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The effect of onion juice on menstrual disorder and hormonal parameters in patients with polycystic ovary syndrome

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Abstract

Our aim in this study was to objectively observe the effect of onion juice on menstrual disorders (irregular menstruation, dysmenorrhea, amenorrhea, menorrhagia, hypermenorrhea, and hypomenorrhea) in patients with *polycystic ovary syndrome* (PCOS). A method that affects these women's quality of life without side effects has an essential effect on infertility as a global problem. We conducted a prospective randomized analysis of age-matched and body mass index (BMI)-matched women between April 2019 and March 2020. The study population included 64 reproductive-aged women with PCOS. Data collection by questionnaire and blood samples was done before and after 15 days of onion juice use. There was a statistically significant association between before and after onion juice use in terms of high density lipoprotein (HDL), low density lipoprotein (LDL), and triglyceride (TG) in case group ($p<0.05$). There was a statistically significant association between before and after onion juice use in terms of irregular menstruation, dysmenorrhea, amenorrhea, and menorrhagia ($p<0.05$) in case group. According to the findings, menstrual disorders decreased after 15 days of onion juice use. As a result, onion juice can be used to reduce the complications of PCOS in women. Improvement in dysmenorrhea and amenorrhea has essential effects on the health of women with PCOS.

Keywords: Polycystic ovary syndrome, irregular menstruation, menstrual disorders, onion juice

1. Introduction

Polycystic ovary syndrome (PCOS) is premenopausal women's most common endocrine disease (1,2). In these women, androgen levels are? is higher than normal, and their ovaries are full of micro follicles that have turned into cysts (3,4). Women with PCOS are usually overweight or obese and experience irregular menstruation (5,6). Diet and exercise are the best ways to treat these patients (7,8). However, there are different opinions about the extent of the impact and how it has been the subject of much research(9,10). The current research has investigated the effect of a diet including onion juice on the clinical and laboratory symptoms of PCOS women.

There are different health implications for the prevalent menstrual disorders (irregular menstruation, dysmenorrhea, hypomenorrhea, menorrhagia, or hypermenorrhea and premenstrual symptoms) as health indicators in women. There is a varying irregular menstruation prevalence from 5% to 35.6%, depending on the occupation, age, and residence country (11). PCOS is the most common cause of menstrual irregularities causing female infertility. It is the most prevalent cause of female infertility because it is very difficult to predict the day of ovulation in these women (12). There are several treatments now, but there is an association between them and moderate to serious side effects. Regular menstruation resulting from the presentation of more effective methods with fewer side effects increases the chance of pregnancy in women.

Oral contraceptive (OC) drugs are used effectively to regulate menstruation. Today, OCs are the first preferred drug group in the patient group with PCOS and menstrual irregularity (13). Venous thromboembolism is the most common vascular complication in women using OCs. The probability of embolism increases 2-4 times in OCs users compared to non-users (14,15). In addition, many studies have reported that OCs cause cervical cancer, especially in positive human papilloma virus (HPV) patients (16,17). OCs, which are widely used as a menstrual regulator in patients with PCOS, have many side effects, which create difficulties in their use in practice (18). Especially patients who have menstrual irregularity and also want pregnancy seek an alternative way (6). The fact that some patient groups did not want to use chemical drugs, resorted to traditional and complementary medicine, our retrospective observation of satisfaction in patients using onion juice, and the fact that no previous study has been done on this subject in the literature encouraged us to conduct this study (19).

The focus of PCOS management is usually on lifestyle changes (diet and exercise) to alleviate symptoms and reduce the related risk of cardiovascular disease and type 2 diabetes (20,21).

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We aimed to compare the menstrual-reducing and menstrual-regulating effects of onion juice in patients with PCOS and its effect on hormones and some biochemical parameters.

