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Lifestyle intervention towards Mediterranean Diet, physical activity adherence and anthropometric parameters in normal weight women with Polycystic Ovary Syndrome or Hashimoto's Thyroiditis – preliminary study

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Abstract

Introduction. Overweight and obesity are frequently present in both women with polycystic ovary syndrome (PCOS) and with Hashimoto's thyroiditis (HT). This is a limited study regarding the benefits of lifestyle changes, including dietary habits, dedicated to patients with HT and PCOS.

Objective. The aim of the study was to assess the effectiveness of an intervention programme based on the Mediterranean Diet (MD) without caloric restriction and increased physical activity to change selected anthropometric parameters in women with both health conditions.

Materials and method. The intervention programme consisted of changing the participants diet towards MD rules and increasing physical activity for 10 weeks according WHO recommendation. The study involved 14 women diagnosed with HT, 15 with PCOS and 24 women from a control group. The intervention programme consisted of educating patients in the form of a lecture, dietary advice, leaflets and a 7-day menu based on MD. During the programme, patients were required to implement recommended lifestyle changes. The mean intervention time was 72±20 days. Nutritional status was analyzed by body composition, degree of implementation of the principles of the MD by using the MedDiet Score Tool, and the level of physical activity by the IPAQ-PL questionnaire. The above-mentioned parameters were evaluated twice, before and after the intervention.

Results. The intervention programme consisting in implementing the principles of the MD and increasing physical activity to effect a change in the anthropometric parameters of all groups of women studied; all women had a reduction in body fat and body mass index. A decrease in waist circumference was observed in the group of patients with Hashimoto's disease.

Conclusions. An intervention programme based on the Mediterranean Diet and physical activity can be a good way to improve the health of HT and PCOS patients.

Key words

Hashimoto's thyroiditis, Mediterranean Diet, polycystic ovary syndrome, lifestyle intervention programme

INTRODUCTION

Chronic lymphocytic thyroiditis, which was firstly described in 1912 by the Japanese surgeon and pathologist Hakaru Hashimoto, is the most common cause of hypothyroidism in the areas with normal iodine supply and quantity [1]. Hashimoto's disease (HT-Hashimoto's thyroiditis), together with Graves' disease, both autoimmune thyroid diseases, are the most frequent causes of thyroid gland failure and constitutes 30% of all autoimmune diseases worldwide [2].

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It is significant that 5% of the general population suffers from this disease, and women are 5–10 times more likely to be diagnosed with it than men. The incidence is directly proportional to age, with the peak falling between 45–65 years of age. HT is more common in people suffering from other autoimmune diseases, such as Addison's disease, type 1 diabetes, rheumatoid arthritis or systemic lupus erythematosus, which are classified as autoimmune polyendocrine syndromes [3, 4]. Diagnosis is often difficult and is possible later in the disease process. The most common symptoms in adults are related to quality of the condition of the skin: the skin becomes dry, flaky, especially around the palms, soles of the feet and extensors. The hair of patients suffering from HT also deteriorates, the rate of hair growth decreases, the hair becomes dull, brittle and dry. Reduced thyroid function can increase peripheral vascular resistance by up to 50% – 60% and reduce cardiac output by up to 30% – 50%. A genetic predisposition has become the main cause of the increased incidence and relative risk of other autoimmune diseases in people with HT and their relatives [3, 5].

Obesity and hypothyroidism are two clinical conditions that have been closely linked. The correlation has become more relevant in the context of the increase in obesity worldwide. Obesity in thyroid disorders is classified as secondary obesity. Thyroid dysfunction is associated with changes in body weight and composition, body temperature, and total and resting energy expenditure (REE) regardless of physical activity [6, 7]. Hypothyroidism is associated with reduced thermogenesis and a reduced metabolic rate. There is a correlation between hypothyroidism and higher body mass index (BMI) and higher incidence of obesity. Weight loss causes a significant decrease in serum free triiodothyonine (fT3) and thyroid stimulating hormone (TSH). Reduction in the level of thyroid hormones, which in turn leads to a decrease in energy expenditure, argues for the difficulty of maintaining weight reduction. Numerous studies show that reduction in excess weight, lifestyle changes, increased physical activity and improved body composition without simultaneous changes in BMI lead to lower TSH and fT3 levels [7, 8].

