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Haemoglobin Levels: Impact on Follicular and Luteal Phases Among School Girls

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ABSTRACT

Menstruation, the periodic monthly peeling of a women uterine lining, provides insight into women's overall health and wellbeing. The four stages of the menstrual cycle including menstruation, the follicular phase, ovulation and the luteal phase as well as several other physiological and biochemical processes can all be impacted by the alteration of hormones. Common menstrual troubles comprise heavy or painful periods, premenstrual syndrome, menorrhagia and anaemia. The appearance of menstrual anemia will impair the growth and development of adolescent girls, such as fall off concentration and learning ability, blight growth, ensuing in unsatisfactory height, diminished physical strength as well as pale skin. This study henceforth aimed to determine the variation in levels of haemoglobin (in the form of iron) during pre and post-menstruation among girl students of Lowa Dibakar Vidyamandir High School, Purba Bardhaman, West Bengal, India. The prevalence estimation of the iron status causing anemia is significantly higher in follicular phase (Hb: 10.80 gm/dL) than those of luteal phase (Hb: 11.98 gm/dL). When evaluating iron status in women of reproductive age, this cyclical transformation as the indicator could be a source of inaccuracy. The issue that affects females of reproductive age requires intervention and our report offers compelling evidence for this.

Keywords: Haemoglobin, anemia, follicular-phase, luteal-phase, iron-deficiency, adolescent

INTRODUCTION

Menstruation is the eviction of the endometrial lining of the uterus through vagina in a regular monthly discharge of complex biological fluid composed of blood[1]. It sets out the body's periodic preparation for ovulation and potential pregnancy[2]. The menstrual cycle is characterized by a series of coordinated hormonal shifts. According to Reed and Carr[3] (2018) menstruation initiates around puberty with a median age of 12.4 in response to the interactions of hormones produced by the hypothalamus, pituitary and ovaries. The length of the cycle is counted by the number of days between the first days of menstrual bleeding of one cycle to the onset of menses of the next cycle, which is approximately 28 days[4]. Follicular and luteal phases can divide menstrual cycle in two stages.

The follicular phase commences from the first day of menses until ovulation. Dilapidated steroid production by the corpus luteum and the dramatic fall of inhibin-A permits the follicle stimulating hormone (FSH) to rise during the last few days of the menstrual cycle[3,5]. This elevation in FSH allocates the recruitment of a cohort of ovarian follicles in each ovary, one of which is destined to ovulate during the next menstrual cycle[3]. Once menses proceed, FSH levels decline due to the negative feedback of estrogen and inhibin-B produced by the developing follicle[3,5,6,7]. FSH triggers the aromatase enzyme in granulosa cells, thus converting androgens to estrogen. A decline in FSH levels directs to the production of a more androgenic microenvironment within adjacent follicles to the growing dominant follicle[2,3]. During the follicular phase, serum estradiol levels increase in parallel to the escalating number of granulosa cells. In the presence of estradiol, FSH stimulates the formation of luteinizing hormone (LH) receptors on granulosa cells allocating progesterone and 17-hydroxyprogesterone secretion which may exert a positive feedback on the estrogen- primed pituitary to augment luteinizing hormone (LH) release[8] from theca cells. LH principally arouses androstenedione production. In the human body, androstenedione is then elated to the granulosa cells where it is aromatized to estrone and finally transformed to estradiol[3]. The LH surge is instigated by a dramatic rise of estradiol produced by the preovulatory follicle. The granulosa cells of the growing follicle also emit a variety of peptides, playing an autocrine/paracrine role in the inhibition of development of the adjacent follicles[3,7]. Subsequently, the decline in LH is owing to the loss of the positive feedback effect of estrogen, by increasing inhibitory feedback effect of progesterone[9].

Luteal phase is considered as postovulatory phase, usually 14 days long. After ovulation, the remaining granulosa cells with the oocyte continue to enlarge and turn into vacuolated in appearance to accumulate a yellow pigment called lutein. The luteinized granulosa cells combine with the newly formed theca-lutein cells and surrounding stroma in the ovary to be as the corpus luteum. The corpus luteum is a transient endocrine organ that predominantly secretes progesterone and its primary function is to prepare the estrogen primed endometrium for implantation of the fertilized ovum[3,10].

