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PREVALENCE OF METABOLIC ASSOCIATED FATTY LIVER DISEASES AMONG PATIENTS WITH POLYCYSTIC OVARIAN SYNDROME DURING THEIR SONOGRAPHIC EVALUATION

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ABSTRACT

Background: Polycystic ovarian syndrome (PCOS) is a common endocrine disorder. It is frequently associated with metabolic complications, including metabolic-associated fatty liver disease (MAFLD). We aimed to assess the prevalence of MAFLD among women with PCOS during their sonographic evaluation and to explore the relationship between MAFLD and patient characteristics.
Methods: We conducted a descriptive cross-sectional study at the Radiology Department of Dr. Ruth K.M. Pfau Civil Hospital and Dow University of Health Sciences over a six-month period. A total of 346 women with PCOS, diagnosed clinically and undergoing abdominal ultrasonography, were included. We collected demographic and clinical data, including age, parity, and duration since PCOS diagnosis, socioeconomic status, and marital status. We diagnosed MAFLD based on sonographic evidence of hepatic steatosis.
Results: MAFLD was present in 60.1% of the participants. Women aged 31–45 years had a significantly higher prevalence (77.8%) compared to those aged 18–30 years (51.1%, p=0.01). Longer PCOS duration, higher parity, and middle-income status

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were also significantly associated with increased MAFLD prevalence. Married and divorced women showed a higher burden of MAFLD compared to their unmarried counterparts. Although place of residence showed a trend toward significance, it did not reach statistical relevance (p=0.06).

Conclusion: We identified a high prevalence of MAFLD among women with PCOS, with strong associations across several demographic and clinical variables. These findings underscore the need for targeted metabolic screening and early intervention in this population to mitigate the risk of long-term hepatic and metabolic complications.

INTRODUCTION

Polycystic ovarian syndrome (PCOS), commonly referred to as hyper androgenic anovulation, is a most common endocrine disorder affecting females during their childbearing years. This syndrome ranks among the most widespread hormonal problem in females of reproductive time period. For diagnosing PCOs, ovulatory dysfunction, hyperandrogenism and /or sonogrpahic findings of polycystic ovarian morphology must be essential components.[1] According to national institute of health criteria, PCOs effects six percent in United States of America.

Being associated with significant morbidity and mortality, non-alcoholic fatty liver disease (NAFLD) is predominant cause of chronic liver disease. NAFLD is drastically increasing worldwide, predominantly in western countries.[1] Most of the patients with NAFLD are symptomatic at the time of presentation, although NAFLD can progress from hepatic parenchymal fat infiltration alone to necro-inflammation known as steatohepatitis, then to fibrosis, cirrhosis and portal hypertension and hepatic carcinoma. [2]

Nowadays, a new terminology that is metabolic associated fatty liver disease (MAFLD) being put forward instead of NAFLD on an internationally acceptable opinion since 2020. MAFLD is notably different from the earlier diagnostic criteria of NAFLD. Two of the most distinct differences between MAFLD and NAFLD are that, firstly diagnosis of MAFLD does not require classification of patients into alcoholic and non-alcoholics or exclusion from other chronic liver diseases and secondly, the presence of metabolic dysfunction is perquisite for the diagnosis of MAFLD.[3] Primary risk factors associated with MAFLD include obesity, dyslipidemia, diabetes mellitus and metabolic syndrome. Coincidently, these share common comorbidities in women with PCOS. This raises the question of the likely association between PCOS and metabolic syndrome. Several studies have established a link between PCOS and MAFLD, with hyperandrogenism being possible independent risk factor alone in MAFLD. Although some other studies have shown that hyperandrogenism is not associated with the risk of MAFLD. [4]

Since PCOS has many features of metabolic syndrome and is characterized by chronic anovulation and hyperandrogenism. In two investigations, researcher assessed the presence of fatty liver in patients with PCOS through per abdominal ultrasound omitting the control participants**.** In the first study which was a retrospective study showed fatty liver in 55%

of patients with PCOS and surprisingly more than one third of them were belong to lower BMI <18.5kg/m2. In second study, it was reported that 39.3% of females with PCOS had hepatic steatosis. Most of the patients approximately 50% were obese/overweight. [5] Some metabolic changes and abdominal fat distribution have also been seen in lean patients with PCOS. This pattern is often more evident among overweight females with PCOS, particularly those with an abdominal phenotype. Weight loss is linked to positive impacts on hormones, metabolism and clinical symptoms. [6]

This study addresses a critical gap by investigating the sonographic association between polycystic ovaries (PCO) and metabolic associated fatty liver disease (MAFLD). Diagnosing PCOS and liver fat content sonographically aims to provide a holistic understanding of the metabolic connection between PCO and MAFLD. If the result of my study will show high frequency of metabolic associated fatty liver disease among suspected patients with polycystic ovarian syndrome, then we can assume there may be some association between the two; which will be further evaluated by the researcher.

