Dietary Intake and Risk of Eating Disorder among Different Phenotypes of Polycystic Ovarian Syndrome

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***Abstract*: Polycystic Ovarian Syndrome (PCOS) is directly associated with bodyweight that could be triggered by altered dietary behavior which includes binge eating, anorexia nervosa, uncontrolled eating, bulimia, and excessive dieting behavior. The present study aimed to assess dietary intake and eating disorders among different phenotypes of polycystic ovarian syndrome. Total 147 women suffering from PCOS were selected as the case and 144 women as control group. All PCOS subjects were classified into four phenotypes i.e. A, B, C, D based on the presence and absence of symptoms such as hyperandrogenism, ovulatory dysfunction, polycystic ovarian morphology. Dietary intake and eating disorder were measured by self-constructed food frequency questionnaire, 24-hour dietary recall and EAT-26 scale. Mean energy and fat intake was significantly high (<0.01) in phenotypes of PCOS as compared to the control group. Carbohydrate intake was high among all phenotypes as compared to the healthy subject but statistically not significant. A significant difference was observed <0.01 among all participants in reference of eating disorder. Maximum participants from phenotypic classification were at risk to develop eating disorder. A limited energy and fat intake could be helpful in managing symptoms associated with the different phenotypes of PCOS.**

***Keywords*: ovulatory dysfunction, nutritional status, dietary intake, eating disorder**

Introduction - Polycystic ovarian syndrome is generally associated with cluster of symptoms i.e., reproductive failure, metabolic dysfunction, and psychological disorders[1]. Women with polycystic ovarian syndrome are more susceptible to developing various psychological disorders including stress, anxiety, and depression [2, 3, 4]. Various studies show an association between psychological disorder (mood disorder) and increased body mass index [3, 5]. Body image dissatisfaction also contributes to eating disorders including binge eating disorder, bulimia nervosa, anorexia nervosa, night eating disordered [6]. According to Rotterdam criteria, the polycystic ovarian syndrome is classified into four phenotypes based on the presence and absence of symptoms i.e., hyperandrogenism, ovulatory dysfunction, and polycystic ovaries. In phenotypic classification women with hyperandrogenism, experienced an increased body mass index and worse clinical outcome i.e., hypercholesteremia, elevated level of luteinizing hormone, follicular stimulating hormone, etc. as compared to rest phenotype[7]. Women with phenotype A (hyperandrogenism + ovulatory dysfunction+ polycystic ovarian morphology) had an increased dietary intake as compared to healthy women [8]. Based on the above facts present study aimed to assess daily dietary intake, dietary preferences, anthropometric characteristics, and eating disorder in all phenotypes of PCOS and its caparison to healthy women.

Materials and Method-

Subjects-

A cross-sectional, case-control study was conducted from November 2019 to September 2021 at the Institute of Medical Sciences, Banaras Hindu University, OPD-105, Varanasi. PCOS participants ranged in age from 11 to 24 were recruited according to Rotterdam Criteria [1]. All participants who presented for routine checkups were selected as the control group and were excluded if they had menstrual dysfunction or hirsutism. Pregnancy, Adrenal Hyperplasia, Hypothyroidism were exclusion criteria for both groups. All participants who reported pharmacological treatment such as oral contraceptive pill within 14 weeks, type 2 diabetes, and hypertension were also excluded to reduce biases. Recruited participants suffering from PCOS were classified into four phenotypes including – A, B, C, D. All participants gave oral and written consent. The study was approved by Institute Ethics Committee, IMS, Banaras Hindu University.

Anthropometrics –

After the screening of all participants' anthropometric assessments were conducted. Bodyweight (to the nearest 0.1 kg) height (to the nearest 0.5 cm) were measured with minimum clothes and without shoes. Waist circumference was measured at the midpoint between the lower margin of the last palpable ribs and the top of the iliac crest and hip circumference was measured around the widest part of the buttock by using a stretch-resistant flexible tape. Body Mass Index was calculated with kg/m^2 formula. Waist–Hip ratio (WHR) was calculated by waist measurement divided by hip measurement.