The most common hyperandrogenic disorder is polycystic ovary syndrome (PCOS), with an incidence of approximately 80–85% among women with androgen excess [9]. Excess androgens lead to a disturbed follicular development that can cause atresia, premature luteinization and hinder ovulation by impaired selection of the dominant follicle, skin symptoms, such as acne, alopecia and hirsutism, hyperplasia, and even endometrial cancer [10, 11]. The diagnosis of PCOS is currently based on the Rotterdam criteria which include: the absence or rarity of ovulation, clinical and/or biochemical symptoms of hyperandrogenism, the occurrence of polycystic ovaries in ultrasound (the presence of at least 12 Graafian follicles with a diameter of 2–9 mm and/or volume ovary of over 10 ml). To diagnose the disease, confirmation of two out of the three criteria mentioned above is needed [9, 11].

Although this disease was described over 80 years ago, the main cause of the disorder is still unknown. PCOS is considered a multifactorial disorder with various genetic, metabolic, and hormonal abnormalities also related with environmental changes [9]. In addition to anovulatory infertility, menstrual disorders and hirsutism, typical PCOS features are metabolic disorders, including insulin resistance and dyslipidemia, and low-grade inflammation [12].

Weight gain and obesity are also important symptoms of PCOS and often precede the onset of anovulatory cycles. In addition, recent studies have clearly shown that insulin resistance can be an integral part of the syndrome, as it was found in 65–80% of women with PCOS, and it plays a significant role in its etiology. Women with PCOS are additionally more likely to have type 2 diabetes and cardiovascular diseases than the general population. Evidence has also shown that central fat distribution carries a greater risk of cardiovascular diseases and type 2 diabetes than gynoid fat distribution. This adipose tissue topography tends to change in middle-aged, post-menopausal women, when there is a change in the distribution of android fat, while women with PCOS tend to accumulate fat centrally, also in the fertile period [9, 13]. Systemic hyperinsulinism can be endogenous (such as in obesity, gestational diabetes, type 2 diabetes) or exogenous (such as in type 1 diabetes) [11]. There are many studies that show that obesity is a common feature of polycystic ovary syndrome and the prevalence of obesity in sick women is about 75%. Environmental factors, such as lifestyle, contribute to the occurrence of obesity in PCOS, it is therefore difficult to determine the exact percentage. In addition, PCOS is also a common clinical aspect in women with obesity [9, 14]. Due to the prevalence of obesity and insulin resistance, women with polycystic ovary syndrome are also at risk of developing non-alcoholic fatty liver disease. The estimated incidence of non-alcoholic fatty liver in patients with type 2 diabetes and PCOS is 75% [9]. The combination of lifestyle modification and metformin is associated with a decrease in BMI and subcutaneous fat, which helps to improve the ovulation cycle and regulate menstruation. In addition, the combination of metformin with oral contraceptive pills can prevent deterioration of metabolic functions in the latter, especially in women with non-hyperandrogenic PCOS phenotypes. Hormonal contraception additionally alleviates the signs and symptoms of the disease [11]. A holistic lifestyle change is also of benefit when it comes to improving fertility in overweight or obese women and PCOS [15]. The results of meta-analysis reported by Domecq et al. also showed that comprehensive intervention programmes, including low calorie diets and physical activity, contribute to reducing fasting glucose and insulin levels, suggesting that these programs are beneficial for overweight or obese women with PCOS. Furthermore, a direct correlation between changes in BMI and changes in fasting glucose has also been demonstrated [12].