2. Material and Method

Thirty-one women were included in the control group, and thirty-three women who consumed brown onion juice for 15 days were included in the case group. A prospective randomized comparison of the anti-menstrual and menstrual-regulating effects of brown onion juice and its effect on blood hormones and some biochemical parameters in PCOS patients was made. In this study, brown onion juice was given to the case group for 15 days. After 15 days, menstrual disorders and laboratory parameters were studied for six months.

All subjects participated in the study voluntarily. It was planned that half of the patients will drink the standardized onion juice prepared in our Bezmialem University Phytotherapy Center twice a day (2 cups of 200 ml in total) on an empty stomach for 15 days, and they will stop curing in case of menstruation any day they drink the brown onion juice. The other half of the patients is our control group, and it is planned to drink the placebo (sugar water with added onion flavor suitable for food) prepared by our Bezmialem University Phytotherapy Center in the same way. In this way, after the patients complete 15 days, the two groups will be compared in a randomized, controlled manner. During the 6-month period after the patients drink onion juice, their menstrual patterns will be compared. The protocol for preparing brown onion juice involves boiling it with water at a ratio of 1:10, including the onion shells, and then diluting the cooled extract with water to the required volume. The prepared brown onion juice will be standardized in terms of the marker components quercetin and quercetin glycosides, and all patients will be provided with the same product. While preparing the placebo product, the onion flavor compatible with the food will be diluted 1:1000 with 1% dextrose water.

The inclusion criteria were as follows: 1) 18-40 years old. The exclusion criteria were as follows: 1) known chronic disease, 2) over 40 years of age, 3) pregnant women, 4) having gastritis, reflux, or onion allergy, and 5) women with the lactation period.

We utilized the G-Power 3.1 program to calculate the example size. The two groups' total mean was calculated based on the Mann-Whitney test with a power of 80%, an effect size of 50%, and beta/alpha ratio of 1 for at least 30 patients for each group (22).

2.1. Statistical Analysis

The Kolmogorov-Smirnov test was conducted to check the normality, and the nonparametric tests were performed given the groups' non-normality before the statistical analyses. Mean and standard deviations (SD) were measured to check each continuous variable, including age, body mass index (BMI), fasting blood sugar (FBS), follicle-stimulating hormone (FSH), luteinizing hormone (LH), Estradiol (E2), Prolactin (PRL), thyroid-stimulating hormone (TSH), Free T4 (FT4), HDL, LDL, total cholesterol, triglyceride, total testosterone, 17-OH Progesterone, *sex hormone-binding globulin (*SHBG),Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), and dehydroepiandrosterone sulfate (DHEAS). The Mann-Whitney U test was deployed to examine the difference between the case and control groups for abnormal continuous variables. An independent t-test was deployed to examine the difference of normal variables. Chi-square tests were applied to describe the relationship between proportions of categorical variables such as pregnancy results, ongoing pregnancy rate, and abortion rate. SPSS v24 was employed for statistical analyses. A value of $p<0.05$ was accepted as statistically significant.

3. Results

This study included sixty-four-year old (26.42±2.48) and BMI (22.61±1.66) women. Table 1 shows that descriptive statistics of maternal characteristics and laboratory parameters.

Table 1. Descriptive statistics of study parameters in women (n=64)

	Study parameters	median (range) mean ± SD
Maternal characteristics	Age	26(23-35)26.42±2.48
	BMI	23(18.4-26.1)22.61±1.66
Laboratory values	FBS	84.5(68-98)84.56±6.41
	FSH	4.3(1.2-8.4)4.38±1.48
	LH	6.95(2.2-11.2)6.96±2.06
	E2	50(24-68)50.44±10.58
	PRL	16(8.48-35.1)17.17±5.23
	TSH	1.835(0.8-5.2)2±0.84
	Free T4	0.58(0.23-1.12)0.59±0.19
	HDL	66(38-89)65.44±10.5
	LDL	97.5(56-185)106.92±30.95
	Total Cholesterol	166(120-285)175.72±41.53
	Triglyceride	55(0.21-89)40.43±37.78
	Total Testosterone	0.645(0.18-158)45.61±52.47
	17OH Progesterone	0.3205(0-1.77)0.38±0.23
	SHBG	39(23.8-124)42.5±18.54
	HOMA-IR	2.42(0.58-5.3)2.39±1.08
	DHEAS	254.5(129-430)262.84±73.96

