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Changes in hemoglobin level in different stages of menstrual cycle in female elite field hockey players of Northeastern region of India

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Abstract:
Menstrual cycle is an event that occurs throughout the reproductive age of a woman before the onset of menopause. During this period, changes in different hormone like progesterone, luteinizing hormone etc levels occurs due to changes in their level of secretion influencing various organs of the body including hematopoiesis. Also, studies had shown iron loss in premenopausal women during menstrual bleeding which may alter the iron status as well as the level of hemoglobin in woman. Studies also shown that athletic performance requires high energy consumption especially in endurance athletes, thus performance may be related to level of hemoglobin as hemoglobin carries oxygen in blood to all organs and tissues of the body. The aim of the present study was to determine the changes in hemoglobin level during different stages viz. menses, the mid follicular and luteal phases over one normal menstrual cycle in 34 female elite field hockey players of Northeastern region of India. Hemoglobin level was measured from the present subjects with the help of automated Hemoglobinometer (HemoCue 201^{+}) at different stages of the menstrual cycle. Collected data was subjected to statistical analysis with the help of (SPSS) version 16.0. The result showed a statistically significant variation occuring in mean and standard deviation of hemoglobin level at different phases of menstrual cycle (menses -10.76±1, mid-follicular- 13.07±0.65 and luteal -12.83±0.59). Also a significant difference was observed between the hemoglobin levels among types of discharge (done by self reported method) during menses.
Key Word*: Hemoglobin, Menstrual cycle, Field hockey, Progesterone, Luteinizing hormone.*

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I. Introduction

Menstrual cycle is the cycle that occurs in female between the age of menarche and menopause. The average length of cycle every month during this period is usually 28 days but may vary from 21 to 40days with secretion of steroid hormones namely, estrogen and progesterone (Hall & Guyton, 12th Edition). The phases of menstrual cycle can be divided in three viz. menses (bleeding), follicular phase or pre-ovulatory phase and post-ovulatory phase or luteal phase (Yoshio Suzuki, 2018). Blood loss during menses may affect the iron status of a female which may indirectly affect the level of hemoglobin in blood as haem is iron group in hemoglobin (Kim I, Yetley EA, Calvo MS, 1993).

Field hockey is the National game of India and very popular sport which is played in almost every state in India. Field hockey is a team game which requires good aerobic capacity viz. endurance for optimizing performance (H.Barun Singh & Joytsna Kailashiya, 2017).

Oxygen in blood is carried by hemoglobin thus due to fluctuation in hemoglobin level, may led to depletion in oxygen carrying capacity of blood to all tissues and organs, which may affect the energy level of body resulting in low aerobic capacity. As sports performance is related to energy expenditure thus hemoglobin level may affect performance of an athlete. Also it may lead to Iron deficiency anemia (Hall & Guyton, 12th Edition).

Despite field hockey is the National game and one of the most popular sports of the country, a very little scientific information is available concerning level of hemoglobin during different phases of menstrual cycle in female athletes. Thus scientific study on hemoglobin level of female field hockey players of North East region may act as a frame of reference for monitoring the training regime in a systematic manner and also to enhance the level of performance.

II. Material And Methods

The study was carried out on 34 young elite female field hockey players of different centres of SAI, North East Region viz. SAI Extension Centre, Thenzawl, Mizoram, SAI NERC Imphal, Manipur under SAI, North East Regional Centre, Imphal. The selected athletes are at least National level performer with 3-4years of playing history. Also athletes with normal menstrual cycle were selected for the present study. All athletes were considered as homogenous as they belonged to almost same socio-economic status with similar dietary habits and undergoing training in same kind of environmental/ climatic condition.

Before commencement of test, all the subjects were clinically examined by the sport medicine physicians following standard procedure (SAI, National Sports Talent Contest Scheme, 1992). A signed consent was obtained from all players willing to participate prior to testing with complete explanation of the purposes, procedures, potential risks and benefits of the tests.

