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A Comparative Study of Body Weight, Hemoglobin Concentration and Hematocrit During Follicular and Luteal Phases of Menstrual Cycle

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The present study comprises the relationship among body weight, hemoglobin and hematocrit during follicular and luteal phases in young menstruating women. Hemoglobin concentration, hematocrit and body weight were measured in 25 healthy normal menstruating women, over 2-3 consecutive menstrual cycles. Hemoglobin concentrations were significantly ($p < 0.05$) lower in follicular phase than in the luteal phase. Hematocrit and body weight did not show any statistically significant differences in both the phases of menstrual cycle. In addition Basal Body Temperature (BBT) showed a significant rise during the luteal phase of the cycles.

Key words: Menstrual cycle, luteal phase, follicular phase, progesterone, LH, FSH

INTRODUCTION

A series of cyclic and closely related events involving the reproductive organs occur in normal, non pregnant adult women at monthly intervals between menarche (at about age 12 years) and menopause (at about age 51 years). These events constitute menstrual cycle. During each normal menstrual cycle, a mature ovum is ovulated and enters the uterine lumen through the fallopian tubes. Steroids secreted by the ovaries affect endometrium and allow the implantation of fertilized ovum. In the absence of fertilization, ovarian secretion of progesterone and estradiol (E2) declines, the endometrium sloughs and menstruation begins. The menstrual cycle requires hypothalamic-pituitary-ovarian axis to produce associated changes in the target tissues of the reproductive tract (endometrium, cervix and vagina), which then permit pregnancy and perpetuation of the species (Hodgen, 1989).

By definition, a menstrual cycle begins with the first day of genital bleeding and ends just before the beginning of next menstrual period. Although the median menstrual cycle duration is 28 days, normal menstrual cycles may vary from 21 to 40 days. The average duration of menstrual flow is 5 ± 2 days, with typical blood loss ranging from 30 to 80 mL (Baldwin *et al.*, 1961; Hallberg *et al.*, 1966; Rybo, 1966).

The normal menstrual cycle, can be divided into follicular and luteal phases. The follicular phase, also known as the proliferative or pre ovulatory phase, begins with the onset of menstruation and ends with ovulation. The luteal phase, sometimes termed the postovulatory or secretory phase, begins with ovulation and ends with the onset of menses, it is more constant half of the menstrual cycle and averages 14 days in length.

Hormonal changes occur during normal menstrual cycle, circulating concentrations of follicle stimulating hormone (FSH) begin to increase in the late luteal phase of the previous menstrual cycle. FSH levels then fall after the early follicular phase increase. Except for a brief peak at mid cycle, FSH levels continue to fall until they reach their lowest levels in the mid luteal phase, just before they begin to increase again before menses.

The circulating Leutinizing Hormone (LH) concentrations also begin to increase in the late luteal phase of the previous menstrual period (Ross *et al.*, 1970; Vande-Wiele *et al.*, 1970). However, in contrast to FSH levels, LH concentrations continue to increase gradually through out the follicular phase. At midcycle there is a significant increase in circulating LH levels that lasts 1 to

3 days, LH levels gradually decrease in the luteal phase to reach their lowest levels just before beginning to increase again prior to menses.

The ovary secretes numerous steroidal hormones, circulating levels of E2 are low during the first half of follicular phase, begin to increase about 7 to 8 days before the preovulatory LH surge. As peak LH levels are reached during the ovulatory phase, E2 levels fall rapidly, only to increase again to a secondary peak 6 to 8 days after the LH surge during the midluteal phase (Hoff *et al.*, 1983). The dominant follicle and corpus luteum synthesize about 95% of circulating E2.

Circulating levels of progesterone and progesterone secretion remain low throughout the follicular phase and begin to increase just before the onset of the LH surge, (Yen *et al.*, 1970; Aido *et al.*, 1976). During the luteal phase, progesterone secretion increases to peak 6 to 8 days after the LH surge. Progesterone levels decrease toward menses unless ovum is fertilized. Serum progesterone levels of 10 ng mL^{-1} or greater 1 week before menses generally indicate normal ovulation.

The present study was designed to assess the relationship between body weights, hemoglobin concentrations and the hematocrit in healthy young women during their follicular and luteal phases of menstrual cycles.

MATERIALS AND METHODS

Twenty-five healthy, non-smoking, normal young women of age 18-22 years were selected for the study and according to self-report they have regular menstrual cycle and normal menses. Before the start of the study, the subjects were explained and briefed about the plan of work. The subjects kept a diary to note the date and duration of menstrual cycle and information about the body weight and the body temperature. The Basal Body Temperature (BBT) was recorded for 2-3 consecutive cycles. The subjects were asked to note the temperature orally with a regular thermometer in Fahrenheit. It was noted immediately each morning and night just before sleeping. For the estimation of hemoglobin concentration and hematocrit blood samples were collected at the beginning and end of menstrual cycle, i.e. for the follicular phase blood was drawn at 1st-6th day of the cycle and for luteal phase 4th-5th day prior to the onset of next menstrual cycle i.e., at 25th-27th day of the same cycle.

The heparinized whole blood was used to measure hemoglobin concentration by cyanmethemoglobin method and hematocrit was determined by micro hematocrit method, using heparinized capillary tubes (Brown, 1984). Data collected for two phases of menstrual cycles were statistically analyzed by using paired t-test.

