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The silent cycle: unveiling anovulation and its lifestyle correlates among urban women in West Bengal

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Abstract: *Background and aims*: Anovulation, is a major contributor to female infertility and is commonly associated with conditions such as polycystic ovary syndrome (PCOS).In West Bengal, increasing urbanization and lifestyle shifts are suspected to impact reproductive health. This study evaluated the prevalence and potential lifestyle factors associated with anovulation in women under 40, while also outlining the relevant clinical and demographic trends. *Methodology:* A cross-sectional study analyzed anovulation among 30 urban women aged 14 to 40 years in West Bengal. Diagnosis involved menstrual history, clinical exams, transvaginal ultrasounds, and hormonal evaluations. Lifestyle data on physical activity, nutrition, and BMI were collected via standardized questionaries. Statistical analysis using ANOVA was conducted to compare means and identifying significant predictors across ovulatory and ovulatory groups. *Result:* The overall point prevalence in these study cohort was found to be 23.62% compared to ovulatory group exhibited significantly higher mean BMI (28.9±11.6 vs. 24.3±3.5 kg/m^2; $p<0.001$) and lower mean weekly physical activity (45 mins vs. 120 mins; $p<0.01$). ANOVA results indicated that central obesity (waist-to-hip ratio ≥ 0.85), high perceived stress scores, and reduced progesterone were statistically significant independent predictors of anovulation ($p< 0.05$). *Conclusion:* A considerable proportion of healthy, frequently cycling urban women in West Bengal suffer from silent anovulation, which is connected to lifestyle factors such as central adiposity and psychological stress. These findings highlight the need for proactive reproductive health screening and targeted lifestyle interventions to improve fertility and metabolic outcomes in developing population.

Keywords: Anovulation, BMI, Prevalence, Lifestyle, Physical Activity.

Abbreviations: PCOS: Polycystic Ovary Syndrome; ART, Artificial Reproductive Technology; BMI: Body Mass Index; FSH: Follicle-Stimulating Hormone; LH: Luteinizing Hormone; TSH: Thyroid-Stimulating Hormone; ANOVA: Analysis of Variance; SD: Standard Deviation

Introduction

Reproductive health is an essential component of women's life, along with irregular menstruation and infertility are further exacerbated by anovulation, which is a condition where the ovaries fail to produce an egg [1].

Anovulation can be significantly impacted by the woman's relationships, general quality of life, and physical and mental health [2]. Despite its significance, anovulation is frequently misdiagnosed or sometime undiagnosed and handled inadequately, especially in underdeveloped nations [3].

Moreover, up to 30% of women of reproductive age are thought to undergo anovulatory cycles, indicating that a significant percentage of women globally are impacted by this condition [4]. It can cause excessive or prolonged bleeding, irregular menstrual periods, and infertility, which can have a major effect on a woman's reproductive health and well-being [5]. An elevated risk of metabolic and cardiovascular conditions, including insulin resistance, type 2 diabetes, and cardiovascular disease has also been connected to anovulation [6].

Urbanization and changing lifestyles have been connected to women's reproductive health difficulties, including anovulation [7]. The adoption of Westernized diets, sedentary lifestyles, and increasing stress levels have all been linked to anovulation [8]. Furthermore, socioeconomic factors including education level, occupation, and income can have an impact on reproductive health outcomes [9].

In India, anovulation is a major public health concern, especially among metropolitan women [10]. The country's growing urbanization and shifting lifestyles have resulted in an increase in reproductive health issues, including anovulation [10-11]. West Bengal, with its distinct cultural, social, and environmental characteristics, provides an intriguing setting for investigating anovulation and its associated. Not withstanding the importance of anovulation as a public health concern, little is known about its prevalence and lifestyle correlates in West Bengal's metropolitan areas. In order to fill this knowledge vacuum, this study will look into how common anovulation is among West Bengali urban women and how it relates to lifestyle factors.

