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Original Article

Association of Body Mass Index and Biochemical Parameters with Pregnancy-Induced Hypertension in Women of District Lahore, Punjab, Pakistan

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ABSTRACT

Hypertension is highly widespread problem in many parts of the world. It is a significant determinant of risk which can lead to cardiovascular morbidity and mortality. Pregnancy induced- hypertension is the hypertension which occurs in a pregnant woman after 20 weeks of gestation, previously having normal blood pressure. **Objective:** To ascertain the risks and complications associated with pregnancy-induced hypertension in females between the ages of 21 and 35 years. **Methods:** This study was conducted on 250 female subjects, which included 50 non-pregnant females, 50 pregnant non hypertensive females, and 150 pregnant hypertensive females. Symptoms were studied with the help of a questionnaire. Blood pressure was measured with the use of a manual blood pressure apparatus. Body mass index (BMI) was determined with the help of weight and height. The biochemical tests were performed in laboratories by taking blood samples with the help of standard methods. Statistical analysis was done by applying the Analysis of Variance (ANOVA). **Results:** Liver Function Tests (LFTs), Renal Function Tests (RFTs), and level of proteinuria were elevated in pregnant hypertensive females. At the same time, the platelet count was low in pregnant hypertensive females as compared to the other two groups. **Conclusions:** The present study showed significant results related to the demographic, BMI, and biochemical parameters.

INTRODUCTION

Hypertension is an increase in blood pressure above average levels [1]. It is a common, potent, and current disease in many parts of the world, which leads to disability and premature deaths [2]. According to a report presented in 2019, the prevalence of hypertension in adults aged (30-79 years) was 34% in men and 32% in women [3]. During pregnancy, hypertensive disorders and many other adverse pregnancy outcomes increase the risks of chronic hypertension and cardiovascular problems [4]. Globally, hypertensive disorders of pregnancy are the primary cause of illness and death [5]. According to WHO, hypertension occurring during pregnancy accounts for about 10% of all pregnancies [6]. It has become the most frequent comorbidity during pregnancy and renders an elevated

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menace, resulting in unfavorable outcomes equally for infants and mothers [7]. Pregnancy-induced hypertension is blood pressure that is greater than 140/90 mmHg on two occasions or is greater than 160/110 mmHg on one occasion in a woman who had normal blood pressure previously [8]. Hypertensive disorder of pregnancy is related to many other disorders including pre-eclampsia, eclampsia, chronic hypertension, and gestational hypertension. Each of the following has a different feto-maternal and pathophysiological consequence. The overall worldwide incidences range from 12-22% [9]. The women with exceeding blood pressure detected after the middle of pregnancy, without proteinuria, are categorized as having gestational hypertension. This term includes women who have pre-eclampsia syndrome as well as those women who do not have the syndrome [10]. In women with gestational hypertension, there is about one-third chance of developing the syndrome. Hypertension is a major health burden related to pregnancy disorder. In Pakistan, its prevalence is quite common at about 9% and is a significant cause of stillbirths in pregnant women [11]. The current study is to investigate the correlation between body mass index and biochemical markers in pregnancy induced-hypertension in pregnant females. The biochemical parameters included Liver Function Tests (LFTs) and Renal Function Tests (RFTs). Liver Function Tests are the blood tests which give information about working of liver [12]. Renal Function Tests include blood tests that are performed to evaluate the kidney function [13].