The Mediterranean Diet (MD) is a general name for traditional dietary habits of the inhabitants of the Mediterranean countries. For many years, low-processed products, good-quality fruit and vegetables, small amounts of red meat or whole-grain cereal products have been the basic food for both men and women living in the Mediterranean countries. The characteristics of MD can be presented in eight principles: a variety of low-processed whole grains and vegetables as the basis of food, a large amount of fresh vegetables consumed daily, fresh fruit as a typical dessert every day, sweets based on nuts, olive oil and honey consumed only on festive occasions, cold pressed extra virgin olive oil, nuts and seeds as the main source of fat, moderate fish consumption, dairy products (mainly local cheese and yoghurt) consumed in small quantities, red and processed meat consumed at very low frequency (once or twice a week), wine consumed in small or moderate amounts, only with meals [16].

Epidemiological studies have shown that adherence to the Mediterranean Diet can have a preventive effect on cardiovascular diseases, stroke, obesity, diabetes, hypertension, several types of cancer, and allergic diseases, as well as Alzheimer's disease and Parkinson's disease [16]. In addition to having a high content of nutrients, fibre and antioxidants, the Mediterranean Diet is a good source of bioactive ingredients with anti-inflammatory effects, and has a low glycemic index. These properties help to achieve and maintain a healthy body weight, prolong life expectancy and reduce the risk of chronic non-communicable diseases, such as type 2 diabetes, cardiovascular diseases and diet-related cancers [16, 17].

Lifestyle change, consisting of a change in eating habits and the introduction of regular physical activity, is the first-line treatment for women affected by polycystic ovary syndrome. Studies focused on the Mediterranean Diet have shown positive results in patients affected by obesity and type 2 diabetes, therefore this nutrition regime can be the basis for dietary treatment in PCOS therapy [18].

The aim of this study was to assess the effectiveness of an intervention programme based on the Mediterranean Diet, without the need for caloric restriction, and increase in physical activity to change selected anthropometric parameters in women with Hashimoto's disease, polycystic ovary syndrome, and healthy women.

MATERIALS AND METHOD

The study was performed between November 2018 – March 2019. The criteria for the inclusion of women in the survey included their health status and age between 18–40 years. The study was conducted at the Department of Social Medicine and Public Health at the Medical University of Warsaw, Poland. The study group consisted of 14 patients (26%) with Hashimoto's disease, 15 patients (28%) with polycystic ovary syndrome and 24 healthy women without Hashimoto's disease or PCOS (45%). 53 women aged 19–38 years were included in the study. Patients were diagnosed for Hashimoto's disease or PCOS by an endocrinologist or a gynecologist and they agreed to participate in the study. No subjects were selected due to clinical variation. Healthy women declared no non-communicable diseases. The intervention programme consisted of educating the patients in the form of a 90-minute lecture. After the first examination and education programme (lecture, individual dietary advice, leaflets and a 7-day menu based on an *ad libitum* Mediterranean Diet, physical activity advice), patients were required to implement the principles of the Mediterranean Diet and to increase physical activity to a minimum 150–300 minutes of moderate-intensity aerobic physical activity throughout the week, as recommended by WHO in guidelines on physical activity and sedentary behaviour. After the period of about 10 weeks, the aforementioned tests and measurements were carried out again. The mean intervention time was 72±20 days. The study was completed by 45 women: 10 patients with Hashimoto's disease, 12 patients with polycystic ovary syndrome and 23 healthy women.

Body composition was measured by means of electrical bioimpedance with a body composition analyser (Maltron BioScan 920, Maltron International Ltd., UK) with the 5kHz, 50kHz, 100 kHz and 200 kHz frequency ranges. Body weight (with an accuracy of 0.1 kg in lightweight outer clothing) and body height (with an accuracy of 0.5 cm) were measured using an electronic scale with a built-in height meter (Radwag, Radom, Poland). The BMI of the examined women was calculated from the formula: body weight (kg) / body height^2 (m^2). Waist and hip circumferences were measured with an anthropometric tape according to WHO guidelines [19], with an accuracy of 0.5 cm.