SD, standard deviation. BMI, body mass index; FBS, fasting blood sugar; FSH, follicle-stimulating hormone; LH, luteinizing hormone; E2, Estradiol; PRL, prolactin; TSH, thyroid-stimulating hormone; FT4, Free T4; HDL,high density lipoprotein ; LDL,low density lipoprotin ; SHBG, *sex hormone-binding globulin* ; DHEAS, dehydroepiandrosterone sulfate.

Table 2 shows the comparison of the control group on maternal characteristics and laboratory values. In the present investigation, we compared laboratory parameters between case and control groups and evaluated the ability of those parameters to distinguish between groups.

Table 2. Comparison of laboratory parameters in two time periods in control group

Study parameters	Before the study (n=33) median (range) mean ± SD	After 15 days (n=33) median (range) mean ± SD	*p*-value
FBS	83(75-94)84.92±5.24	86(68-98)85.53±5.98	0.742**
FSH	3.7(2.5-7.1)4.28±1.28	4.7(1.2-8.4)4.49±1.69	0.465**
LH	7.1(2.75-11.23)6.71±1.76	6.7(2.35-10.97)6.59±2.2	0.242*
E2	46(24-66)48.96±10.98	51(33-67)50.03±10.18	0.277*
PRL	16(12-34.1)17.22±5.12	17.6(8.48-23)17.14±4.99	0.749*
TSH	1.52(0.79-4.9)2.18±0.87	2.21(0.78-3.15)2.21±0.71	0.514*
Free T4	0.59(0.24-1.14)0.59±0.17	0.53(0.22-0.91)0.57±0.18	0.490**
HDL	64(37-79)66.99±9.97	68(49-87)67.99±9.93	0.523*
LDL	113(75-187)117.12±28.58	87(55-159)115.71±28.98	0.654*
Total Cholesterol	169(121-279)185.97±47.19	164(125-239)183.15±29.85	0.234**
Triglyceride	80(51-88)73.99±11.98	0.5(0.21-57)74.08±13.73	0.754*
Free Testosterone	0.35(0.17-0.79)90.38±0.14	96(0.36-158)93.74±33.76	0.746**
17OH Progesterone	0.34(0.2-1.76)0.39±0.28	0.32(0-0.74)0.36±0.15	0.966*
SHBG	39.2(24.7-123)46.91±24.96	37(32-82)47.55±24.54	0.789**
HOMA-IR	2.47(0.76-5.3)2.35±1.08	2.14(0.58-4.5)2.22±1.07	0.585*
DHEAS	253.2(128-431)271.37±81.19	258(174-389)275.03±62.69	0.214*

M, Mean; N, number of subjects; FBS, fasting blood sugar; FSH, follicle-stimulating hormone; LH, luteinizing hormone; E2, Estradiol; PRL, prolactin; TSH, thyroid-stimulating hormone; FT4, Free T4; HDL,high density lipoprotein ; LDL,low density lipoprotin ; SHBG, *sex hormone-binding globulin* ; DHEAS, dehydroepiandrosterone sulfate * Mann-Whitney U test; ** Independent t-test