METHODS

In order to study the biochemical parameters (renal and hepatic parameters) in relation to hypertension in pregnant females, the study was conducted from March 2022 to May 2022 on 250 female subjects between the age of 21-35 years, which included 50 non-pregnant women in Group 1, 50 pregnant and non-hypertensive females placed in Group 2. Group 3 included 150 pregnant and hypertensive females. All pregnant females were in the fourth to sixth month of their pregnancy. The blood samples and records of the subjects were collected from different hospitals in Lahore. Sample size was decided considering [14]. All pregnancies with metabolic disorders or fetal and maternal abnormalities were excluded due to short duration of our study. Symptoms of pregnancy induced-hypertension and history were also studied by taking information through a performance-based questionnaire. This questionnaire was designed keeping in view the aims and objectives of this study. Though this questionnaire, the subjects were asked about age, weight, history of hypertension along with symptoms associated with pregnancy induced-hypertension. The blood pressure of every patient was recorded with the help of a manual blood pressure apparatus, Certeza Cr.1004 Aneroid sphygmomanometer. A working group of the National High Blood Pressure Education Programme established criteria for the diagnosis of hypertension in pregnant women. [15]. Weight was measured with digital weighing balance, TANITA weight balance (Model No 01701). It was taken in kilograms (Kg). Height was measured with the help of measuring tape. It was taken in centimeters (cm). These parameters were used to calculate the Body Mass Index (BMI). The body mass index may be defined as "individual body weight divided by the square of the height". The body mass index formula yields a measurement unit of Kg/m^2.

BMI = Body Mass (taken in Kilograms) / Height (taken in m^2)

The range of BMI for the underweight, overweight, standard and obese subjects are:

A BMI value of < 18.5 is taken as an underweight.
A BMI value of 25-29.9 is taken as an overweight
A BMI value of 18.5-24.9 is taken as a normal.
A BMI value of > 30 suggests that an individual is obese [16].

Blood samples were collected by a registered technician using sterilized disposable syringes (Becton Dickinson Private Limited) following the standard protocols. They were sent to laboratories for biochemical measures, which included Liver Function Tests (LFTs) and Renal Function Tests (RFTs). LFTs include serum bilirubin, Alanine Transaminase (ALT), Aspartate Transaminase (AST), and Alkaline Phosphatase (ALP). RFTs, including serum creatinine, serum uric acid, blood urea, proteinuria, and platelet count, were noted from the results of these tests. Data were represented as Mean ± SEM (Standard Error of Mean). ANOVA was applied to the parameters for the comparison of the mean between the three groups. Bar graphs represent the comparison between groups. The graphs were made on a Microsoft Excel sheet, and all statistical work was done on the SPSS 21.0 version.

RESULTS

The symptoms of hypertension observed and their percentage are as follows: Severe Headache, swelling of face, hand, and feet, severe pain below ribs, pain in the upper right abdomen, vomiting, dizziness, and nosebleeds (Table 1).

Table 1: Symptoms of pregnancy-induced hypertension and their respective percentages in patients

Symptoms of PIH	Percentage of Patients
Severe Headache	30.7%
Swelling of face, hand, and feet	20.2%
Severe pain below the ribs	25.6%
Pain in the upper right abdomen	18.7%
Vomiting	20.3%
Dizziness	30.3%
Nosebleeds	15.7%

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Within the scope of this investigation, 55% of the patients exhibited a familial predisposition to hypertension. Hypertension is strongly influenced by one's family history, making it a substantial risk factor. Women who have had hypertension in a previous pregnancy are more vulnerable to developing it again in another pregnancy. About 62% of the patients who are included in our study had hypertension in their previous pregnancy. It showed that a history of hypertension plays an important role in developing hypertension in the next pregnancy. The mean age value of non-pregnant females was found to be 28.12 ± 0.62 years as compared to the mean age values of 25.2 ± 0.63 years and 29.3 ± 0.37 years of pregnant non-hypertensive and pregnant hypertensive females respectively. The mean BMI value of non-pregnant females was found to be 28.62 ± 0.21 Kg/m2 as compared to 27.76 ± 0.64 Kg/m2 and 29.01 ± 0.17 Kg/m2 of pregnant non-hypertensive and pregnant hypertensive females respectively. It showed that BMI was significantly higher in pregnant hypertensive females as compared to the other two groups ($p<0.05$) (Figure 1).

