SHORT COMMUNICATION

EFFECT OF DIFFERENT PHASES OF MENSTRUAL CYCLE ON PHYSICAL WORKING CAPACITY IN INDIAN POPULATION

GIRIJA B.* AND SHIVAKUMAR VEERAIAH

Department of Physiology,
Bangalore Medical College & Research Institute,
Bangalore

(Received on May 2, 2010)

Abstract: Women in large number are engaged in skilled and unskilled sectors of job and there is increasing participation of women in sports. Considering the fact that cyclical endocrine profile in females can have bearing on cardiovascular and respiratory function, in turn on physical capacity, the study of effects of phases of menstrual cycle on physical working capacity was undertaken in 40 female students of Bangalore Medical College. The subjects were instructed to come to the lab during each of three different phases of menstrual cycle. Resting heart rate (HR), respiratory rate (RR), BP were recorded. Subjects were made to exercise on Bicycle Ergometer and their maximum aerobic capacity was assessed as PWC170 (Physical working capacity at the heart rate 170). On statistical analysis we found resting RR and resting HR high during luteal phase with ‘P’ values of P<0.01, P<0.01 respectively. We also found PWC170 decreased during luteal and menstrual phase with ‘P’ values of P<0.05 and P<0.01. From the present study it can be concluded that resting HR and RR are increased during the luteal phase. Also PWC170 is decreased during the luteal and menstrual phases, this can have an adverse effect on the physical work output of females during these two phases.

Key words: cardiovascular respiratory function menstrual phases physical capacity sex hormones

INTRODUCTION

Women constitute 48% of total Indian population. As per the figures quoted by census India department, 10.8% of working women are engaged in skilled sector and 88.87% in unskilled sector as labourers. The progress of the country is dependent also on the efficiency of unskilled group which in turn depends on their physical performance. Also the increasing participation of women in competitive sports has drawn attention of scientists to understand effect of menstrual cycle on athletic performance.

*Corresponding Author: Dr. B. Girija, No. 1661, 38th Cross, East End ‘A’ Main, 9th Block, Jayanagar, Bangalore-69; Cell No.: 9845884840; E-mail: girija_kumar_48@yahoo.co.in
The reproductive function is cyclical in women and is characterized by cyclical endocrine profile. Both estrogen and progesterone have individual, interactive and sometimes opposing physiological actions, which can have implication on cardiovascular and respiratory functions in turn on physical working capacity.

There are two schools of thought; one school of thought suggests that different menstrual phases affect physical performances (1–4). Another school of thought suggests, different menstrual phases do not affect physical performance (5–7). Hence study was undertaken to resolve conflict between two schools of thought. The element of social stigma attached to menstrual cycle in Indian society as a factor influencing physical performance is irrelevant in the western population on which most of the studies are made. So the present study is undertaken in Indian population to study the effect of this factor also. PWC_{170} (Physical working capacity at the heart rate 170) is used as a tool to asses maximal aerobic capacity during phases of menstrual cycle in this study, wherein the subject is not exposed to the risk of actual maximal performance.

MATERIALS AND METHODS

40 female medical students of Bangalore Medical College in age group 18-22 years having regular cycles, with no evidence of cardio-pulmonary disease from physical examination and ECG and no obvious signs of weakness or debility were selected as subjects. They were instructed to come to the lab during each of three different phases. Day 1-5 during menstrual phase, 9-12, during follicular phase and days 19-21, during luteal were selected to represent, menstrual, follicular and luteal phases respectively (2). The phases were confirmed by serial follicular scanning. height, weight were recorded during first visit. During each sitting resting heart rate, respiratory rate and BP were recorded. Heart rate recorded using ECG, RR and BP recorded clinically.

Physical working capacity was measured using Friction brake type bicycle ergometer. Maximum capacity was expressed as PWC_{170}. PWC_{170} – is a cardiovascular test expressed as Steady state work rate at the heart rate 170. This concept was given by Wahlund (8) based on the fact that the cardiac output, a product of stroke volume and heart rate is proportionate to the VO_{2} max (9). The maximum stroke volume is achieved at an oxygen consumption of 40% of VO_{2} max and mean pulse rate of 110/min (10). Cardiac output at higher workloads is singularly brought about by increase in heart rate. But the cardiac output is not increased even by increase in heart rate beyond 170-180/min because of decreasing diastolic period leading to less filling of the heart. So pulse rate is an estimate of the limit to which cardiac output can be increased (10). Maximum aerobic capacity can be calculated from lower HR by extrapolating the values to HR 170(8). Previously VO_{2} max was determined as a measure of maximal performance. Hill (11) pointed out that cardiovascular transport and not pulmonary transport was the limiting factor in oxygen transport. Then Wade & co-workers (9) determined cardiac output as a measure to evaluate work capacity. Astrand & co-workers (10) showed linear relationship between pulse rate, cardiac output and maximum oxygen consumption. Based on all the above studies Wahlund
When PWC\textsubscript{170} of three phases were compared, performance decreased in luteal and menstrual phases as per Table I, in agreement with findings of Doskin (2), Mesaki (13), Veena Mehta (1) and Lebrun (14) and it is in disagreement with findings of Doolittle (5) and Brian and Davies (6).

