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Polycystic ovary syndrome (PCOS) is a multisystem disease affecting females of childbearing age. This disease imposes a huge economic, social and psychological burden on the patient. The first line management of PCOS is lifestyle modification. However, there are no Sri Lankan data about the diet and physical activity of these women. This is a case-control study to compare the dietary habits and physical activity between 99 hirsute-PCOS women and 100 age-matched controls. We compared the dietary intake and physical activity of the two groups using a validated food frequency chart and a physical activity questionnaire. The Student t test and Mann-Whitney U test were used for statistical analysis. Food consumption pattern was similar in both groups except for a significantly higher consumption of eggs, refined carbohydrates, pulses and grains in controls. PCOS patients in the BMI category of 18.5 to 24.9 kg/m² consumed significantly less amounts of fish, eggs, dairy products, pulses and grains. With regard to physical activity, light, moderate and heavy exercise was significantly higher in controls. It is concluded that hirsute PCOS women seem to have different dietary habit and reduced physical activity than controls.

Keywords: Nutrition, polycystic ovary syndrome, physical activity, hirsutism

Polycystic ovary syndrome (PCOS) is one of the commonest endocrine disorders affecting women of childbearing age. It comprises endocrine, metabolic and reproductive abnormalities and is associated with a higher incidence of impaired

glucose tolerance, type 2 diabetes, hyperinsulinemia, unfavorable lipid profile, increased risk of cardiovascular diseases, subfertility, obesity, fatty liver disease and mood disorders (1).

About 80% of the PCOS population consists of a phenotype associated with a high body mass index (BMI) and increased waist to hip ratio (2). This phenotype has also been shown to have worse metabolic features (3). Additionally, there is evidence showing a difference between the diet and physical activity of PCOS patients and controls (4, 5).

Lower basal metabolic rate, higher tendency to eat more due to a bulimia-like disorder driven by androgens, and lower pre-eaters satiety and increased appetite, when compared to controls, may be the contributory factors for the higher BMI (6, 7). Lower pre-eaters satiety and increased appetite are thought to be due to higher orexigenic hormones (ghrelin) and lower anorexigenic hormones (cholecystokinin) (8). This phenomenon is also linked to the increased serum leptin and leptin resistance, which is associated with abdominal obesity (9). The adolescents with PCOS have been shown to consume a surplus of calories than controls with comparable BMI (10).

Therefore, lifestyle changes which consist of dietary modifications and increasing physical activity are aimed at changing the body weight and reducing the complications of this complex disease.

A hypocaloric diet has been shown to improve the hyperandrogenism and insulin resistance of obese PCOS patients. Weight loss has been shown to induce spontaneous ovulation and improve metabolic and hormonal derangements in these patients (11, 12). Although the effect of weight loss on reproductive health has not been studied in controlled trials, an uncontrolled study consisting of 33 anovulatory PCOS patients has shown that reducing 5-10% of weight by diet and physical exercise leads to reduced ovarian volume and micro follicle number and spontaneous pregnancy (13). However, the data on the effects of dietary modification in PCOS patients with normal BMI are limited.

Lifestyle modification can be arranged once the baseline dietary habits and physical activity are well documented. Studies examining the pattern of food intake and physical activity of PCOS patients in Sri Lanka are lacking. Therefore, this case-control study was done to compare the dietary habits and physical activity of PCOS patients with controls.

SUBJECTS AND METHODS

The study was conducted at the Department of Pharmacology, Faculty of Medicine, University of Peradeniya, Sri Lanka. Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, University of Peradeniya (protocol no. 2013/EC/52). Patients were recruited from Gynecology and Medicine clinics of the Teaching Hospital Peradeniya and the National Hospital Kandy. Written informed consent was obtained from all the subjects. Participants comprised patients with PCOS diagnosed in accordance with Rotterdam Consensus Conference Criteria 2003 with a modified Ferriman-Gallwey hirsutism score of 8 or more, in the age range of 18 to 40 years. The control group comprised an age-matched sample of women without PCOS and hirsutism. Undergraduate students and staff members of Faculty of Medicine University of Peradeniya were invited as the control group. Their age range was between 19 and 43 years. Patient recruitment started on 01st April 2015 and ended after 2 years. The convenience sampling method was used. The exclusion criteria were secondary causes for hyperandrogenism (21-hydroxylase-deficient non-classic congenital adrenal hyperplasia, classic congenital adrenal hyperplasia, androgen-secreting neoplasm, side effects from medication, hypothyroidism, hyperprolactinemia, Cushing's syndrome), pregnancy or lactation, presence of chronic systemic disease or taking medications affecting appetite or weight. The exclusion criteria were determined based on the history and examination findings.

