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EXERCISE INDUCED CHANGES DURING MENSTRUAL CYCLE PHASES ON SODIUM, POTASSIUM AND CHLORIDE IN SEDENTARY AND SPORTS WOMEN

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ABSTRACT

In this study 15 female sedentary post graduate students (M.A. and M.sc) and 15 female students of Master of Physical Education (M.P.Ed) who represent Annamalai University in Inter University tournaments were selected by adopting random sampling method. The dependent variables selected were sodium, potassium and chloride. The three phases of menstrual cycle such as menstrual phase, proliferative Phase and secretary phase were treated as independent variables. For each subject the blood samples were collected during mid period of menstrual, Proliferative and secretary phases, before and after the treadmill exercise. The auto analyser used for the estimation of sodium,potassium and chloride was AVL 983 – S Electrolyte Analyser. The experimental design employed is 2 X 3 factorial design. To arrive meaningful conclusions 2 X 3 ANOVA with last factor repeated, Simple Effect test and Schaffer's tests were competed. It was concluded that a) the sodium concentration have exhibited significant increase after the exercise during proliferative phase when compared to menstrual phase. Further, it is significantly higher during secretary phase than menstrual phase, irrespective of groups, b) the increase on potassium concentration after the exercise is significantly higher during proliferative phase when compared to menstrual phase. Further, the increase is significantly higher during secretary phase than menstrual phase for sports women, c) the increase on chloride concentration after the exercise is significantly higher during proliferative phase. Further, the increase is significantly higher during secretary phase than menstrual phase irrespective of group.

KEYWORDS: Exercise induced changes – menstrual cycle phases – sedentary and Sports Women.

INTRODUCTION

Women are mother of race and the liaison between generations. Indian culture gives much importance for this section of the society. India has been symbolised as mother country keeping in view of exemplary qualities of women such as patience, love, affection, sympathy, generosity etc. **(Desai, 1961).** Due to traditional, cultural and social attitudes women have limited opportunities and hence their outlook is narrowed. Many girls have not reached the maximum potentiality in sports simply because of cultural problems. The role of women in the society has changed vastly in the past few decades. This change has been accompanied by a change in the society's attitude towards women participation in sports.

One of the factors associated with women sports is menstruation. When the changes concerned with the ovulation and the formation of the corpus luteum goes on in the ovary, the uterine endometrium shows striking cyclical changes. The changes constitute the menstrual cycle. The most prominent features of this cycle are a monthly flow of blood from the uterus. This is called menstruation or menses. A menstrual cycle begins with the onset of menstrual bleeding and ends just before the next menstruation. The period from one menstrual discharge to the next is called as menstrual cycle. The duration of menstrual, proliferative and secretary phases are 0 to 4th, 5th to14th and 15th to 28th days **(Patton, 1989).**

During normal menstruation approximately 40 millilitres of blood and an additional 35 millilitres of serous fluid are lost. This menstrual fluid is normally non-clotting, because a fibrinolysin is released along with the necrotic endometrial material. However, if excessive bleeding occurs from the uterine surface the quantity of fibrinolysin may not be sufficient to prevent clotting. In general menstrual disorders are amenorrhoea, dysmenorrhoea, menorrhagia, metrorrhagia, hypornenorrhoea, oligomenorrhoea, polymenorrhoea, leucorrhoea, pre menstrual tension etc (**Singh, 1996**).

Indeed there are numerous reports in the literature of female athletes who experience athletic amenorrhoea. It appears that the incidence of amenorrhoea is higher in the participants of some sports than in other sports. The occurrence of irregular menses is high in distance runners and ballet dancers, while much lower incidences are reported for swimming and cycling. It is also reported that incidence of amenorrhoea in the general population is approximately 3% only, while the distance runners is 24% (**McArdle & Katch, 1986**).

In the past it has been generally believed that participation in stremous exercise and sports during menstruation could be physically harmful. When large population of Hungarian women athletes were surveyed

it was found that there were no disturbances of the onset of menarche or during the menstrual periods. Recently it has been established that vigorous athletic training and competition do not adversely affect either the menarche menstruation or subsequent obstetric and gynecologic history **(Loucks, 1990).** With regard to women in sports, sports medicine has received a considerable amount of attention in recent years. Sports biochemistry is recognized as one of the vital areas of sports medicine to enhance sports performance.