Also through pretested questionnaires maintaining complete confidentiality, data for the average duration of their menstruation, age at menarche, duration of menstruation period with amount of menstrual blood loss were collected by self-reported method. The different level of hemoglobin of the participants was monitored at SAI NERC laboratory in the morning 2, 10 and 22 days (±2 days) after menstrual bleeding started. Testing for each athlete hemoglobin level was divided into three stages viz. Stage 1 (menses -2^{nd} day of menstruation), Stage 2 (mid follicular phase – 10^{th} ±2 day of menstrual cycle) & Stage 3 (luteal phase – 22^{nd} ±2 day of menstrual cycle) (Yoshio Suzuki, 2018).

The laboratory tests for estimation of hemoglobin level during different stages of each player's menstrual cycle were performed at room temperature varying from 20^oC – 22^oC with relative humidity varying between 50% and 60%. Height, weight & BMI were measured and calculated during the first stage of testing by standard procedures. Hemoglobin was measured in the laboratory by using automated Hemoglobinometer (HemoCue 201^+) from all the subjects.

Study ethics was implemented following the Declaration of Helsinki (1964). Data obtained were analyzed using the Statistical Program for Social Sciences (SPSS) version 16.0 for Windows (SPSS Inc., Chicago, Il, USA). Mean and standard deviation was obtained for all parameters viz. age, height, weight, BMI, number of days for a regular menstrual cycle and hemoglobin levels at different stages of the cycle. Significance test for hemoglobin level at different phases of the cycle was estimated by a one way repeated measured analysis of variance (linear model).

Also players were divided according to their types of discharge during menses viz. heavy discharge and moderate or scanty discharge followed by statistical analysis of their hemoglobin level during menses by estimating mean, standard deviation and significance level.

III. Result

Table no 1 depicts mean and standard deviation of various parameters of 34 elite hockey players of Northeastern region of India viz. Age (yrs.) 16.06±1.16, Height (cm) 154.36±3.96, Weight (kg) 51.44±5.3, BMI (kg/m^2) 21.57±1.86, Regular Menstrual Cycle (day) 27.58±2.47, hemoglobin level at different phases of menstrual cycle (menses 10.76±1, mid follicular phase 13.07±0.65 & luteal phase 12.83±0.59. Hemoglobin level was found to be highest in mid follicular phase, lowest in menses and normal level in luteal phase of the menstrual cycle.

Table no 1: Mean and standard deviation of different parameters of 34 female elite hockey players of Northeastern region of India:

Age (yrs.)	Height (cm)	Weight (kg)	BMI (kg/m^2)	Regular Menstrual Cycle (day)	Hemoglobin level (g/dL)		
					Stage 1	Stage 2	Stage 3
16.06±1.16	154.36±3.96	51.44±5.3	21.57±1.86	27.58±2.47	10.76±1	13.07±0.65	12.83±0.59

Table no 2 depicts mean, standard deviation & level of significance of hemoglobin level during different stages of one complete menstrual cycle of each subject. A one way repeated measured analysis of variance was conducted to evaluate the null hypothesis that there is no change in subject's different level of hemoglobin during different stages of menstrual cycle. But results depicted significant time effect thus there is significant evidence to reject the null hypothesis. Follow up comparison indicated that each pair wise difference was significant, $p<0.01$. So, the result showed significantly ($p<0.05$) lower level of hemoglobin in stage 1 compared to stage 2 and stage 3 of the cycle. Also it was observed that mean and standard deviation of stage 3 significantly ($p<0.05$) lower than that of stage 2 of the menstrual cycle.

Table no 2: Mean, standard deviation & level of significance during changes in hemoglobin level in different stages of menstrual cycle in female elite hockey players of Northeastern region of India:

Number of participants	Stage 1 (menses -2nd day of menstruation) (g/dL)	Stage 2 (mid follicular phase – 10th ±2 day of menstrual cycle) (g/dL)	Stage 3 (luteal phase – 22nd ±2 day of menstrual cycle) (g/dL)
34	10.76±1*	13.07±0.65*	12.83±0.59*

Level of Significance:*= *p<0.05*

Table no3 showed significance level among association between types of discharge and hemoglobin level during stage 1 viz. 2nd day of menstruation. It was found that 41.2% of the subjects had heavy discharge whereas 58.8% of the subjects had moderate or scanty during the menses days by self-reported method. Mean and standard deviation of hemoglobin level of the subjects with heavy discharge was found out to be 10.19±1.05 which showed significantly ($p<0.05$) lower level of hemoglobin than subjects with moderate or scanty discharge 11.17±0.76.