Estimating the prevalence of anovulation among West Bengali urban women, investigating its relationships to lifestyle factors like as food, physical activity, stress, and socioeconomic level, and identifying potential predictors are the objectives of this study. Women between the ages of 14 and 40 years from a district of West Bengal will be recruited using a cross-sectional design, and information on lifestyle factors, sociodemographic traits, and reproductive health outcomes will be gathered via a standardized questionnaire. Hormonal profiles and menstrual history will be used to diagnose anovulation. The results will guide public health campaigns and actions that support women's reproductive health and wellbeing in the area. With implications for public health policy and practice in reproductive health and women's health, the study will add to the expanding body of knowledge on anovulation and its lifestyle correlates in urban Indian women.

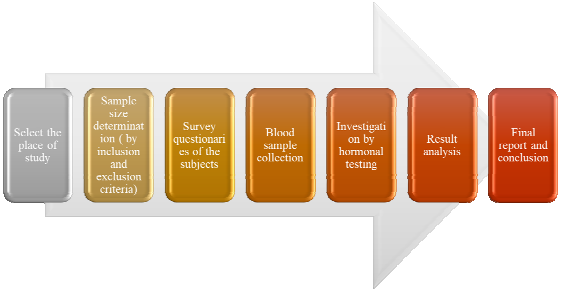
Due to notable gaps in earlier research, the previous research gap has narrowed. These include different prevalence rates of contraceptive usage and reproductive health, a lack of specialized study on the prevalence of anovulation among West Bengali urban women, and a paucity of investigation into the influence of lifestyle factors on reproductive health outcomes, including anovulation. The necessity for focused interventions is also emphasized by highlighting the differences between urban and rural areas in terms of reproductive health outcomes, healthcare access, and contraceptive use. Research on the prevalence of anovulation, lifestyle factors and anovulation, and urban-rural differences in reproductive health outcomes, including anovulation, are all possible directions for further study. By filling in these gaps, the study can further knowledge of anovulation and its effects on the health of women in the area.

Material and Methods

Ethical aspects: These study was followed the guidelines of the center's Institutional Review Board. Written informed consent was not required for this retrospective study.

Study design, time frame, and location: Hospitals strategically position themselves based on their area of expertise, the level of healthcare services they provide, the facilities they provide, and their role within the community's healthcare system. The renowned tertiary care facilities included in this study - Serum diagnostic Center is situated in a prominent area with a high population density. Of the approximately 127 women under reproductive age group (14-40 yrs) are examined on that locality with signs and symptoms, 30 patients had been selected for additional research, and 97 were excluded because they didn't fulfill the inclusion criteria. The experimental design and technique (Figure 1).

Fig-1: Experimental design of the research study.



Inclusion and Exclusion criteria: The inclusion criteria of this research study were, Women under aged 14-40 years, have urban residents of West Bengal, Women with regular menstrual cycles (25-35 days) or irregular menstrual cycles, and Women who willing to participate in the study by oral consent.

The Exclusion Criteria of this research were, Women outside the 14-40 years age range, who don't have a permanent residents or women from other states, Women with known medical conditions that may affect ovulation, such as polycystic ovary syndrome (PCOS), thyroid disorders, or premature ovarian failure, Women currently using hormonal medications or hormonal contraceptives, Women who are pregnant or lactating, and Women undergoing infertility treatment or assisted reproductive technology (ART). Some of additional considerations may include in this research are, Women who speak and understand Bengali or English and Women with cognitive impairments that may affect their ability to provide informed consent or participate in the study.

Study protocol: Menstrual history, clinical exams, transvaginal ultrasounds, and hormonal evaluations were all used to make the diagnosis. A standardized questionnaire was used to collect lifestyle data such as physical activity, nutrition, and BMI. Blood sample were collected from the selected study groups and further hormonal study and biochemical tests were conducted like - determination of FSH, LH, Estrogen, Progesterone, TSH, and Glucose for more analysis.

