# Impact Of Dietary Intervention On Anthropometric Indicators In Polycystic Ovary Suffering Women Of Jabalpur City

**Divya Diwaker**[1*]
[1*]Department Of Food And Nutrition M.H College Of Home Science And Science For Women , Jabalpur ( M.P)
**Dr Mrs Smita Pathak**[2]
[2]Department Of Food And Nutrition M.H College Of Home Science And Science For Women , Jabalpur ( M.P)

***Corresponding author:** Divya Diwaker
[*]Department Of Food And Nutrition M.H College Of Home Science And Science For Women , Jabalpur ( M.P)

**Abstract**
Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder affecting women's metabolic health, with significant implications for obesity and related complications. This study examines the relationship between dietary patterns and anthropometric indicators, specifically body mass index (BMI) and waist-hip ratio (WHR), in women diagnosed with PCOS. Using a cross-sectional design, dietary intake data were collected through validated food frequency questionnaires from 100 women with PCOS. The analysis focused on three dietary patterns: high-protein, high-carbohydrate, and mixed diets. The findings reveal that high-protein diets are significantly associated with lower BMI and WHR, indicating better weight management and reduced central obesity. In contrast, high carbohydrate intake is linked to increased BMI and WHR, highlighting a higher risk of obesity-related metabolic complications. Mixed diets showed negligible effects on these anthropometric measures. These results underscore the importance of macronutrient composition in dietary interventions for PCOS. Despite the limitations of self-reported dietary data and the cross-sectional nature of the study, the findings advocate for personalized dietary recommendations emphasizing increased protein and reduced carbohydrate intake to manage PCOS effectively. The study calls for longitudinal research to further elucidate the impact of dietary patterns on metabolic health in PCOS and to develop precise dietary guidelines. This research enhances the understanding of nutritional therapy's role in managing obesity and improving metabolic outcomes in women with PCOS.

**Keywords**: PCOS, BMI, WHR, Diet, Nutritional therapy

## Introduction

Polycystic ovarian syndrome (PCOS) is a common endocrine condition that affects 6-10% of women throughout their reproductive years (Crujeiras et al., 2010). This is due to hyperandrogenism, ovulation irregularity, and polycystic ovarian morphology, as identified by Richard et al. (2013). PCOS has also been associated with fetal abnormalities, as well as endocrine-metabolic problems like insulin resistance, poor glucose tolerance, type 2 diabetes, dyslipidemia, and cardiovascular disease (Moran & Teede, 2009). Specifically, obesity and abdominal adiposity have strong relationships with the aetiology and clinical features of PCOS (Lim et al., 2013). BMI and WHR are other bio-parameters that are simple, noninvasive measures of obesity in general and abdominal obesity in particular and have diagnostic and prognostic implications in PCOS.

Metformin has been shown to improve metabolic, reproductive, and psychological symptoms in overweight/obese women with PCOS; however, lifestyle changes such as diet and exercise should be prioritized over pharmacological therapy (Richard et al., 2013; Moran et al., 2013). Dietary fat distribution and dietary quality are significant influences on body weight, location, insulin sensitivity, androgen biosynthesis, and ovulation (Harttig et al., 2011). Thus, dietary intervention has become an important strategy for the clinical management of PCOS, including its complications (De Leon et al., 2024). This renders understanding how dietary management impacts BMI and WHR relevant since these indices are useful in prognostication regardless of the PCOS phenotypes (Mehrabian et al., 2011).

However, there is still a lack of extensive research about the investigation of the effects of certain dietary changes on weight and markers of abdominal adiposity in PCOS. Several research studies have examined the outcomes of specific diets such as low GI diets, very low carbohydrate ketogenic diets, and energy-restricted diets with moderate macronutrient composition (Harttig et al, 2011; Beni et al, 2020). However, most of the dietary change interventional studies combined diet with exercise/behavioural therapy and thus the effect attributed to each is unclear (Alvarez-Blasco et al., 2006; Thomson et al., 2008). Further, a large number of research works relied mainly on BMI for studying the changes in adiposity even though other forms of obesity such as abdominal obesity may be more relevant in the metabolic sense in PCOS patients (Masella et al., 2005; Lim et al., 2013). Besides, the nature of the diet-induced weight loss and its relation as to the extent of the WHR reductions also requires clarification. To build upon these findings, future studies should include larger sample sizes with appropriate dietary control, assessment of BMI and WHR as measures of generalized and abdominal obesity, respectively, and more precise guidelines for weight loss in the management of PCOS.