Table 3. Comparison of laboratory parameters in two time periods in case group

Study parameters	Before the study (n=31) median (range) mean ± SD	After 15 days (n=31) median (range) mean ± SD	
FBS	83(72-96)83.42±6.36	86(68-98)85.77±6.33	0.144**
FSH	3.8(2.5-7.1)4.28±1.28	4.7(1.2-8.4)4.49±1.69	0.595*
LH	7.2(2.98-11.2)7.31±1.89	6.5(2.2-11.2)6.59±2.2	0.162*
E2	47(24-67)48.94±11.68	52(34-68)52.03±9.18	0.242**
PRL	16(11-35.1)17.12±5.2	17.6(8.48-23)17.23±5.34	0.925*
TSH	1.56(0.8-5.2)1.79±0.9	2.23(0.8-3.5)2.22±0.73	**0.008***
Free T4	0.62(0.25-1.12)0.63±0.19	0.54(0.23-0.95)0.55±0.19	0.090**
HDL	65(38-80)61.64±10.06	69(50-89)69.49±9.53	**0.005***
LDL	112(76-185)116.42±29.77	88(56-163)96.81±29.34	**0.007***
Total Cholesterol	177(120-285)186.21±48.91	165(123-245)164.55±28.65	0.036**
Triglyceride	81(52-89)74.58±12.27	0.5(0.21-57)4.08±13.73	**<0.001***
Free Testosterone	0.36(0.18-0.82)0.4±0.15	96(0.36-158)93.74±33.76	**<0.001***
17OH Progesterone	0.35(0.1-1.77)0.4±0.29	0.32(0-0.74)0.36±0.15	0.866*
SHBG	39.1(23.8-124)46.21±25.06	38(32-52)38.55±4.54	0.329*
HOMA-IR	2.47(0.76-5.3)2.55±1.08	2.14(0.58-4.5)2.22±1.07	0.235**
DHEAS	253.2(129-430)251.38±82.49	258(174-389)275.03±62.69	0.204**

M, Mean; N, number of subjects; FBS, fasting blood sugar; FSH, follicle-stimulating hormone; LH, luteinizing hormone; E2, Estradiol; PRL, prolactin; TSH, thyroid-stimulating hormone; FT4, Free T4; HDL,high density lipoprotein ; LDL,low density lipoprotin ; SHBG, *sex hormone-binding globulin* ; DHEAS, dehydroepiandrosterone sulfate * Mann-Whitney U test; ** Independent t-test

There was not a statistically significant association between two periods of time in terms of FBS, FSH, LH, E2, PRL, TSH, Free T4, HDL, LDL, Total Cholesterol, Triglyceride, Free Testosterone, 17OH Progesterone, SHBG, HOMA-IR, and DHEAS in the control group (p<0.05).

As stated in Table 3, a Mann-Whitney test did not find a statistically significant association between before and after the consumption of onion juice in the case group in regard to Age, BMI, FSH, LH, PRL, TSH, 17OH Progesterone, and SHBG (p>0.05). Independent t-test did not find a statistically significant association between before and after the consumption of onion juice in the case group in terms of FBS, E2, Free T4, total cholesterol, HOMA-IR, and DHEAS (p>0.05). The Mann-Whitney test found a statistically significant association between before and after the consumption of onion juice in the case group in regard to HDL, LDL, triglyceride, and total testosterone (p<0.05). The serum HDL and free testosterone levels were significantly higher in case group before the consumption of onion juice. The serum LDL and triglyceride levels were significantly higher in the case group before the consumption of onion juice.

As stated in Table 4, a chi-square test found a statistically significant association between the treatment rate of dysmenorrhea and the consumption of onion juice (p<0.05). There was a statistically significant association between the treatment rate of menorrhagia and the consumption of onion juice (p<0.05). There was a statistically significant association between the treatment rate of hypermenorrhea and the consumption of onion juice (p<0.05). There was not a statistically significant association between the treatment rate of hypomenorrhea and the consumption of onion juice (p>0.05). Onion juice's impact on the menstrual cycle was observed in this study based on the results represented in table 4.