Table no 3: Association between types of discharge and Stage 1 viz. 2nd day of menstruation, hemoglobin level:

Types of discharge	Number of cases	Percentage (%)	Stage 1 (menses -2nd day of menstruation) (g/dL)	F value and level of significance between Hb level
Heavy discharge	14	41.2	10.19±1.05	9.902*
Moderate or scanty discharge	20	58.8	11.17±0.76	

Level of Significance:*= *p<0.05*

IV. Discussion

All 34 female field hockey players were found to be in their teenage as depicted from mean and standard deviation of their age in years 16.06±1.16. From Table 1 mean and standard deviation of height (cm) 154.36±3.96, weight (kg) 51.44±5.3 and BMI (kg/m^2) 21.57±1.86 athletes from the present study was found be almost similar to a study on anthropometric profile of young female field hockey athletes of same age group (H.Barun Singh & Joytsna Kailashiya, 2017) (height (cm) 155.14±5.32, weight (kg) 51.17±7.69 and BMI (kg/m^2) 21.14±1.82). As both the research where conducted on Indian elite field hockey athletes of same age group. In the present study regular menstrual cycle days mean and standard deviation was found to be 27.58±2.47days which almost equal to one normal menstrual cycle which is usually of 28days.

From Table 2 it was depicted that there was a significantly ($p<0.05$) lower level of hemoglobin in stage 1 compared to stage 2 and stage 3 of the cycle. Also it was observed that mean and standard deviation of stage 3 significantly ($p<0.05$) lower than that of stage 2 of the menstrual cycle. A previous study has described that level of hemoglobin reaches the lowest in menses and peak in luteal or late luteal phases of menstrual cycle (Kim I, Yetley EA, Calvo MS,1993). Similarly a significant low level was observed in the menses than the luteal stage of menstrual cycle in the present study subjects also. From another study by (Surbhi Kotwaney & Pushparaja Shetty, 2014) lower level of hemoglobin during menses is due to menstrual bleeding as for the present study values show a similar result thus hemoglobin level lowest at menses may be due to menstrual bleeding. According to (Rushton et.al., 2001) haem is synthesized in mitochondria of cells and there are no study related to changes in mitochondria numbers during a menstrual cycle in female so it may be concluded that changes in hemoglobin level is only due the changes in different hormone levels. Another study of (Yoshio Suzuki, 2018) it was found lower level of hemoglobin in luteal phase than that of mid follicular phase same as the present study where a significance ($p<0.05$) was observed and they also described luteal phase value as normal level of hemoglobin in the female body. Similar result was also observed in the present study where there was a significantly ($p<0.05$) lower value of hemoglobin in luteal phase than mid follicular phase.

Table 3 depicts percentage of athlete having higher discharge and moderate or scanty discharge during the menses. Also it was observed from the present study that heavy discharge subjects have significantly low level of hemoglobin than subject's who had moderate or scanty discharge during the menses (stage 1) which may be due to the blood loss during menstruation. A study showed that the blood loss during menstruation results in a negative iron load in women and increases the risk for developing iron-deficiency anemia (Silotry, 2011). So athletes of the present study may have more of a risk of developing iron-deficiency anemia as iron depletion takes place due to heavy physical exercise, iron loses in sweat as well as in feces and urine through intravascular Hemolysis and frequent microtruama and micro bleedings in athletes (Jadwiga Malczewska et. al., 2000).

V. Conclusion

Present study concluded that there was a significant variation in the level of hemoglobin at different stages of menstrual cycle. Also hemoglobin level is related to types of discharge during menses. Further study will be required to understand changes in the Iron status and hemoglobin level of female athletes during

menstrual cycle as level of hemoglobin may be related to performance of an athlete and also female health condition.

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