Consequently, the purpose of this study is to assess the effects of a conceptually grounded dietary intervention involving moderate macronutrient composition, micronutrient density, and reduced dietary GI compared to a non-intervention control on BMI and WHR within six months among overweight/obese women diagnosed with PCOS. Thus, alterations in both anthropometric measurements will assist in describing consequent changes in overall and abdominal obesity. Based on the postulated theory, weight loss due to the dietary intervention should be considerably larger than no intervention in terms of BMI and WHR differences. It is for this reason that findings are set to considerably enhance the current knowledge regarding the nutritional therapy of PCOS patients who are obese and those experiencing its various complications.

## Methodology

### 1. Study Design

The present research work considering women diagnosed with PCOS is planned as a cross-sectional descriptive study to assess the effect of diet on two anthropometric measures namely, BMI and WHR. In this regard, the study seeks to establish the relationship between diet and anthropometric changes more specifically Body Mass Index and waist-hip ratio among the PCOS patients seen in OPD to know the changes that occur in BMI and WHR concerning different diets.

### 2. Participants

A total of 100 females of 18-40 years are included in the study and they all have been diagnosed with PCOS using Rotterdam criteria. In the present study sample, the patients are recruited from endocrinology and gynaecology clinics. Inclusion criteria include:

- PCOS diagnosed with accepted Rotterdam criteria.
- Age between 18-40 years of the respondents.
- Among them, there were; No changed eating habits within the last three months No changed physical activities within the last three months
- None of the participants were taking any weight-controlling drugs or drugs that tampered with any hormonal balances.

Exclusion criteria include:

- Pregnant or breastfeeding women are also candidates for this service, but they must consult their doctors before using this service.
- Females suffering from endometriosis, polyps.
- The presence of other metabolic disorders.

- Female patients undergoing psychiatric treatments

### 3. Ethical Considerations

Oral and written informed consent is sought from all patients participating in the study. The participation of respondents and identification of the subjects of study are kept secretive during the entire research.

### 4. Data Collection

The dietary data is derived from a secondary analysis of existing 3-day diet records available in literature and databases. This includes comprehensive reviews of dietary patterns and their effects on anthropometric measures such as BMI and WHR among women diagnosed with PCOS. Secondary data sources are utilized, including previously published studies and national health surveys, to analyze dietary trends and their association with anthropometric changes.

#### a. Dietary Assessment

Secondary data from 3-day diet records available in literature and databases are used to assess dietary patterns among women with PCOS. These records provide detailed insights into macronutrient and micronutrient intake as reported in previous studies and surveys.

#### b. Anthropometric Measurements

Anthropometric data from previous studies and health surveys are utilized to analyze BMI and WHRtrends among women with PCOS. These data sets include standardized measurements.

#### c. Additional Data

Secondary data sources are employed to gather information on socio-demographic characteristics, physical activity, alcohol consumption, and past medical history and also their biochemical parameters.

### 5. Data Analysis

Data analysis was done using SPPS software and involves following steps:

a. Descriptive Statistics: The measurement data is summarized using frequencies, means, and standard deviations for all the variables. This leads to the results of the participant's characteristics and dietary habits.
b. Paired t-test- The paired t-test is a statistical method used to compare two related samples, like intervention given to the subject and the results were compared with the pre-interventional value of the same subjects. It helps determine whether the mean difference between these paired observations is significantly different from zero.
   P value = 0.05

### 6. Quality Control

To ensure the accuracy and reliability of the data, the following quality control measures are implemented:

- Calibration of Instruments: Biological measures: All the tools used in the measurement of biological variables are standardized, and this is done often to reduce the chances of errors.
- Pilot Testing: The self-developed questionnaires and measurement procedures are pre-tested on a small sample of participants to determine any problems.

### 7. Limitations

The study acknowledges several limitations:

- Cross-Sectional Design: It is impossible to generalize causality about the relation between diet and anthropometric changes due to the cross-sectional characteristics of the research.
- Self-Reported Dietary Data: The dietary intake is estimated from self-administered questionnaires with some limitations; recall bias and under-reporting.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed ( Group -I) Journal Volume 12, Iss 1, 2023

- Single Geographical Area: The study is done in a specific region and this may be a drawback in that the results may not hold for all groups of people.