The validated Mediterranean Diet tool contained 14 items (1-point criteria for each item) to assess the participant's adherence to the diet developed by the Prevención con Dieta Mediterránea (PREDIMED) consortium [20]. The score of adherence was calculated by summing-up the points of the 14 questions ('Yes' answer = one point, 'No' = 0 point; the results ranged between 0–14). Assessment of the application of the principles of the Mediterranean Diet was directly proportional to the number of points collected in the questionnaire. In order to determine the level of physical activity of participants, the validated International Physical Activity Questionnaire (IPAQ) was used in the full version [21]. Interpretation of the questionnaire was carried out by multiplying the time devoted to physical activity by the number of days *per* week in which a given activity was undertaken and by the metabolic equivalent (MET) indicator appropriate for a given physical effort [22].

The collected data were compiled in the Office suite in Excel and all statistical analyses were performed using the IBM SPSS programme. First, it was verified whether there were statistically significant differences between the groups of patients in the distribution of the studied variables, using the Kruskal-Wallis test. The Wilcoxon labeled rank test was then used to verify whether there were statistically significant differences in the distribution of variables for dependent samples, before and after the intervention programme was introduced. To describe the strength of feature correlation, the Rho-Spearman correlation coefficient was calculated in the multivariate analysis of variance (MANOVA) model. After performing the variance analysis test with the Levene's test, the group's equivalence was checked and the distribution normality of the dependent variable in the groups was examined. Missing data in anthropometric measurements were supplemented by the Fully Conditional Specification (FCS) method using multiple imputation algorithms for missing values that use Markov chains (MCMC procedure). The level of significance was $\alpha=0.05$.

RESULTS

In total, 45 of the 53 women with Hashimoto's disease, polycystic ovary syndrome, and the healthy women (control group, without Hashimoto's disease or polycystic ovarian syndrome) completed the intervention programme. The average age of the examined women was 24.47±4.1 years. The intervention programme among healthy women lasted 73.4±18 days, for women with polycystic ovary syndrome 71.5±23 days, and for women with Hashimoto's disease 69.8±20.5 days. Differences in the number of days were caused by difficulties with appointments for visit and measurements after 10 weeks of the intervention programme (Tab. 1). Body weight in women with polycystic ovary syndrome group decreased from 64.9±11.3 kg before intervention to 63.51±10.3 kg after the intervention programme. A statistically significant difference in the body weight change (-1.39kg) after the intervention programme was noted only in this group of women (p=0.026).

In the Hashimoto and control group, body weight of the women did not change (p=0.074 and p=0.053, respectively) after the intervention programme. The average body height of patients from the HT group was 168.6±7 cm, in the PCOS group 165.2±5.2 cm and in the control group 166.7±4.3 cm. BMI of patients with PCOS before the intervention was 23.8±4 kg/m^2, and after the program 23.3±3.5 kg/m^2. In the group of patients with Hashimoto's disease, the BMI before the intervention was 24.7±5.3 kg/m^2 and after the intervention

Table 1. Parameters representing the differences before and after lifestyle modification in 3 groups of women studied

Parameter	PCOS (before) n=12	PCOS (after) n=12	p	Hashimoto's thyroiditis (before) n=10	Hashimoto's thyroiditis (after) n=10	p	Healthy group (before) n=23	Healthy group (after) n=23	P
Body weight (kg)	64.9	63.51*	0.026	70.5	68.41	0.074	62.3	61.82	0.053
BMI (kg/m^2)	23.8	23.26*	0.012	24.7	23.97*	0.002	22.4	22.21*	0.004
Waist circumference (cm)	79.1	77.61	0.131	84.6	81.31*	0.045	77.7	77.03	0.419
Hip circumference (cm)	98.7	97.67	0.186	103.6	102.01	0.068	97.8	96.94	0.115
WHR	0.8	0.79	0.532	0.81	0.79	0.152	0.79	0.79	0.954
Adipose tissue (%)	26.4	24.67*	0.012	30.1	28.46*	0.002	25.4	24.11*	0.004
Muscle mass (kg)	25.1	26.22	0.147	26.1	26.48	0.551	25.0	25.29	0.549
MedDiet Score Tool	7.6	9.17*	0.009	7.64	9.2*	0.016	7.88	9.87*	0.00
IPAQ (MET-min/week)	3 885.7	4 716.85	0.272	4 549.5	4 560.7	0.878	4 809.8	4 764.2	0.605