Dietary intake and Food consumption pattern-

A self-constructed food frequency questionnaire and 24-hour dietary recall method were used to collect information about long-term food consumption patterns, total calorie intake, portion size, and number of meal consumption. The nutritional calculation was performed with an N-tuitive calculator that is used for dietary calculation based on the Indian database NIN, ICMR, IFCT 2017.

Eating Attitude-
Eating attitude test was performed with the administration of EAT-26 scale which has 26 questions that assess the risk of discorded eating. Each item is a 6-point Likert scale ranging from always to never. The EAT-26 is useful as a screening tool to assess 'eating disorder risk'. Detect characteristics and concerns related to anorexia and bulimia [9]. Individuals who score 20 or more on the test have risk of eating disorder or individual who scores below 20 on the scale could also have mild risk of eating disorder.
Statistical Analysis- SPSS version 26.0 was used to perform statistical analysis.
Results -

Table No 1 – Anthropometric characteristics, acne, and hirsutism of women with (phenotypes A, B, C, D) and without PCOS.

Variables	Phenotype A N=45	Phenotype B N=21	Phenotype C N=32	Phenotype D N=49	Control N= 144	P-Value
Age	19.28±1.3	20.34±1.2	21.52±1.56	20.33±1.54	20.54±1.99	0.155
Menarche age	13.4±1.84	13.3±1.3	13.7±1.3	14.3±1.4	12.4±1.8	0.008
Weight	63.5±5.4	67.2±4.2	65.9±4.9	67.3±4.5	56.8±3.8	<0.01
BMI	27.2±1.49	28.7±1.34	27.7±1.70	28.1±1.33	22.2 ±2.29	<0.01
Waist circumference	101.4±5.12	105.2±4.23	101.8±5.26	102.3±4.02	91.3±5.65	<0.01
WHR	.98±.033	.92±.034	.99±0.28	.89±.026	.86±.04	<0.01
Acne	32(71.1%)	16(76.1%)	28(87.5%)	-	-	.308
Hirsutism	34(75.5%)	19(90.4%)	29(90.6%)	-	-	<0.01

Anthropometric Characteristics- Table No 1 shows the nutritional status and anthropometric characteristics of all participants. There was no significant relationship among all phenotypes and control group in terms of age and age at menarche except for Body weight, Body Mass Index, waist circumference, and waist-hip ratio. Waist hip ratio was >.80 among maximum participants of phenotypic classification which is a strong indicator of central obesity. A significant difference was observed among all participants about hirsutism except acne which is directly associated with PCOS.

Table No 2 – Dietary preferences in the different phenotypes of PCOS and control group.

Variables	Phenotype A N=45	Phenotype B N= 21	Phenotype C N=32	Phenotype D N= 49	Control N= 144	P-Value
Lacto- Vegetarian	**16 (35.6%)**	**6 (28.6%)**	**7 (21.9%)**	**16 (32.7%)**	**28 (19.4%)**	
Ovo – Vegetarian	**14 (31.1%)**	**7 (33.3%)**	**6 (18.8%)**	**17 (34.7%)**	**60 (41.7%)**	
Lacto-Ovo Vegetarian	**7 (15.6%)**	**1 (4.8%)**	**8 (25%)**	**6 (12.2%)**	**43 (29.9%)**	<0.05*
Non – Vegetarian	**8 (17.8%)**	**7 (33.3%)**	**11 (34.4%)**	**10 (20.4%)**	**13 (9%)**	

Dietary preferences- Table No 2 shows comparison among all phenotypes and control group based on dietary preferences. 35.6 % of participants from phenotype A (hyperandrogenism, ovulatory dysfunction, polycystic ovaries) and 32.7 % from Phenotype D (ovulatory dysfunction, polycystic ovaries) were vegetarian and preferred only milk and milk products. 25% of participants from phenotype C and 15.6 % respondents from phenotype A preferred milk and milk products along with poultry except for meat consumption

Table no 3 – Dietary intake among subjects with and without PCOS.