Major problems of gynecological morbidity are abnormal uterine bleeding[11]. Regular cyclic menstruation results from synchronized relationship between the endometrium and the regulatory factors. Abnormal uterine bleeding upshots from any turbulence, flanked by the regulatory mechanism of pituitary ovarian axis or pelvic diseases[12]. This may affect 10-30% of women in reproductive age group depending on the pattern and factors causing abnormal bleeding and the reproductive health of the woman[12,13]. According to Betha et al.[14], acute uterine abnormal bleeding is a type of hemorrhage in woman of reproductive age, entailing immediate intervention to avert further blood loss, whereas, the chronic abnormal uterine bleeding is bleeding from uterine corpus with abnormal duration volume or frequency. It is reported that in developing countries, the prevalence of abnormal uterine bleeding seems to concern around 5-15% of women in their reproductive period[11].

Excessive menstrual blood loss called menorrhagia provoke iron deficiency and anemia which can be life threatening without treatment[15,16]. Reduce in menstrual flow called amenorrhea is also an indication of iron-deficiency anemia[14,17]. In addition, estrogen and progesterone-related alterations in the menstrual cycle may control extracellular fluid and thereby, lead to plasma volume expansion[19,20] which is the major cause to the fluctuation in haemoglobin concentration throughout the menstrual cycle[21]. During the luteal phase, elevated systemic iron levels and

progesterone contributed to an elevated level of the body's iron regulatory hormone named hepcidin[22]. However, in the late luteal phase an increase in inflammatory cytokines, the reduction in progesterone and estradiol or the increase in prostaglandins may cause fatigue, headaches, mood changes, sleep disruption and poor concentration/memory, all of which are commonly associated symptoms with iron deficiency[23,24].

The association between the severity of menstrual cycle and haemoglobin level has not been investigated and future research may seek to clarify if menstrual symptoms are exacerbating with depleted iron stores. Henceforth, the present study is concentrated to the fluctuation of haemoglobin level during menstrual cycle among adolescent female students in an Indian school of Purba Burdhaman.

MATERIALS & METHODS

This prospective cohort study is done among adolescent female students in the Lowa Dibakar Vidyamandir High School, lies in Dwarnari, in the district of Purba Bardhaman, West Bengal, India from April, 2023 to September, 2024.

Inclusion criteria:

- All girls are with regular menstrual cycle
- All girls are of age upto 16 years.

Exclusion criteria:

- Females more than 16 years.
- Candidates with bleeding disorders.
- Females with anatomical causes.
- Pregnancy and pregnancy related conditions

Data is taken from a specially designed pretested questioner proforma for obtaining the lifestyle variables, age, height, weight, age at menarche, pattern and duration of menstruation period with amount of menstrual blood loss has been collected by self-reported method and menstrual history. The physical and gynaecological examinations were done by the gynaecologist. Students are asked to undergo the laboratory examinations from the primary health care centre, situated in front of the school. Blood samples were collected during the luteal phase (premenstrual) and follicular phase (post menstrual). All the laboratory data hence are investigated by Primary Health Center, Lowa, Galsi-I, Purba Bardhaman, under Swasthya Bhavana, West Bengal. Datas are stockpiled from this health care centre and analyzed. Necessary statistics have been used for the present study. Cut of value was set as $p \leq 0.05$.

RESULT

In the present study haematological parameters like haemoglobin concentration were investigated along with its modulation in different phases of the menstrual cycle. All parameters of follicular phase and luteal phase are measured and a considerable change in Hb concentration is seen. During luteal phase mean Hb concentration is 11.988g/dl ± 1.05 while in follicular phase it is 10.832g/dl ± 0.63. Figure 1 shows that out of 25 students of Lowa, Purba Bardhaman, 11 girls (44%) show high haemoglobin change (>1.0g/dl). About 12% students have change in haemoglobin level >2.0g/dl. Here *p* value is less than 0.05, indicating rejected null hypothesis. Thus significant difference between haemoglobin level of luteal and follicular phase is pointed out.

