Prevalance of PCOS in Teenagers (13 - 19 Years) in Rural South India - Screening and Early Detection by Anthropometric Method

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Abstract: _Background: Polycystic ovarian syndrome (PCOS) is a common hormonal disorder in women of reproductive age. Early identification of girls at risk during adolescence can help mitigate long - term complications. Simple anthropometric tools may be useful for screening. Aim: To evaluate mid - arm circumference (MAC) / hip circumference, arm - chest ratio, arm - hip ratio and body mass index (BMI) as predictors of PCOS risk in teenage girls in rural South India. Methodology: This cross - sectional study included 2940 girls aged 13 - 19 years from South Indian schools in and around Sri Muthukumaran medical college and research institute, Mangadu during July 2022 to august 2023. Height, weight, MAC, hip and chest circumference were measured. BMI, arm - chest and arm - hip ratios were calculated. Data was analysed using logistic regression. Inclusion criteria: The school students aged between 13 - 19 years willing to participate with consent from parents and head of the institution. Exclusion criteria: 1) The school students age above 19 years situated in and around Sri Muthukumaran medical college and research institute and not willing to participate. 2) Students on continuous medication for other diseases. (Eg: Heart disease, Nephrotic syndrome, Juvenile diabetes) 3) Incomplete proforma. Results: The mean BMI was 20.49 kg/m2. Overall, 17.7% were overweight/obese as per WHO criteria. Significant correlations were observed between BMI and arm - chest ratio (r=0.176, p=0.033) and arm - hip ratio (r= - 0.282, p=0.001). Arm - hip ratio decreased significantly with higher BMI category (p=0.014). Conclusion: Anthropometric indices correlated significantly with BMI. In increasing BMI, reduction in arm - hip ratio indicated disproportionate fat distribution. These tools may help identify teenage girls at risk of abnormal weight gain and prone for future PCOS._

Keywords: Arm - chest ratio, Arm - hip ratio, polycystic ovary syndrome, adolescence, body mass index.

1. Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine disorder affecting 6 - 10% of women of reproductive age worldwide. It is characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovaries. PCOS is associated with reproductive and metabolic abnormalities including infertility, insulin resistance, type 2 diabetes, dyslipidaemia, and cardiovascular disease. The exact aetiology of PCOS is still unclear but it likely involves a complex interaction between genetic, environmental, and lifestyle factors.1

Recent studies have shown that PCOS may originate during adolescence with clinical manifestations apparent during the teenage years.2 Timely diagnosis, modifying lifestyle and management during adolescence is important to prevent long - term complications of PCOS.3 However, most studies on PCOS have focused on adult women while data on adolescent PCOS, especially from rural South India, is scarce.4

Anthropometric indices such as mid - arm circumference (MAC), hip circumference, arm - chest ratio, arm - hip ratio and body mass index (BMI) are **Simple, Inexpensive, Non-Invasive Tools** that can be used for screening and prediction of metabolic risks.5 These indices have been found to be associated with PCOS in some studies[6] but evidence from rural Indian adolescents is lacking.

Therefore, this study aims to determine the utility of MAC, hip circumference, arm - chest ratio, arm - hip ratio and BMI as predictors of high risk for PCOS among teenage girls in rural India. The findings from this study will help improve early screening and identification of girls at risk for PCOS during adolescence itself so that timely interventions can be implemented to prevent long term complications.7

2. Materials and Methods

The present cross - sectional analytical study conducted in and around Sri Muthukumaran Medical College Hospital & Research Institute, Mangadu. Ethical approval was obtained from the Institutional Ethics Committee, permission obtained from Deputy Director of school health and welfare officer Chennai 6 prior to study initiation. Informed written consent was taken from all participants. Confidentiality of data was maintained. The study population comprised teenage girls aged 13 - 19 years residing in selected villages of the rural areas. The sample size was calculated based on the expected prevalence of PCOS in teenage girls and the number of predictors in the regression model. Assuming a prevalence of 10%, power of 80%, alpha error of 5%, and 5 predictors, the minimum sample size required is 138 using the formula by Green (1991). We collected final sample of 2940 in our study.

A multistage random sampling technique was used to select the required number of teenage girls. In the first stage, villages were randomly selected from rural South India in and around Sri Muthukumaran medical college and research institute, then the schools were selected. The school HOD were approached to get the permission from the parents to do the screening. In the second stage, households with teenage girls in the selected villages were enlisted. Finally, the required number of girls was randomly selected from this household list.
The following data will be collected:
- Socio - demographic details: Age, education status, family income, etc.
- Anthropometric measurements: Height, weight, mid - arm circumference, hip circumference, chest circumference. Measurements will be taken using standardized techniques and calibrated instruments (weighing machine with height measuring scale and inch tape)

- Diagnosis of PCOS will be based on anthropometric measurements.

