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Physiology

# EFFECT OF DIFFERENT PHASES OF MENSTRUAL CYCLE ON CARDIORESPIRATORY FITNESS (VO2MAX) IN YOUNG FEMALES

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**ABSTRACT** In todays world where women have stepped their foot in every field,it becomes important to understand the physiological changes that occur in her, differing her from her male counterpart,the most important being the monthly menstrual cycle. It is important to know if these cyclical changes occuring due to hormonal influences have any effect on a womans' physical work capacity, so as to take necessary steps to minimize the effects if there are any. Cardiorespiratory fitness is recognized as an important component of health and it may be necessary for the performance of functional activities.$VO_{2max}$ which can be calculated using treadmill is one of the most common parameters in measuring a persons cardiorespiratory fitness and we have evaluated the $VO_{2max}$ during phases of menstruation in young females. This was a cross sectional study consisting of 30 healthy females 18-25 years of age. After getting institutional ethical clearance and written consent from each participant,$VO_{2max}$ (maximum oxygen uptake)was directly assessed by the Bruce treadmill test method during all the three phases of menstrual cycle.The parameters were analyzed for statistical significance using ANOVA and $p<0.05$ was considered the level of significance.This study showed that $VO_{2max}$ is not significantly affected by the changing hormonal levels across the normal menstrual cycle.

**KEYWORDS :** $VO_{2max}$, Bruce treadmill test, menstrual cycle

## INTRODUCTION

Due to the effect of different hormones in different phases of menstrual cycle, females are likely to have varying abilities in their exercise performance during these phases. Cardiorespiratory fitness is recognized as an important component of health and it may be necessary for the performance of functional activities. $VO_2$max (The derivation is V- volume per time, $O_2$ – oxygen, max – maximum)which can be calculated using treadmill is one of the most common parameters in measuring a persons cardiorespiratory fitness[1]. $VO_2$ max is the maximum capacity to transport and utilize oxygen during incremental exercise.

## NEED FOR THE STUDY

In todays world where women have stepped their foot in every field,it becomes important to understand the physiological changes that occur in her, differing her from her male counterpart,the most important being the monthly menstrual cycle. It is important to know if these cyclical changes occurring due to hormonal influences have any effect on a womans' day to day activities i.e physical work capacity, so as to take necessary steps to minimize the effects if there are any.

## OBJECTIVES OF THE STUDY[2]

1. To estimate $VO_2$ max in menstrual phase – 3rd day of menstrual cycle
2. To estimate $VO_2$ max in follicular phase - 10th day of menstrual cycle
3. To estimate $VO_2$ max in luteal phase - Between 20-24th day of menstrual cycle
4. To compare $VO_2$ max in the above three phases of menstrual cycle

## INCLUSION CRITERIA

1. Healthy females in the age group 18-25yrs.
2. Regular menstrual cycle with cycle duration of 28-30days.
3. No history of medical illness.
4. No history of any drug intake to regularise menstrual cycle.

## EXCLUSION CRITERIA

1. Female students with irregular menstrual cycles.
2. Students with any medical illness.
3. Students on any medication.

## MATERIALS AND METHODS

30 healthy female students with regular menstrual cycles attending various courses at the college were told to come to the department by 9:00am on the specified day. Entire protocol was explained to the subjects and written informed consent was taken before the procedure. A pre designed proforma was used to collect the sociodemographic data. Subjects fulfilling the inclusion criteria were given a 5minutes rest followed by warm-up on the treadmill for 5-min at her desired running pace[2].The Bruce treadmill test[3] was performed to measure the $VO_2$ max.The treadmill was then set to a speed of 2.74km/hr with an incline of 10%. After 3 minutes the speed and incline was increased to 4.02 km/hr with an incline of 12%. Incline and speed was increased every 3 minutes according to the Bruce protocol[4]. This procedure was repeated until the subject could no longer run and the test was completed. At the end of procedure the time taken to complete the test was recorded (T). $VO_2$ max was calculated using the below formula[3]:

$VO_2$ max (ml/kg/min) = $14.76 - (1.379xT) + (0.451xT^2) - (0.012xT^3)$

Experimental protocol was repeated during the three phases of the same menstrual cycle of every subject.

