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Blood Pressure Pattern in Pregnant Women of Different Body Mass Index in Three Trimesters of Pregnancy

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ABSTRACT

Study of blood pressure (BP) changes during pregnancy is essential for understanding the complications of pregnancy like birth defects, gestational diabetes, pre-eclampsia, bleeding disorders etc. Determinants of blood pressure systolic blood pressure (SBP), diastolic blood pressure (DBP) influenced by the pre-pregnancy body mass index (BMI) and its values gradually change during all the three trimesters. At present, little is known about the association of BP parameters with different grades of BMI in all the trimesters of pregnancy so our objective of this study was to elucidate the aforesaid relationship. We selected 200 pregnant women from antenatal clinics of obstetrics & gynaecology, J.N.Medical College, A.M.U.,Aligarh. Pre-pregnancy body mass index (BMI) was calculated by using Quetlet's Index. On the basis of BMI, all participants were divided into three groups: underweight, normal, overweight. Reading of blood pressure of participating women was taken by using a standard mercury sphygmomanometer in each of the three trimesters. Mean values were calculated and compared between different BMI groups in all the trimesters and of pregnancy. The statistical software SPSS (version 16) was used for data analysis and unpaired t- test was applied. SBP,DBP of underweight, and overweight pregnant women were not significantly decreased from first to second trimester and were not significantly increased from second to third trimester. In pregnant women of normal weight, there was a significant fall in SBP,DBP in mid pregnancy followed by which further increase up to the third trimester. The nonsignificant fall in BP parameters in underweight and overweight pregnant women in mid pregnancy was related to the increase in the risk of development of pre-eclampsia. The cause of pre-eclampsia may be explained by the mechanism involved in endothelial dysfunction which will be discussed later on. We found that the level of risk for complications of pregnancy is increased with abnormal BP parameter patterns in pregnant women having different BMI; thus, women with unhealthy weight should be offered preconception counseling, nutritional consultation, exercise program, and careful screening of obstetrics complications during pregnancy.

Key Words: Pregnancy; BP monitoring; Pre-eclampsia; BMI.

INTRODUCTION

Blood pressure studies in pregnancy reflect information regarding pregnancy outcomes. In human pregnancy, vast changes occur in the cardiovascular system which include an initial fall in systemic vascular tone, 40% increase in the cardiac output and an equally great expansion of the plasma volume

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INTRODUCTION

Blood pressure studies in pregnancy reflect information regarding pregnancy outcomes. In human pregnancy, vast changes occur in the cardiovascular system which include an initial fall in systemic vascular tone, 40% increase in the cardiac output and an equally great expansion of the plasma volume simultaneously during the first eight weeks of pregnancy and which persist throughout the pregnancy [1]. These changes are thought to ensure adequacy of uteroplacental perfusion through the different stages of pregnancy [2]. Several studies have been done on the normal pattern of blood pressure in pregnancy which showed an initial decrease in diastolic blood pressure (DBP) during 13 to 20 weeks of gestation, then further increase to slightly above the previous value [3,4]. Pregnancy is also influenced by body mass index (BMI), so pre-pregnancy body mass index is a parameter which influences the blood pressure throughout the pregnancy. BMI can be divided into underweight, normal weight, and overweight or obese. All these grades of BMI affect blood pressure parameters through different mechanism. In pregnant women, increased adiposity, measured using pre-pregnancy BMI, has been consistently associated with important medical complications of pregnancy such as pre-eclampsia, gestational diabetes mellitus, abruptio placentae, and operative delivery [5,6,7].

In pregnant women who are clinically healthy, blood pressure, most notably diastolic blood pressure, falls steadily until the middle of gestation and then rises again until delivery [8]. In women who develop pre-eclampsia, this mid-pregnancy fall in blood pressure does not occur; instead, blood pressure tends to remain stable during the first half of pregnancy and then rise continuously until delivery [8]. It is also the case that, even before pre-eclampsia manifests itself, these women have higher blood pressure levels in early pregnancy than pregnant women who remain normotensive [8].

Research indicates that hypertensive diseases of pregnancy, including pre-eclampsia, may be early manifestations of essential hypertension and cardiovascular disease in later life. It has, therefore, been postulated that pregnancy may be a "stress test" that reveals women with hypertensive tendencies [9,10].

When blood pressure is high before 20 weeks, it is more likely to be chronic hypertension (i.e. pre-existing or occurring before pregnancy) [11]. If it is pregnancy-induced high blood pressure, it usually occurs after 20 weeks of pregnancy and this condition is known as pre-eclampsia, where there is appearance of protein in urine, with swelling of feet, ankles and face in addition to raised blood pressure [12]. The most severe form of BP in pregnancy is called eclampsia with seizures (fits, convulsions) in mother, endangering the life of both the fetus and the mother. Blood pressure (BP) levels and body mass index (BMI) are known risk factors parameters for pre-eclampsia and gestational hypertension. In pregnant women, increased adiposity, as measured using pre-pregnancy BMI, is of global concern. There are few instances where investigators have assessed the extent to which the body mass index had clinically important consequences on maternal blood pressure levels during the different trimester, of pregnancy. The aim of this study is to observe the association of BP with pre-pregnancy BMI in a large population of pregnant women in different trimesters of pregnancy.

