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ASSESSING THE IMMEDIATE HEART RATE RESPONSE ON STANDING IN PREGNANT FEMALES: A CASE-CONTROL CLINICAL STUDY

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ABSTRACT

Background: Changes in the sympathetic and parasympathetic functions of pregnant females can be harmful or beneficial, and should be critically evaluated before therapeutic intervention. These are attributed to hormonal changes and the mechanical pressure of the fetus. Studying these alterations can help predict existing autonomic dysfunctions.

Aim: To assess immediate heart rate response, a parasympathetic function test to standing known as 30:15 ratio in pregnant females residing in India.

Methods: The present case-control observational study was done on 240 females having 120 controls (non-pregnant) and 120 cases with 40 females in each trimester of pregnancy. Based on CANWIN- Cardiac Autonomic Neuropathy Analyzer, immediate heart rate response was assessed. Data were analyzed using ANOVA and multiple comparison analysis.

Results: The study results showed a significant increase in the immediate heart rate response after standing in non-pregnant females compared to pregnant females.

Conclusion: A significant reduction in immediate heart rate on standing is seen the pregnant females when compared to the non-pregnant females residing in India. Parasympathetic functions should be studied for the prediction of any autonomic dysfunction pre-existing during pregnancy.

Keywords: CANWIN, Heart rate, Parasympathetic function, Pregnancy, pregnant females.

INTRODUCTION

Pregnancy is marked by different changes in the various regulatory functions of the human body. These alterations are usually started by the hormones of the placenta and ovary in the

first trimester of pregnancy and are constantly modified with the advancement in the gestational age. In pregnancy, various physiologic adaptations take place in the human body much before they are vital.[1] In the seventh week of pregnancy, metabolic and cardiopulmonary changes are being observed in the human body along with alterations in the overall body composition. Also, a decrease in systemic vascular resistance is seen by gestational hormones, low-resistance circulation development, increase heat production by the developing fetus, and increased prostaglandin concentrations in the uterus of the pregnant female.[2]

From the 15th week of gestation, raised heart rate is seen. Also, increased blood volume is seen owing to raised plasma volume, which in turn, increases the cardiac output in pregnant females. Raise in stroke volume and heart rate lead to marked cardiac output augmentation in pregnant females.[3] Increased cardiac output and heart rate during rest in pregnancy can be attributed to parasympathetic deviation towards the term. Previous literature data suggest that in females that are non-pregnant, both diastolic and systolic blood pressure increase on standing immediately and return to baseline levels in 10 minutes, whereas, in pregnant females, both diastolic and systolic blood pressure on standing decreases.[4]

Lower diastolic pressure in pregnancy can be due to a decrease in right atrial distension by decreased venous return pulsatility by the growing fetus. Also, a downward trend is seen in the Valsalva maneuvers ratio in pregnant females from early to late pregnancy. This can be attributed to chronic volume overload and physiologic adaptation during pregnancy. Both in non-pregnant and pregnant females pulse rates remain unchanged.[5]

Response of heart rate on standing is seen as the postural stress test was done to remain unchanged during early pregnancy. However, a significant decrease is seen in the postural stress test during the last trimester of pregnancy.[6] However, other literature data suggest no alteration in the heart rate response in the pregnant female with slightly weaker changes in blood pressure of pregnant females compared to non-pregnant females. Deranged cardiovascular parameters in pregnant females can be due to deranged cardiovascular parameters. Improved hemodynamic stability is noted during the second half of pregnancy due to increased blood volume.[7]

The previous literature data do not clarify whether immediate heart response or heart rate change or not during pregnancy. Hence, the present study was done to evaluate the immediate heart response of standing females compared to non-pregnant females.

MATERIALS AND METHODS

The present case-control observational study was done to evaluate the immediate heart response of standing females compared to non-pregnant females.

The study included a total of 240 females within the age range of 19-30 years and the mean age of 23.4±4.26 years. The inclusion criteria for the study were subjects in the age range of 19-30 years, who could complete the cardiovascular autonomic activity, had no systemic disease, visited the institute for a routine check-up, and subject willing to participate in the study. Exclusion criteria were subjects with a history of medication affecting cardiovascular

activity, tobacco, alcohol, cardiovascular disease, and subjects' not giving consent to participate in the study.

Among 240 subjects, 120 females were pregnant constituting the cases and the remaining 120 were divided into three groups based on the trimester they were in. These females made the controls. After explaining the detailed study design, informed consent was taken from all the participants in both written and verbal form. After final inclusion, detailed history was recorded for all the subjects followed by an examination.

The data recorded were age, menstrual history, medical history, family history, weight in kgs, and height in feet in both pregnant and non-pregnant females. The findings suggesting autonomic neuropathy were given special emphasis. Autonomic CANWIN (Cardiac autonomic neuropathy analyzer) was used to assess immediate heart rate response to standing (ratio of 30:15). Immediate heart rate response on the standing of >1.04 was considered normal and for <1.03 was considered a reduced immediate heart rate response.

The collected data were subjected to statistical evaluation using SPSS version 20, Chicago Inc., USA, ANOVA test, Fischer's extract test, and Chi-square tests. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at $p<0.05$.

