CARDIOVASCULAR ALTERATIONS DURING HUMAN PREGNANCY: INDIAN RURAL PERSPECTIVE

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Abstracts: **BACKGROUND & OBJECTIVES:** Pregnancy alters the cardiovascular physiology and may influence the maternal history of related disorders. The cardio-respiratory adaptations allow adequate fetal growth and development. Although, vital and required, scanty data for blood pressure indices for Indian rural population is found in literature. **METHOD:** After ethical approval ambience was created in OPD's of Obstetrics and Gynecology department of Dhiraj General Hospital, Vadodara. The incidental and random selection led females in two groups, pregnant (N=300) and nonpregnant (N=100). Pregnant females were grouped as three different trimesters of pregnancy, 100 studied in each group. Blood pressure indices and pulse and its variables were assessed. **OBSERVATIONS & RESULTS:** Statistically significant ($p < 0.001$) increase in pulse rate from nonpregnant (82.53) to pregnant (92.6) states rise of 12%, a difference of 10.07 beats/min. Gradual increase during gestation was recorded (ANOVA $p<0.01$). Blood pressure indices show insignificant trimesteric differences except for pulse pressure (ANOVA $p<0.001$). Pregnant females (N=300) showed minor but significant fall in SBP, DBP and MBP when compare to the non pregnant group, while PP showed significant rise in pregnant group (42.53±6.76 vs 44.34±8.42, $p < 0.05$). **CONCLUSION:** Pregnancy is an adaptive phase in terms of cardiovascular parameters. The maternal blood pressure indices alterations are compensated via reflex increase in heart rate or vice versa. Thus, the pregnant women with respiratory diseases pose a special challenge. Other parameters are needed to be studied thoroughly in rural population as no literature is available.

Key Words: Cardiovascular, blood pressure indices, pulse pressure

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Introduction: Pregnancy is a unique state, in which virtually all maternal systems are dramatically altered in order to permit the sustenance and growth of intrauterine concepts.[1] Cardiovascular system undergoes significant changes during the course of pregnancy, as increases in CO and a decrease in maternal systemic vascular resistance; the RAS system is significantly activated; and the heart and vasculature undergoes remodeling.[2] These adaptations allow adequate fetal growth and development, and maladaptation has been associated with fetal morbidity or poor outcome.[3-4]

Although blood pressure indices have been shown fall in reported studies but discrepancies are there for the time course for the drop, as some reported during mid pregnancy,[5] some reported at term, while most found decrease in overall pregnant group.[6] Some cardiovascular alterations may mimic the symptoms of related clinical conditions. Longitudinal studies will provide more reliable estimate of occurrence of cardiovascular diseases or their prior presence in pregnant female, cardiovascular maladaptations or effect of parity on cardiovascular Physiology.[7-8] Moreover early diagnosis and treatment through regular antenatal checkups is a key factor to prevent hypertensive disorders of pregnancy and its complications.

Increasing PP, indicating poor arterial compliance, was evident early in pregnancies of women who subsequently developed preeclampsia.[9] This study is conducted to evaluate cardiovascular alterations in Indian rural pregnant female all throughout, in order to accurately diagnose and treat the cardio-pulmonary diseases, if present in gravid women

Material and Methods:

Ethics: This study was complied with the ethical committee guidelines of SVIEC (EC No. SVIEC/ON/MEDI/PhD/1202) and the procedures

followed were in accord with the ethical standards of Sumandeep Vidyapeeth.

Population & Sample size: Pregnant women attending antenatal clinic of Dhiraj General Hospital, Vadodara city. Nonpregnant women matched with age and socioeconomic status studied as control. Random sampling was used. Total 400 female participants were studied. Group 1 comprised pregnant group included 300 pregnant women, 100 in each trimester serially and vertically both. Determination of different trimester was based on LMP or reported by clinician. Group 2 was control group included 100 apparently healthy nonpregnant women. Blood pressure indices and heart rate were recorded in all participants.

