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Original Research Article

Evaluation of female infertility in relation to BMI and residential lifestyle factors: a cohort study from central Karnataka, India

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ABSTRACT

Background: The body mass index (BMI) affects reproductive success, however, regional distribution patterns among rural and urban women with infertility have not been fully explored. The present study is aimed to analyze the body mass index among rural and urban women with primary and secondary infertility in central karnataka region, India.
Methods: This study is carried out from 2023 to 2025, which recruited 191 confirmed infertile female subjects aged between 18-50 years, from in and around the Chitradurga and Davangere districts Body Mass Index (BMI) was computed using weight(kg)/height(m)² and categorized using Indian standards.
Results: A total of 191 infertile women were included in this study. Among the diagnosed female infertile subjects, the prevalence of primary infertility was higher in urban areas (55.5%) than in rural areas (29.8%). In contrast, secondary infertility was more prevalent in rural areas (8.9%) than in urban areas (5.5%). This study records overweight and obesity are prevalent among infertile women in both rural and urban residents. No significant association between residence type and BMI category among infertile female subjects are observed.
Conclusions: Residential lifestyle and elevated BMI are important risk factors for female reproductive health. The results of the present study indicating that the prevalence obese and overweight among the female infertile subjects is similar in both rural and urban residents.

Key words: Female infertility, BMI, Rural and urban region

INTRODUCTION

The world health organization (WHO) defines infertility is a medical condition, resulting in the inability to conceive, after 12 months or more of regular unprotected sexual intercourse with the same healthy male or female partner.[1] Female infertility is broadly classified into primary and secondary infertility; primary infertility refers to individuals who have never experienced a pregnancy whereas secondary infertility refers to those who have had at least one prior pregnancy but are currently unable to conceive again.[2] This distinction is clinically and socially important because the two categories differ substantially in their etiological factors and the different conditions, it influences the diagnosis and clinical evaluation.[3] Infertility in both primary and secondary forms has been well documented through population-based studies from Central India and Karnataka among different demographic, reproductive, and socio-cultural attributes of the affected population.[4,5] Meta analysis data suggested

that, in India prevalence of female infertility among women of reproductive age in India is approximately 8%, among them 5% is the primary and the 2% for the secondary infertility.[6]

There are notable variations in reproductive health between rural and urban India regarding the prevalence of infertility, emographic features, socioeconomic statuses and availability of reproductive health services.[5,7,8,9] Rural-urban differences in lifestyle and nutritional patterns may influence body composition, metabolic health, reproductive health, and pregnancy outcomes.[10,11] In particular, variations in BMI, dietary habits, physical activity, and healthcare-seeking behaviour may contribute to differences in reproductive outcomes, including infertility and reproductive loss.[7] Therefore, examining these factors across rural and urban populations is important for understanding the population-specific determinants and patterns of adverse reproductive outcomes in India. Based on the above literature the present study is aimed to evaluating BMI in relation to reproductive loss, in comparison with rural and urban female infertile subjects, which may help to identify population-level differences and potential factors associated with adverse reproductive outcomes.

METHODS

Sample design

In this prospective study, one hundred and ninety-one (191) individuals were included in this study. Based on the medical records the conditions were classified in to primary and secondary infertility. This work was carried out during 2023-2025, in collaboration with Basaveshwara Medical College and hospital. Samples were collected from the different hospitals situated in and around Chitradurga and Davangere districts of Karnataka, India.

Institutional ethics clearance (IEC)

IEC is obtained from the Institutional Ethics Committee of Basaveshwara Medical College & Hospital, Chitradurga (BMC&H/IEC/150/2023-2024) and consent was also obtained from the concerned maternity clinics and fertility centers.

Patient consent

Informed written consent was taken from all participants in their local language (Kannada and English). A detailed genetic registry was taken pertaining to their family history of marriage, infertility, miscarriages, life style, occupation, habits, etc., using a detailed Proforma.

Inclusion criteria

Female patients with either primary or secondary infertility in the age group of 18 to 50 years are included in this study.

Exclusion criteria

Patients those who refused to be part of the study were excluded.

BMI calculation

Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Based on the calculated BMI values, participants were classified into underweight (<18.5 kg/m^2), normal weight (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2), and obese (≥25.0 kg/m^2) categories using the Indian reference criteria for BMI classification.[12,13,14]

Statistical analysis

The obtained data were entered into a Microsoft Excel spreadsheet; further Chi-square test of independent is performed to determine whether there is a significant association between the variables. The statistical analyses were conducted using IBM-Statistical Package for the Social Sciences (SPSS) version 20.