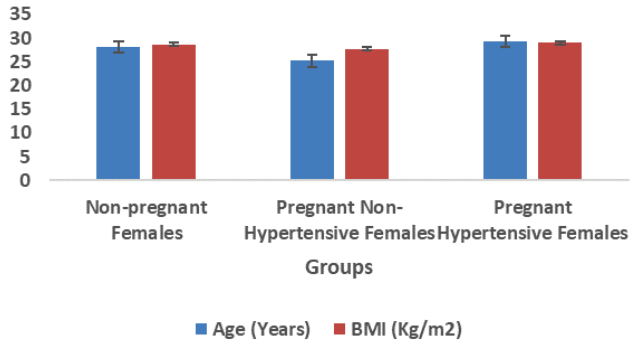

Figure 1: Mean ± SEM of age and Body Mass Index (Kg/m^2) in three groups.

The mean systolic B.P. value of non-pregnant females was found to be 119.6 ± 0.90 mmHg as compared to 119.4 ± 0.72 mmHg and 142.33 ± 0.76 mmHg in pregnant non-hypertensive and pregnant hypertensive females respectively. It showed that systolic B.P. was significantly higher in pregnant hypertensive females as compared to the other two groups ($p<0.05$). The mean diastolic B.P. value of non-pregnant females was found to be 75.8 ± 0.71 mmHg as compared to the mean diastolic B.P. value of 75 ± 0.71 mmHg and 96.73 ± 0.54 mmHg of pregnant non-hypertensive and pregnant hypertensive females respectively. It showed that diastolic B.P. was significantly higher in pregnant hypertensive females as compared to the other two groups ($p<0.05$) (Figure 2).

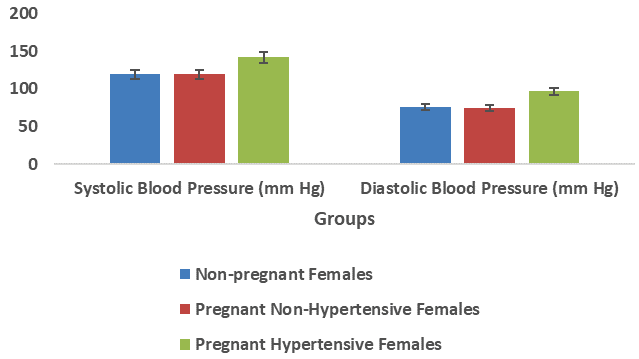

Figure 2: Mean ± SEM of systolic and diastolic blood pressure (mmHg) in three groups.

Mean serum bilirubin value of non-pregnant females was found to be 0.288 ± 0.02 mg/dl as compared to 0.2 ± 0.02 mg/dl and 0.55 ± 0.01 mg/dl values in pregnant non-hypertensive and pregnant hypertensive females respectively (Figure 3).

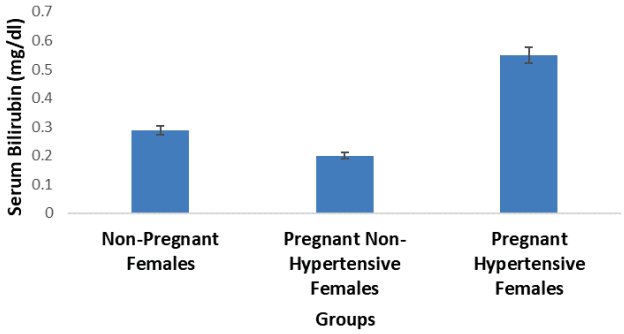

Figure 3: Mean ± SEM of serum bilirubin (mg/dl) in three groups.