**TABLE I : Showing comparison of resting HR, RR, BP, and PWC\textsubscript{170} of three different phases and the significance.**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>F</th>
<th>L</th>
<th>M vs L</th>
<th>F vs M</th>
<th>L vs F</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>85.13</td>
<td>82.23</td>
<td>87.98</td>
<td>NS</td>
<td>NS</td>
<td>P&lt;0.01 (S)</td>
</tr>
<tr>
<td>RR</td>
<td>19.93</td>
<td>19.78</td>
<td>21.20</td>
<td>P&lt;0.05</td>
<td>NS</td>
<td>P&lt;0.01 (S)</td>
</tr>
<tr>
<td>BP</td>
<td>112.85</td>
<td>110.70</td>
<td>112.90</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>PWC\textsubscript{170}</td>
<td>317.63</td>
<td>325.50</td>
<td>316.38</td>
<td>NS</td>
<td>P&lt;0.05 (S)</td>
<td>P&lt;0.01 (S)</td>
</tr>
</tbody>
</table>

(M: Menstrual; F: Follicular; L: Luteal; HR: Heart rate; R: Respiratory rate; BP: Blood pressure; PWC\textsubscript{170}: Physical working capacity at the heart rate 170.)

Increased resting heart rate during luteal phase is attributed to increased sympathetic activity due to exaggerated cardio vascular response to hormonal changes (1). Increased resting RR during luteal phase is due to progesterone increasing sensitivity of respiratory centres to CO\textsubscript{2}(16). Autonomic parameters like resting HR and RR are index of cardiac and respiratory performance. A female in luteal phase makes the onset of exercise with increased HR and RR.

**DISCUSSION**

The preliminary links in the O\textsubscript{2} transport chain are cardiovascular and respiratory system. The progesterone increases sensitivity of respiratory centres to CO\textsubscript{2} during the exercise and enhances the
increment in rate of respiration. The increase in rate of respiration at the cost of depth of respiration increases wasted ventilation in the form of anatomical dead space (17). The decreased mechanical efficiency of the respiratory system due to this leads to increased O$_2$ consumption by respiratory muscles themselves, leading to a point nearer to critical ventilation (18). High sympathetic activity during luteal phase (1) heightens the increment in HR during exercise and thereby reduces the cardiac output. It is established that aerobic capacity or work done is directly proportionate to cardiac output. Keeping in view the above facts, a female in luteal phase starts with higher HR & RR as well as there is exaggerated HR and RR responses to exercise stimulus. Thus the cardiovascular system and respiratory system are the links in limiting O$_2$ transport during luteal phase. Hence the VO$_2$max reflected by the PWC$_{170}$ is decreased in the luteal phase.

Study also showed decreased exercise performance during menstrual phase which can be attributed to psychic and physiologic factors. Neurotic component acquiring somatic manifestation could be psychic factor (14). Fluid retention in muscular compartment causes pain and discomfort and decreases contractility of muscles which is a physiologic factor (19). In our Indian society social stigma attached to menstruating women can also be considered as a factor to decrease the performance. Estimation of female sex hormones during different phases and its correlation to working capacity may reveal more facts.

**Conclusion**

The present study was undertaken considering relevancy of the problem in Indian society of today. Large percentages of women are uneducated and are executing unskilled activities and also there is increasing participation of women in athletes. Unlike in men, the endocrine profile of female hormones is cyclical during their sexual cycles. It is necessary to enquire into role of such cyclical endocrine profile in maintaining psychic and physical harmony to extract optimum work. The work capacity was estimated and expressed as PWC$_{170}$ during three phases of menstrual cycle in each of 40 female students of Bangalore Medical College. Pre and Post exercise autonomic parameters were recorded, statistically analysed and discussed. Following conclusions are made:

1. The working capacity during luteal and menstrual phase is decreased.
2. The resting heart rate and respiratory rate are high during luteal phase.

**REFERENCES**

3. Gamberale F, Strindberg L, Wahlberg I. Female work capacity during the menstrual cycle. *Physiological and psychological reactions.*
Indian J Physiol Pharmacol 2011; 55(2)