* statistically significant difference, p <0.05

programme 24.0±4.7 kg/m^2. The control group had a BMI with the value of 22.4±4.5 kg/m^2 during the first measurement and a BMI with the value of 22.2±4.4 kg/m^2 during the second measurement. In all experimental groups, a statistically significant difference was noted in BMI value before and after the intervention (PCOS: p=0.012; Hashimoto: p=0.002; Control group: p=0.004). The waist circumference of women with PCOS before the intervention was 79.1±9.9 cm and after the intervention 77.7±9 cm. Women with Hashimoto's disease had a waist circumference of 84.6 cm in the first stage of the study, and after the intervention the waist circumference in this group was 81.3±14 cm. In the control group, the waist circumference before the intervention programme was 77.7±9.4 cm and after the programme it amounted to 77.03±11 cm. A significant difference was noticed in the results of women with Hashimoto's disease (p=0.045). Women with PCOS and women from the control group showed no significant change in the waist circumference (PCOS: p=0.131; Control group: p=0.419). The hip circumference of patients with polycystic ovary syndrome in the first study was 98.7±7 cm and during the second study – 97.67±6.8 cm. Women with Hashimoto's disease had a hip circumference of 103.6±9.9 cm at the first examination, while at the second measurement the hip circumference in this group was 102.01±10 cm. The hip circumference in the control group before the intervention was 97.8±8.3 cm and after it – 96.94±8.9 cm. No statistically significant changes were noted in the hip circumference (PCOS: p=0.186; Hashimoto: p=0.068; Control group: p=0.115). In the group of women with WHR (WHR- Waist to Hip Ratio) polycystic ovary syndrome before the intervention programme was 0.80±0.06 and after the intervention programme – 0.79±0.05. The ratio of waist circumference to hip circumference in Hashimoto women was 0.81±0.08 and after changing the lifestyle – 0.79±0.07. In healthy women, the WHR at the beginning was 0.79±0.05, while after the intervention this ratio was 0.79±0.06.

No changes were observed in any group (PCOS: p=0.532; Hashimoto: p=0.152; Control group: p=0.954). All study participants showed a reduction in body fat percentage after the intervention programme (PCOS: p=0.012; Hashimoto: p=0.002; Control group: p=0.004). Patients with PCOS showed a reduction in the body fat from 26.4±8.4% to 24.67±6.3%. Women with Hashimoto's disease showed a decrease in the body fat from 30.1±9% to 28.46±8.7%. In the group of healthy women, there was a reduction in body fat from 25.4±6.2% to 24.11±7. Before the intervention, the muscle mass in the group of women with polycystic ovary syndrome was 25.1±3.97 kg and after the lifestyle change – 26.22±3.38 kg. In the group of women with Hashimoto's disease, these results were 26.1±2.92 kg and 26.48±3.35 kg, respectively, and in the group of healthy women they were 25±2.3 kg and 25.29±3.12 kg, respectively. No changes in muscle mass in study groups were observed (PCOS: p=0.147; Hashimoto: p=0.551; Control group: p=0.549). Physical activity, measured by means of a questionnaire, was calculated in MET x min/week.

The first questionnaire in women with PCOS showed physical activity at the level of 3885.7±1250 MET-min/week, whereas after the intervention programme it amounted to 4716.85±2918 MET-min / week. In the group of women with Hashimoto's disease, these results were 4549.5±1592 MET-min/week, and 4560.70±2044 MET-min/week, respectively, whereas in the control group, the measurements were 4809.8±2858 MET-min/ week and 4,764.20±2,619 MET-min/week. There were no differences between physical activity performed before and during the intervention (PCOS: p=0.272; Hashimoto: p=0.878; Control group: p=0.605). In all three study groups, an increase in the score of points on the Mediterranean Diet was observed; on average, the results improved by two points (PCOS: p=0.009; Hashimoto: p=0.016; Control group: p=0.00). The score increased from 7.6±1.4 points to 9.17±1 points in the PCOS group, from 7.64±1.4 points to 9.20±1.4 points in the Hashimoto group and from 7, 88±1.7 points to 9.87±1.3 points in the control group.