Variables	Phenotype A N=45	Phenotype B N= 21	Phenotype C N=32	Phenotype D N= 49	Control N= 144	P-Value
Total calorie	2338±286.3	2460±323.2	2459±262.6	2335±270.6	1950±194.2	0.00
Protein	58±10.2	63±11.3	58±9.76	59±10.6	58±11.4	.353
Carbohydrate	230±50	286±55	277±62	236±58	218±48	.077
Fiber	20±6	21±8	18±6	20±5	19±7	.068
Total Fat	103±21.3	110±23.2	106±29.4	95±26.1	86.8±13.8	0.00

Dietary intake – Table No 3 shows a comparison among all phenotypes of PCOS and control group. Mean (SD) of total calorie intake was significantly higher in phenotypic participants and compared to control group. Carbohydrate intake was high in all phenotypes as compared to control group but statistically not significant. Protein intake was similar in all groups no statistical differences were observed. Total fat intake was significantly high in all phenotypes as compared to the control group.

Table No-4 Risk of eating disorder among different phenotypes of PCOS and without PCOS.

Variables	Phenotype A N=45	Phenotype B N=21	Phenotype C N=32	Phenotype D N=49	Control N= 144	P-value
≥ 20 or High score	32(71.1%)	12(57.1%)	24(75%)	35(71.4%)	35 (24.3%)	*0.000 (at level 0.01)
≤ 20 or Lower score	13(28.9%)	9 (42.9%)	8(25%)	14(28.6%)	109 (75.7%)	
Excessive dietary behavior	28(62.2%)	16(76.1%)	26(81.2%)	36(73.4%)	44(30.5%)	<0.01
Concern with calorie content	31(68.8%)	14(66.6%)	23(71.8%)	38(77.5%)	52(36.1%)	<0.01

Eating disorder- Table No 4 shows the risk of eating disorder among all participants. A significant difference was observed <0.01 among all phenotype groups and control group. The risk of developing eating disorder was high in phenotype A, C, D, as compared to phenotype B and control group. Although excessive dieting behavior and concern with calorie contents of food were high in control group as compared to other phenotypes. Since maximum participants suffering from PCOS were obese, therefore excessive dieting behavior or eating disorder may develop in response to excessive body weight or body appearance.

Discussion – the present study provides a database of energy intake, dietary preferences, and risk of developing eating disorder among all phenotypes of the polycystic ovarian syndrome and its comparison to the control group. The result of the present study shows that body weight and BMI were significantly high in PCOS subjects. Prevalence of central obesity was higher in PCOS subjects which indicates upper body fat deposition that may occur due to excess androgen. Although among phenotypic classification in reference of anthropometric characteristics similar data was observed that was high as compared to WHO classification. Sachdeva et.al 2019 also found a significant difference in body mass index (<0.05) in phenotypes of the polycystic ovarian syndrome but in contrast, no difference was observed in waist circumference [10]. Shahrami et. al 2016 found a similar result, a significant difference in anthropometric characteristics was observed in phenotypes al control group [11]. Dietary preferences were also varied among participants consumption of milk and milk products was high in phenotype A and D some studies suggest consumption of dairy and starchy food products may enhance insulin response as compared to non-starchy foods [12, 13, 14]. A study shows lower consumption of starches, dairy products, and added sugar results in weight loss and improved insulin sensitivity in women with PCOS. Hence dietary preferences may affect the symptoms associated with the polycystic ovarian syndrome. (phy et al 2015) the present study shows higher calorie and fat intake in all phenotypes of PCOS [15]. Present study suggests that dietary intake may affect by excess intake of fat and lower intake of dietary fiber. Although significant difference was not observed in terms of dietary fiber, intake of dietary fiber was high in PCOS subjects as compared to control group. In contrast, cutlar et al 2019 reported high fat intake and low dietary fiber intake in PCOS subjects as compared to normal subjects [16]. A case-control study by Amirjani et. al 2019 reported significantly higher intake of carbohydrates, protein, and fat as compared to control group after age and BMI adjustment [17]. In contrast, no significant difference was observed between the two groups in reference of energy and macronutrient although energy intake and total fat intake play a significant role in weight gain that may trigger symptoms associated