MATERIAL AND METHODS

This prospective study was conducted in the Department of Physiology in collaboration with Department of Obstetrics & Gynaecology, J. N. Medical College, A.M.U., Aligarh. Two hundred

Table No.1, Distribution of Pregnant women according to the different grades of body mass index.

S. No.	Characteristics	Cut-off values	Grade	Pregnant women(n=200) No. (%)	Mean values of BMI
I	BMI	<18.5	Under weight	29 (14.5)	16.52±0.94
		≥18.5 - <24.9	Normal	104(52)	22.48±1.48
		>25.0	Over weight	67 (33.5)	27.36±1.54

Table No.2, Mean values of blood pressure parameters in different groups of BMI in all the three trimester of pregnancy

S.No.	Trimester of Pregnancy	Underweight		Normal		Overweight	
		SBP	DBP	SBP	DBP	SBP	DBP
1.	First- First 12 weeks	137.0±5.56	85.0±2.66	118.0±8.30	84.4±5.37	130.0±1.83	77.0±2.88
2.	Second- 13 to 28 weeks	139.4±4.98	83.43±3.81	120.8±7.44	73.56±6.34	132.9±1.59	78.66±1.96
3.	Third- 29 to 40 weeks	145.8±3.66	86.6±2.81	124.8±6.32	83.43±4.74	140.8±1.66	80.41±2.34

SBP- Systolic blood pressure, DBP**-** Diastolic blood pressure

Table No. 3, Comparative significance of change of blood pressure (SBP, DBP) in different trimesters of pregnancy

S.No.	Trimester of Pregnancy	Underweight		Normal		Overweight	
		SBP	DBP	SBP	DBP	SBP	DBP
1.	First Trimester versus Second Trimester	0.205	0.382	0.243	0.021*↓	0.228	0.500
2.	Second Trimester versus Third Trimester	0.263	0.344	0.342	0.004*↑	0.736	0.364

(*P value < 0.05 was taken as significant.)

SBP- Systolic blood pressure, DBP- Diastolic blood pressure

pregnant women were selected from antenatal clinics of obstetrics & gynaecology, J.N.Medical College, A.M.U.,Aligarh. Details of each pregnant woman were filled in antenatal visit proforma which included questions regarding smoking history, physical activity, alcohol consumption, socioeconomic & educational status, and investigations like hemoglobin, urine albumin or protein or sugar. Females who had major disorder (cardiac, respiratory, renal or hematological disorder) and those taking antihypertensive medications or cholesterol-lowering medications were not considered in the study. Pre-pregnancy body mass index (BMI) was calculated using Quetlet's Index, which is body weight (in kg) divided by height (in meter2). On the basis of BMI ,all subjects were divided into three groups, that is underweight whose BMI [13,14] was less than 18.5kg/m2, normal whose BMI was between 18.5 and 24.9kg/m2, and overweight whose BMI was more than 25 kg/m2. Body weight was measured on the digital weighing scale with shoes off and wearing the least possible clothes (to the nearest 0.5kg) with each subject. Height was measured in cm (to the nearest 0.5 cm) with the subject standing in an erect position without shoes, against a vertical scale attached on the wall. Reading of blood pressure of participating women of different BMI group was taken in each of the trimesters. First trimester is the first 12 weeks, second trimester is 13 to 28 weeks, and third trimester is 29 to 40 weeks of gestation [15]. For B.P measurement, three readings were taken at 3 minutes. interval in sitting position on the left arm by using a standard mercury sphygmomanometer, and the average value was recorded. systolic blood pressure (SBP) and diastolic blood pressure (DBP) were defined as the points of the appearance and disappearance of Korotkoff sounds, respectively. Mean values of SBP and DBP were calculated and compared between different BMI groups in all the trimesters of pregnancy. The statistical software SPSS (version 16) was used for data analysis and we applied unpaired t- test. Comparative significance of change of SBP, DBP in different trimester of pregnancy was assessed among pregnant women of different BMI. P value < 0.05 was taken as significant.

OBSERVATION & RESULTS

A total of 200 pregnant women of different pre-pregnancy body mass index participated in the study.

Table 1 shows the distribution of pregnant women according to the different grades of body mass index. Maximum (52%) females had of normal pre-pregnancy body mass index, 33.5% were obese and 14.5% were underweight.

Table 2 shows the mean values of blood pressure parameters in different groups of BMI in all the three trimesters of pregnancy. Mean values of SBP were increased from first trimester to third in all the groups of BMI. DBP was decreased from first to second, then increased from second to third trimester in underweight and normal BMI groups, but it gradually increased from first to third trimester in overweight females.

