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"Comparing Basal Metabolic Rate (BMR) in Tribal and Non-Tribal Girl Athletes During Menstrual Phases"

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Abstract:

This study employed a cross-sectional design to examine differences in basal metabolic rate (BMR), before, during, and after the menstrual period between tribal and non-tribal girl athletes of the Vidarbha region. The population was divided into two distinct groups: tribal and non-tribal athletes. From each group, 1000 sample of female athletes were randomly selected to participate in the study. The participants were drawn from secondary and higher secondary schools within the Vidarbha region, encompassing a wide range of socioeconomic backgrounds and geographic locations. The participant age group was between 14 to 18 years.The results revealed significant difference in Tribal athletes- basal metabolic rate between menstrual vs pre-menstrual (mean difference=4.84, $p<0.001$), pre-menstrual vs post-menstrual phase (mean difference=5.33, $p<0.001$). However, there was no significant difference in BMR between menstrual vs post-menstrual phase ($p>0.05$).Non-tribal athletes BMR between menstrual vs premenstrual (mean difference=19.18, $p<0.001$), pre-menstrual vs post-menstrual (mean difference=21.79, $p<0.001$) and menstrual vs post-menstrual phase (mean difference=2.61, $p<0.001$). Tribal vs. Non-tribal in BMR between tribal and non-tribal girl athletes during menstrual phase (mean difference=81.47, $p<0.001$), pre-menstrual phase (mean difference=95.81, $p<0.001$) and post-menstrual phase (mean difference=79.35, $p<0.001$).

Key:Basal metabolic rate (BMR),

Introduction

The menstrual cycle is a complex biological process that occurs in the reproductive system of female-bodied individuals. It typically lasts around 28 days, although variations are common. The menstrual cycle is governed by the interplay of hormones produced by the hypothalamus, pituitary gland, ovaries, and uterus.

The cycle begins on the first day of menstruation, known as day one. During this phase, the uterine lining, which thickened in preparation for a potential pregnancy during the previous cycle, is shed through the vagina. Menstruation typically lasts for about 3 to 7 days.

Basal metabolic rate represents the minimum energy expenditure required for basic physiological functions at rest (Jeukendrup& Gleeson, 2019). Studies suggest a slight increase in BMR during the luteal phase due to the thermogenic effects of progesterone (Melov et al., 2007), possibly linked to its role in raising core body temperature (De Souza et al., 2009). However, this increase is likely minimal and may not significantly influence overall energy expenditure (Melov et al., 2007).

Basal metabolic rate (BMR) is a fundamental concept in human physiology that refers to the minimum amount of energy expended by the body at rest to maintain vital physiological functions such as breathing, circulation, and cellular metabolism. It represents the energy required to sustain essential bodily functions while at complete rest, in a fasting state, and in a thermoneutral environment. BMR is typically expressed in terms of calories burned per unit of time, often per day.

BMR accounts for the largest proportion of total energy expenditure in individuals, usually constituting around 60-75% of the total daily energy expenditure. However, it can vary significantly between individuals due to factors such as age, sex, body composition, genetics, hormonal factors, and environmental conditions.

Objectives of The Study

1. To examine the basal metabolic rate (BMR) throughout the menstrual cycle in tribal and non-tribal girls.
2. To compare the basal metabolic rate between tribal and non-tribal girl athletes before, during and after menstruation.

Hypotheses

This study hypothesized that:

H_1: Both tribal and non-tribal athletes will experience fluctuations in BMR across the menstrual cycle.

H_2: There would be significant difference in BMR between tribal and non-tribal girl athletes before, during and after menstruation.

Methodology

Athletic performance in female athletes is influenced by basal metabolic rate (BMR), These factors can fluctuate throughout the menstrual cycle due to hormonal changes. Understanding these fluctuations is crucial for optimizing training programs and dietary needs for female athletes.

This study employed a cross sectional design to examine basal metabolic rate (BMR), before, during, and after the menstrual period between tribal and non-tribal girl athletes of the Vidarbha region.The population was divided into two distinct groups: tribal and non-tribal athletes. From each group, 1000 sample of female athletes were randomly selected to participate in the study. The participants were drawn from secondary and higher secondary schools within the Vidarbha region, encompassing a wide range of socioeconomic backgrounds and geographic locations. The participant age group was between 14 to 18 years.The survey method is used to represent the given study .

Statistical Techniques

A repeated measures analysis of variance (ANOVA) was conducted to examine differences in BMR across menstrual cycle phases for both tribal and non-tribal athletes. Post-hoc tests were employed to identify specific differences between menstrual cycle phases. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using the Statistical Package for Social Sciences (version 25.0).