Statistical analysis: Microsoft software was used to do statistical studies using statistically based methods. Epidemiological and clinical parameters were presented considering both absolute and relative frequencies. Means and standard deviations have been used to describe variables that are regularly distributed. ANOVA was used in the statistical analysis to compare means and find significant predictors between the ovulatory and non-ovulatory groups.

Results

Participants were relatively young (mean age=26.06 ± 4.27), with average height (mean ±SD= 1.33±0.25) and slightly overweight weight (mean ±SD= 46.63±6.18) according to BMI (mean ± SD= 28.9 ± 11.6), Majority of participants are single/divorced (83.33%), most participants have post-secondary education (76.66%) and physical activity levels vary, with the highest percentage having high physical activity [Table 1].

Table-1: Selected characteristic of study groups, participants [n (%) =30 (100)]

Variable	Values
Age years, Mean ± SD	26.06 ± 4.27
Height in meters, Mean ± SD	1.33 ± 0.25
Weight in kilograms, Mean ±SD	46.63 ± 6.18
Body mass Index, Mean ± SD	28.91±11.66
Educational, post-secondary [n = %]	
• ≤High School	23.33
• Post-secondary	76.66
Marital Status, [n = %]	
• Single/Divorced	83.33
• Married	16.66
Sexual activity, [n=%]	
• NOT Active	53.33
• Previous not current	33.33
• Active	16.66
Physical activity, [n= %]	
• Low	26.66
• Moderate	30
• High	43.33
Mean timing of physical activity (mins)	45
Current Smoker, [n=%]	6.66
Alcohol consumption in past 12 months, [n=%]	3.33
Waist-to-hip ratio	>0.85

Table 2 shows data variables and their statistical representation for various hormones and glucose levels across different phases of the menstrual cycle. Some hormone means are below their respective normal ranges. For example, FSH and LH phases have means within or below normal ranges with varying T statistics, while Estrogen, Progesterone, TSH, and Glucose phases have means and T statistics are provided for different phases or conditions, with some means being below or within normal ranges. 't' statistics indicate varying degrees of deviation from expected values. Although glucose levels (fasting and postprandial) are slightly above the given normal values.

Table-2: Data Variables and statistical representation. (n=30, df=28)				
Variables	**Mean**	**Normal value**	**Standard deviation (SD)**	**'t'-values**
FSH (IU/L)				
• Early to Mid-follicular phase	0.98	1.37-9.9	0.14	-0.37
• Ovulatory Phase	3.4	6-26	1.30	0.81
• Luteal Phase	0.89	1.1-9.2	0.10	-1.83
LH (IU/L)				
• Early to Mid-follicular phase	6.5	8.7-76.3	1.98	1.33
• Ovulatory Phase	0.49	0.5-11.4	0.86	-0.10
• Luteal Phase	0.27	0.5-16.9	0.11	-0.63
Estrogen (IU/L)				
• Early to Mid-follicular phase	1.34	1.68-6	0.13	-2.09
• Mid-Luteal Phase	1.04	1.7-7.7	0.41	-0.32
Progesterone (ng/ml)	3.15	5.0-20	0.39	-0.61
TSH (µU/mL)	6.91	0.4-4.0	1.56	1.11
Glucose (mg/dl)				
• Fasting blood glucose	124.8	100	5.34	1.02
• Postprandial blood glucose	144.6	140	14.05	2.42

Table 3 shows the ANOVA test results of all variables shows, Estrogen and Progesterone: Both have P values <0.05, which indicates that the results are statistically significant. This means there's a significant difference between the groups being compared for these variables. FSH, LH, TSH, Blood Glucose: These variables have P values greater than 0.05 (0.44, 0.82, 0.82, and 0.57 respectively), indicating that the results are not statistically significant. This suggests there's no significant difference between the groups for these variables based on the ANOVA test.

Table-3: ANOVA test results of all variables		
Variables	**F-value**	**p-value**
• FSH	0.71	0.44
• LH	0.56	0.82
• Estrogen	11.06	<0.05
• Progesterone	0.72	<0.05
• TSH	0.74	0.82
• Blood Glucose	0.43	0.57

Fig-2: Line diagram showing FSH, LH, estrogen and progesterone levels of anovulatory patients.