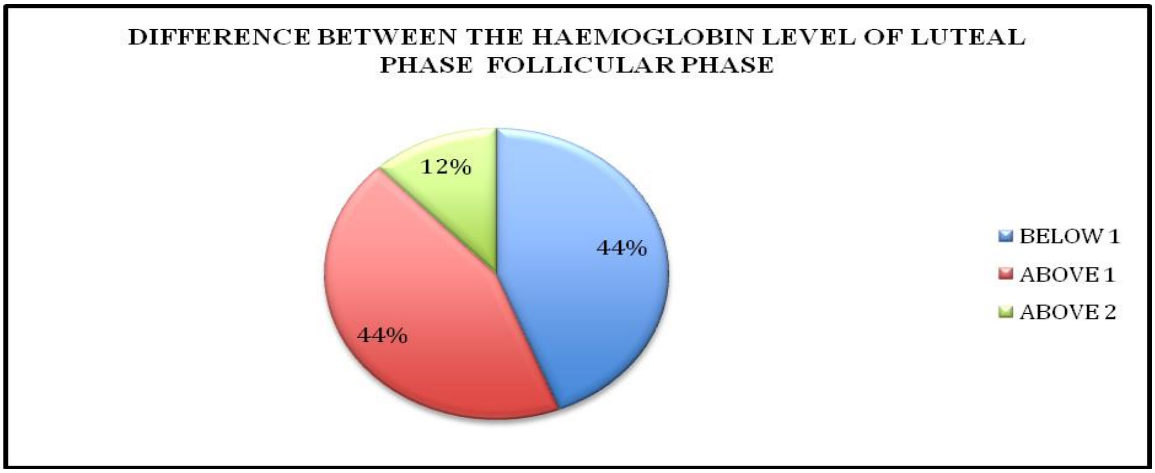

Figure 1: Difference in hemoglobin level between luteal phase and follicular phase (*p* value <0.05)

According to the Figure 2, the data obtained on haemoglobin levels during the luteal phase of the menstrual cycle are 64% normal and 36% are affected by mild anemia. No cases of moderate or severe anemia are found.

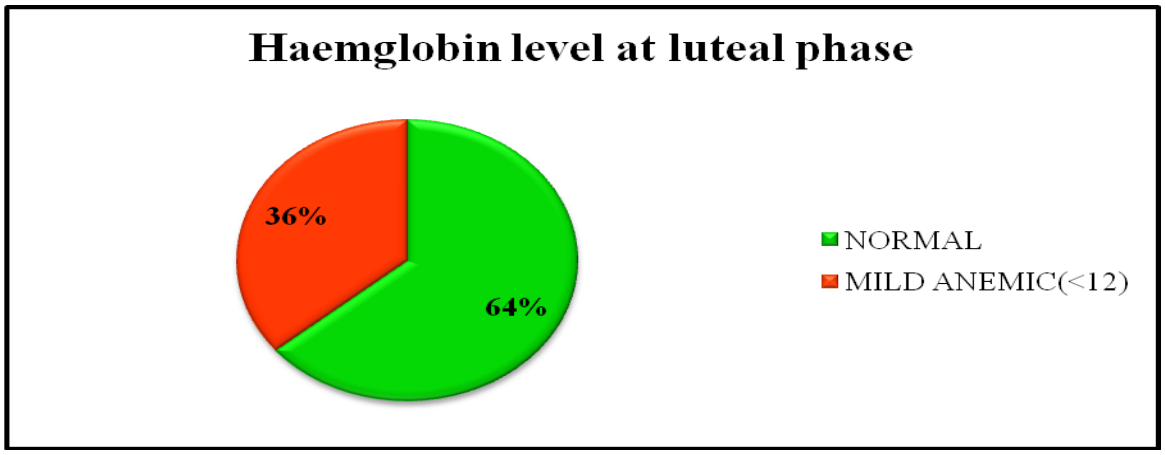

Figure 2: Haemoglobin level at luteal phase (*p* value <0.05)

But, from Figure 3 we can see that in post menstrual phase i.e. in follicular phase the haemoglobin level we obtained that are only 4% normal, 28 % affected by mild anemia and 63% are moderately anemic i.e. haemoglobin level dropped below 10.0g/dl.