Table 4. The relationship between menstruation problems between case and control groups

Variables		Case(n=31) n(%)	Control(n=33) n(%)	p
Menstruation occurred after the 15-day treatment period	Yes	27 (81.2)	8 (25.8)	**<0.001***
	No	6 (18.8)	23 (74.2)	
The dysmenorrhea	Yes	5 (15.1)	26 (83.9)	**<0.001***
	No	28 (84.9)	5 (16.1)	
4 or more amenorrhea in 6 months	Yes	13 (39.4)	25 (80.6)	**<0.001***
	No	20 (60.6)	6 (19.4)	
The menorrhagia	Yes	4 (12.1)	17 (54.8)	**<0.001***
	No	29 (87.9)	14 (45.2)	
The hypermenorrhea	Yes	15 (45.5)	24 (75.9)	**0.009***
	No	18 (54.5)	7 (24.1)	
The hypomenorrhea	Yes	14 (42.4)	18 (58)	0.211*
	No	19 (57.6)	13 (42)	

*A Chi-square test

4. Discussion

The current study examined the possible effects of onion juice on menstruation problems and laboratory parameters in women with PCOS. In our study, the menstruation occurrence (81.2 % vs. 25.8%), dysmenorrhea (15.1% vs. 83.9%), amenorrhea frequency (39.4% vs. 80.6%), menorrhagia (12.1% vs. 54.8%), and hypermenorrhea (45.5% vs. 75.9%) were significantly different between the case and control groups, respectively. In dysmenorrhea as the primary variable, 84.9% of women have reported treatment for dysmenorrhea. In women who used onion juice, four or more amenorrheas in 6 months occurred much less frequently (39.4% vs. 80.6%). Only 12% of women in the case group have faced menorrhagia.

Hypermenorrhea and menorrhagia are directly related to an increase in menstrual flow (23). Hypermenorrhea is less common after onion juice consumption than in the control group (45.5% vs. 75.9%). The hypomenorrhea was nearly the same in both groups. This study showed statistically significant differences after the consumption of onion juice in HDL, LDL, triglyceride, and free testosterone parameters. Changes in these laboratory parameters cause menstrual-reducing and menstrual-regulating effects.

Dysmenorrhea is a considerable health-related problem in women of reproductive age (24). Bajalan et al. (25) reported the effect of food groups and eating habits on this problem. Based on the study's findings, the use of onion juice can be very effective in improving this pain and can be suggested as an effective treatment. Except for hypomenorrhea, other menstrual disorders demonstrated a positive effect of onion consumption. The frequency of amenorrhea has decreased by half after consuming onion juice, which is important considering the importance of amenorrhea in the reproductive system.

Nutrition and exercise are two non-drug treatments to

relieve the symptoms of the disease (20). It has been proven that lifestyle modifications, particularly exercise and diet, have effectively managed the symptoms and reduced the risk factors associated with PCOS (26). According to many people, this has a higher effect than medication. Several studies have been conducted on the effect of exercise and diet on obese women with PCOS and found that weight loss has led to favorable results (20,21,27). In the current study, the main difference from previous studies is that the effect of onion juice is unrelated to weight loss. This treatment can be effective regardless of weight.

Krouni et al. (28) reported a reduction in BMI, free testosterone and LH levels and an increase in SHBG after low calorie diets. The high-calorie diet leads to reversible hormonal disorders and menopause (29). Medicinal plants of natural origin are also known as low-calorie foods, and medicinal plants have been shown to help alleviate PCOS complications (30). Wang et al. (31) identified Cinnamon's function as an adjunctive therapy to treat PCOS. The effect of Cinnamon on metabolic dysfunction and menstrual cycle in PCOS women was studied in another research as a randomized controlled trial on 45 women. Oral cinnamon supplements were administered. The luteal phase, menstrual cycle, and progesterone levels were all followed. The menstrual cycle was enhanced through Cinnamon supplementation, which was found to contribute to the treatment of PCOS. Jelodar et al. (32) studied flax seeds' effect on PCOS patients' ovarian morphology, concluding that ovarian volume decreased, the number of follicles in the ovaries increased, and menstrual cycle duration improved through flax seed supplementation. On the contrary, the research found that body weight, blood sugar levels, or hirsutism did not improve.

