	20.8 (26)	23.7 (55)	
Education*				**0.021**
Without completed higher education	52.3 (56)	67.2 (84)	60.3 (140)	
With completed higher education	47.7 (51)	32.8 (41)	39.7 (92)	

PCOSG: women with a diagnosis of PCOS; CG: women without a diagnosis of PCOS. *Chi-square test and **Fisher's Exact Test.

Among the women with PCOS, 57.0% presented some degree of hirsutism, 30.8% reported using medications for glycemic control, 49.5% used hormonal contraceptives, 2% used antiandrogens, and 18.7% used dietary supplements.

Regarding nutritional status, 52.8% of the total participants were classified as eutrophic, 26.4% as overweight, and 16.5% as obese. Figure 1 illustrates the statistically significant difference in weight and BMI between women with and without PCOS.

Figure 1. Weight and body mass index of women with and without polycystic ovary syndrome.



PCOSG: women with a diagnosis of PCOS; CG: women without a diagnosis of PCOS. BMI: body mass index. *Mann-Whitney U. p-values < 0.05 between groups.

When assessing the level of physical activity and sleep quality, no statistically significant difference was observed between the two groups. It is noteworthy that 40.1% were classified as irregularly active or sedentary, and 57.3% had poor sleep quality (Table 2).

Table 2. Sleep quality and physical activity level in women with and without polycystic ovary syndrome. Ouro Preto, MG, 2021.

Variables	PCOSG %(n)	CG %(n)	Total %(n)	p-value*
Sleep				0.170
Good	24.3 (26)	30.4 (38)	27.6 (64)	
Poor	56.1 (60)	58.4 (73)	57.3 (133)	
Sleep disorder	19.6 (21)	11.2 (14)	15.1(35)	
Physical activity				0.709
Very active	27.1 (29)	32.0 (40)	29.7 (69)	
Active	31.8 (34)	28.8 (36)	30.2 (70)	
Irregularly active/sedentary	41.1 (44)	39.2 (49)	40.1(93)	

PCOSG: women with a diagnosis of PCOS; CG: women without a diagnosis of PCOS. *Chi-square test

There was no statistically significant difference in the consumption of different food groups between the PCOSG and the CG. However, when analyzing the association of BMI with dietary intake in women with PCOS, eutrophic women showed a higher protein consumption score than those with excess weight (Table 3).

Table 3. Dietary intake in women with and without polycystic ovary syndrome. Ouro Preto, MG, 2021.

	Food groups			
	Group 1 Med(IQ)	*Group 2 Med(IQ)*	*Group 3 Med(IQ)*	*Group Med(IQ)*
PCOSG	0.153 (0.070-0.311)	0.857 (0.625-1.250)	0.593 (0.355-1.000)	0.786 (0.500-1.000)
CG	0.145 (0.079-0.245)	0.893 (0.642-1.107)	0.547 (0.344-0.844)	0.893 (0.714-1.214)
*p-value**	0.652	0.920	0.280	0.079
BMI PCOSG				
<25 Kg/m^2	0.152 (0.078-0.251)	0.893 (0.700-1.285)	0.708 (0.367-1.062)	0.786 (0.570-1.178)
≥25 Kg/m^2	0.158 (0.065-0.378)	0.786 (0.607-1.214)	0.547 (0.297-0.928)	0.786 (0.464-1.000)
*p-value**	0.830	**0.039**	0.080	0.149

Group 1 = Ultra-processed foods; Group 2 = Animal and plant-based proteins; Group 3 = Vegetables, fruits, and nuts; Group 4 = Cereals, roots, and tubers. Med: median; IQ: 25th–75th percentile. * Mann-Whitney U test.

PCOSG: women with a diagnosis of PCOS; CG: women without a PCOS diagnosis

DISCUSSION

The present study aimed to evaluate the nutritional status, dietary intake, physical activity, and sleep quality in women with and without a diagnosis of polycystic ovary syndrome (PCOS). It was observed that women with PCOS had higher body weight and BMI compared to those without the syndrome. Additionally, women with PCOS and excess weight showed lower protein intake compared to their eutrophic counterparts with PCOS.

Excess weight is a common feature of the condition. Women with PCOS are three times more likely to develop overweight and obesity compared to women without the diagnosis.[22] The findings of this study align with other results in the literature.[8,10,23,24] The excess weight may be explained by metabolic alterations such as IR, DM, dyslipidemia, hypertension, atherosclerosis, and hormonal imbalances commonly found in PCOS.[14] Furthermore, the recent nutritional transition, characterized by increased intake of ultra-processed foods and reduced physical activity, may contribute to weight gain.[25]

In this study, when analyzing the dietary intake of food groups among women with PCOS, eutrophic individuals had higher protein consumption. It is known that protein provides greater satiety compared to other macronutrients and has a higher thermogenic effect, which may help maintain healthy body weight.[26] Additionally, when combined with a regular exercise routine, protein intake may contribute to a negative energy balance, support weight loss, body composition changes, and metabolic control.[27] Moreover, proper protein distribution throughout the day helps optimize amino acid utilization and maximize thermo genesis, which can be particularly relevant for women with PCOS given the potential positive effects on insulin resistance and hormonal regulation.[28]