RESULTS

In the present study, a total of 191 female infertile subjects were included, out of which 85.5% (163) are primary infertile females and 14.5% (28) are secondary infertile females, which is described in table 1. Table 2 depicts the infertile cases with rural and urban lifestyle. Among 191 female infertile subjects, 74 (38.7%) infertile cases were from rural areas, while 117 (61.3%) were from urban areas. Out of 163 primary infertile cases, 29.8% (57) were from rural areas, and 55.5% (106) were from urban areas. Furthermore, 17 (8.9%) were secondary infertile cases from the rural area, while 11 (5.8%) were from urban areas, no significance difference was observed between the residential factor with different infertile conditions (X^2=6.673, df=1, P=0.10). Table 3 shows the distribution of female infertile subjects based on BMI, among infertile female subjects, BMI was significantly associated with infertility, Chi-square teste showed the significant P value with BMI (χ^2=81.497, df=2, P=0.01). This study recorded a higher frequency of infertile female subjects in the obese group (63.8%, n=122), followed by overweight (21.4%, n=41) and normal weight (14.6%, n=28), no participants were underweighted. The mean BMI values in these groups were 25.2±0.17 kg/m^2 (obese), 23.6±0.30 kg/m^2 (overweight), and 21.5±1.10 kg/m^2 (normal). Table 4 shows the distribution of primary and secondary infertile subjects across BMI categories. Primary infertility cases showed a higher prevalence of obese subjects [63.1% (n=103)], followed by overweight [21.4% (n=35)] and normal weight [15.3% (n=25)], whereas among secondary infertility cases, 67.8% (n=19) were obese, 21.4% (n=6) overweight, and 10.7% (n=3) normal weight. The statistical test did not show a significant difference between these groups (Pearson χ^2=0.430, df=2, P=0.807). Table 5 shows the distribution of infertile female subjects

according to BMI categories among different types of residence (rural and urban). Out of 191 female infertile subjects, 117 (61.3%) subjects were from urban residences while 74 (38.7%) were from rural areas. Out of 122 obese subjects 62.3% (72) were from urban areas and 66.2% (49) were from rural areas. Out of 41 overweight subjects, 16(21.6%) were from rural residence while 25 (21.3%) were from urban residence.

Table 1: Distribution of types of infertile subjects.

Infertility conditions	Total (n=191)
Primary infertility	163 (85.3%)
Secondary infertility	28 (14.5%)

Table 2: Distribution of Female infertile subjects with rural and urban regions (residences) in the study area.

Residence type	Infertile condition	No. of subject	%	Total No. of Subject	%	Chi-square test
Rural	Primary infertile	57	29.8	74	38.7	X^2 =6.673, df=1, P=0.10
	Secondary infertile	17	8.9			
Urban	Primary infertile	106	55.5	117	61.3	
	Secondary infertile	11	5.8			

Table 3: Distribution of infertile females based on Body mass Index (BMI).

	No. of subjects BMI 25 and above (Obese)	No. of subjects BMI-23.0 to 24.9 (Overweight)	No. of subjects BMI-18.5 to 22.9 (Normal)	Under weight	Chi-square test
Infertile female subjects	122 (63.8)	41 (21.4)	28 (14.6)	0	X^2=81.497, df=2, P=0.01*
Mean ±SD	25.2±0.17	23.6±0.3	21.5±1.1		

Table 4: Distribution of primary and secondary infertile subjects based on BMI.

	No. of subjects BMI 25 and above (Obese)	%	No. of subjects BMI- 23.0 to 24.9 (Overweight)	%	No. of subjects BMI-18.5 to 22.9 (Normal)	%	Chi-square test
Primary infertility	103	63.1	35	21.47	25	15.3	163
Secondary infertility	19	67.8	6	21.42	3	10.7	28
Total	122		41		28		191

Table 5: Comparison of female infertile subjects and BMI with Residence type.