The positive effects of different types of onions on diabetes (33), hypertension (33), liver and kidney injury (34), and sperm (35) were the primary motivation to conduct this study. The onion in the Middle East and Asian countries is widely known to be used in traditional medicine and food.

However, there are few studies about the effect of onion juice on women. Lee et al. (36) did the only similar study. In this study, the Welsh onion was administered to letrozole-treated rats for two weeks for treatment. Regarding serum hormonal levels, onion extract therapy positively affected serum estrogen levels and LH/FSH ratio. LH and FSH are necessary for ovulation, and PCOS patients often have an increased LH/FSH ratio two to threefold, causing ovulation disruption. Based on the findings, ovarian cysts and follicular growth are normalized by the onion extract. The steroid hormone-related receptors in the letrozole-induced PCOS rat model showed mRNA expression restoration after being treated with onion extract. Onion extract treatment altered and relieved ovarian function. Contrary to this study, our results did not affect the LH and FSH parameters of onion juices.

The main limitation of this research is its small sample size. The sample size was limited to 64 patients. Based on our knowledge, the present study is the first time onion juices were used to treat menstrual disorders. In this study, the unpleasant side effects of PCOS, such as irregular menstruation, were improved using onion juice. Most of the studies on the effect of exercise and nutrition on PCOS seek to reduce the complications of this disease by losing weight. Providing a successful method for treating the disease without side effects is one of the most important strengths of this study.

In this study, brown onion juice was used. This type of onion is chosen because of its abundance in the country and easier access. The future study is aimed to investigate the effects of different types of onion. For future studies, it is recommended to check the length of different treatments (one month, two months and three months) on the effect of onion juice.

This study revealed that onion juice can be used to reduce the complications of PCOS in women. The availability of onion juice can be a valuable opportunity to popularize this type of treatment. Additional investigations are required to explore the causal relationship between onion juice and menstrual disorders.

Conflict of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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None to declare.

Authors' contributions

Concept: A.Ş.K., Design: A.Ş.K., Data Collection or Processing: A.Ş.K., Analysis or Interpretation: A.Ş.K., Literature Search: A.Ş.K., Writing: A.Ş.K.

Ethical Statement

The Ethics Committee of Bezmialem University Hospital approved this prospective randomized study. (Date:6.3.2019 Decision No:5/26). Sixty four women participated in this study between April 2019 and March 2020. All procedures were carried out in accordance with the ethical rules and the principles of the declaration of Helsinki.

References

1. Alanya Tosun Ş, Gurbuz T, Cebi A, Tosun A, Gokmen O, Usta M. Association of increased levels of omentin-1 and carotid intima-media thickness with early signs of cardiovascular risk in patients with polycystic ovary syndrome: A prospective case control study. Journal of Obstetrics and Gynaecology Research. 2022; 48(1): 169-77.

2. Juliawan IMP, Suwana FP, Annas JY, Akbar MF, Widjiati W. High sucrose and cholic acid diet triggers PCOS-like phenotype and reduces enterobacteriaceae colonies in female wistar rats. Pathophysiology. 2022; 29(3): 344-53.

3. Aftab B, Imran M, Shahrukh SI. Effect of Phytoestrogens in the Treatment of Polycystic Ovary Syndrome in Rat Model. Journal of

Food and Nutrition Research. 2022; 10(7): 518-25.

4. Madenli AA, İnci Ö, Gürbüz T. The relationship between anti mullerian hormone level and endometrial polyp frequency in patients with polycystic ovary syndrome. Journal of Medicine and Palliative Care.2022; 3(3): 263-7.

5. Gurbuz T, Gungor ND. Understanding the Effects of Obesity over Polycystic Ovary Syndrome by Analyzing Insulin Resistance and Thyroid Hormone in Different BMI Levels. The ulutas medıcal journal. 2021; 7(1):8-.