METHODOLOGY

In the present study 15 female sedentary post graduated students studying M.A. and M.Sc. subjects and 15 female students of Master of Physical Edycation (M.P.Ed) who regularly involved in vigorous sports training and represented Annamalai University in Inter University tournaments on different games were selected by adopting random sampling method. Both groups are staying in University women hostel. The dependent variable selected were sodium, potassium and chloride. The three phases of menstrual cycle such as menstrual phase, Proliferative phase and secretary phase were treated as independent variable.

The monthly flow of blood from the genital tract of women is menses. The cyclic, physiologic discharge through the vagina of blood and mucosal tissues from the non pregnant uterus is menstruation. In general the duration is 0 to 4th days. The proliferative phase coincides with the later portion of the follicular phase of the ovarian cycle. At the beginning of the proliferative phase large portions of the endometrial epithelium are absent, there is only a small population of stromal cells and only arteries remain as a result of the necrosis and sloughing of endometrial tissue at the end of the preceding menstrual cycle. In general the duration of proliferative phase is 5th to 14th days. The secretary phase of the endometrial cycle begins at the same time as the luteal phase of the ovarian cycle. Progesterone and estrogen, released from the corpus luteum, stimulate the secretion of greater copious amount of mucus, rich in carbohydrate from the endometrial glands. Straomal proliferation and cell growth continue during the secretary phase, the endometrium becomes eedematous and endometrial arteries and glands become increasing tortuous and spiralized. In general the duration of secretary phase is 15th to 28th days (**Patton, 1989**).

Electrolyte is a substance that dissociates into ions when fused or in solution and thus becomes capable of conducting electricity, an ionic solute **(Hutler, 2001).** Venous blood was collected from the subjects with the help of disposable syringes. For each subject the blood samples were collected during mid period of menstrual, proliferative and secretary phase before and after the treadmill exercise. The subjects had these menstrual cycle phases on different dates. Based on the pilot study, the intensity and duration of the treadmill exercise was fixed. The speed was 10 km/h, the slope was 5 per cent and the duration was 5 minutes. The subjects has the pulse rate between 140 and 150 per minute and there by the sub maximal load was confirmed.

The auto analyser used for the estimation of sodium, potassium and chloride was AVL 983-S Electrolyte Analyser, manufactured by AVL AG Biomedical Instruments, Schaffhausen, Switzerland. These variables were estimated by using 0.2 ml. of serum and expressed as mmol/l. It was estimated in Research Laboratory of Biochemistry wing, Rajah Muthiah Medical College, Annamalainagar, Tamil Nadu.

The experimental design employed is 2X3 factorial design with the last factor was repeated measures. The same design was used separately for normal condition and also for exercise induced changes. With regard to statistical techniques 2X3 ANOVA with last factory repeated was calculated separately to explore the changes under normal condition and for exercise induced changes (mean gain). When the interaction (group X menstrual cycle phases) was found to be signibicant, Simple Effect test was used. Further, whenever simple effect test showed significance, Scheffe's test was applied wherever necessary.

ANALYSIS OF SODIUM

The mean and standard deviation of exercise induced changes in sedentary and sports women on sodium during menstrual cycle phases is given in table I.

TABLE-I
MEAN AND STANDARD DEVIATION FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON SODIUM (MMOL/L) DURING MENSTRUAL CYCLE PHASES

Group	Menstrual		Proliferative		Secretary	
	Mean	S.D	Mean	S.D	Mean	S.D
Sedentary	1.42	0.53	3.42	0.72	3.97	1.12
Sports Women	1.51	0.53	3.24	1.17	3.33	0.98

The analysis of variance is presented in table II.

TABLE – II
ANALYSIS OF VARIANCE FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON SODIUM (MMOL/L) DURING MENSTRUAL CYCLE PHASES

Source of Variance	Sum of Square	df	Mean Square	F ratio	Level of Significance
Group	1.32	1	1.32	1.05	NS
Error	35.31	28	1.26		
Menstrual phases	83.58	2	41.79	78.43	0.01
Group x Menstrual Phase	2.06	2	1.03	1.93	NS
Error II	29.84	56	0.53		

The tabulated F ratio for : 0.05 0.01 level
df 1 & 28 = 4.20 7.64
df 2 & 56 = 3.15 4.98

NS = Not Significant

It is clear from the table II that the obtained F ratio 1.05 for the group is not significant. It is inferred that there is no significant variation between sedentary and spots women for exercise induced changes on sodium concentration irrespective of menstrual cycle phases. With regard to menstrual cycle phases, the F ratio arrived by the statistical calculation 78.43 is significant at 0.01 level of significance. It reveals that the exercise induced changes on sodium concentration differ significantly menstrual cycle phases irrespective of group. The result of Scheffe's test is given in table III.