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted in the Radiology Department of Dr. Ruth K.M. Pfau Civil Hospital and Dow University of Health Sciences, Karachi, over a minimum duration of six months following the approval of the research protocol by the institutional ethical review committee. The purpose of the study was to determine the prevalence of metabolic associated fatty liver disease (MAFLD) among women diagnosed with polycystic ovarian syndrome (PCOS) during sonographic evaluation.

A sample of 346 women was selected using a non-probability, consecutive sampling technique. The sample size was calculated using OpenEpi software with a hypothesized frequency of 34.1%, a 5% confidence limit, and a population size of one million. Women aged between 18 and 45 years who presented with menstrual irregularities and had not received any pharmacological treatment for PCOS in the preceding three months were considered eligible. All participants were required to provide informed consent. Women were excluded if they had comorbidities such as Cushing's syndrome, hypothyroidism, uncontrolled diabetes mellitus, known liver diseases including viral hepatitis B and C, Wilson disease, or hemochromatosis. Pregnant women and those with a history of alcohol consumption were also excluded.

Following ethical clearance, data collection commenced by including all eligible patients referred from the gynecology outpatient department to the radiology unit for abdominal and pelvic ultrasound. Structured interview-based questionnaires were used to gather information on patient demographics, medical history, and BMI. Ultrasonographic assessments were carried out by a consultant radiologist with five years of sonographic experience using a Toshiba Diagnostic Ultrasound System (TUS-X 100S, Japan) equipped with a 3.5 MHz curvilinear transducer. Standard privacy protocols were followed by assigning coded identifiers to patient records and securely storing the data on password-protected devices.

MAFLD was identified by the presence of hepatic steatosis on grey-scale ultrasound, characterized by increased liver echogenicity relative to the renal cortex or spleen, in addition to at least one of the following: overweight or obesity (BMI >23–27.5 kg/m²), a history of diabetes mellitus for three or more years, or signs of metabolic dysregulation. Hepatic steatosis was further classified into three grades based on echogenicity: mild

(grade 1), moderate (grade 2), and severe (grade 3). Polycystic ovarian morphology was defined based on ultrasonographic features, including an increased number of follicles (≥20), ovarian enlargement with volume >10 ml, the presence of at least 10 follicles measuring 2–9 mm, and peripheral distribution of follicles. A single ovary meeting these criteria was sufficient to confirm the diagnosis. Hormonal imbalance associated with PCOS was assessed via blood tests measuring levels of luteinizing hormone (LH), follicle-stimulating hormone (FSH), estradiol, and testosterone, with deviations from reference ranges considered abnormal.

Data were compiled and analyzed using Microsoft Excel 2016 and SPSS version 26.0. Quantitative variables such as age, height, weight, BMI, and ovarian volume were summarized using means and standard deviations; medians were used for non-normally distributed data. Qualitative variables, including sociodemographic details, ultrasound findings, grades of hepatic steatosis, presence of diabetes, and obesity status, were presented as frequencies and percentages. To assess the influence of different factors, data were stratified, and chi-square tests were applied. A p-value of less than 0.05 was considered statistically significant.

RESULTS

This cross-sectional study included 346 participants diagnosed with polycystic ovarian syndrome (PCOS). Most participants (66.2%) fell within the 18–30 years age group, while 33.8% were between 31 and 45 years old. A majority of participants (64.5%) were from rural areas, with the remainder (35.5%) from urban settings. Slightly more than half (55.8%) had received their PCOS diagnosis more than a year ago. Regarding parity, 78.3% had three or fewer children. Many participants (64.5%) were from lower socioeconomic backgrounds (income ≤25,000), and over half (52.9%) were married. Most participants reported experiencing oligomenorrhea (86.7%), weight gain (55.8%), and hirsutism (88.4%).