6. Gurbuz T, Gokmen O. A Novel Index to Overcome the Assessment Limitations of Insulin Resistance in Polycystic Ovary Syndrome Homeostatic Model Assessment Index to Red Blood Cell Distribution Width Ratio. Journal of reproductıve medıcıne. 2021; 66(1-2): 9-14.

7. Gürbüz T, Gökmen O, BÖR ED, Uluocak A. Investigating the relationship of serum levels of afamin and interleukin-10 with insulin resistance in infertile women with polycystic ovary syndrome. Journal of Surgery and Medicine. 2021; 5(3): 264-8.

8. Shahid R, Awan KA, Iqbal MJ, Munir H, Saeed I. Diet and lifestyle modifications for effective management of polycystic ovarian syndrome (PCOS). Journal of Food Biochemistry. 2022: e14117.

9. Walker K, Decherney AH, Saunders R. Menstrual dysfunction in PCOS. Clinical Obstetrics and Gynecology. 2021; 64(1): 119-25.

10. Park Y-J, Shin H, Jeon S, Cho I, Park HJ. Development and effects of college-based lifestyle modification program for menstrual health of young adult women with irregular menses: a randomized controlled trial. International journal of environmental research and public health. 2021; 18(1): 233.

11. Kwak Y, Kim Y, Baek KA. Prevalence of irregular menstruation according to socioeconomic status: A population-based nationwide cross-sectional study. PloS one. 2019; 14(3): e0214071.

12. Gurbuz T, Tosun SA, Cebi A, Gokmen O, Usta M. Investigating fetuin-a and paraoxonase-1 activity as markers in polycystic ovary syndrome based on body mass index: a prospective case-control study. Cureus. 2021;13(10): e18553.

13. Legro RS, Arslanian SA, Ehrmann DA, Hoeger KM, Murad MH, Pasquali R, et al. Diagnosis and treatment of polycystic ovary syndrome: an Endocrine Society clinical practice guideline. The Journal of Clinical Endocrinology & Metabolism. 2013; 98(12): 4565-92.

14. Vinogradova Y, Coupland C, Hippisley-Cox J. Use of combined oral contraceptives and risk of venous thromboembolism: nested case-control studies using the QResearch and CPRD databases. bmj. 2015; 350: h2135.

15. de Bastos M, Stegeman BH, Rosendaal FR, Vlieg AVH, Helmerhorst FM, Stijnen T, et al. Combined oral contraceptives: venous thrombosis. Cochrane Database of Systematic Reviews. 2014(3).

16. Moreno V, Bosch FX, Muñoz N, Meijer CJ, Shah KV, Walboomers JM, et al. Effect of oral contraceptives on risk of cervical cancer in women with human papillomavirus infection: the IARC multicentric case-control study. The Lancet. 2002; 359(9312): 1085-92.

17. Gierisch JM, Coeytaux RR, Urrutia RP, Havrilesky LJ, Moorman PG, Lowery WJ, et al. Oral Contraceptive Use and Risk of Breast, Cervical, Colorectal, and Endometrial Cancers: A Systematic ReviewOral Contraceptives and Breast, Cervical, Colorectal, and Endometrial Cancers. Cancer epidemiology, biomarkers & prevention. 2013; 22(11): 1931-43.

18. Morgante G, Massaro M, Di Sabatino A, Cappelli V, De Leo V. Therapeutic approach for metabolic disorders and infertility in women with PCOS. Gynecological Endocrinology. 2018; 34(1): 4-9.

19. Al Basri SF, Al Abdali JA, Alzubaidi HM, Almarhabi AA, Alzubaidi MA, Al Qarni G, et al. Knowledge of Reproductive Age Women About Oral Contraceptive Pills in Al-Qunfudah, Saudi Arabia. Open Access Journal of Contraception. 2022; 13: 61.