The mean ALT value of non-pregnant females was found to be 17.12 ± 0.33 IU/L as compared to the mean ALT value of 15.68 ± 0.27 IU/L and 21.95 ± 0.69 IU/L of pregnant non-hypertensive and pregnant hypertensive females respectively (Figure 4)

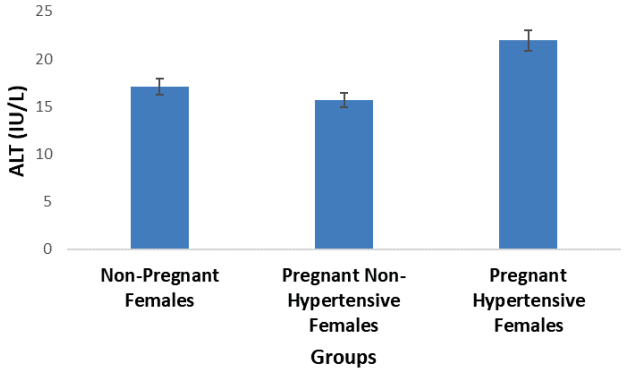

Figure 4: Mean ± SEM of ALT (IU/L) in three groups.

The mean AST value of non-pregnant females was found to be 11.68 ± 0.26 IU/L as compared to the mean AST value of 12.22 ± 0.15 IU/L and 27.78 ± 0.74 IU/L of pregnant non-hypertensive and pregnant hypertensive females respectively (Figure 5).

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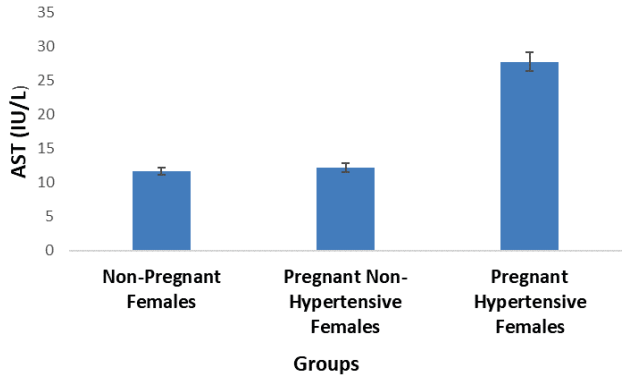

Figure 5: Mean ±SEM of AST (IU/L) in three groups.

The mean ALP value of non-pregnant females was found to be 50.78 ± 1.75 IU/L as compared to the mean ALP value of 111.08 ± 1.04 IU/L and 143.6 ± 2.81 IU/L of the pregnant non-hypertensive and pregnant hypertensive females respectively. The mean serum creatinine value of the non-pregnant females was found to be 0.434 ± 0.01 mg/dl as compared to 0.376 ± 0.01 mg/dl and 0.62 ± 0.01 mg/dl in pregnant non-hypertensive and pregnant hypertensive females respectively (Figure 6).

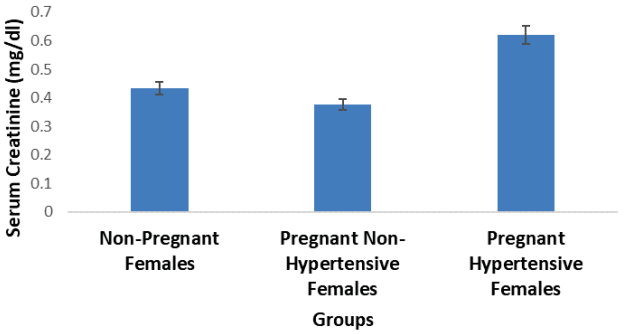

Figure 6: Mean ± SEM of serum creatinine (mg/dl) in three groups.

The mean serum uric acid value of non-pregnant females was found to be 2.96 ± 0.03 mg/dl as compared to the mean serum uric acid value of 3.488 ± 0.03 mg/dl and 5.003 ± 0.10 mg/dl of the pregnant non-hypertensive and pregnant hypertensive females respectively (Table 2)(Figure 7).