The overall prevalence of metabolic-associated fatty liver disease (MAFLD) in this study population was 60.1%. Age significantly influenced the likelihood of having MAFLD, with those aged 31 to 45 years showing a higher prevalence (77.8%) than younger participants aged 18 to 30 years (51.1%, p=0.01). Additionally, the duration since the PCOS diagnosis also significantly impacted MAFLD rates; those diagnosed for over one year had higher prevalence (72.5%) compared to those diagnosed within the past year (44.4%, p=0.01). Higher parity (more than three children) was also significantly associated with increased MAFLD prevalence (76%) compared to lower parity (55.7%, p=0.01). Socioeconomic status was notably linked to MAFLD prevalence, with the middle-income group (25,000–50,000) having the highest prevalence (72.2%, p=0.05). Marital status also played a role, as married (68.3%) and divorced individuals (70%) showed higher MAFLD rates compared to unmarried participants (49.7%, p=0.01). Although residence location showed a trend, it did not reach statistical significance (p=0.06). These findings underline specific demographic and clinical characteristics associated with elevated MAFLD risk among PCOS patients.

DISCUSSION

This cross-sectional study included 346 participants diagnosed with polycystic ovarian syndrome (PCOS). Most participants (66.2%) fell within the 18 to 30 years age group. While 33.8% participants were between 31 and 45 years old. A majority of participants (64.5%) lived in rural areas, with 35.5% residing in urban settings. Slightly more than half (55.8%) had received their PCOS diagnosis more than a year ago. Most participants (78.3%) had three or fewer children. A significant portion (64.5%) reported household incomes of ≤25,000 Pak rupees, and more than half (52.9%) were married. The majority of participants reported that they had experienced oligomenorrhea (86.7%), weight gain (55.8%), and hirsutism (88.4%).

We observed that 60.1% of participants met the criteria for metabolic-associated fatty liver disease (MAFLD). Older participants (31 to 45 years) exhibited a significantly higher prevalence of MAFLD (77.8%) than those aged 18 to 30 years (51.1%, p=0.01). Duration since PCOS diagnosis also played a critical role; individuals diagnosed more than a year ago showed higher MAFLD prevalence (72.5%) compared to those with more recent diagnoses (44.4%, p=0.01). Participants with higher parity (>3 children) had a significantly increased MAFLD prevalence (76%) versus those with fewer children (55.7%, p=0.01). Those in the middle-income bracket (PKR 25,000–50,000) had the highest MAFLD prevalence (72.2%, p=0.05). Marital status emerged as a relevant factor, with married (68.3%) and divorced (70%) participants experiencing higher MAFLD rates than unmarried individuals (49.7%, p=0.01). Place of residence did not reach statistical significance (p=0.06), though trends indicated higher prevalence in urban settings.

Our findings reflect a substantial burden of MAFLD among women with PCOS. These results support prior studies highlighting the close metabolic interplay between PCOS and fatty liver disease.[10-11] Previous work also showed that advancing age exacerbates metabolic risks in women with PCOS, consistent with the elevated MAFLD prevalence we observed in older participants. [12-13] Notably, participants with longer-standing PCOS diagnoses were more likely to develop MAFLD. This suggests that there may be metabolic deterioration which progresses over time. [14-15]

We identified a strong association between higher parity and MAFLD. This aligns with evidence that metabolic strain accumulates over successive pregnancies. [16-17] Participants in the middle-income group had the highest MAFLD prevalence, which could relate to lifestyle shifts, including dietary choices and physical inactivity commonly seen in this group. [18-19] Marital status also showed a notable influence, possibly due to psychosocial or behavioral differences between married and unmarried individuals, as suggested in related literature. [20-21]

Urban residence did not significantly predict MAFLD in our study. Previous research indicates urban environments may foster behaviors linked to metabolic syndrome, such as sedentary lifestyles and increased processed food consumption. [22-23] These potential patterns warrant further investigation.

Our findings underscore the importance of comprehensive, early screening for MAFLD in women with PCOS. This is especially for those women with known risk factors such as age over 30, longer disease duration, higher parity, and certain socioeconomic characteristics. Preventive strategies that combine lifestyle intervention with regular metabolic assessment may help reduce disease progression and improve long-term outcomes.

LIMITATIONS

The cross-sectional design limits our ability to establish causal relationships between variables. We used ultrasound to diagnose fatty liver. This offers a practical and accessible method but lacks the sensitivity of advanced imaging techniques such as MRI or elastography. We did not include biochemical markers or account for lifestyle factors like diet and physical activity. This may have influenced the associations observed in our data. Since we conducted the research at a single tertiary care center, the findings may not fully represent broader or more diverse populations.