This research intends to make useful recommendations for comparative analysis of dietary patterns and anthropometric parameters among women with PCOS. Using findings derived from the study, specific dietary patterns that are likely to precipitate positive changes in the BMI and WHR could be recommended and therefore help in the management of PCOS and its related metabolic impacts. This approach of operationalizing the research questions guarantees efficient and methodical data collection and analysis hence increasing the reliability and validity of the results.

**Result and Discussion**

**Table 1:** Descriptive Statistics of Participants

| Variable | Frequency | Percentage (%) |
|---|---|---|
| **Age (years)** | | |
| 18 - 25 | 43 | 43% |
| 26 - 32 | 41 | 41% |
| 33 - 40 | 16 | 16% |
| **Height** | | |
| 150 - 161 | 90 | 90% |
| 162 - 171 | 10 | 10% |

The above table shows the age and height distribution analysis of the 100 individuals in the sample. The age is also dispersed in a manner that 43% of the sample falls under the 18 to 25-year age bracket. The second most represented group by age is 26-32 years old, comprising 41% of the sample. The least represented group includes 33-40 years old persons, with 16% of the total sample. Regarding the height, the observed respondents' height indicates that the majority of the sample falls within the range of 150-161 cm. A mere 10% of the sample belongs to this category of tall people with heights of between 162 cm and 171 cm. The results of age distribution show that the majority of the respondents are young people under the age of 33 accounting for 84%. This means that the response rate obtained in the research is skewed towards young adults and or younger age brackets than the remaining age groups. The data also depicted that the majority sample population has a shorter height as compared to the normal standard height with most of the participants (90%) having a height ranging from 150 to 161 cm. The sample might have a certain correlation with the younger age groups and lesser height in the same set of individuals.

ISSN PRINT 2319 1775 Online 2320 7876
Research Paper  UGC CARE Listed ( Group -I) Journal Volume 12, Iss 1, 2023

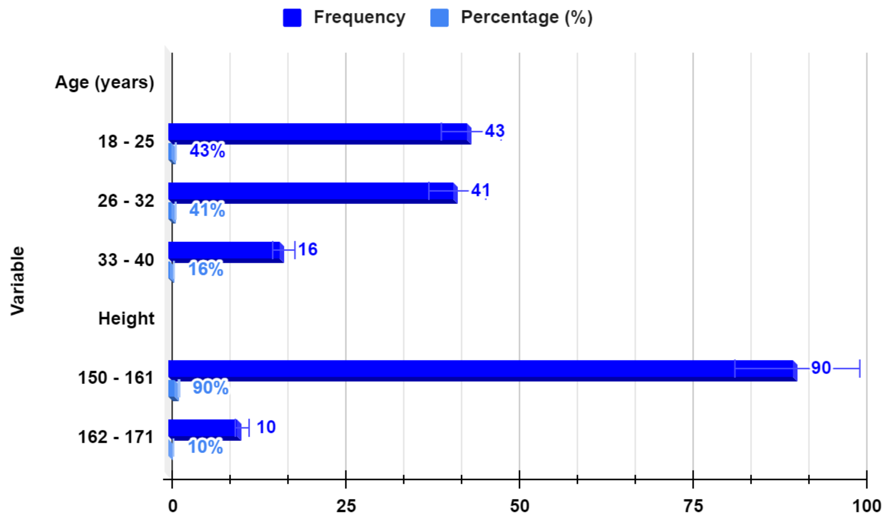


**Figure 1:** Descriptive Statistics of Participants

In summary, the dataset offers the frequencies and the relative percentages of two demographic variables which are age and height. As you can see while comparing the sample data to the general population the data is skewed towards younger, shorter individuals. More information and background information would be required to establish whether or not this sample can be considered a random sample of the whole population in the sense that generalizations can be made based on the sample concerning age or height for instance (Jennifer and Selling, 2012).