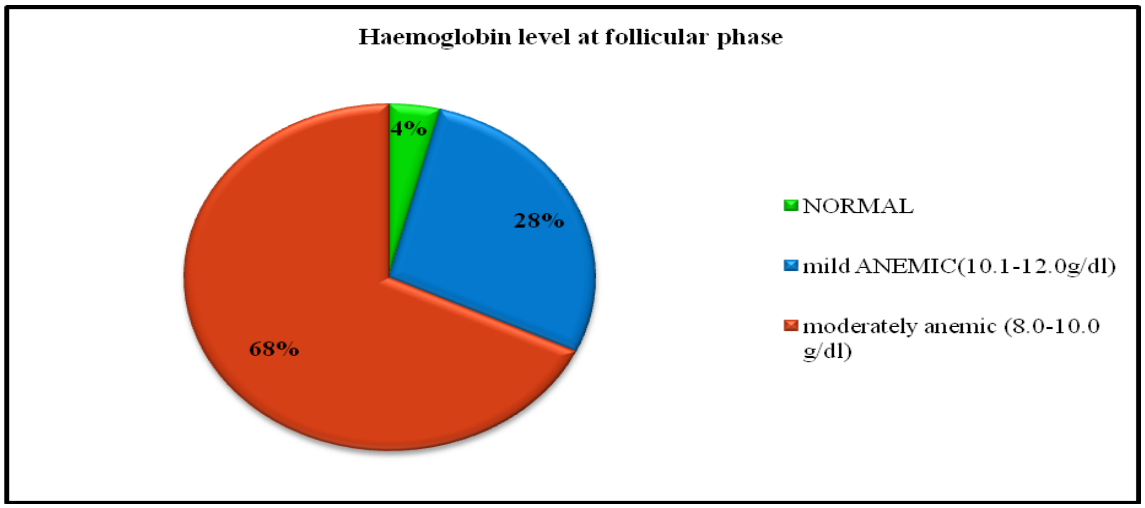

Figure 3: Haemoglobin level at follicular phase (*p* value <0.05)

Comparing the anemic level between pre menstrual and post menstrual phase in the Figure 4 we obtained that when 36% of the students are anemic during the luteal phase at the same time it is 96 % of the students that are suffering from anemia at the follicular phase. This indicates that if the haemoglobin levels remain unchecked during the pre menstrual phase it can lead from no anemia to mild anemia even upto severe anemia during the post menstrual phase.

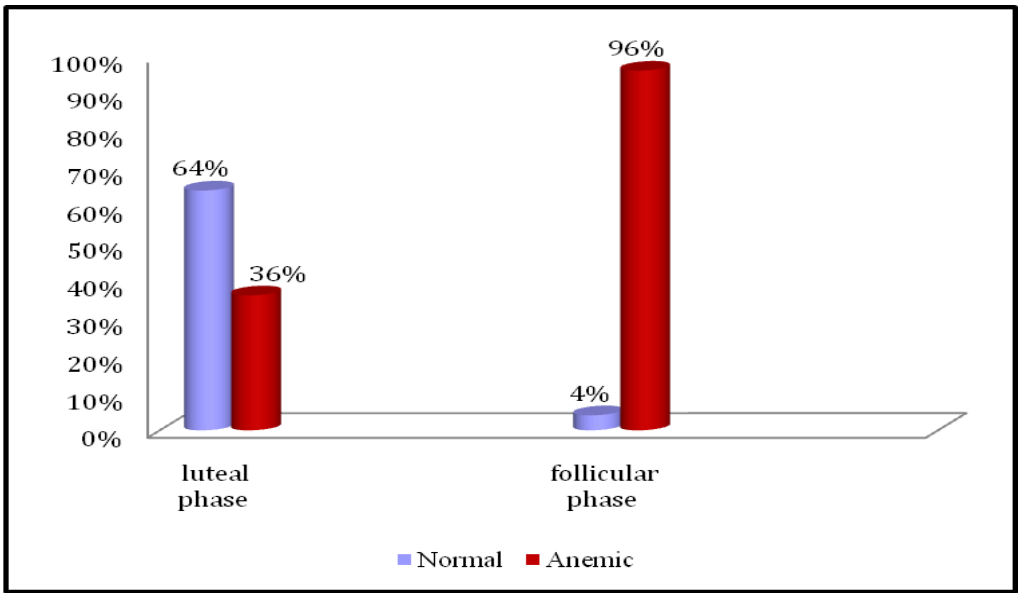

Figure 4: Comparison of anemic level between luteal and follicular phase. (*p* value <0.05)