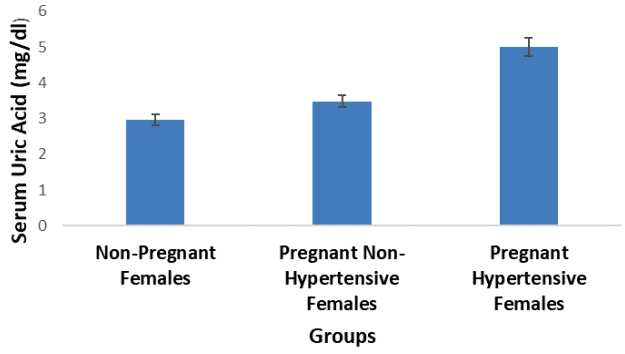

Figure 7: Mean ±SEM of serum uric acid (mg/dl) in three groups.

The Mean blood urea value of non-pregnant females was found to be 14.28 ± 0.28 mg/dl as compared to the mean blood urea value of 7.72 ± 0.29 mg/dl and 26.26 ± 0.38 mg/dl of the pregnant non-hypertensive and pregnant hypertensive females respectively. The mean platelet count value of non-pregnant females was found to be 315.26 ± 3.33 ×109/liter as compared to the mean platelet count value of 309.92 ± 3.51 ×109/liter and 196.54 ± 2.84 ×109/liter of the pregnant non-hypertensive and pregnant hypertensive females respectively (Figure 8).

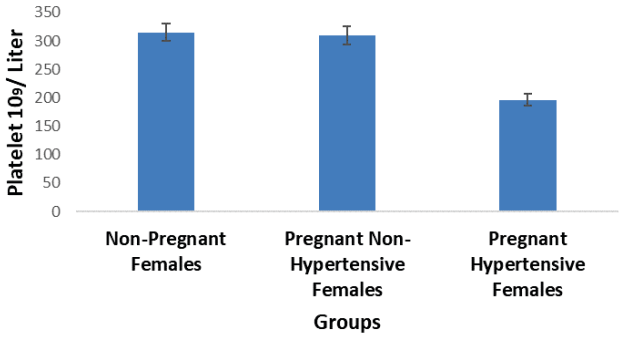

Figure 8: Mean ±SEM of platelet count ×10^9/Liter in three groups.

The mean proteinuria value of non-pregnant females was found to be 126.56 ± 1.23 mg/day as compared to the mean proteinuria value of 216.36 ± 2.84 mg/day and 411.3 ± 3.84 mg/day of the pregnant non-hypertensive and pregnant hypertensive females respectively. All the demographic and biochemical parameters of study subjects have been described in tabular form as shown in table 2.

Table 2: Demographic and biochemical parameters of non-pregnant, pregnant non-hypertensive and pregnant hypertensive groups

Parameters	Groups			
	Non-Pregnant Females (Group 1)	Pregnant Non-Hypertensive Females (Group 2)	Pregnant Hypertensive Females (Group 3)	Significance
N (Number)	50	50	50	
Age (years)	28.12 ± 0.63	25.2 ± 0.63	29.3 ± 0.37	p<0.05
BMI (Kg/m2)	28.62 ± 0.21	27.76 ± 0.64	29.01 ± 0.17	p<0.05
Systolic B.P. (mmHg)	119.6 ± 0.90	119.4 ± 0.72	142.33 ± 0.76	p<0.05
Diastolic B.P. (mmHg)	75.8 ± 0.71	75 ± 0.71	96.73 ± 0.54	p<0.05
Serum Bilirubin (mg/dl)	0.288 ± 0.02	0.2 ± 0.02	0.55 ± 0.01	p<0.05
ALT (IU/L)	17.12 ± 0.33	15.68 ± 0.27	21.95 ± 0.69	p<0.05
AST (IU/L)	11.68 ± 0.26	12.22 ± 0.15	27.78 ± 0.74	p<0.05
ALP (IU/L)	50.78 ± 1.75	111.08 ± 1.04	143.6 ± 2.81	p<0.05
Serum Creatinine (mg/dl)	0.434 ± 0.01	0.376 ± 0.01	0.62 ± 0.01	p<0.05
Serum Uric acid (mg/dl)	2.96 ± 0.03	3.488 ± 0.03	5.003 ± 0.10	p<0.05
Blood urea (mg/dl)	14.28 ± 0.28	7.72 ± 0.19	26.26 ± 0.38	p<0.05
Platelet count 109/ Liter	315.26 ± 3.33	309.92 ± 3.51	196.54 ± 2.84	p<0.05
Proteinuria (mg/day)	126.56 ± 1.23	216.36 ± 2.84	411.3 ± 3.84	p<0.05