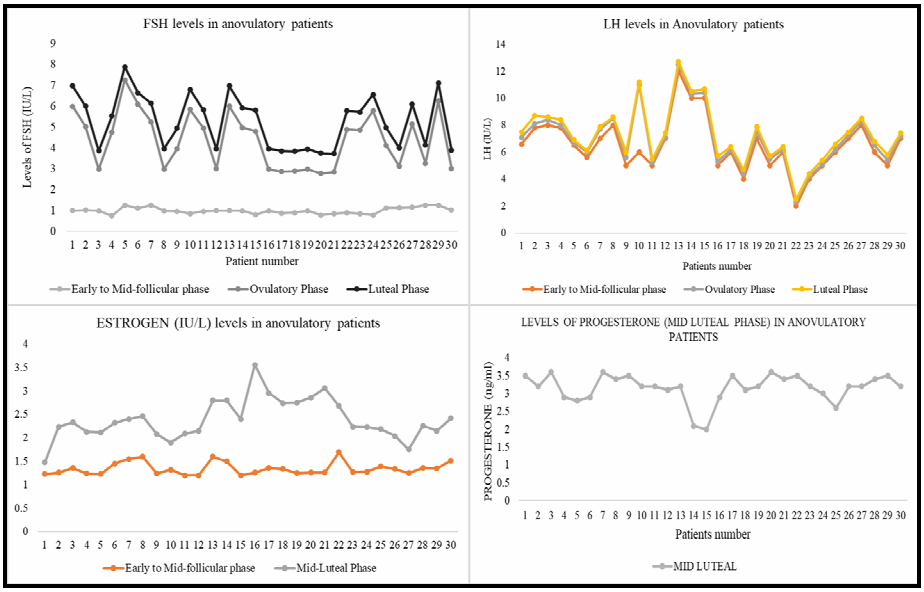
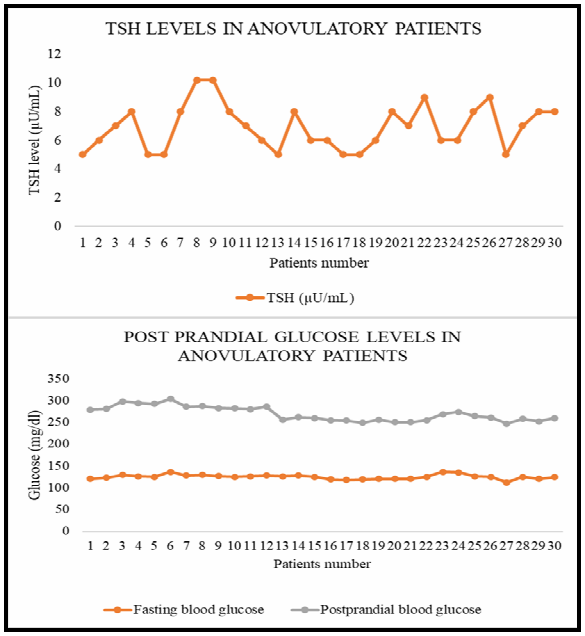


Figure 2, and 3 shows FSH (Follicle-Stimulating Hormone), LH (Luteinizing Hormone), Estrogen, Progesterone, TSH and Blood Glucose levels in anovulatory patients across different phases of the menstrual cycle - Early to Mid-follicular phase, Ovulatory Phase, and Luteal Phase.

Fig-3: Line diagram showing TSH and Glucose levels of anovulatory patients.



Discussion

Younger women, or pre-menopausal women, as well as those going through the menopause transition, are more likely to experience anovulation [12]. The primary cause of anovulation is hypogonadotropic hypogonadism, which is defined by the pituitary gland's selective inability to produce follicle-stimulating hormone and luteinizing hormone [13-14]. The most common age group in our study was working age, or 18 to 35 years old. Modern women were the focus of this study because, in our daily lives, stress management is frequently linked to increased workloads in all spheres of life, whether they be home or economic, and this causes hormonal changes in women [15].