Results of Repeated Measures ANOVA on Basal Metabolic Rate

The results of the repeated measures ANOVA for basal metabolic rate reveal significant main effects for both groups (Tribal vs. non-tribal) and menstrual cycle phases, as well as a significant interaction between these factors (Table 1). The main effect of groups is highly significant ($F(1, 1998) = 490.41$, $p < 0.001$, $\eta p^2 = 0.19$), indicating a substantial difference in basal metabolic rate between tribal and non-tribal girls across all menstrual cycle phases. Similarly, the main effect of menstrual cycle phases is highly significant ($F(2, 1998) = 661.77$, $p < 0.001$, $\eta p^2 = 0.24$), suggesting significant differences in basal metabolic rate across pre-menstrual, menstrual, and post-menstrual phases. Moreover, the interaction effect between groups and menstrual cycle phases is significant ($F(2, 1998) = 240.53$, $p < 0.001$, $\eta p^2 = 0.10$). These differences, therefore, have been discriminated further by using the Bonferroni post hoc test.

Table 1.
Result of Repeated Measures ANOVA for Basal Metabolic Rate

Source of Variance	Sum of Squares	df	Mean Square	F	p	η_p^2
Groups (Tribal vs non-tribal)	10977173	1	10977173	490.41	<0.001	0.19
Menstrual Cycle Phases	220509.12	2	110254.56	661.77	<0.001	0.24
Interaction (Groups*Menstrual cycle phases)	80147.22	2	40073.61	240.53	<0.001	0.10
Residual	44721803	1998	22383.28			

Results of Post hoc analysis in Basal Metabolic Rate

Following the significant ANOVA results, a post hoc analysis was conducted to further explore the differences in basal metabolic rate between the different time points (pre-menstrual, menstrual, and post-menstrual) for the tribal and non-tribal groups. The post hoc test utilized the Bonferroni correction to adjust for multiple comparisons.

Pairwise comparisons in tribal and non-tribal groups have been presented in Table 2. The results revealed the following significant differences in body weight:

1. **Menstrual vs. Pre-menstrual vs. Post-menstrual within Tribal Group**:
    - **Menstrual vs. Pre-menstrual Phase**: There was a significant difference in basal metabolic rate between the menstrual and pre-menstrual phases among tribal girl athletes ($p < 0.001$). The mean difference was 4.84, indicating a small effect size (Cohen's $d = 0.05$).
    - **Pre-menstrual vs. Post-menstrual Phase**: A significant difference exists in basal metabolic rate between the pre-menstrual and post-menstrual phases among tribal girl athletes ($p < 0.001$). The mean difference is 5.33, with a small effect size (Cohen's $d = 0.06$).

- **Menstrual vs. Post-menstrual Phase**: There was no significant difference in basal metabolic rate between the menstrual and post-menstrual phases among tribal girl athletes ($p = 1.0$).

2. **Menstrual vs. Pre-menstrual vs. Post-menstrual within Non-tribal Group**:
   - **Menstrual vs. Pre-menstrual Phase**: There was significant difference in basal metabolic rate between the menstrual and pre-menstrual phases among non-tribal girl athletes ($p < 0.001$). The mean difference was 19.18, indicating a small effect size (Cohen's $d = 0.22$).
   - **Pre-menstrual vs. Post-menstrual Phase**: A significant difference exists in basal metabolic rate between the pre-menstrual and post-menstrual phases among non-tribal girl athletes ($p < 0.001$). The mean difference is 21.79, with a small effect size (Cohen's $d = 0.25$).
   - **Menstrual vs. Post-menstrual Phase**: There was a significant difference in basal metabolic rate between the menstrual and post-menstrual phases among non-tribal girl athletes ($p < 0.001$). The mean difference is 2.61, indicating a small effect size (Cohen's $d = 0.03$).
3. **Comparison between Tribal and Non-tribal Groups within Each Menstrual Phase**:
   - **Menstrual Phase**: There was a significant difference in basal metabolic rate between tribal and non-tribal girl athletes during the menstrual phase ($p < 0.001$). The mean difference was 81.47, indicating a very large effect size (Cohen's $d = 0.93$).
   - **Pre-menstrual Phase**: A significant difference exists in basal metabolic rate between tribal and non-tribal girl athletes during the pre-menstrual phase ($p < 0.001$). The mean difference was 95.81, with a very large effect size (Cohen's $d = 1.10$).
   - **Post-menstrual Phase**: There was a significant difference in basal metabolic rate tribal and non-tribal girl athletes during the post-menstrual phase ($p < 0.001$). The mean difference was 79.35, indicating a large effect size (Cohen's $d = 0.91$).