RESULTS

The results of the present study showed that the average body weights of 25 young healthy women were 54.16 ± 6 kg and 54.76 ± 5.9 kg during follicular and luteal phases of the menstrual cycle respectively (Fig. 1), thus statistically non-significant changes occur in the body weights during any phase of menstrual cycle. However, mean BBT recorded were $98.56 \pm 0.06^\circ\text{F}$ and $98.81 \pm 0.14^\circ\text{F}$ during follicular and luteal phases respectively, showed a significant ($p < 0.05$) rise during the luteal phase (Fig. 2).

The mean hemoglobin concentration in the young healthy women were 9.45 ± 1.1 g dL⁻¹ in follicular phase and 10.62 ± 0.98 g dL⁻¹ were during luteal phase of the cycle (Fig. 3), the statistical analysis showed a significant ($p < 0.05$) fall in the mean hemoglobin concentration during follicular phase of menstrual cycle than the luteal phase.

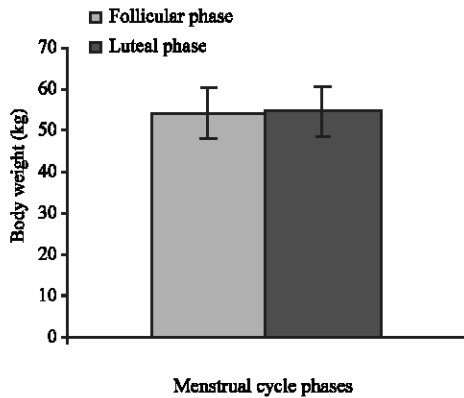


Fig. 1: Comparison of mean body weights in follicular and luteal phases

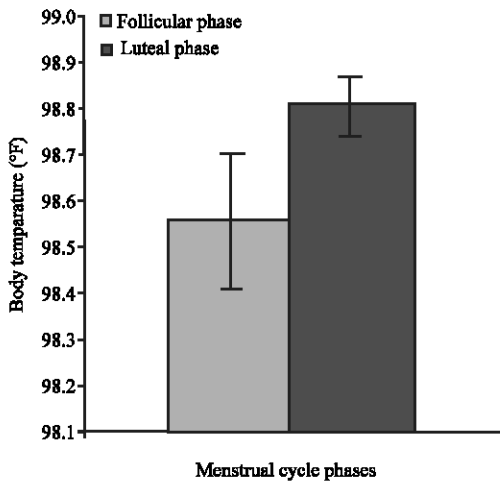


Fig. 2: Comparison of body temperatures in follicular and luteal phases

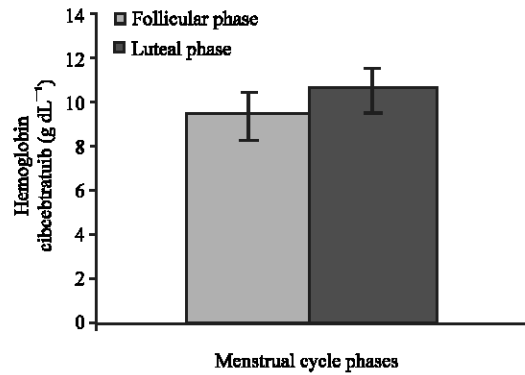


Fig. 3: Comparison of mean hemoglobin concentration in follicular and luteal phases

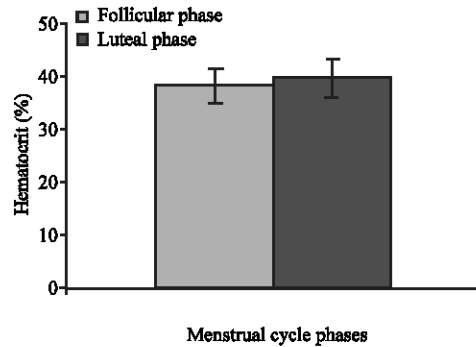


Fig. 4: Comparison of mean hematocrit in follicular and luteal phases

The mean percentages of hematocrit were $38.24 \pm 3\%$ and $39.44 \pm 3.7\%$, during the follicular and luteal phases of menstrual cycle, respectively (Fig. 4) that showed a non-significant difference during both phases.

DISCUSSION

Present findings showed that mean body weights did not show any significant relationship in any of the two phases of menstrual cycle (Chapman *et al.*, 1997; Tazeen *et al.*, 2005). While basal body temperatures showed a significant rise at the luteal half of the cycle, which was due to progesterone secretion at the time of ovulation (Reber *et al.*, 1995; Tazeen *et al.*, 2005).

The mean hemoglobin concentration in almost all the subjects during follicular phase was significantly lower than the luteal phase of menstrual cycle, most commonly due to menstrual blood loss resulting in iron deficiency anemia (Hallberg, 1979; Simmons, 1997). Other studies indicate that postmenopause women compared with premenopause women have high hemoglobin concentration in the luteal phase. Low hemoglobin concentration in the premenopause women may be

associated with high levels of progesterone in the luteal phase of cycle (Leon-Velarde *et al.*, 2001), while mean hematocrit values showed a non - significant difference between both phases of menstrual cycle. It is suggested that high levels of ovarian steroid hormones progesterone and estrogen which have comparatively high blood levels in luteal phase may affect the hematopoiesis but did not produce any effect on hemoglobin concentration and percent hematocrit (Reeves *et al.*, 2001).

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