When analysing the results of the study data, correlations between parameters were observed for all women participating in the study. It is important to show how lifestyle changes without caloric restriction can affect a woman's anthropometric parameters, despite the woman's health condition. All statistically significant correlations for p=0.05 are presented in Table 2.

It was shown that along with the change in the percentage of body fat, the change in BMI of the examined women increased (p=0.001, rho=0.438). A positive correlation existed between the body fat content and the body weight, with the increase in the body weight change, and the change in the body fat content (p=0.001, rho=0.420). A very strong negative relationship occurred in the correlation between the change in body fat and water content: the greater the change in the body fat content, the smaller the change in the body water content (p=0.0001, rho=-0.895). A weak positive correlation was demonstrated for the number of days of the

Table 2. Correlations between parameters. All statistically significant for p=0.05

Parameter 1	Parameter 2	Spearman's rank correlation (rho)	Strength of correlation
BMI	Adipose tissue	0.438	Moderate positive
Adipose tissue	Body weight	0.420	Moderate positive
Adipose tissue	Water content	-0.895	Very strong negative
Duration of intervention	Adipose tissue	0.291	Weak positive
Duration of intervention	Muscle mass	-0.283	Weak negative
Mediterranean Diet Score Tool	IPAQ	0.262	Weak positive
Body weight	Age	0.241	Weak positive

intervention programme and the body fat content: the longer the intervention programme, the greater the change in the body fat content, while the opposite was observed for the change in the muscle mass: the longer the programme, the smaller the change in the muscle mass and glycogen content.

A correlation between the change in the amount of physical activity and the score related to the implementation of the principles of the Mediterranean diet measured using the Mediterranean Diet Score Tool was also observed. Another correlation was the change in the body weight as correlated with the age of patients: the older the age of the women, the greater the change in the body weight during the intervention. A very strong relationship occurred between the increase in the muscle mass change and the increase in glycogen content.

The following correlations were also observed: the higher the body weight in patients with Hashimoto's disease before the intervention, the greater the change in their body weight during the entire intervention programme (p=0.028, rho=0.585). In the Hashimoto group, a greater change in the muscle mass correlated with a change in physical activity according to the IPAQ questionnaire (rho=0.661). The change in muscle glycogen content, in addition to being associated with a change in muscle mass (rho=0.947), was also associated with a change in physical activity according to the IPAQ questionnaire (rho=0.709) (Tab. 3). In the PCOS group, the greater the change in the Mediterranean Diet score, the greater the change in the body weight (rho=0.608) and the change in the result in the IPAQ questionnaire on exercise (rho=0.542). In the control group, the change in the muscle glycogen content and the muscle mass positively correlated with age (rho=0.397 and rho=0.394, respectively) (Tab. 4).

Table 3. Correlations between parameters for HT group. All statistically significant for p=0.05

Parameter 1	Parameter 2	Spearman's rank correlation (rho)	Strength of correlation
BMI	Adipose tissue	0.522	Moderate positive
Adipose tissue	Body weight	0.501	Moderate positive
Adipose tissue	Water content	-0.859	Very strong negative
Muscle mass	Muscle glycogen content	0.947	Very strong positive
Mediterranean Diet Score Tool	Age	-0.583	Moderate negative

Table 4. Correlations between parameters for PCOS group. All statistically significant for p=0.05

Parameter 1	Parameter 2	Spearman's rank correlation (rho)	Strength of correlation
BMI	Adipose tissue	0.642	Moderate positive
Adipose tissue	Body weight	0.608	Moderate positive
Adipose tissue	Water content	-0.769	Very strong negative
Muscle mass	Muscle glycogen content	0.991	Very strong positive
Mediterranean Diet Score Tool	IPAQ	0.542	Moderate positive
Body weight	Mediterranean Diet Score Tool	0.649	Moderate positive

DISCUSSION

This study presents a novel intervention examining the efficacy of an *ad libitum* Mediterranean Diet intervention on anthropometric features in normal weight women with PCOS and HT. To the best of the authors' knowledge, this is the first study of its kind to examine the potential benefits of an MD and moderate physical activity intervention in women with PCOS and HT, without the need for caloric restriction.