RESULTS

The present case-control observational study was done to evaluate the immediate heart response of standing females compared to non-pregnant females. Among 240 subjects, 120 females were pregnant constituting the cases and the remaining 120 were divided into three groups based on the trimester they were in including 40 subjects each. The demographic characteristics of the study subjects are listed in Table 1. The mean age of the study subjects was 23.42±3.35 years with 23.16±3.67 in controls, 22.37±2.35, and 23.33±2.71 years for trimesters 1, 2, and 3 respectively. Hemoglobin was lowest in the 3rd trimester with 10.83±0.46 gm/dl, followed by 2nd trimester with 10.72±0.43gm/dl, 11.48±0.47gm/dl in 1st trimester, and 11.16±0.66gm/dl in non-pregnant females. Gestational age was 8.83±1.79, 20.43±3.89, and 33.96±2.97 in the 1st, 2nd, and 3rd trimesters. Weight was significantly higher in the 2nd trimester with **52.14±6.66** kgs and 3rd trimester with 58.03±5.64kgs compared to 1st trimester and controls. The height differed non-significantly between controls, 1st trimester, 2nd trimester, and 3rd trimester with $p>0.05$ (Table 1).

On assessing the 30:15 ratio or immediate heart response rate in the different groups of the study subjects, it was seen that in non-pregnant females, it was 1.13±0.14, which decreased in 1st trimester to 1.11±0.15, and further in 2nd trimester to 1.10±0.14. This ratio and immediate heart response were further reduced in the 3rd trimester to 1.06±0.15 as shown in Table 2.

On comparing the immediate heart response to standing in non-pregnant females to pregnant females, the results showed a significant reduction in immediate heart response to standing as seen in non-pregnant and pregnant females of all the three trimesters with $p<0.05$ as depicted in Table 3.

DISCUSSION

The present case-control observational study was done to evaluate the immediate heart response of standing females compared to non-pregnant females. Among 240 subjects, 120

females were pregnant constituting the cases and the remaining 120 were divided into three groups based on the trimester they were in including 40 subjects each. The demographic characteristics of the study subjects are listed in Table 1. The mean age of the study subjects was 23.42±3.35 years with 23.16±3.67 in controls, 22.37±2.35, and 23.33±2.71 years for trimesters 1, 2, and 3 respectively. Hemoglobin was lowest in the 3rd trimester with 10.83±0.46 gm/dl, followed by 2nd trimester with 10.72±0.43gm/dl, 11.48±0.47gm/dl in 1st trimester, and 11.16±0.66gm/dl in non-pregnant females. Gestational age was 8.83±1.79, 20.43±3.89, and 33.96±2.97 in the 1st, 2nd, and 3rd trimesters. Weight was significantly higher in the 2nd trimester with 52.14±6.66 kgs and 3rd trimester with 58.03±5.64kgs compared to 1st trimester and controls. The height differed non-significantly between controls, 1st trimester, 2nd trimester, and 3rd trimester with $p>0.05$. These demographics were comparable to the studies of Panja S et al[8] in 2013 and Thomas WT et al[9] in 2005 where authors assessed subjects with anthropometric parameters comparable to the present study.

For the assessment of the 30:15 ratio or immediate heart response rate in the different groups of the study subjects, it was seen that in non-pregnant females, it was 1.13±0.14, which decreased in the 1st trimester to 1.11±0.15, and further in 2nd trimester to 1.10±0.14. This ratio and immediate heart response were further reduced in the 3rd trimester to 1.06±0.15. These results were consistent with the findings of Kuo CD et al[10] in 2000 and Heiskanen N et al[11] in 2008 where authors reported a similar 30:15 ratio or immediate heart rate response in their subjects like in the present study.

Concerning the comparison of the immediate heart response to standing in non-pregnant females to pregnant females, the results showed a significant reduction in immediate heart response to standing as seen in non-pregnant and pregnant females of all the three trimesters with $p<0.05$. These findings were in agreement with the studies of Pal GK et al[12] in 2007 and Mandal RA et al[13] in 2021 where authors also reported a significant reduction in heart rate on standing in all pregnant and non-pregnant females.

CONCLUSION

Considering its limitations, the present study concludes that a significant reduction in immediate heart rate on standing is seen the pregnant females when compared to the non-pregnant females residing in India. Parasympathetic functions should be studied for the prediction of any autonomic dysfunction pre-existing during pregnancy. However, the present study had a few limitations including a small sample size, short monitoring time, and geographical area biases. Hence, more longitudinal studies with larger sample size and longer monitoring period will help reach a definitive conclusion.

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TABLES

Characteristics	**Non-pregnant**	**1st trimester**	**2nd trimester**	**3rd trimester**
Age (years)	23.42±3.35	23.16±3.67	22.37±2.35	23.33±2.71
Hemoglobin (gm/dl)	11.16±0.66	11.48±0.47	10.72±0.43	10.83±0.46
Gestation age (weeks)		8.83±1.79	20.43±3.89	33.96±2.97
Weight (kgs)	5.15±4.79	48.62±5.62	52.14±6.66	58.03±5.64
Height (ft)	49.32±5.64	5.11±4.84	5.13±5.07	5.14±4.97

Table 1: Comparison of demographic parameters in the study subjects

Test	**Non-pregnant (n=120)**	**1st trimester (n=40)**	**2nd trimester (n=40)**	**3rd trimester (n=40)**
30:15 ratio	1.13±0.14	1.11±0.15	1.10±0.14	1.06±0.15

Table 2: Immediate heart response to standing in pregnant and non-pregnant females

Trimester	**Non-pregnant**	**1st trimester**	**2nd trimester**
1st trimester	**<0.05**		
2nd trimester	**<0.05**	>0.05	
3rd trimester	**<0.05**	**<0.05**	>0.05

Table 3: Immediate heart response to standing in pregnant and non-pregnant females