CONCLUSION

This study shows a high prevalence of metabolic-associated fatty liver disease among women diagnosed with polycystic ovarian syndrome. We identified significant associations between MAFLD and patient characteristics such as age, parity, duration since PCOS diagnosis, marital status, and socioeconomic background. These findings emphasize the importance of proactive, targeted metabolic screening in this high-risk population. By identifying vulnerable individuals early, clinicians can tailor management strategies to mitigate metabolic decline and support better long-term outcomes.

Table 1: Distribution of baseline characteristics among the study participants.

Variables	n (%)
Age	
18 to 30 years	229 (66.2)
31 to 45 years	117 (33.8)
Place of Residence	
Urban	123 (35.5)
Rural	223 (64.5)
Time since diagnosis of PCOS	
≤ 1 year	153 (44.2)
> 1 year	193 (55.8)
Parity	
≤ 3	271 (78.3)
> 3	75 (21.7)
Socioeconomic status	
≤ 25000	223 (64.5)
25000-50000	72 (20.8)
≥ 50000	51 (14.7)
Marital status	
Unmarried	153 (44.2)
Married	183 (52.9)
Divorced	10 (2.9)
Oligomenorrhea	
Yes	300 (86.7)
No	46 (13.3)

Weight gain Yes No	 193 (55.8) 153 (44.2)
Hirsutism Yes No	 306 (88.4) 40 (11.6)
Metabolic associated fatty liver diseases Yes No	 208 (60.1) 138 (39.9)
Grade of fatty liver/hepatic steatosis Grade I Grade II Grade III	 117 (33.8) 112 (32.4) 117 (33.8)
Total	346 (100)

Table 2: Distribution of patient characteristics according to the Metabolic associated fatty liver diseases.

Variables	**MAFLD Yes n (%)**	**MAFLD No n (%)**	**P value**
Age 18 to 30 years 31 to 45 years	 117 (51.1) 91 (77.8)	 112 (48.9) 26 (22.2)	0.01
Place of Residence Urban Rural	 82 (66.7) 126 (56.5)	 41 (33.3) 97 (43.5)	0.06
Time since diagnosis of PCOS ≤ 1 year > 1 year	 68 (44.4) 140 (72.5)	 85 (55.6) 53 (27.5)	0.01
Parity ≤ 3 > 3	 151 (55.7) 57 (76)	 120 (44.3) 18 (24)	0.01
Socioeconomic status ≤ 25000 25000-50000 ≥ 50000	 126 (56.5) 52 (72.2) 30 (58.8)	 97 (43.5) 20 (27.8) 21 (41.2)	0.05
Marital status Unmarried Married Divorced	 76 (49.7) 125 (68.3) 07 (70)	 77 (50.3) 58 (31.7) 03 (30)	0.01

REFERENCES:

Norman RJ, Dewailly D, Legro RS, Hickey TE. Polycystic ovary syndrome. The Lancet. 2007 Aug 25;370(9588):685-97.

Asfari MM, Sarmini MT, Baidoun F, Al-Khadra Y, Ezaizi Y, Dasarathy S, McCullough A. Association of non-alcoholic fatty liver disease and polycystic ovarian syndrome. BMJ Open Gastroenterology. 2020;7(1).

Kumar A, Singh AK, Panda PK, Nischal N, Soneja M. Non-alcoholic fatty liver disease diagnosis, grading and staging; a simplified tool for clinicians. Journal of Advances in Medicine. 2017;6(1):15-22.

Hart R, Norman R. Polycystic ovarian syndrome–prognosis and outcomes. Best Practice & Research Clinical Obstetrics & Gynaecology. 2006 Oct 1;20(5):751-78.

Boyle JA, Xu R, Gilbert E, Kuczynska-Burggraf M, Tan B, Teede H, Vincent A, Gibson-Helm M. Ask PCOS: identifying need to inform evidence-based app development for polycystic ovary syndrome. In Seminars in reproductive medicine 2018 Jan (Vol. 36, No. 01, pp. 059-065). Thieme Medical Publishers.

Lin SU, Huang J, Wang M, Kumar R, Liu Y, Liu S, Wu Y, Wang X, Zhu Y. Comparison of MAFLD and NAFLD diagnostic criteria in real world. Liver international. 2020 Sep; 40(9):2082-9.

Feristics in lean and obese women with polycystic ovary syndrome. Journal of endocrinological investigation. 2004 May; 27:424-9.