Following screening, approximately 127 women in the reproductive age range were enrolled. The purpose of this study was to determine the prevalence of anovulation in women and to examine the various hormonal levels that distinguish these women from one another according to whether or not ovulation occurs. We may also claim that 23.62% of these 127 participants had anovulation and 76.38% had regular menstruation, with 30 of them having irregular menstrual cycles and 97 having regular menstruations, or were normal. Hormonal testing measures, including the measurement of FSH, LH, estrogen, progesterone, TSH, and blood glucose, were used to examine and contrast these participants. In the cases of FSH, LH, estrogen, and progesterone, we found that the findings of these 23.62% of participants fell short of the reference ranges and were below the control. However, it had ranges higher than the control for both TSH and glucose.

Figure 2 shows that FSH levels are generally higher in the Early to Mid-follicular phase compared to the Ovulatory and Luteal phases. There's a noticeable variation in FSH levels among patients in the Early to Mid-follicular phase. FSH levels tend to be lower and more stable in the Ovulatory and Luteal phases. On Figure 2 LH levels show a similar trend across the three phases for most patients. The lines for Early to Mid-follicular phase, Ovulatory Phase, and Luteal Phase are closely aligned, indicating similar LH levels across these phases for anovulatory patients. There's some variation in LH levels among patients but overall patterns are similar across phases. Figure 2 shows estrogen levels (IU/L) in anovulatory patients across two phases: Early to Mid-follicular phase (orange line), Mid-Luteal Phase (grey line). Estrogen levels in the Mid-Luteal Phase are higher than in the Early to Mid-follicular phase. Both phases show fluctuations in estrogen levels across patients.

Figure 2 shows progesterone levels (ng/ml) in the Mid-Luteal phase in anovulatory patients. Progesterone levels fluctuate across patients. Levels are generally below 4 ng/ml. Figure 3 shows TSH levels in anovulatory patients. The TSH levels range from approximately 4 to 10 µU/mL across 30 patients. There's variability in TSH levels among patients, with some peaks and troughs. Figure 3 shows postprandial glucose levels in anovulatory patients. Fasting blood glucose levels are relatively stable around 100 mg/dl.

Postprandial blood glucose levels are higher, around 300 mg/dl, and also relatively stable across patients.

Figure 4 and 5 shows comparative status of FSH, LH, estrogen, progesterone, TSH and glucose levels between normal and anovulatory patients using BAR diagrams. On Figure 4 shows anovulatory patients have lower levels of LH, Estrogen and Progesterone compared to normal patients, particularly notable in the mid-cycle LH surge and luteal phase progesterone. This difference is consistent with the pathophysiology of anovulation, where disrupted hormone profiles contribute to lack of ovulation. On Figure 5 shows anovulatory patients have higher mean TSH levels and higher glucose levels during fasting and postprandial states. These results suggest a potential link between anovulation and altered TSH and glucose metabolism.

Fig-4: Bar diagram showing comparative status of FSH, LH, estrogen and progesterone levels between normal and anovulatory patients.