TABLE –III
SCHEFFE'S TEST OF SIGNIFICANCES FOR EXERCISE INDUCED CHANGES ON SODIUM (MMOL/L) DURING MENSTRUAL CYCLE PHASES IRRESPECTIVE OF GROUP

Means values			Means Difference	Level of Significance
Menstrual Cycle Phases				
Menstrual	Proliferative	Secretary		
1.47	3.33		1.86	0.01
1.47		3.65	2.18	0.01
	3.33	3.65	0.32	NS

The confidence interval required for 0.05 & 0.01 level of significant are 0.48 and 0.60 respectively

NS= Not Significant

Table III shows that the exercise induced changes on sodium concentration differ significantly during proliferative phase when compared to menstrual phase. Further, it is significantly higher during secretary phase than menstrual phase irrespective of group. Table II also shows that the obtained F ratio 1.93 for interaction between group and menstrual cycle phases is not significant..

ANALYSIS OF POTASSIUM

The mean and standard deviation of exercise induced changes in sedentary and sports women on potassium during menstrual cycle phases is given in table- IV

TABLE – IV
MEAN AND STANDARD DEVIATION FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON POTASSIUM (MMOL/L) DURING MENSTRUAL CYCLE PHASES

Group	Menstrual		Proliferative		Secretary	
	Mean	S.D	Mean	S.D	Mean	S.D
Sedentary	1.02	0.37	4.23	1.21	5.41	0.62
Sports Women	0.61	0.51	2.15	0.77	2.37	1.02

The analysis of variance is presented in table V.

TABLE –V
ANALYSIS OF VARIANCE FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN OF POTASSIUM (MMOL/L) DURING MENSTRUAL CYCLE PHASES

Source of Variance	Sum of Square	df	Mean Square	F ratio	Level of Significance
Group	76.82	1	76.82	102.84	0.01
Error I	20.92	28	0.75		
Menstrual Cycle Phases	155.83	2	77.92	130.58	0.01
Group x Menstrual Cycle Phases	26.52	2	13.26	22.22	0.01
Error II	33.41	56	0.60		

The tabulated F ratio for : 0.05 0.01 level
df 1& 28 = 4.20 7.64
df 2&56 = 3.15 4.98

It is evident from table V that the obtained F ratio 102.84 for group is significant at 0.01 level. It reveals that the exercise induced changes on potassium concentration is significantly higher for sedentary women than their counterpart irrespective of menstrual cycle phases. Regarding menstrual cycle phases the F ratio arrived at by the statistical calculation 130.58 is significant at 0.01 level. It denotes that the exercise induced changes on potassium concentration differ significantly during menstrual cycle phases irrespective of group. From the table V it is further observed that the obtained F ratio 22.22 for interaction between group and menstrual cycle phases is significant at 0.01 level. As the interaction is significant Simple Effect was calculated and the result is given in table VI.

TABLE - VI
SIMPLE EFFECT TEST FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON POTASSIUM (MMOL/1) DURING MENSTRUAL CYCLE PHASES

Source of Variance	Sum of Square	df	Mean Square	F ratio	Level of Significance
Menstrual	**1.30**	**1**	**1.30**	**2.17**	**NS**
Proliferative	**32.51**	**1**	**32.51**	**54.18**	**0.01**
Secretary	**69.52**	**1**	**69.52**	**115.87**	**0.01**
Sedentary	**309.44**	**2**	**154.72**	**257.87**	**0.01**
Sportswomen	**55.24**	**2**	**27.62**	**258.12**	**0.01**
Error	**33.41**	**56**	**0.60**		

The tabulated F ratio for 0.05 0.01
df 1& 56 = 4.00 7.08
df 2&56 = 3.15 4.98

NS = Not Significant

It is evident from table VI that the exercise induced changes on potassium concentration for sedentary and sports women differ significantly during proliferative and secretary phases. Table VI also indicates that the exercise induced changes on potassium concentration for sedentary and sports women differ significantly during the three menstrual cycle phases. The result on Scheffe's test is presented in table VII.

TABLE -VII
SCHEFFE'S TEST OF SIGNIFICANCE FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON POTASSIUM (MMOL/1) DURING MENSTRUAL CYCLE PHASES

Group	Mean Values			Mean Difference	Level of Significance
	Menstrual Cycle Phases				
	Menstrual	Proliferative	Secretary		
Sedentary	1.02	4.23		3.21	0.01
	1.02		5.41	4.39	0.01
		4.23	5.41	1.18	0.01
Sportswomen	0.61	2.15		1.54	0.01
	0.61		2.37	1.76	0.01
		2.15	2.37	0.22	NS

The confidence interval required for 0.05&0.01evel of significance are 0.70 and 0.85 respectively.