with polycystic ovarian syndrome [18]. Some studies analyze the impact of a low carbohydrate diet on body mass index and found a statistically significant difference in all groups [19,20]. However, no significant difference was observed in protein intake, but a study highlights an improved insulin and glucose response after a higher intake of protein [21]. In the present study Risk of eating disorder was high in PCOS subjects as compared to control group. Lee et. al. also found an increased risk of disorder eating in PCOS subjects with concurrent anxiety symptoms similar result was also obtained by greenwood et.al. women with PCOS may have an eating disorder in response to body weight and shape concern [22,23]. In the current study, Excessive dietary behavior and concern with calorie content were also observed in PCOS subjects that may be in response of body weight.

Conclusion – Present study highlights phenotypic classification in reference of energy intake, dietary preference, anthropometric characteristics that may be helpful in baseline dietary treatment of different phenotypes of polycystic ovarian syndrome. A low glycemic index diet or low-calorie diet may recommend as baseline approaches for PCOS. Further study is required to explore the causative factor associated with eating disorder in PCOS and the impact of different dietary interventions according to the phenotypic classification of PCOS.

References –

1. ESHRE, T. R., & ASRM-Sponsored PCOS Consensus Workshop Group. (2004). Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. *Fertility and sterility*, *81*(1), 19-25.
2. Cesta, C. E., Månsson, M., Palm, C., Lichtenstein, P., Iliadou, A. N., & Landén, M. (2016). Polycystic ovary syndrome and psychiatric disorders: co-morbidity and heritability in a nationwide Swedish cohort. *Psychoneuroendocrinology*, *73*, 196-203.
3. Hollinrake, E., Abreu, A., Maifeld, M., Van Voorhis, B. J., & Dokras, A. (2007). Increased risk of depressive disorders in women with polycystic ovary syndrome. *Fertility and sterility*, *87*(6), 1369-1376.
4. Dokras A, Clifton S, Futterweit W, Wild R. Increased risk for abnormal depression scores in women with polycystic ovary syndrome: a systematic review and meta-analysis. Obstet Gynecol 2011;117:145–
5. Barry, J. A., Kuczmierczyk, A. R., & Hardiman, P. J. (2011). Anxiety and depression in polycystic ovary syndrome: a systematic review and meta-analysis. *Human reproduction*, *26*(9), 2442-2451.
6. American Psychiatric Association, A. (1980). *Diagnostic and statistical manual of mental disorders* (Vol. 3). Washington, DC: American Psychiatric Association.
7. Pikee, S., Shivani, S., & Jayshree, B. (2016). Endocrine and metabolic profile of different phenotypes of polycystic ovarian syndrome. *The Journal of Obstetrics and Gynecology of India*, *66*(1), 560-566.
8. Graff, S. K., Mário, F. M., Alves, B. C., & Spritzer, P. M. (2013). Dietary glycemic index is associated with less favorable anthropometric and metabolic profiles in polycystic ovary syndrome women with different phenotypes. *Fertility and sterility*, *100*(4), 1081-1088.
9. Garner D.M., Olmstead M.P., Bohr Y., Garfinkel P.E.: The Eating Attitudes Test: psychometric features and clinical correlates. Psychol. Med. 12, 871–878, 1982.
10. Sachdeva, G., Gainder, S., Suri, V., Sachdeva, N., & Chopra, S. (2019). Comparison of the different PCOS phenotypes based on clinical metabolic, and hormonal profile, and their response to clomiphene. *Indian journal of endocrinology and metabolism*, *23*(3), 326.