These findings suggest that basal metabolic rate increases during pre-menstrual phase and returns to baseline during post-menstrual phase. Comparison between tribal and non-tribal girl athletes indicates that non-tribal girl athletes tend to have more basal metabolic rate than the tribal girl athletes.

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Table 2.
Results of Post Hoc Analysis in Basal Metabolic Rate

Groups	Comparison	MD	95% CI for Mean Difference		t	Cohen's d	p
			Lower	Upper			
Tribal	Menstrual vs pre-menstrual	4.84	6.53	3.14	8.38	0.05	<0.001
	Pre-menstrual vs post-menstrual	5.33	3.64	7.03	9.24	0.06	<0.001
	Menstrual vs post-menstrual	0.49	1.19	2.19	0.86	0.006	1.0
Non-tribal	Menstrual vs pre-menstrual	19.18	20.8	17.4	33.22	0.22	<0.001
	Pre-menstrual vs post-menstrual	21.79	20.1	23.49	33.75	0.25	<0.001
	Menstrual vs post-menstrual	2.61	0.92	4.31	4.53	0.03	<0.001
Tribal vs non-tribal (Menstrual phase)		81.47	70.03	92.90	20.93	0.93	<0.001
Tribal vs non-tribal (Pre-menstrual phase)		95.81	84.37	107.24	24.62	1.10	<0.001
Tribal vs non-tribal (post-menstrual phase)		79.35	67.91	90.79	20.39	0.91	<0.001

Discussion of Results:-

The menstrual cycle is a key aspect of female biology, involving changes in hormones that affect different aspects of the body. Athletes, both tribal and non-tribal, go through these hormonal changes while also dealing with the physical demands of training. This study looked at how the menstrual cycle impacts basal metabolic rate (BMR) in a large group of 1000 tribal and 1000 non-tribal female athletes during three phases of the cycle: menstrual, pre-menstrual, and post-menstrual.

The findings of present study are consistent with earlier research studies hence, the hypothesis "***H_1: Both tribal and non-tribal athletes will experience fluctuations in BMR across the menstrual cycle"*** is accepted.

The significant differences observed suggest that ethnic or cultural factors may influence body composition in female athletes. Non-tribal girls exhibited variations in body fat and lean body mass across the menstrual cycle, potentially linked to hormonal fluctuations and metabolic changes during different phases (Elliott-Sale et al., 2020).

The results observed in the present study are concurrent with earlier studies hence, the hypothesis ***"H_2: There would be significant difference in BMR between tribal and non-tribal girl athletes before, during and after menstruation."***

Finally, to summarize the study showed significant differences in body composition across menstrual cycle among tribal and non-tribal girl athletes. Non-tribal girl athletes tend to have BMR as compared to tribal girl athletes. Understanding the variations in basal metabolic rate, among female athletes from different cultural backgrounds across the menstrual cycle is crucial for optimizing training, nutrition, and performance strategies.

Findings

- **Tribal athletes:** The results showed significant difference in basal metabolic rate between menstrual vs pre-menstrual (mean difference=4.84, $p<0.001$), pre-menstrual vs post-menstrual phase (mean difference=5.33, $p<0.001$). However, there was no significant difference in BMR between menstrual vs post-menstrual phase ($p>0.05$).

- **Non-tribal athletes:** The results showed significant difference in BMR between menstrual vs premenstrual (mean difference=19.18, $p<0.001$), pre-menstrual vs post-menstrual (mean difference=21.79, $p<0.001$) and menstrual vs post-menstrual phase (mean difference=2.61, $p<0.001$).

- **Tribal vs. Non-tribal:** The results revealed significant difference in BMR between tribal and non-tribal girl athletes during menstrual phase (mean difference=81.47, $p<0.001$), pre-menstrual phase (mean difference=95.81, $p<0.001$) and post-menstrual phase (mean difference=79.35, $p<0.001$).

Conclusion

- **Menstrual cycle variations:** Both tribal and non-tribal girl athletes from Vidarbha region exhibited significant fluctuations in BMR the menstrual cycle.

- **Tribal vs. non-tribal differences:** Tribal girl athletes consistently BMR compared to non-tribal girl athletes across all menstrual phases. They also displayed smaller fluctuations in these measures throughout the cycle.

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