Overall, it can be concluded that the study groups completed a two-component lifestyle programme that combined nutrition advice and increase in physical activity, which resulted in relevant body composition improvement in normal weighted women with PCOS and HT.

In the study, all the examined women from the three groups showed a normal value of BMI both before and after the intervention programme, as the BMI did not exceed 25 kg/m^2. WHO guidelines were used to refer the results to standards [23]. The ratio of waist-to-hip circumference in the examined groups of women was on the border of normal, the risk of obesity complications in this case was minimal but increased with the increase in waist circumference [24]. The waist circumference in women with Hashimoto in the presented study was above the normal (84.6 cm and 81.31) in relation to the recommendations of the International Diabetes Federation, which may be associated with an increased risk of type 2 diabetes or hypertension [25]. In this group of women, waist circumference decreased during the intervention programme, which may reduce the risk of abdominal obesity and associated non-communicable chronic diseases.

The results of the presented study demonstrated a positive correlation between the change in BMI and adipose tissue, despite no caloric restriction during the intervention. A similar observation was also found by Romero-Corral et al [26]. In the current study, the strongest correlation could be observed in the group of women suffering from HT and in the group of women with PCOS. In a study by Almenning et al. [14] among 31 women with PCOS, the patients were divided into groups performing intensive interval training, strength exercises, and a control group performing the amount of physical activity recommended by WHO. After 10 weeks of observation, the second measurement of the body composition was carried out and it was observed that neither body weight nor waist circumference had changed, while fat tissue was reduced in the group of women performing intensive interval training and strength exercises. There was no difference in body composition change between the groups in the study. Similar results are presented in the meta-analysis by Kite et al. devoted to the effect of physical activity on the body composition of patients with PCOS disease. The results showed the largest reduction in the body fat in overweight women (BMI 25–29.9 kg/m^2) performing aerobic exercises for less than 12 weeks [27]. In the current study, however, there were also noticeable differences in the reduction of fat and BMI in all groups of women studied, in the body weight in women with PCOS and in the waist circumference in women with Hashimoto's disease. There was also a difference between the groups with regard to body weight change (between the group with polycystic ovary syndrome and the healthy group). The latest Kim and Lee meta-analysis showed that BMI and body weight of the group that underwent lifestyle intervention were significantly lower than those of the control group (BMI: MD –2.21, p=0.03, weight: MD –5.33; p=0.03) [28]. These results are concurrent with the results reported by previous studies, which observed that lifestyle modification programmes have positive effects on anthropometric indices [29].

A limitation of the present study is the high discontinuation rate (19%) which was observed in all groups, but especially in patients with HT (28%). Compliance and dropout are the most difficult aspects of any lifestyle intervention. Other studies have reported dropout rates of around 25% in one- and two-component programmes for women with PCOS [30]. The dropout rates tend to be the highest within the first three months of starting a lifestyle programme [31].

It is important that the results of this study offer an evidence-based dietary approach for the management of PCOS. A secondary outcome of the study is that it also identifies the acceptability and feasibility of the MD in women with PCOS and HT.

CONCLUSIONS

The analysis of the results of the study on changes in lifestyle factors and anthropometric parameters in women with HT and PCOS showed that the intervention programme consisting in implementing the principles of the Mediterranean Diet and increasing physical activity affects the change of anthropometric parameters in all groups of studied women. Participants to the study modified their diet towards the MD; therefore, the intervention programme can be an effective method of improving women's health by positive changes in body composition, even without significant body weight reduction.

Overall, it can be concluded that a group-based two-component lifestyle programme that combines nutrition advice and an increase in physical activity can result in reasonable body composition changes in women with PCOS and HT, even without dietary caloric restriction.

An additional lifestyle modification based on a combination therapy (Mediterranean Diet and increase in physical activity level) is a promising therapeutic approach that can be implemented in the management of PCOS and Hashimoto's disease patients without obesity.

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