Inclusion criteria's: Age group: 20-40 years, Gestational age: 4^{th} to 40^{th} weeks, primipara or multipara, Singleton pregnancy.

Protocol: After informed consent and information about the study, participants were given 15 min rest. After that pulse rate and blood pressure were measured. MBP and PP were calculated.

Statistical analysis: ANOVA used for within group variation analysis during each trimester of pregnancy and unpaired student's t-test was used for between group variations of pregnant and control group. The α error for a significant t-test to be set at the 5% level.

Result: Table I: Age, Height and Weight of nonpregnant (control) group and pregnant women in three different trimesters

Variables		I Tm	II Tm	III Tm	Control	p value (ANOVA)
Age	M	23.03	22.32	22.7	26.35	p>0.05,
(Yrs)	SD	2.45	2.5	2.65	4.41	NS
Height	M	156	156	153	154	p>0.05,
(cm)	SD	5.4	6.5	7.1	6.3	NS
Weight	M	46	48.29	50.74	46.9	p<0.05,
(Kg)	SD	7.33	6.52	6.5	4.13	S

S-Significant, NS-Nonsignificant, Tm- Trimester

Significant trimesteric difference were found for weight (ANOVA p value <0.05) and also found to be significantly more (49.69±6.72 vs 46.9±4.13, p<0.05) in pregnant group (N=300) when compared with nonpregnant group (N=100). Statistically significant (p <0.001) increase in pulse rate from nonpregnant (82.5) to pregnant (92.6) states rise of 12% (10 beats/min). Highest mean was obtained in third trimester, an increase by 13.83% when collated with controls (p<0.05).

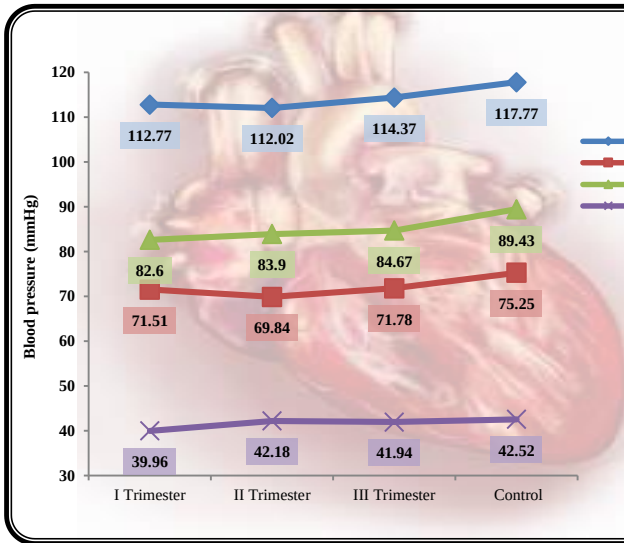
Blood pressure indices (Table-II) show insignificant trimesteric differences except for pulse pressure (ANOVA p<0.001). Pregnant females (N=300) showed minor but significant fall in SBP, DBP and MBP when compare to the non pregnant group, while PP showed significant rise in pregnant group (42.53±6.76 vs 44.34±8.42)

Table II: Blood Pressure Indices & Pulse rate of nonpregnant (control) group and pregnant women in three different trimesters

Variables		I Tm	II Tm	III Tm	Control	p value ANOVA
SBP	M	112.7	112.0	114.5	117.7	P>0.0
(mmH	S	7	2	7	7	5,NS
g)	D	7.53	8.88	11.52	8.48	
DBP	M	71.51	69.84	71.78	75.25	P>0.0
(mmH	S	7.53	5.91	6.51	5.74	5,NS
g)	D					
MBP	M	82.6	83.9	84.67	89.43	P>0.0
(mmH	S	16.6	5.68	12.8	10.02	5,NS
g)	D					
PP	M	39.96	42.18	41.94	42.52	P<0.0
(mmH	S	9.6	8.81	10.46	6.76	01,S
g)	D					
Pulse (/min)	M	86.96	90.47	93.95	82.53	p<0.0
	S	9.30	8.09	9.97	10.02	5, S
	D					