Although no specific dietary composition for PCOS has been established, the literature suggests a dietary pattern composed of complex carbohydrates with low glycemic index, fiber intake from fruits, vegetables, legumes, and whole grains, and healthy fats, particularly omega-3 sources and increased protein

intake.[29-31] Such dietary adjustments may not only support weight loss but also improve symptoms and metabolic disturbances associated with PCOS.[2,28,32]

When the intake of different food groups was compared, no statistically significant differences were found between women with and without PCOS. This finding contrasts with literature reports, which suggest that women with PCOS tend to consume more simple carbohydrates, saturated and trans fats, and less fiber and complex carbohydrates than those without the condition.[33,34] A potential explanation for this result is that the participants in this study, regardless of diagnosis, were young adults, most of whom did not have a partner, which may reflect in dietary choices that favor ultra-processed foods rich in simple carbohydrates and saturated/trans fats.[35]

Poor dietary quality has been associated with intestinal health issues, including dysbiosis. This condition may compromise intestinal barrier integrity, leading to increased intestinal permeability and a state of low-grade chronic inflammation, common in women with PCOS.[36] Inflammation and intestinal dysfunction also affect hormonal physiology since the gut microbiota plays a role in modulating estrogen and androgen levels, hormones directly involved in PCOS pathogenesis.[37]

Moreover, compromised gut health may impair melatonin synthesis, a hormone essential for circadian cycle regulation, since approximately 90% of serotonin (a melatonin precursor) is produced in the gut. This may negatively impact the sleep-wake cycle and exacerbate sleep disturbances commonly observed in women with PCOS.[38] Therefore, maintaining a high-quality diet is essential to promote intestinal and hormonal health, supporting melatonin synthesis and the proper functioning of the serotonin/melatonin axis.

In the present study, most women exhibited poor sleep quality, which corroborates the literature reporting that women with PCOS often experience sleep difficulties, including trouble falling or staying asleep, increased sleep latency, and higher prevalence of disorders such as insomnia and sleep apnea.[39] Exposure to artificial light at night, for example, may interfere with melatonin production. Beyond its role in sleep regulation, melatonin also contributes to hormonal and metabolic balance, potentially exacerbating hyperandrogenism and insulin resistance in PCOS.[40]

Furthermore, stress and anxiety, often elevated in women with PCOS due to psychological impacts of symptoms such as acne, hirsutism, and infertility, can further impair sleep quality. This establishes a vicious cycle that perpetuates both sleep and hormonal disturbances.[41] Therefore, it seems plausible that altered sleep hygiene could be both a cause and a consequence of PCOS, highlighting the need for interventions that simultaneously address sleep, stress management, and hormonal complications of the syndrome.

An important factor to consider is the high rate (40.1%) of irregularly active or sedentary women in the sample, which is considered a risk factor both for women with PCOS[42] and those without, regarding the development of no communicable chronic diseases (NCDs).[43] A possible explanation for this finding is the increase in screen time and use of digital devices in recent years, which intensified during the COVID-19 pandemic as people adapted their work and study routines to remote formats and faced social distancing.[44,45] Supporting this, Sousa et al.[46] reported that 79.5% of women with PCOS were sedentary.

For women with PCOS, physical activity can improve insulin resistance, lipid profile, fertility, and androgen levels.[42,47] Additionally, it enhances sleep quality and helps manage anxiety and depression,[43] contributing to weight loss.[42]

This study has some limitations worth noting. It was conducted during the COVID-19 pandemic, and therefore, some data may have been influenced by social distancing and lifestyle adaptations related to food,

sleep, and daily activities. Furthermore, PCOS diagnosis and anthropometric information (weight and height) were self-reported, which may affect accuracy and introduce bias in the results.

Despite these limitations, the findings allow for mapping of lifestyle behaviors in women with PCOS. It is important to emphasize that a healthy dietary pattern, combined with physical activity and adequate sleep, is a key element not only for maintaining the health of women without PCOS but also for those with the syndrome. Hence, further longitudinal and interventional studies are needed to better understand the influence of diet, physical activity, and sleep on women with PCOS.

CONCLUSION

The management of PCOS should be comprehensive and integrative, including interventions aimed at promoting regular physical activity, improving sleep quality, and adopting a protein-rich diet. These strategies may support weight loss, enhance body composition, and improve hormonal and overall metabolic health.

Additionally, future research should further explore the relationship between lifestyle factors, macronutrient intake, and health outcomes in women with PCOS to develop more personalized and effective interventions

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Contributors

Tavares NF was responsible for data collection, writing, data analysis and interpretation. Toffolo MCF and Maurício SF contributed to data interpretation, revision, and approval of the final version. Vieira RAL was responsible for study design, data interpretation, revision, and approval of the final version.

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