Table 3 shows the comparative significance of change of blood pressure (SBP, DBP) in different trimesters of pregnancy. We have seen that SBP and DBP of underweight and overweight pregnant women were not significantly decreased from first to second trimester and it were not significantly increased in the third trimester. 2nd pregnant women of normal weight, there was nonsignificant increase in SBP from first to second and third trimester. At the same time, there was a significant fall in DBP in second trimester, from first trimester known as mid pregnancy fall, which further increased in third trimester in normal weight pregnant women.

DISCUSSION

The present study is intended to understand the association of BP with pre-pregnancy BMI in a large population of pregnant women in different trimesters of pregnancy. In healthy pregnant women, blood pressure, most notably diastolic blood pressure, falls gradually until the mid trimester and then rises again until delivery. In healthy pregnancies, this mid pregnancy fall in diastolic pressure is a physiological phenomenon triggered by a decrease in total peripheral vascular resistance, which is due, in turn, to vasodilatation starting in early gestation [16]. In our study, we found that diastolic pressure of pregnant women with normal BMI decreases significantly from first trimester to second trimester and then increases significantly from second to third trimester. This observation of normal physiological mid pregnancy fall in diastolic pressure was seen in normal weight pregnant women only, whereas underweight and overweight pregnant women, SBP and DBP, were not significantly decreased from first to second trimester and not significantly increased from second to third trimester. So, in these women mid-pregnancy fall in blood pressure was not seen; rather, blood pressure tends to remain stable during the first half of pregnancy and then rise continuously until delivery. The lack of such a fall in underweight and overweight pregnant women, which has also been noted in patients with pre-eclampsia, suggests failure of normal cardiovascular adaptation to pregnancy which might be due to endothelial dysfunction [17,18]. Recent studies have provided evidence that endothelial dysfunction, as indicated by a lower flow-mediated vasodilatation, precedes the development of pre-eclampsia, suggesting that endothelial dysfunction is a possible cause of pre-eclampsia [17,19]. Etiology of pre eclampsia in not clear exactly, but it is believed that pathophysiology of pre-eclampsia is endothelial cell dysfunction and intense vasospasm which is related with placental factors induced by impaired perfusion to placenta. Endothelial cell injury occurs due to oxidative stress and inflammatory mediators, and causes intravascular coagulation so there is loss of fluid. This increases the vascular sensitivity to vasopressors leading to vasospasm, responsible for abnormal blood pressure change during pregnancy. Endothelial cell injury and vasospasm both are in a vicious cycle. Dekker GA et al [20] postulated the hypothesis to know the pathophysiology of pre-eclampsia in which they described four etiologies, i.e., placental ischemia, very low-density lipoprotein versus toxicity, immune maladaptation, genetic imprinting. Another study by Roberts et al., (1989) [21] and Roberts and Redman, (1993) [22] focusing on the etiologies of pre eclampsia suggests that inappropriate systemic endothelial activation and dysfunction were the causes of pre-eclampsia and, therefore, complications, associated with it are more prominent in women having diabetes, obesity, thrombophilia, chronic hypertension, etc.(Dekker and Sukcharoen, (2004) [23] , Redman and Sargent, (2005) [24] and Sibai et al., (2005) [25]. All the above studies defined the etiologies and mechanism of pre-eclampsia which also support our study where the role of abnormal pre-pregnancy body mass index on blood pressure parameters in all the three trimesters has been established the mechanism responsible for its pathophysiology. Our study as well as correlates the BP changes during different trimesters with all the grades of BMI and some of the mechanisms of the cause, except in underweight women where the mechanism behind these changes in blood pressure is not fully understood. It, therefore, has been well established that abnormal body mass index affects blood pressure parameters in pregnant women

which may lead to pre-eclampsia which further affects mother as well as fetus.

CONCLUSIONS

1.) In pregnant women, abnormal body mass index, as measured by pre-pregnancy BMI, has been consistently associated with important medical complications of pregnancy, such as pre-eclampsia.

2.) Pre-eclampsia is also a leading cause of perinatal and maternal mortality.

3.) In view of the above risks the American College of Obstetricians and Gynecologists (ACOG) has recommended :

(a) Body mass index (BMI) should be recorded for all women at the initial prenatal visit, and information concerning the maternal and fetal risks of a very elevated BMI in pregnancy should be provided.

(b) Preconception counseling for obese women who are planning a pregnancy.

(c) Women at an unhealthy weight should be offered both nutrition consultation and an exercise program.

(d) Consultation with weight loss specialists before attempting another pregnancy.

(e) Physical activity alone produces only a modest reduction in weight compared with dieting alone.

(f) According to the American College of Sports Medicine (ACSM). Those who are obese or overweight can begin with activities such as walking, starting with a 5-minute workout and gradually working up to their goal over many weeks .

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