N S = Not Significant

Examination of the table VII shows that exercise induced changes on potassium concentration for sedentary women differ significantly during each menstrual cycle phases. It is clear from the table that exercise induced changes on potassium differ significantly for sports women during proliferative phase when compared to menstrual phase. Further, it is significantly higher during secretary phase than menstrual phase.

ANALYSIS OF CHLORIDE

The mean and standard deviation of exercise induced changes in sedentary and sports women on chloride during menstrual cycle phases is given in table VIII.

TABLE -VIII
MEAN AND STANDARD DEVIATION FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON CHLORIDE (MMOL /L) DURING MENSTRUAL CYCLE PHASES

Group	Menstrual		Proliferative		Secretary	
	Mean	S.D	Mean	S.D	Mean	S.D
Sedentary	1.30	0.58	3.04	1.02	2.53	1.42
Sports Women	1.34	0.56	2.86	0.98	3.11	1.25

The analysis of variance is presented in table IX.

TABLE- IX
ANALYSIS OF VARIANCE FOR EXERCISE INDUCED CHANGES IN SEDENTARY AND SPORTS WOMEN ON CHLORIDE (MMOL/1) DURING MENSTRUAL CYCLE PHASES

Source of Variance	Sum of Square	df	Mean Square	F ratio	Level of Significance
Group	0.48	1	0.48	0.56	NS
Error I	24.19	28	0.86		
Menstrual Cycle Phases	49.15	2	24.57	21.84	0.01
Group x Menstrual Cycle Phases	2.29	2	1.15	1.02	NS
Error II	63.00	56	1.13		

The tabulated F ratio for: 0.05 0.01 NS=Not Significant
df 1&28 = 4.20 7.64
df 2&56 = 3.15 4.98

It is clear from the table IX that the obtained F ratio 0.56 for the group is not significant. It is inferred that there is no significant variation between sedentary and sports women for exercise induce changes on chloride concentration irrespective of menstrual cycle phases. With regard to menstrual cycle phases, the F ratio arrived at by the statistical calculation 21.84 is significant at 0.01 level. It reveals that the chloride concentration differ significantly during menstrual cycle phases, irrespective of group. The result of Scheffe's test is given in table X.

TABLE - X
SCHEFFE'S TEST OF SIGNIFICANCE FOR EXERCISE INDUCED CHANGES ON CHLORIDE (MMOL/ L) DURING MENSTRUAL CYCLE PHASES IRRESPECTIVE OF GROUP

Mean Values			Mean Difference	Level of Significance
Menstrual Cycle Phases				
Menstrual	**Proliferative**	**Secretary**		
1.32	2.95		1.63	0.01
1.32		2.82	1.50	0.01
	2.95	2.82	0.13	**NS**

The confidence interval required for 0.05 & 0.01 level of significant are 0.68 and 0.85 respectively. NS= Not Significant

Table X shows that the exercise induced changes on chloride concentration is significantly higher during proliferative phase when compared to menstrual phase. Further it is significantly higher during secretary phase than menstrual phase, irrespective of group. Table IX also shows that the obtained F ratio 1.02 for interaction between group and menstrual phases is not significant.

CONCLUSION

Based on the findings of the study it is concluded that

1. There is no significant difference between sedentary and sports women for exercise induced changes on sodium concentration irrespective of menstrual cycle phases.
2. The sodium concentration have exhibited significant increase after the exercise during proliferative phase when compared to menstrual phase. Further it is significantly higher during secretary phase than menstrual phase irrespective of group.
3. Significant increase has been observed on potassium concentration after the exercise between sedentary and sports women during proliferative and secretary phase.
4. The increase on potassium concentration after the exercise differs significantly among menstrual cycle phase for sedentary women.
5. The increase on potassium concentration after the exercise is significantly higher during proliferative phase when compared to menstrual phase. Further, the increase is significantly higher during secretary phase than menstrual phase for sportswomen.
6. There is no significant variation between sedentary and sports women for exercise induced changes on chloride concentration irrespective of menstrual cycle phases.
7. The increase on chloride concentration after the exercise is significantly higher during proliferative phase. Further, the increase is significantly higher during secretary phase than menstrual phase, irrespective of group.

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