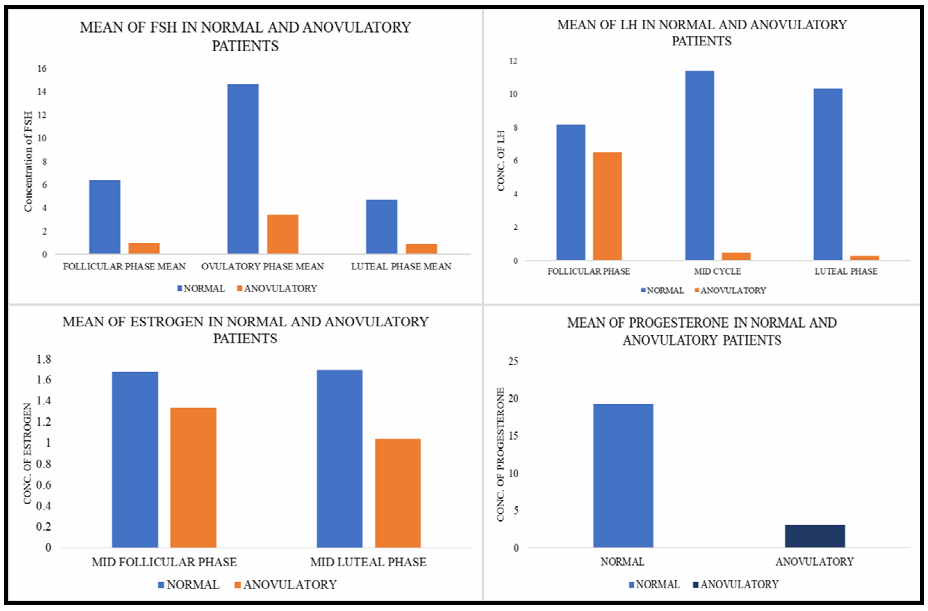
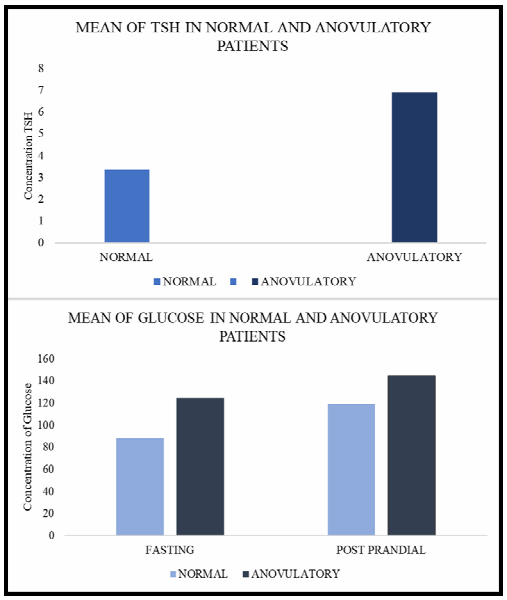


Fig-5: Bar diagram showing comparative status of TSH and Glucose levels between normal and anovulatory patients.



As a result, there were significant variations in the average outcomes of the parameters used, which aided in identifying the hormonal variations among women experiencing different dietary or other socioeconomic stressors that prevented ovulation even though they were in the fertile age range [16-17]. We can infer from the study of the target individuals that anovulation is common among modern women because of issues like as the stress that women face in their careers, diet, and emotions [18].

Conclusion

The study clarifies the problem of anovulation among West Bengali urban women, which is frequently disregarded. Our results show that anovulation is quite prevalent in this population, and lifestyle factors such food habits, levels of physical activity, stress, and

socioeconomic status are important. Consequently, the hormonal levels of premenopausal or fertile women changed as a result of the effects of a disturbed circadian rhythm, obesity, the use of chemicals in food or cosmetics, smoking, drinking, and poor eating habits that resulted in nutritional deficiencies [19-20]. We might infer from the aforementioned data that the mechanism of the regular ovulatory cycle is being disrupted by these contemporary issues [21-22]. Therefore, this study also recommends that women have a better lifestyle and environment, which includes eating a balanced diet, having a normal circadian rhythm that may aid in the systematic regulation of ovulation, and having an impact on socioeconomic factors.

Research emphasizes the necessity of raising awareness and educating people about reproductive health, menstrual health, and the significance of getting medical help for irregular periods. Healthcare professionals can create focused interventions to support reproductive health and enhance fertility outcomes by knowing how lifestyle corresponds with anovulation. In the end, this study adds to the expanding corpus of research on anovulation and its effects on women's health, highlighting the significance of tackling this quiet problem in order to advance the general wellbeing of women in metropolitan West Bengal and beyond.

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