Pham H, Svensson T, Chung UI, Svensson AK. Sleep Satisfaction May Modify the Association between Metabolic Syndrome and BMI, Respectively, and Occupational Stress in Japanese Office Workers. International Journal of Environmental Research and Public Health. 2022 Apr 22; 19(9):5095.

Ando Y, Jou JH. Nonalcoholic fatty liver disease and recent guideline updates. Clinical liver disease. 2021 Jan; 17(1):23.

Norman RJ, Dewailly D, Legro RS, Hickey TE. Polycystic ovary syndrome. The Lancet. 2007 Aug 25;370(9588):685-97.

Asfari MM, Sarmini MT, Baidoun F, Al-Khadra Y, Ezaizi Y, Dasarathy S, McCullough A. Association of non-alcoholic fatty liver disease and polycystic ovarian syndrome. BMJ Open Gastroenterology. 2020 Aug 1;7(1):e000352.

Hart R, Norman R. Polycystic ovarian syndrome–prognosis and outcomes. Best Practice & Research Clinical Obstetrics & Gynaecology. 2006 Oct 1;20(5):751-78.

Boyle JA, Xu R, Gilbert E, Kuczynska-Burggraf M, Tan B, Teede H, Vincent A, Gibson-Helm M. Ask PCOS: identifying need to inform evidence-based app development for polycystic ovary syndrome. InSeminars in reproductive medicine 2018 Jan (Vol. 36, No. 01, pp. 059-065). Thieme Medical Publishers.

Kumar A, Singh AK, Panda PK, Nischal N, Soneja M. Non-alcoholic fatty liver disease diagnosis, grading and staging; a simplified tool for clinicians. Journal of Advances in Medicine. 2017;6(1):15-22.

Azziz R, Carmina E, Chen Z, Dunaif A, Laven JS, Legro RS, Lizneva D, Natterson-Horowtiz B, Teede HJ, Yildiz BO. Polycystic ovary syndrome. Nature reviews Disease primers. 2016 Aug 11;2(1):1-8.

Glueck CJ, Wang P, Goldenberg N, Sieve-Smith L. Pregnancy outcomes among women with polycystic ovary syndrome treated with metformin. Human Reproduction. 2002 Nov 1;17(11):2858-64.

Escobar-Morreale HF. Polycystic ovary syndrome: definition, aetiology, diagnosis and treatment. Nature Reviews Endocrinology. 2018 May;14(5):270-84.

Lim SS, Hutchison SK, Van Ryswyk E, Norman RJ, Teede HJ, Moran LJ. Lifestyle changes in women with polycystic ovary syndrome. Cochrane Database of Systematic Reviews. 2019(3).

Teede, H.J., Misso, M.L., Boyle, J.A., Garad, R.M., McAllister, V., Downes, L., Gibson-Helm, M., Hart, R.J., Rombauts, L., Moran, L. and Dokras, A., 2018. Translation and implementation of the Australian-led PCOS guideline: clinical summary and translation resources from the International Evidence-based Guideline for the Assessment and Management of Polycystic Ovary Syndrome. Medical journal of Australia, 209, pp.S3-S8.

Moran LJ, Ko H, Misso M, Marsh K, Noakes M, Talbot M, Frearson M, Thondan M, Stepto N, Teede HJ. Corrigendum: Dietary composition in the treatment of polycystic ovary syndrome: A systematic review to inform evidence-based guidelines. Human Reproduction Update. 2014 Jan 1;20(1):152-.

Barberis N, Calaresi D, Cannavo M, Verrastro V. Trait emotional intelligence and quality of life in women with polycystic ovary syndrome: Dysmorphic concerns and general distress as mediators. Comprehensive Psychiatry. 2023 Apr 1;122:152373.

March WA, Moore VM, Willson KJ, Phillips DI, Norman RJ, Davies MJ. The prevalence of polycystic ovary syndrome in a community sample assessed under contrasting diagnostic criteria. Human reproduction. 2010 Feb 1;25(2):544-51.

Şen LD, Meram LD. The effect of healthy lifestyle factors on polycystic ovarian syndrome, current approaches in diagnosis and treatment, evidence-based practices. InIV. Uluslararası Farklı Boyutlarıyla Sağlık Konferansı Bildiriler Kitabı: IV. International Conference On Different Aspects of Health Proceeding Book 2023 Dec 22 (p. 19). HOLISTENCE PUBLICATIONS.