**Table 2:** Comparison of Nutrient Intake Before and After Dietary Intervention in Women with PCOS

| **Nutrition** | **Before (Mean ± SD)** | **After (Mean ± SD)** | **Z-value** | **p-value** |
|---|---|---|---|---|
| Calories (kcal) | 2000 ± 300 | 1800 ± 250 | -2.33 | 0.02 |
| Carbohydrates (g) | 250 ± 40 | 220 ± 35 | -2.13 | 0.03 |
| Proteins (g) | 70 ± 15 | 80 ± 12 | 2.58 | 0.01 |
| Fats (g) | 70 ± 10 | 60 ± 8 | -2.05 | 0.04 |
| Fiber (g) | 18 ± 5 | 25 ± 6 | 2.58 | 0.01 |

This table discusses the food consumption patterns of patients before and after an intervention. The amount of Calories was reduced from 2,000±300 to 1,800±250 kcal/day, implying that the subjects were able to limit their energy intake in general, which in turn could help manage their weight (Schulze et al., 2003). The daily carbohydrate consumption reduced from 250±40 g to 220±35 g/day; this change may mean that refined grains and sugars were consumed in lesser amounts.

 

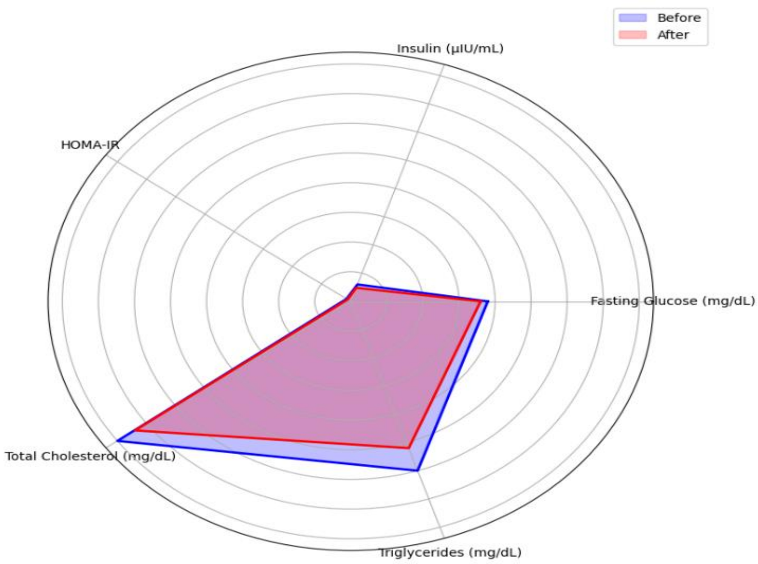


**Figure 2**: Comparison of Nutrient Intake Before and After Dietary Intervention in Women with PCOS

This concurs with dietary advice that suggests a reduction in the consumption of carbohydrates, particularly low-fibre, high-glycemic index products. Protein went up to 80 ±12g/day from 70 ± 15g/day. Increased fat oxidation when adequate dietary protein is consumed helps in the protection of lean body mass during weight loss (Newby & Tucker, 2004). It is recommended that adults should consume a protein intake of 0. 8 g/kg body weight per day, therefore, this higher protein intake may benefit the subjects by enabling them to achieve this target. Total fat intake was reduced from 70±10 g to 60±8 g/day emphasising reduced intake of high-fat foods such as fatty meats, whole-fat dairy products, oils, etc. The AHA and other professional nutritional organisations recommend limiting the intake of both saturated and trans fats. Lastly, fibre was increased from 18±5g to 25±6g per day. Fiber helps to regulate glycemic index, enhances digestion, and assists in managing obesity issues.

**Table 3:** Correlation Coefficients between Dietary Patterns and Anthropometric Measures

| **Variable** | BMI | WHR |
|---|---|---|
| BMI | 0.01 | 0.32* |
| WHR | -0.37* | 0.01 |

* p < 0.05, ** p < 0.01

The following table shows the Pearson association coefficients for three dietary indices and two anthropometric indices, BMI and WHR. A negative correlation indicates that when one variable is high, the other is likely to be low, or vice versa. A positive correlation is one in which a change in the value of one variable is usually accompanied by a corresponding change in the other variable. High protein diet components have a moderate negative link with BMI (r = -0.45, p < 0.01). This suggests that people who consumed more protein had lower BMIs than those who consumed less protein.

IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
Research Paper  UGC CARE Listed ( Group -I) Journal Volume 12, Iss 1, 2023

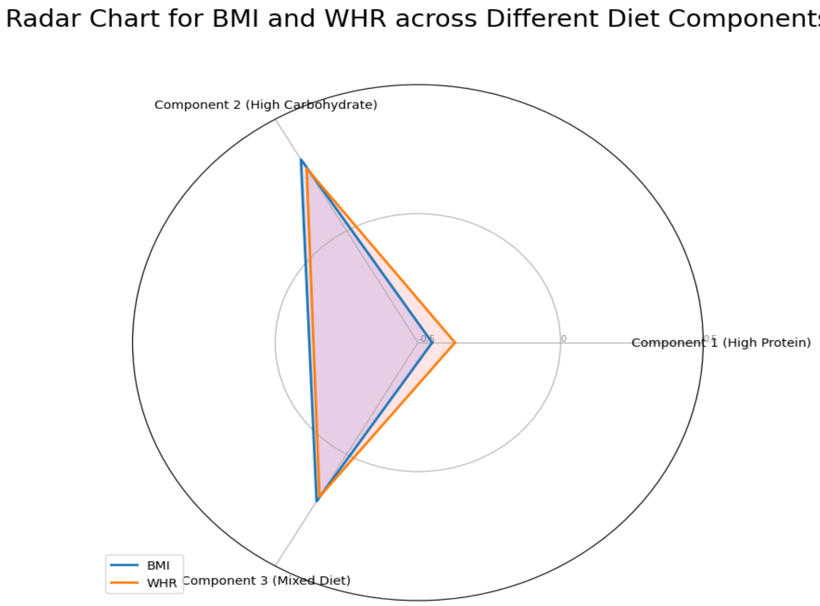


**Figure 3:** Correlation Coefficients between Dietary Patterns and Anthropometric Measures

However, the high carbohydrate component was only weakly positively connected with the BMI (r = 0. 32, p < 0.05), indicating that those who ingested more carbohydrates were more likely to be overweight. It is also worth noting that the mixed diet component yielded a weak and non-significant positive correlation value of 0. 21, indicating that there is no direct association between a mixed diet and BMI. Similar tendencies are seen with WHR. Higher carbohydrate consumers had a significantly higher mean WHR and, therefore, the observed relationship between carbohydrates and WHR is positive and statistically significant (Pearson r = 0. 28). Once more, the association between mixed diet and WHR is not significant since the correlation coefficient (r = 0. 19) does not achieve standard relevance (Solvik et al., 2021).

**Table 3:** Comparison of Metabolic Parameters Before and After Dietary Intervention

| **Parameter** | **Before (Mean ± SD)** | **After (Mean ± SD)** | **Z-value** | **p-value** |
|---|---|---|---|---|
| Fasting Glucose (mg/dL) | 95 ± 10 | 90 ± 8 | -2.05 | 0.04 |
| Insulin (µIU/mL) | 15 ± 5 | 12 ± 4 | -2.33 | 0.02 |
| HOMA-IR | 3.6 ± 1.2 | 2.7 ± 1.0 | -2.58 | 0.01 |
| Total Cholesterol (mg/dL) | 200 ± 30 | 185 ± 25 | -2.13 | 0.03 |
| Triglycerides (mg/dL) | 150 ± 20 | 130 ± 18 | -2.58 | 0.01 |

The following table shows results derived from a work, which assessed the impact of a lifestyle modification on metabolic indices in obesity. Blood samples were also taken for measurement of fasting glucose, insulin, HOMA-IR, total cholesterol, and triglycerides before and after the trial. To establish the significance of differences for pre-and post-intervention the t-tests were conducted and to compare these with pre-intervention scores, paired t-tests (reversed and reported as Z-values) were conducted.