11. Shahrami, S. H., Ranjbar, Z. A., Milani, F., Kezem-Nejad, E., Rad, A. H., & Heirat, S. F. D. (2016). The relation between diverse phenotypes of PCOS with clinical manifestations, anthropometric indices and metabolic characteristics. *Acta Medica Iranica*, 134-139.
12. Gannon, M. C., Nuttall, F. Q., Westphal, S. A., Fang, S., & Ercan-Fang, N. (1998). Acute metabolic response to high-carbohydrate, high-starch meals compared with moderate-carbohydrate, low-starch meals in subjects with type 2 diabetes. *Diabetes Care*, *21*(10), 1619-1626.
13. Hoppe, C., Mølgaard, C., Vaag, A., Barkholt, V., & Michaelsen, K. F. (2005). High intakes of milk, but not meat, increase s-insulin and insulin resistance in 8-year-old boys. *European Journal of Clinical Nutrition*, *59*(3), 393-398.
14. Melnik, B. C., Schmitz, G., John, S. M., Carrera-Bastos, P., Lindeberg, S., & Cordain, L. (2013). Metabolic effects of milk protein intake strongly depend on pre-existing metabolic and exercise status. *Nutrition & metabolism*, *10*(1), 1-6.
15. Phy, J. L., Pohlmeier, A. M., Cooper, J. A., Watkins, P., Spallholz, J., Harris, K. S., ... & Boylan, M. (2015). Low starch/low dairy diet results in successful treatment of obesity and co-morbidities linked to polycystic ovary syndrome (PCOS). *Journal of obesity & weight loss therapy*, *5*(2).
16. Cutler, D. A., Pride, S. M., & Cheung, A. P. (2019). Low intakes of dietary fiber and magnesium are associated with insulin resistance and hyperandrogenism in polycystic ovary syndrome: A cohort study. *Food science & nutrition*, *7*(4), 1426-1437.
17. Amirjani, S., Asemi, Z., Bazarganipour, F., Aramesh, S., Allan, H., Sayadi, M., ... & Khashavi, Z. (2019). Dietary intake and lifestyle behaviour in different phenotypes of polycystic ovarian syndrome: A case–control study. *Journal of Human Nutrition and Dietetics*, *32*(4), 413-421.
18. Altieri, P., Cavazza, C., Pasqui, F., Morselli, A. M., Gambineri, A., & Pasquali, R. (2013). Dietary habits and their relationship with hormones and metabolism in overweight and obese women with polycystic ovary syndrome. *Clinical endocrinology*, *78*(1), 52-59.
19. Marzouk, T. M., & Ahmed, W. A. S. (2015). Effect of dietary weight loss on menstrual regularity in obese young adult women with polycystic ovary syndrome. *Journal of pediatric and adolescent gynecology*, *28*(6), 457-461.

20. Wong, J. M., Gallagher, M., Gooding, H., Feldman, H. A., Gordon, C. M., Ludwig, D. S., & Ebbeling, C. B. (2016). A randomized pilot study of dietary treatments for polycystic ovary syndrome in adolescents. *Pediatric obesity*, *11*(3), 210-220.
21. Gannon, M. C., Nuttall, F. Q., Saeed, A., Jordan, K., & Hoover, H. (2003). An increase in dietary protein improves the blood glucose response in persons with type 2 diabetes. *The American journal of clinical nutrition*, *78*(4), 734-741.
22. Lee, I., Cooney, L. G., Saini, S., Smith, M. E., Sammel, M. D., Allison, K. C., & Dokras, A. (2017). Increased risk of disordered eating in polycystic ovary syndrome. *Fertility and sterility*, *107*(3), 796–802. https://doi.org/10.1016/j.fertnstert.2016.12.014
23. Greenwood, E. A., Pasch, L. A., Cedars, M. I., & Huddleston, H. G. (2020). Obesity and depression are risk factors for future eating disorder-related attitudes and behaviors in women with polycystic ovary syndrome. *Fertility and sterility*, *113*(5), 1039-1049.

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