NS-Nonsignificant, S-Significant, Tm-Trimester

Graph I: Blood pressure indices of nonpregnant (control) group and pregnant women in three different trimesters



Discussion: Gradual significant increase in pulse rate during gestation was recorded. Statistically significant increase in heart rate (HR) from nonpregnant to pregnant (82.53±10.02 vs 92.6±9.06, p<0.001) group was also observed, may be secondary to blood volume expansion during pregnancy.[6,10] Study found highest mean pulse value was obtained in third trimester where an increase by 13.83% was observed, when collated with controls. Research for the same parameters stated gradual increase throughout the pregnancy and 16% (13 beats/min) rise in heart rate by seventh week of gestation when compared with the control.[11] Most of the data, however, supports the notion that at third trimester and between 33 and 36 weeks of pregnancy normal pregnant women achieves a peak blood volume expansion of 50% above the pre-pregnancy level which may be the cause of increase in heart rate.[5,6]

Table II shows blood pressure indices of pregnant women in three different trimesters and in control group. Mean values for SBP/DBP obtained were 117/75, 112/71, 112/69 and 114/71 mmHg in control, first trimester, second trimester and third trimester group respectively. The trimesteric variations are insignificant which may be due to compensatory regulatory mechanisms achieved during the progression of pregnancy. Studies found that blood pressure indices reached a statistically significant trough at gestational age 22-24 weeks and fall with advance gestational age, results in overall unaltered pressure.[5]

Blood pressure indices in pregnant group (N=300) showed significant but minor lower values of SBP and DBP when compared with nonpreganant control (SBP;117.77±8.48 vs 113.53±9.9 and DBP;75.24±5.74 vs 71.24 vs 6.6). Significant decrease in MBP, as 89.4±10.02 in control subjects and 81.9±14.29 in pregnant group had been also stated in present study. Study reported SBP in pregnant group 4.25 mmHg, DBP was 4.01 mmHg and MBP 7.53 mmHg lower than non pregnant group.[10] Our results are similar to the study, were MBP measured during pregnancy and postpartum showed a statistically significant drop of 9.8 mmHg (95% CI 5.3–14.2) at gestational age 22–24 weeks when compared with the nonpregnant state.[5]

Correlating fluctuations in these parameters, minor decrease in BP led to considerable reflex rise in HR and vice-a-versa, may be brought about by irradiation of impulses from respiratory centers to cardiac centers or by feedback mechanisms through reflexes.[5] Studies also reveal that hemodilution causes insignificant rise/almost no change in HR and MBP due to increased activity of right atrial type-B receptors and causes alteration in smooth muscle tone. Hence it's predominately the role of hormones that lead to changes in HR and BP and not the adrenergic receptors or hemodilution that play insignificant role.[12,13]

Blood pressure indices show insignificant trimesteric difference except in the value of PP. pulse pressure, a measure of arterial compliance, shows highly significant trimestric variation (ANOVA p<0.001) and is found to be significantly elevated in pregnant female when compared with nonpregnant group (42.53±6.76 vs 44.34±8.42). Similar findings were reported in a prospective cohort of 576 nulliparas where PP was examined during weeks 7-15, 16-24, and

25-38 of gestation and at 6-8 weeks postpartum. Elevated PP, indicating poor arterial compliance, was evident early in pregnancy.[14]

Pregnancy is an adaptive phase in terms of cardiovascular parameters. The maternal blood pressure indices alterations are compensated via reflex increase in heart rate or vice versa. Thus, the pregnant women with respiratory diseases pose a special challenge. The cardio-respiratory adaptations allow adequate fetal growth and development.

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