DISCUSSION

Menstruation is the most striking affair in the progression of female puberty, which in turn is a part of adolescence[25]. During the two phase of menstrual cycle, pre-ovulatory or follicular phase and post- ovulatory or luteal phase, the estrogen concentration is higher in the follicular phase while progesterone surge occurs during the luteal phase[3,25]. Haemoglobin, a metalloprotein is present in red blood cell to transport oxygen[26] is higher in after menstrual period. According to Kotwaneyet al[27] and Mondal et al[25] there is significant variation in the levels of hemoglobin between the follicular and luteal phases. Heavy menstrual bleeding may upshot in a negative iron load in women and increases the risk for developing iron-deficiency anemia[25,28]. This may affect on the cognitive function, school absenteeism and in all aspects of life of the women of reproductive age[29].

In this study, the loss of blood was sufficient enough to cause a significant dwindle in haemoglobin level, compared to the pre-menstrual and post menstrual stages, which is found in corroboration with the studies of Shilpa et al[30] and Ruhimat et al[31]. This study also reveals that in premenstruating phase about 64% of the females were non anaemic and 36% were affected by mild anemia, whereas, the number significantly turned around to be only 4% non anemic and 96% being affected by mid anemia in the post menstruating phase due to drop off the haemoglobin level substantiating the findings of Lugos et al[32] and Munro et al[33]. Estrogen and progesterone may be the crucial factors to regulate this phenomenon. Estrogens have a number of actions that may lower haemoglobin levels and consequently, hemocrit readings. Estrogens diminish the bone marrow's response and endorse fluid retention, thus suppress erythropoietin synthesis[34,35]. However, progesterone antagonizes these effects[36]. The blood loss during menstruation results in a negative iron load in women and amplifies the risk for developing iron

deficiency anaemia[28]. This indicates that if haemoglobin levels remain unchecked during premenstrual phase it can lead from no anemia to mild anemia even upto severe anemia during the post menstrual phase. Additionally, this research indicates that the concentration of haemoglobin and the red blood cell count may rise from the early menstrual phase to the post-ovulatory period, and then fall as the menstrual cycle comes to a close, which are corroborating with the findings of Harewood et al[37]. Women who experience excessive menstruation may be at risk for iron insufficiency. In this period, appetite also lowers the intake of nutrients, like iron and amino acids, henceforth wholesome food is required daily[38]. Due to inadequate food intake and subsequent bleeding issues, the respondents' diet had an impact on their haemoglobin levels in this study. Reduced nerve impulses and disruption of the dopamine receptor system might result from the body's metabolism and nerve cells not functioning at their best due to a lack of haemoglobin[39].

CONCLUSION

It can be inferred from a-fore-mentioned studies that the average examination indicates a drop in haemoglobin levels during menstruation. Our results imply that iron-status indicator-values are influenced by the menstrual cycle phases. Assessing iron status in large population surveys that include women of reproductive age, may be inaccurate due to these cyclical fluctuations. This manuscript outlines the components required to address the widespread collection of situations that impact the lives of girls and women of reproductive age. It also offers evidence in favour of the necessity for action. In the majority of cases, the form of anaemia can be managed by addressing the underlying reason of heavy periods, supplementing with iron, or using hormonal contraception. Further studies are required in order to find the underlying cause for such fluctuations in haemoglobin level in context of hormonal treatments.