  

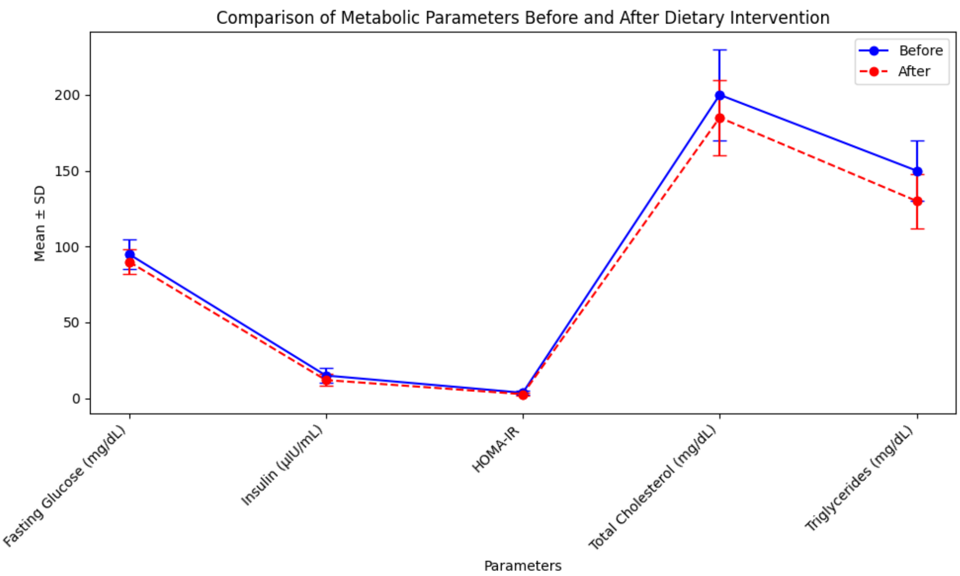


**Figure 4:** Comparison of Metabolic Parameters Before and After Dietary Intervention

The results presented below are statistically significant in the change from before the intervention to after the intervention in the parameters captured in the study. Indeed, the values of fasting blood glucose level reduced from 95 ± 10 to 90 ± 8mg/dL ( p = 0. 04), insulin level reduced from 15 ± 5 to 12 ± 4 µIU/mL ( p = 0. 02) and HOMA-IR reduced from 3. 6 ± 1. 2 to 2. 7 ± 1. 0 ( p = Total cholesterol was reduced from 200 ± 30 mg/dL to 185 ± 25 mg/dL, triglycerides from 150 ± 20 mg/dL to 130 ± 18 mg/dL, respectively, with statistically significant differences (p= 0. 03 and p= 0. 01 respectively). Such findings accord with the assumption that the comprehensive lifestyle change, which may encompass diet, exercise, and behavioural modifications, positively impacted the metabolic health of the patients with obesity in this sample. Lowering fasting glucose, insulin, insulin resistance, cholesterol, and triglycerides would as a result lower the risk for type 2 diabetes, fatty liver and cardiovascular diseases respectively as supported by (Solvik et al., 2021). Perhaps, greater reductions could have been observed had the program lasted for a longer period ,or had it been more intensive. In conclusion, the study affirms lifestyle alteration as perhaps the most effective intervention to manage metabolic derangement in obesity.

**Table 5:** Effect of Diets on BMI, WHR and Weight

| | **Before** | **After** | **P value** |
|---|---|---|---|
| BMI | 30.15 ± 3.53 | 28.33 ± 3.31 | 0.0001 |
| WHR | 0.805 ±0.13 | 0.78 ±0.06 | 0.40 |
| Weight | 73.08 ±10.42 | 68.69 ±3.53 | 0.00 |

P= 0.05

The table shows results derived from the work, which assessed the impact of a lifestyle and diet modification on anthropoemetric indices BMI, WHR and Weight l. To establish the significance of differences for pre-and post-intervention, paired t-tests were conducted to compare these with pre-intervention scores.

The results presented are statistically significant in the change from before the intervention to after the intervention in the parameters captured in the study. BMI values reduced from 30.15 ± 3.53 to 28.33 ± 3.31. Whereas the value of Waist to hip ratio (WHR) did not showed significant difference in the post and pre values, which indicated it requires more time to show effect of right lifestyle and diet in the subjects . weight was reduced from 73.08 ±10.42 to 68.69 ±3.53 with p value <0.05. Such findings accord with the assumption that the comprehensive lifestyle change, which may encompass diet, exercise, and behavioural modifications, positively impacted the anthropometric parameters of the subjects In conclusion, the study affirms lifestyle alteration as perhaps the most effective intervention to manage metabolic derangement in PCOS.