A validated, interviewer-administered food frequency questionnaire was used to collect dietary data. The participants were asked to provide answers based on their food consumption patterns and frequency of different foods in a daily and a seven-day food recall (14, 15)

Assessment of the level of physical activity

The short version of the International Physical Activity Questionnaire (IPAQ) was employed to assess physical activity during a day and seven-day period (16).

Physical activity data were recorded by self-reported recall with regard to frequency and duration of three categories of activity lasting 10 minutes or more, i.e. light exercise (like walking briskly for recreation or exercise or to get to or from places), moderate exercise (like sweeping, gardening, lifting moderately heavy goods, moderate exercise classes, recreational swimming, dancing) and heavy exercise that makes a person breathe harder or puff and pant (like cycling fast, chopping firewood, lifting heavy goods, farming). Physical activity for the whole week was converted to metabolic equivalent of task (MET) minutes in each of the three categories of physical activity by multiplying with the metabolic equivalent value assigned to each category: light exercise minutes $\times$ 3.3 METs, moderate exercise minutes $\times$ 4.0 METs and heavy exercise minutes $\times$ 8 METs(17).

One MET is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml oxygen per kg body weight. The MET minute is used as a method to indicate and compare the absolute intensity and energy expenditure of different physical activities.

Anthropometric measurements - The body weight and height were measured by standard techniques. BMI was calculated by dividing weight in kilograms by the square of height in meters

Based on previous studies, the sample size was calculated using the formula:

$$N = \frac{2 \sigma^2}{(\mu_1 - \mu_2)^2} f(\alpha, \beta)$$

Where σ is the standard deviation and μ is the sample mean. The value of α was taken at 95% confidence level and β at 80% confidence level

According to the calculation, a sample size of 100 patients was needed for the study

Statistical analysis

All statistical analyses were carried out using SPSS (version 20) and p values < 0.05 were considered statistically significant. For data with a normal distribution (BMI data), student t-test was used to identify differences between the two groups. Mann Whitney U test was used for food frequency data and physical activity data that were not normally distributed.

RESULTS

There were 99 hirsute-PCOS patients and 100 control subjects. They were between 19- 43 years of age. The mean BMI of PCOS group was 27.48 (± 5.13) kg/m² and controls was 20.86 (± 4.71) kg/m² and this difference was statistically significant ($p < 0.001$). Table 1 shows the number of patients in different BMI categories.

Table 1. Number of patients in different BMI categories

BMI	PCOS Patients N (%)	Controls N (%)
<18.5	6 (6.1)	15 (15.3)
18.5 - 24.9	22(22.2)	73 (74.5)
25 - 29.9	42(42.4)	8(8.2)
>30	29(29.3)	2(2.0)

$\chi^2=77.869$, df = 3, $p<0.001$

For the analysis, the dietary questionnaire was categorized to 8 main food categories (meat, fish, egg, pulses and grains, vegetables and fruits, refined carbohydrates, fried foods and dairy products).

The consumption of meat, fish, vegetables and fruits, fried foods and dairy products was equal between the two groups. Eggs, refined carbohydrate, pulses and grains consumption was statistically significantly higher in controls (table 2).

Table 2. Frequency of various food categories consumed by PCOS patients and controls

Food Category	Median		p
	PCOS Patients (portions per week)	Non – PCOS Patients (portions per week)	
Meat	2	2	0.249
Fish	3	4	0.480
Egg	2	3	0.000
Pulses and Grains	14	21	0.028
Vegetables and Fruits	26	23	0.229
Refined Carbohydrates	8	11	0.000
Fried Foods	2	3	0.060
Dairy Products	3	7	0.285

When food categories were analyzed according to the BMI, there was significantly higher consumption of fish, egg, dairy products, pulses and grains in non-PCOS subjects in BMI category of 18.5 - 24.9 kg/m². PCOS subjects in BMI category of 25-29.9 kg/m² had consumed significantly higher amounts of fried food than the controls. With

regard to other food categories, there is no statistically significant difference according to BMI (supplementary data).

Concerning physical activity, all three categories of exercise were significantly higher in controls (table 3).