Declaration by Authors

Ethical Approval: Approved

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REFERENCES

1. Yang H, Zhou B, Prinz M, Siegel D. Proteomic Analysis of Menstrual Blood, Molecular & Cellular Proteomics 2012; 1024-1035.
2. Thiyagarajan DK, Hajira Basit H, Rebecca Jeanmonod R. Physiology, Menstrual Cycle.
3. Reed BG and Carr BR. The Normal Menstrual Cycle and the Control of Ovulation, 2018; https://www.ncbi.nlm.nih.gov/books/NBK279054/#_ncbi_dlg_citbx_NBK279054.
4. Hallberg L, Högdahl AM, Nilsson L, Rybo G. Menstrual blood loss--a population study. Variation at different ages and attempts to define normality. Acta Obstetricia et Gynecologica Scandinavica. 1966;45(3):320–351.
5. Groome NP, Illingworth PJ, M O'Brien M, Pai R, Rodger FE, Mather JP, McNeilly AS. Measurement of dimeric inhibin B throughout the human menstrual cycle. Journal of Clinical Endocrinology Metabolism. 1996; 81(4):1401–1405.
6. Sawetawan C, Carr BR, McGee E, Bird IM, Hong TL, Rainey WE. Inhibin and activin differentially regulate androgen production and 17 alpha-hydroxylase expression in

human ovarian thecal-like tumor cells. Journal of Endocrinology, 1996;148(2): 213–221.
7. Welt CK, Martin KA, Taylor AE, Lambert-Messerlian GM, Crowley WF, Smith JA, Schoenfeld DA, Hall JE. Frequency modulation of follicle-stimulating hormone (FSH) during the luteal-follicular transition: evidence for FSH control of inhibin B in normal women. Journal of Clinical Endocrinology and Metabolism 1997; 82(8):2645–2652.
8. Fink G. Gonadotropin secretion and its control, in the physiology of reproduction. E. Knobil, J.D. Neill, and et al., Editors. 1988, Raven: New York. p. 1349-1377.
9. Katt JA, Duncan JA, Herbon L, Barkan A, Marshall JC. The frequency of gonadotropin-releasing hormone stimulation determines the number of pituitary gonadotropin-releasing hormone receptors. Endocrinology. 1985;116(5):2113–2115.
10. Koos R.D. Potential relevance of angiogenic factors to ovarian physiology. Seminar in Reproductive Endocrinology, 1989;7:29.
11. Choudhury SA and Nath P. Abnormal uterine bleeding; its prevalence, causes and management in a tertiary care hospital. The New Indian Journal of OBGYN, 2020; 7(1): 52 – 57.
12. Sedhai L, Shrestha A. Abnormal uterine bleeding; its prevalence, causes and management in Chitwan. Journal of Chitwan Medical College, 2012;1(2):36-8.
13. Farrel E. Dysfunctional uterine bleeding. Australian Family Physician, 2004; 33 (11): 906-908.
14. Betha K, Malavatu L, Talasani S. Distribution of causes of abnormal uterine bleeding using new FIGO classification system-PALM COEIN: a rural tertiary hospital based study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 2017; 6(8): 3523-3527.
15. Nelson AL and Ritchie JJ. Severe anemia from heavy menstrual bleeding requires heightened attention. American Journal of Obstetrics & Gynecology, 2015; 213(1):97. e1-97. e6.
16. Menorrhagia (Heavy Menstrual Bleeding). Clevelandclinic, 2024. https://my.clevelandclinic.org/health/diseases/17734-menorrhagia-heavy-menstrual-bleeding.
17. Tonai S, Kawabata A, Nakanishi T, Joo Yeon Lee JY, Okamoto A, Masayuki Shimada M Yamashita Y. Iron deficiency induces female infertile in order to failure of follicular development in mice. Journal of Reproduction and Development, Vol. 66, No 5, 2020.
18. Beth S. What to know about anemia and periods. https://www.medicalnewstoday.com/articles/anemia-and-periods2024
19. Stachenfeld NS and Taylor HS. Progesterone increases plasma volume independent of estradiol. Journal of Applied Physiology, 2005; 98: 1991–1997.
20. Aguree S, Bethancourt HJ, Taylor LA, Rosinger AY, Gernand AD, Plasma volume variation across the menstrual cycle among healthy women of reproductive age: A prospective cohort study. Physiology Reports, 2020; 23;8(8):e14418.
21. Cullinane EM, Yurgalevitch SM, Saritelli AL, Herbert PN, Thompson PD. Variations in plasma volume affects total and low-density lipoprotein cholesterol concentrations during the menstrual cycle. Metabolism, 1995; 44(8): 965–971.
22. Hapangama DK an Bulmer JN. Pathophysiology of heavy menstrual bleeding. Womens Heal, 2016; 12, 3. 10.2217/whe.15.81.
23. Bruinvels G, Goldsmith E, Blagrove R, Simpkin A, Lewis N, Morton K, Suppiah A, Rogers JP, Ackerman KE, Newell J, Pedlar C. Prevalence and frequency of menstrual cycle symptoms are associated with availability to train and compete: a study of 6812 exercising women recruited using the Strava exercise app. British Journal of Sports Medicine, 2021; 55: 438–443.
24. Badenhorst CE, Adrienne K. Forsyth AK, Govus AD. A contemporary understanding of iron metabolism in active premenopausal females. Frontiers in Sports and Active Living, 2022; DOI 10.3389/fspor.2022.903937.
25. Mondal D, Chatterjee D, Bandyopadhyay AR. Changes in hemoglobin level in Bengali women in menstrual cycle of India. IOSR Journal of Nursing and Health Science (IOSR-JNHS), 2020; DOI: 10.9790/1959-0902015859.
26. Rhodes CE, Denault D, Varacallo M. Physiology, Oxygen Transport.