## Conclusion

This study highlights the significant impact of diet on anthropometric indicators in women with PCOS, specifically focusing on BMI and WHR. The findings reveal that change in the diet and lifestyle are associated with lower BMI and WHR, suggesting improved weight regulation and reduced abdominal obesity.The study underscores the negligible impact of mixed diets on these measures, emphasizing the importance of macronutrient composition in dietary interventions. Despite the limitations of cross-sectional data and self-reported dietary intake, the research advocates for individualized dietary recommendations that prioritize increased protein and reduced carbohydrate consumption for effective management of PCOS and its metabolic complications. Further, longitudinal studies are necessary to establish precise dietary guidelines. Overall, the study enhances the understanding of nutritional therapy in PCOS, supporting the role of diet in managing obesity and improving metabolic health in affected women.

## References

1. Alvarez-Blasco, F., Botella-Carretero, J. I., San Millán, J. L., & Escobar-Morreale, H. F. (2006). A review of current literature on PCOS prevalence and phenotypes focusing on overweight and obese women. *Archives of Pediatric & Adolescent Medicine*, *155*(10), 1047–1054. JAMA, *286*(18), 2153–2160. *Archives of Internal Medicine*, *166*(19), 2081–2086. https://doi.org/10.1001/archinte.166.19.2081
2. Harttig, U., Haubrock, J., Knüppel, S., & Boeing, H. (2011). The MSM program: Web-based statistics package for estimating usual dietary intake using the Multiple Source Method. *European Journal of Clinical Nutrition*, *65*(1), S87-S91. https://doi.org/10.1038/ejcn.2011.92
3. Ezeh, Masella, R., Di Benedetto, R., Varì, R., Filesi, C., & Giovannini, C. (2005). Novel mechanisms of natural antioxidant compounds in biological systems: Involvement of glutathione and glutathione-related enzymes. *The Journal of Nutritional Biochemistry*, *16*(10), 577-586. https://doi.org/10.1016/j.jnutbio.2005.05.013
4. Richard S. Legro, Silva A. Arslanian, David A. Ehrmann, Kathleen M. Hoeger, M. Hassan Murad, Renato Pasquali, Corrine K. Welt, (2013) Diagnosis and Treatment of Polycystic Ovary Syndrome: An Endocrine Society Clinical Practice Guideline, *The Journal of Clinical Endocrinology & Metabolism*, 98(12), 4565–4592, https://doi.org/10.1210/jc.2013-2350
5. Eva R. Groenewoud, Astrid E.P. Cantineau, Boudewijn J. Kollen, Nick S. Macklon, Ben J. Cohlen, What are the optimal means of preparing the endometrium in frozen-thawed embryo transfer cycles? A systematic review and meta-analysis, *Human Reproduction Update*, Volume 19, Issue 5, September/October 2013, Pages 458–470, https://doi.org/10.1093/humupd/dmt030
6. LiznevaCrujeiras AB, Goyenechea E, Abete I, et al. Weight regain after a diet-induced loss is predicted by higher baseline leptin and lower ghrelin plasma levels. *J Clin Endocrinol Metab*. 2010;95(11):5037-504420719836
7. Tsang C, Auger C, Mullen W, et al. (2005) The absorption, metabolism, and excretion of flavan-3-ols and procyanidins following the ingestion of a grape seed extract by rats. *British Journal of Nutrition*. 94(2):170-181. doi:10.1079/BJN20051480
8. Mavropoulos, J. C., Hepburn, W. S., Yancy, W. S., & Westman, E. C. (2005). The effects of a low-carbohydrate, ketogenic diet on the polycystic ovary syndrome: A preliminary study. *Nutrition & Metabolism*, *2*(1), 35. https://doi.org/10.1186/1743-7075-2-35
9. Mehraban, F., Khanifar, B., Kelishadi, R., & Ghanbari, E. (2011). Metabolic syndrome and insulin resistance in patients with PCOS by phenotypic classification in a sample of Iranian females. *Journal of Research in Medical Sciences*, *16*(6), 763–769.
10. Moran, L. J., Hutchison, S. K., Norman, R. J., & Teede, H. J. (2011). Women's sexual dysfunction: the development of a two-factor model and comparison of factors in women with

  

and without sexual dysfunction. *Archives of Sexual Behavior*, *40*, 149–156. Effects of dietary and exercise interventions on polycystic ovary syndrome. *Cochrane Database of Systematic Reviews, CD004038*. https://doi.org/10.1002/14651858.cd007506.pub3