Table 3: Physical activity in metabolic equivalents (MET) in PCOS Patients and controls

Physical Activity (MET/week)	PCOS Patients		Controls		P
	N	Mean Mean (±SD)	N	Mean Mean (±SD)	
Heavy exercise	38	100.39 (±74.88)	45	140.00 (±161.87)	0.399
Moderate Exercise	50	103.48 (±63.13)	55	159.14(±181.43)	0.554
Light Exercise	67	95.15(±75.02)	100	169.11 (±192.27)	0.001

Table 4: Physical activity in metabolic equivalents (MET) according to BMI categories

BMI categories (kg/m ²)	MET/week (SD)		P*
	PCOS patients	Controls	
<18.5	94.17 (115.69)	247.33 (293.79)	0.24**
18.5 - 24.9	198.18 (134.0)	290.14 (384.85)	0.09
25 - 29.9	155.09 (136.23)	144.63 (101.52)	0.84**
>30	135.35 (146.02)	630.0 (466.69)	0.37**

*P calculated with independent t test

** Sample size is inadequate

The difference in physical activity (MET/week) between PCOS patients and controls according to BMI categories were not statistically significant, except for the BMI category 18.5 – 24.9. The sample sizes of all other three BMI categories were inadequate for analysis, and therefore this finding could have been due to a type II error.

DISCUSSION

In this study, consumption of eggs, refined carbohydrates, pulses and grains was significantly higher in controls. Although refined carbohydrates are considered to promote weight gain and impaired glucose tolerance, our cohort of hirsute-PCOS patients had consumed significantly low amounts of refined carbohydrates than the controls and it is a favorable trend. A similar study showed PCOS group consumed significantly more white bread (7.9 +/- 4.4 vs. 5.5 +/- 2.9 servings over 4 days) and tended to consume more fried potatoes than did the control group which is in contrast to our findings (18).

The consumption of meat, fish, dairy products, fried foods, vegetables and fruits was equal in both groups. In both PCOS patients and controls, daily fruit and vegetable consumption was 3.7 and 3.2 times per day respectively. The recommended daily consumption of fruits and vegetables of 5 servings was not achieved by both groups. Therefore, in general, the fruits and vegetable consumption was not satisfactory in our cohorts of

people. The reason could be the higher price of fruits and vegetables compared to starchy foods.

Finding of this study suggest that non-PCOS individuals with normal BMI (18.5 - 24.9 kg/m²) consume more healthy foods which contain fibers and protein than people with PCOS and same BMI. The reasons for PCOS patients with normal BMI consuming less amount of fiber and protein need further evaluation.

A considerable amount of evidence supports the fact that the patients with PCOS consume an equal amount of macro and micronutrients to non-PCOS women regardless of their BMI (19, 20). But some studies show that women with PCOS consume more calories and less fiber than women without PCOS (4, 21). Surprisingly, some studies show that women with PCOS eat a healthier diet than women without PCOS (17).

In our study, all categories of physical activity were less in hirsute-PCOS patients. In both groups, all were mostly engaged in light exercises. The difference in the amount of heavy and moderate exercise was not statistically significant. However, the control group had engaged in significantly more light exercise than PCOS patients.

However, some PCOS women with equal amount of energy intake to normal controls show higher body weight than controls suggesting that diet alone may not be the contributory factor for higher BMI (17)(22). These findings suggest that it may be the type of specific food rather than the total energy intake and lack of physical activity that contribute to higher BMI (17).

Food habits differ considerably from country to country and the choice depends on the local availability and cultural preferences. There is no Sri Lankan study that has examined the dietary habits and physical activity of hirsute-PCOS patients. Lifestyle modification could be achieved better if data on the dietary habits and the physical activity of our PCOS patients are available.

This study suggests that hirsute-PCOS patients did not differ significantly from controls concerning diet but their physical activity of all intensities is significantly lower. When the physical activity was compared according to BMI categories, patients in BMI category of 18.5 - 24.9 had a significantly lower amount of physical activity than the controls. However, the number of patients in the other three BMI categories was not adequate to compare the true difference.

The limitations of our study were that the baseline BMI did not match and data on the economic status and the social background were not collected (since they may affect the food consumption and physical activity). However, it is difficult to get a BMI matched control group as PCOS patients tend to have higher BMI.

Author declaration

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Author Contributions

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2. Dilan D. J. Bandara
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5. Nishan S. Kalupahana
6. Shanthini Rosairo
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	Contributors						
	1	2	3	4	5	6	7
Concepts	√		√	√	√		
Design	√		√	√	√	√	
Definition of intellectual content	√		√	√	√		
Literature search	√						
Clinical studies	√		√	√	√	√	
Experimental studies	√		√	√	√	√	
Data acquisition	√	√				√	
Data analysis	√						√
Statistical analysis	√	√					√
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Manuscript editing	√	√	√	√	√		
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Availability of data and materials

On request from corresponding author

Ethics approval and consent to participate

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Competing interests

None

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