	Residence type				
BMI	**Rural**	**%**	**Urban**	**%**	**Total**
Obese	49	66.2	73	62.3	122
Over weight	16	21.6	25	21.3	41
Normal	9	12.1	19	16.2	28
Total	74 (38.7%)		117 (61.3%)		191

X^2=0.619, df=2, P=0.734

Moreover, 28 normal weight subjects were found in this study, out of whom 9(12.1%) were from rural area and 19(16.2%) were from urban area. No underweight subjects were found in both types of residence. There is no significant relationship between the type of residence and BMI category among infertile female subjects (χ^2= 0.619, df =2, P =0.734).

DISCUSSION

The prevalence of infertility may vary from one region to the other, due to differences in the characteristics of populations.[15-17] Difference in prevalence is also reported for its type, between primary infertility (characterized by women who have not previously conceived) and

secondary infertility which involves at least one prior conception but an inability to conceive subsequently.[18,19] A comprehensive assessment of the proportion of primary and secondary infertility, is a crucial for developing effective management approaches.[20,21] This study records 85.3% of primary infertile subjects, while 14.6% are secondary infertile subjects, although the prevalence in our cohort is higher than the previous studies, which had reported about 75% primary and 25% secondary infertility cases.[6,22,23] Moreover, primary infertility was the most common type among the rural and urban areas. Even though, the present study records the percentage of primary infertility was higher among the urban residents, the frequency distribution of the infertility type was not statistically different by the place of residence (χ^2=6.673, df=1, P=0.10). The higher percentage of primary infertility among the urban residents in the current study conforms to the results from previous studies, which have shown that the prevalence of primary infertility is higher among urban women compared to the rural region.[24, 25] However, there are instances where infertility rates among rural women are notably higher compared to those in urban areas.[26] Conversely in this study the secondary infertile is higher in rural residential subjects than the urban region. This variation is linked to various factors such as infections, limited access to health care.[24]

Obesity has emerged as a major global public health concern, with substantial implications for reproductive health. Among 191 infertile women, 122 (63.8%) were obese (BMI≥25 kg/m²), 41 (21.4%) were overweight (BMI 23.0–24.9 kg/m²), and 28 (14.6%) had normal BMI (18.5–22.9 kg/m², no women were underweighted. The distribution across BMI categories was significantly non-uniform (χ^2=81.497, df=2, P=0.01), indicating a marked over-representation of women with elevated BMI. This pattern aligns with reports from earlier study, where 70–80% of infertile women are overweight or obese, and obesity is associated with a two- to three-fold increased risk of infertility, particularly ovulatory and PCOS-related subtypes.[27] In this study, higher BMI was associated with both primary and secondary infertility, and primary infertility accounted for most cases across all BMI categories. Notably, obesity was somewhat more prevalent among women with secondary infertility (67.8%) than among those with primary infertility (63.6%). These findings differ from those of, earlier study (Sing et al., (2023) who found no consistent difference in BMI distribution between primary and secondary infertility.[28]

Earlier studies of infertile women report that most participants are overweight or obese, regardless of residence, and that an abnormal BMI is a risk factor for infertility.[29] Conversely, large global and regional analyses highlight that rural BMI is rising rapidly and, in many settings, rural women now have equal or higher mean BMI than urban women, so the rural–urban gap is narrowing or even reversing in some populations.[30]

In this study elevated BMI was common in both rural and urban residents. Of 74 rural women, 49 (66.2%) were obese (BMI≥25 kg/m²), 16 (21.6%) were overweight (BMI 23.0–24.9 kg/m²), and 9 (12.2%) had normal BMI (18.5–22.9 kg/m²). Among 117 urban female infertile subjects, 73 (62.4%) were obese, 25 (21.4%) overweight, and 19 (16.2%) had a normal BMI. Although urban women contributed more cases in absolute numbers, the proportion of obese and overweight women was similar in rural and urban groups. This pattern aligns with reports that overweight and obesity are prevalent among infertile women in both rural and urban settings, with residents not consistently distinguishing BMI categories.[29] In the Indian context, rural and urban populations exhibit considerable heterogeneity in lifestyle, dietary practices, occupational patterns and socioeconomic conditions.[10,31]

CONCLUSION

Rural populations are often characterized by greater reliance on locally available and traditionally prepared foods, higher levels of agricultural or physically occupational activity. In contrast, urban populations are increasingly exposed to sedentary lifestyles, energy-dense and processed foods, changing dietary patterns, occupational stress, and reduced levels of routine physical activity. However, these patterns are not uniform and may vary substantially according to socioeconomic status, education, occupation, cultural practices, and geographic region.

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