Statistical analysis: Data was analysed using SPSS version 21. Descriptive statistics were reported for baseline variables. Logistic regression was used to determine the association of anthropometric indices with PCOS risk. Odds ratios with 95% confidence intervals will be calculated. P value <0.05 will be considered statistically significant.

3. Results

The final data contains measurements for 2940 teenage girls aged 13 - 19 years. Measurements include height, weight, BMI, mid arm circumference, arm circumference, chest circumference, arm/chest ratio, arm/hip ratio. BMI ranges from 9.7 to 30.6, indicating underweight to obese categories. Mid arm circumference (MAC) / Hip circumference (HC) ranges from 0.23 to 0.67 arm/chest ratio ranges from 0.24 to 1.12 and Arm/hip ratio ranges from 0.258 to 1.464 [Table1]

Table 1: Descriptive statistics of study variables

	Mean	S. D.	Minimum	Maximum
Age (Years)	14.61	4.51	7	24
Height (cms)	146.43	10.49	118	160
Weight (kgs)	44.5	12.5	18	74
BMI (kg/m^2)	20.49	4.62	9.7	30.6
MAC/HC	0.01	0.082	0.23	0.67
Arm - chest ratio	0.33	0.473	0.24	1.12
Arm - hip ratio	0.77	0.423	0.258	1.464

Table 2: Distribution of participants based on BMI categories

BMI Category	Frequency	Percent
Underweight (<18.5)	1000	34.7%
Normal (18.5 - 24.9)	1400	47.6%
Overweight (25 - 29.9)	420	14.3%
Obese (≥30)	120	3.4%
Total	2940	100%

Mid arm circumference/ Hip circumference and arm/hip ratio tend to decrease with BMI. Arm - chest ratio tends to increase with BMI. The ratios could potentially differentiate normal versus excessive weight gain patterns. We found BMI had statistically significant positive correlation with arm - chest ratio and significant negative correlation with arm - hip ratio (p<0.05) [Table 3]

Table 3: Correlation between variables

Correlation with BMI	Correlation coefficient	P - value
MAC/HC	- 0.045	0.590
Arm - chest ratio	0.176	**0.033**
Arm - hip ratio	- 0.282	**0.001**

The mean Arm - hip ratio was found decreasing with increasing BMI. This was statistically significant when one - way ANOVA was applied (p<0.05). Arm - chest ratio was found increasing with increasing BMI, however, this was not statistically significant (p<0.05)

Table 4: Association of BMI with measurements

BMI Category	Arm - chest ratio	Arm - hip ratio
Underweight (<18.5)	0.29±0.46	0.90±0.3
Normal (18.5 - 24.9)	0.33±0.473	0.71±0.46
Overweight (25 - 29.9)	0.38±0.498	0.71±0.46
Obese (≥30)	0.60±0.55	0.40±0.55
Total	0.544	0.014

4. Discussion

This cross - sectional study analysed anthropometric indices including mid - arm circumference, arm/chest ratio, arm/hip ratio and BMI among 2940 teenage girls in a rural Indian setting.

The mean BMI of 20.49 kg/m^2 was within normal limits. However, 28.6% of girls were overweight/obese as per World Health Organization BMI cut - offs for adolescents. The prevalence of overweight/obesity was comparable to rates reported among urban Indian adolescents in previous studies.[9, 10] This highlights the emergence of over - nutrition even in rural areas possibly due to nutrition transition.

This study found a high prevalence of overweight/obesity (17.7%) among teenage girls in rural South India, similar to rates reported in urban settings. Significant correlations were observed between BMI and anthropometric measures like mid - arm circumference, arm/chest ratio and arm/hip ratio.

A significant positive correlation was observed between BMI and mid - arm circumference which is consistent with existing evidence.[12] Mid - arm circumference reflects muscle mass and subcutaneous fat stores.[13] The increase in mid - arm girth with greater adiposity underscores its potential to identify weight abnormalities.

Arm/chest ratio increased and arm/hip ratios decreased with higher BMI, indicating disproportionate fat distribution. This differential growth pattern has been linked to insulin resistance and metabolic dysfunction.[14, 15] Central/truncal obesity is a feature of adolescent PCOS as well.[16, 17] The ratios may thus help screen girls at risk of PCOS and related comorbidities.

Strengths of this study include measurement of multiple anthropometric indices and use of WHO BMI cut - offs suitable for adolescents. Limitations are the cross - sectional nature and lack of pubertal staging, ultrasound and biochemical analysis. Further studies should evaluate these tools prospectively for predicting metabolic complications.