https://www.ncbi.nlm.nih.gov/books/NBK538336/#_ncbi_dlg_citbx_NBK538336
27. Kotwaneyet S and Shetty P. Variation in Haemoglobin levels during menstrual cycle. Nitte University Journal of Health Science 2014; 4(2).
28. Silotry N, Nimmagadda HK, Kumari RA. Comparison of hemoglobin levels in women with and without premenstrual syndrome during premenstrual, menstrual and postmenstrual stages. International Journal of Biological and Medical Research, 2011; 2(4): 1017 – 1022.
29. Vashisht A, Pathak R, Agarwalla R, Patavegar BN, Panda M. School absenteeism during menstruation amongst adolescent girls in Delhi, India. Journal of Family and Community Medicine, 2018; 25(3): 163 – 168.
30. Shilpa N, Vijayanath Itagi V, Rani R. A Study of Hemoglobin Concentration in Different Phases of Menstrual Cycle. International Journal of Physiology, 2018; 6 (2): 90 – 94.
31. Ruhimat U, Irma Mir'atul Hasanah I, Wilujeng EO, Rosmiati. Overview of Haemoglobin Levels Before and After Menstruation in Female Students of STIKes Muhammadiyah Ciamis. Mukhtabar Journal Volume, 2023; 1 (2):65-71.
32. Lugos MD, Vwamdem NI, Polit UY, Ofojekwu MJN, Damen JG. Screening for Anaemia at Different Phases of the Menstrual Cycle among Female Students in a Nigerian University. Journal of Hematology and Blood Transfusion Disorder, 2019; 6: 022.
33. Munro MG, Mast AE, Powers JM, Kouides PA, O'Brien SH, Richards T, Lavin M, Levy BS. The relationship between heavy menstrual bleeding, iron deficiency, and iron deficiency anemia. American Journal of Obstetrics Gynecology, 2023; 229(1):1-9.
34. Dukes P, Goldwasser E. Inhibition of erythropoiesis by estrogens. Endocrinology, 1961; 69: p. 2.
35. Bleiberg I and Perah G. Sex hormones and the regulation of erythroid spleen colonies development of fetal liver origin. Blood, 1975; 45(4):511-515.
36. Anderson WA, Desombre ER, Kang YH. Estrogen-Progesterone Antagonism with Respect to Specific Marker Protein Synthesis and Growth by the Uterine Endometrium. Biology of Reproduction, 1977; 16(3):409–419.
37. Harewood WJ, Gillin A, Hennessy A, Armitstead J, Horvath JS, Tiller DJ. The effects of the menstrual cycle, pregnancy and early lactation on haematology and plasma biochemistry in the baboon (Papio hamadryas). Journal of Medical Primatology, 2000; 29(6):415–420.
38. Suhanda P and Suyatini S. Hubungan Lamanya Menstruasi Dengan Kadar Haemoglobin Pada Mahasiswi Politeknik Kesehatan Kemenkes Banten. Jurnal Medikes (Media Informasi Kesehatan), 2016; 3(2): 143–148.
39. Hastuty M. Hubungan Kejadian Anemia dan Kebiasaan Minum Susu dengan Kejadian Dismenorea Di SMA Negeri 2 Bangkinang Kota. Journal Doppler, 2020; 4(2): 124–132.

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