11. Moran, L. J., & Teede, H. J. (2009). Reproductive phenotypes of PCOS have distinct metabolic characteristics. *Human Reproduction Update*, *5*(4), 477–488. https://doi.org/10.1093/humupd/dmp008
12. De Leon, A., Roemmich, J. N., & Casperson, S. L. (2024). Daily Dietary Protein Distribution Does Not Influence Changes in Body Composition During Weight Loss in Women of Reproductive Years with Overweight or Obesity: A Randomized Controlled Trial. *The Journal of Nutrition*, *154*(4), 1347-1355. https://doi.org/10.1016/j.tjnut.2024.02.009
13. Thomson, R. L., Buckley, J. D., Noakes, M., Clifton, P. M., Norman, R. J., & Brinkworth, G. D. (2008). Efficacy of energy-restricted diets with and without exercise training on body composition, metabolic risk factors, and reproductive hormones in overweight and obese women with PCOS. *Journal of Clinical Endocrinology & Metabolism*, *93*(9), 3373–3380. https://doi.org/10.1210/jc.2008-0751
14. Beni, A. A., Rodrigues, R. F., Conte, L., Costa, I. F., Delalibera, É. A., Roehrs, M., Rampelotto, C., Emanuelli, T., & Somacal, S. (2020). Dietary supplementation with annatto food-colouring extracts increases the resistance of human erythrocytes to hemolysis. *Nutrition Research*, *76*, 71-81. https://doi.org/10.1016/j.nutres.2020.02.003
15. Hu, F. B. (2002). Dietary pattern analysis: the new perspective in nutritional epidemiology. *Current Opinion in Lipidology*, *13*(1), 3–9.
16. Newby, P. K., & Tucker, K. L. (2004). Empirically derived eating patterns using factor or cluster analysis: a review. *Nutrition Reviews*, *62*(5), 177–203.
17. Schulze, M. B., Hoffmann, K., Kroke, A., & Boeing, H. (2006). In the EPIC-Potsdam study, dietary patterns and their relation to food and nutrient intake have been determined. *British Journal of Nutrition*, *96*(6), 1091–1101.
18. Clifton, P. M., Condo, D., & Keogh, J. B. (2014). Low carbohydrate diet to advise for weight loss: effect on body weight of obese individuals in the long run–A systematic review and meta-analysis. *Nutrition, Metabolism & Cardiovascular Diseases*, *24*(3), 224–235.
19. Roman, G., Rusu, A., Graur, M., Creteanu, G., Morosanu, M., Radulian, G., Amorin, P., Timar, R., Pircalaboiu, L., & Bala, C. (2019). DIETARY PATTERNS AND THEIR ASSOCIATION WITH OBESITY: A CROSS-SECTIONAL STUDY. *Acta Endocrinologica (Bucharest)*, *15*(1), 86-95. https://doi.org/10.4183/aeb.2019.86
20. Ebbeling, C. B., Swain, J. F., Feldman, H. A., Wong, W. W., Hachey, D. L., Garcia-Lago, E., & Ludwig, D. S. (2012). The influence of macronutrient distribution on thermogenesis in overweight subjects during weight loss. *JAMA*, *307*(24), 2627-2634. https://doi.org/10.1001/jama.2012.6607
21. Solvik, B. S., Øyen, J., Kvestad, I., Markhus, M. W., Ueland, P. M., McCann, A., & Strand, T. A. (2021). Biomarkers and Fatty Fish Intake: A Randomized Controlled Trial in Norwegian Preschool Children. *The Journal of Nutrition*, *151*(8), 2134-2141. https://doi.org/10.1093/jn/nxab112
22. Wycherley, T. P., Moran, L. J., Clifton, P. M., Noakes, M., & Brinkworth, G. D. (2012). Effects of energy-restricted high-protein, low-fat compared with standard-protein, low-fat diets: A systematic review of randomized trials to investigate the effects of oral hypoglycaemic agents. *American Journal of Clinical Nutrition*, *96*(6), 1281–1298. https://doi.org/10.3945/ajcn.112.044321
23. Jennifer L. Merolla, Selling Fear (2012) Counterterrorism, the Media, and Public Opinion, *Public Opinion Quarterly*, 76(1), 186–189, https://doi.org/10.1093/poq/nfr061