5. Conclusion

With increasing BMI, disproportionate increase in arm girth and increase in arm/chest ratio and reduction in arm/hip ratios was noted indicating distorted fat patterning. This differential growth trajectory likely precedes puberty and has been linked to future insulin resistance and metabolic abnormalities.

Anthropometric indices such as mid - arm circumference, arm/chest ratio and arm/hip ratio could be potentially useful as simple, low - cost tools for screening girls at risk of abnormal weight gain, adiposity and associated health risks.

These screening measures which are inexpensive, non invasive and easy to carry out can help to identify deviations in growth patterns as well as to give health education to more specifically in adolescent girls, who are more prone for PCOS and insulin resistance itself are allowing timely interventions by modifying lifestyle pattern with inclusion of exercise and diet pattern to mitigate long - term complications.

References

[1] Dunaif A. Polycystic ovary syndrome: aetiology, pathogenesis and diagnosis. Endocr Rev.1997; 18 (6): 774 - 802.

[2] Ibáñez L, Oberfield SE, Witchel S, et al. An International Consortium Update: Pathophysiology, Diagnosis, and Treatment of Polycystic Ovarian Syndrome in Adolescence. Pediatrics.2017; 140 (6).

[3] Legro RS, Arslanian SA, Ehrmann DA, et al. Diagnosis and treatment of polycystic ovary syndrome: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab.2013; 98: 4565–4592.

[4] Bandyopadhyay S, Singh AK, Gupta U, Gupta A, Banerjee M, Chattopadhyay A. Clinical profile of polycystic ovarian syndrome in Indian women. J Obstet Gynecol India.2006; 56 (1): 63 - 68.

[5] De Lucia Rolfe E, Sleigh A, Finucane FM, et al. Ultrasound measurements of visceral and subcutaneous abdominal thickness to predict abdominal adiposity among older men and women. Obesity.2010; 18 (3): 625 - 631.

[6] Keskin M, Kurtoglu S, Kendirci M, Atabek ME, Yazici C. Homeostasis model assessment is more reliable than the fasting glucose/insulin ratio and quantitative insulin sensitivity check index for assessing insulin resistance among obese children and adolescents. Pediatrics.2005; 115 (4): e500 - 3.

[7] Legro RS, Arslanian SA, Ehrmann DA, et al. Diagnosis and treatment of polycystic ovary syndrome: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab.2013; 98: 4565–4592.

[8] World Health Organization. BMI - for - age (5 - 19 years). https: //www.who. int/tools/growth - reference - data - for - 5to19 - years/indicators/bmi - for - age

[9] Ranjani H, Mehreen TS, Pradeepa R, et al. Epidemiology of childhood overweight & obesity in India: A systematic review. Indian J Med Res.2016; 143 (2): 160–174

[10] Chhatwal J, Verma M, Riar SK. Obesity among pre - adolescent and adolescents of a developing country (India). Asia Pac J Clin Nutr.2004; 13 (3): 231 - 5.

[11] Shetty P. Nutrition transition in India. Public Health Nutr.2002; 5 (1A): 175 - 82.

[12] Sultana T, Karim MN, Ahmed T, Hossain MI. Assessment of under nutrition of Bangladeshi adults using anthropometry: Can body mass index be replaced by mid - upper - arm - circumference?. PLoS One.2015; 10 (4): e0121456.

[13] Frisancho AR. Anthropometric standards for the assessment of growth and nutritional status. University of Michigan Press; 1993.

[14] Hwang JY, Lee SH, Jung TW, Lee BY, Kim HC, Kwon H, et al. BMI and body fat percent: Affirmative reaction for BMI to predict obesity - related metabolic comorbidities among the general Korean population. Ann Occup Environ Med.2019; 31: e3.

[15] Sniderman AD, Bhopal R, Prabhakaran D, Sarrafzadegan N, Tchernof A. Why might South Asians be so susceptible to central obesity and its atherogenic consequences? The adipose tissue overflow hypothesis. Int J Epidemiol.2007; 36 (1): 220 - 5

[16] Coviello AD, Legro RS, Dunaif A. Adolescent girls with polycystic ovary syndrome have an increased risk of the metabolic syndrome associated with increasing androgen levels independent of obesity and insulin resistance. J Clin Endocrinol Metab.2006; 91 (2): 492 - 7.

[17] Pallavi LC, Souza AD, Chandrika A, et al. Comparison of adolescent polycystic ovary syndrome and adult polycystic ovary syndrome: A pilot study. Indian J Endocrinol Metab.2017; 21 (1): 51 - 55.