The days of experimental trial during different phases of menstrual cycle was:[2]

- 3rd day of menstrual cycle for menstrual phase evaluation
- 10th day of menstrual cycle for follicular phase evaluation
- Between 20-24th day of menstrual cycle for luteal phase evaluation.

## STATISTICAL ANALYSIS AND RESULTS

Statistical analysis for this cross sectional study was done by using SPSS for Windows (Version 13 evaluation Version, 2006), SPSS Inc. New York (Statistical presentation system software) by one way ANOVA to check for the statistical significant difference in $VO_2$ max during different phases of menstrual cycle. $P<0.05$ was taken as significant value

**Table 1: Showing changes in the $VO_2$ max in ml/kg/min during three phases of menstrual cycle of all subjects.**

| | Mean | Std. Deviation |
|---|---|---|
| Menstrual | 24.0627 | 4.86581 |
| Follicular | 23.1241 | 5.16340 |
| Luteal | 23.5017 | 5.78985 |
| Total | 23.5628 | 5.24169 |

**Table 2: Comparison of changes in the $VO_2$ max in ml/kg/min during three phases of menstrual cycle of all subjects.**

| | P value |
|---|---|
| Follicular vs luteal | 0.956 |
| Follicular vs menstrual | 0.771 |
| Menstrual vs luteal | 0.911 |

The above two tables showing comparison of $VO_2$ max during different phases of menstrual cycle shows no statistically significant variation.

## DISCUSSION

Normal menstrual cycle in a female is of 28 days duration with first day of menstrual bleeding taken as first day of the cycle. The menstrual phase lasting for 4 to 5 days,from day 6 to day 14 is the proliferative phase and the last phase is secretory phase from day 15 to day 28[5]. During these phases there occurs various changes in the hormonal levels in the female body, the major ones being estrogen and progesterone. In this study we have tried to analyse if these hormonal changes in different phases ,menstrual phase in particular ,will affect cardiorespiratory fitness (measured in the form of VO2max) and hence the athletic performance in females.

The present study which was done in females who were not trained athletes, shows no significant variation in performance between any phase of menstrual cycle. During the proliferative phase as estrogen is more[6],it is called the estrogen phase and likewise the secretory phase is called the progestronic phase. These hormones do cause cardiorespiratory changes in females. Their main function on the cardiovascular system includes increase in the capillary wall strength, vasodilatory effect on vascular smooth muscle in coronary arteries and peripheral vascular beds[7]. In addition it also lowers the cardiovascular response to stress[7]. According to the present study the hormonal effects on cardiorespiratory fitness measured by estimating $VO_2$max, are not statistically significant enough to produce changes in exercise performance . These results are similar to the results in the study by Pratima Chatterjee et.[8], on trained athletes which shows no significant relation between $VO_2$ max and menstrual cycle. Similar results were also seen in the study by Sunitha G. et.al.[9] where $VO_2$max in different phases of menstrual cycle in female athletes showed no significant relation. Teresa M. Dean, et al.[10] reported that $VO_2$ max, maximal heart rate and other measures of cardio-respiratory fitness are not significantly affected by the changing sex steroid levels observed across the normal menstrual cycle. However studies done by Bandyopadhyay et.al[2] showed significantly lower $VO_2$ max in follicular phase. Our study was done on non athletic females to know if there is any significant change taking place in female body during menstrual phase that will hinder her normal daily routine. Menstrual cycle is said to have a lot of psychological and physiological effects on female body. But these changes should not stop her from doing her daily routine. Hence this study was done to see if these changes in female body during the different phases will affect her exercise performance as her daily routine itself involves a lot of physical exercise.

## CONCLUSION

From this study we can conclude that there is no significant change in cardiorespiratory fitness levels ($VO_2$ max) and hence her day to day activities during different phases of menstrual cycle in normal untrained females .Since no measures were done to regularise the cycles,the added influence of those pills were not considered.

## LIMITATIONS

$VO_2$max measurements were limited to individual subject's perception of exhaustion.

Other factors that may affect exercise performance between $VO_2$ max test sessions including amount of sleep, nutrition were to be controlled and accounted for in the results.
Study needs to be done on much larger population to reconfirm the findings.

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