20. Ajith DM. Nutritional Management Of Pcos: A Review Article. Journal of Positive School Psychology. 2022; 6(8): 8979-84.

21. Markantes GK, Tsichlia G, Georgopoulos NA. Diet and exercise in the management of PCOS: Starting from the basics. Polycystic Ovary Syndrome: Elsevier; 2022; 97-115.

22. Faul F, Erdfelder E, Buchner A, Lang A-G. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. Behavior research methods. 2009; 41(4): 1149-60.

23. Ağar M, Güngör K, Güngör N, Kavrut M, MADENLP A. Vitamin D supplementation inhibits NF-kB signaling pathway in lean and obese women. European Review for Medical and Pharmacological Sciences. 2022; 26: 3973-7.

24. Unnisa H, Annam P, Gubba NC, Begum A, Thatikonda K. Assessment of quality of life and effect of non-pharmacological management in dysmenorrhea. Annals of Medicine and Surgery. 2022; 81:104407.

25. Bajalan Z, Alimoradi Z, Moafi F. Nutrition as a potential factor of primary dysmenorrhea: a systematic review of observational studies. Gynecologic and obstetric investigation. 2019; 84(3): 209-24.

26. Aly JM, Decherney AH. Lifestyle modifications in PCOS. Clinical Obstetrics and Gynecology. 2021; 64(1): 83-9.

27. Arentz S, Smith CA, Abbott J, Bensoussan A. Perceptions and experiences of lifestyle interventions in women with polycystic ovary syndrome (PCOS), as a management strategy for symptoms of PCOS. BMC women's health. 2021; 21(1): 1-8.

28. Krouni A, Forouhari S, Akbarzadeh M, Dabbaghmanesh MH, Jowkar F, Salehi M, et al. Effect of High Fibre, Low Calorie Balanced Diet in Obese Women with Hirsutism: A Randomised Clinical Trail. Journal of Clinical & Diagnostic Research. 2018; 12(6).

29. Hosseini S, Jahromi M, Sayadi M. Effect of vitamin C supplementation on the levels of related hormones in infertile women with polycystic ovary syndrome (PCOS) in Shiraz City. Int J Health Sci. 2014; 2(1): 61-70.

30. Andhalkar S, Chaware V, Redasani V. A review on medicinal plants of natural origin for treatment of polycystic ovarian syndrome (PCOS). Asian Journal of Pharmaceutical Research and Development. 2021; 9(3): 76-81.

31. Wang JG, Anderson RA, Graham III GM, Chu MC, Sauer MV, Guarnaccia MM, et al. The effect of cinnamon extract on insulin resistance parameters in polycystic ovary syndrome: a pilot study. Fertility and sterility. 2007; 88(1): 240-3.

32. Jelodar G, Masoomi S, Rahmanifar F. Hydroalcoholic extract of flaxseed improves polycystic ovary syndrome in a rat model. Iranian journal of basic medical sciences. 2018; 21(6): 645.

33. Oboh G, Ademiluyi AO, Agunloye OM, Ademosun AO, Ogunsakin BG. Inhibitory effect of garlic, purple onion, and white onion on key enzymes linked with type 2 diabetes and hypertension. Journal of dietary supplements. 2019; 16(1): 105-18.

34. Zhou N, Zhao Y, Zhang L, Ning Y. Protective effects of black onion polysaccharide on liver and kidney injury in T2DM rats through the synergistic impact of hypolipidemic and antioxidant

abilities. International Journal of Biological Macromolecules. 2022.

35. Jayanti NE, Harlina, I'tishom R, editors. An effect of dayak onion (Eleutherine americana Merr) on quality of the sperm. AIP Conference Proceedings; 2019: AIP Publishing LLC.

36. Lee YH, Yang H, Lee SR, Kwon SW, Hong E-J, Lee HW. Welsh onion root (Allium fistulosum) restores ovarian functions from letrozole induced-polycystic ovary syndrome. Nutrients. 2018; 10(10): 1430.