DISCUSSION

In the present study, age was directly associated with pregnancy-induced hypertension, which is one of the major risk factors. The statistical analysis revealed a

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significant difference between the two groups, with a p-value of less than 0.05. It also showed that the chance of hypertension increases with age. This result is supported by [17]. According to a report, women with a familial history of hypertension in their moms and sisters were at a heightened risk of pregnancy-induced hypertension [18]. The presence of hypertensive disorders in one's family history heightens the likelihood of developing eclampsia and HELLP syndrome (a condition characterized by hemolysis, increased liver enzymes, and low platelet count). In the current investigation, we observed that the risk of hypertension increases if the person had family and history of hypertension. About 62% of the patients which are included in our study had hypertension in their previous pregnancy, so it is clear that the women with pregnancy-induced hypertension in their previous pregnancy are more vulnerable to developing it again in their subsequent pregnancy. About 55% of the patients in our study have a family history of hypertension. It was found that hypertension, a medical disorder arising from elevated blood pressure, exhibits a robust correlation with Body Mass Index (BMI) [19]. The present study indicates that there was a strong association between hypertension and BMI. The statistical result showed that the difference between them is significant ($p<0.05$). According to a report, systolic blood pressure increased significantly with age in both men and women, and diastolic blood pressure also increased significantly with age [20]. This study shows that prevalence increased with age. Similar results were found in our study. Both systolic and diastolic blood pressure increases with the age. It has been reported earlier that the women with abnormal LFTs levels exhibited maximum systolic and diastolic blood pressures. They showed a trend towards more proteinuria but lower platelet concentrations [21]. It has been noticed that adverse maternal results were more common in women with abnormal ALT, ALP, AST and serum bilirubin levels ($p<0.05$). In the present study, the LFTs, ALT (Alanine Transaminase), AST (Aspartate Transaminase), serum bilirubin, and ALP (Alkaline Phosphatase) were significantly higher in the pregnant hypertensive group as compared to the other two groups ($p<0.05$). According to a report, the findings indicate that the preeclamptic group exhibited higher liver function tests. The results of this study showed that the prevalence of any abnormal liver function tests in the hypertensive group was significantly higher in the women with preeclampsia [22]. Higher levels of renal function tests were observed in hypertensive pregnant females. The results obtain support from research conducted earlier [23]. It has been reported that the platelet counts were lower in pre-eclampsia and eclampsia groups as compared to the control group [24]. The results of this study showed that the platelet count in preeclampsia and eclampsia group had significantly decreased when compared with the control group ($p<0.05$). Similar results were observed in our study that the platelet count was significantly decreased in the pregnant hypertensive women ($p<0.05$). The signs and symptoms of preeclampsia include increased serum creatinine levels, low platelet counts, and pain in the upper abdomen, namely in the epigastric region and the right upper quadrant. They also report symptoms such as headache, visual problems, or other indicators related to the brain. [25]. Similar observations have been made in this study.

CONCLUSIONS

In present study, it has been found that, age, BMI and family history of hypertension are risk factors responsible for pregnancy-induced hypertension in the pregnant hypertensive women as compared to the non-pregnant and non-hypertensive subjects. The relationship of pregnancy-induced hypertension to LFTs and RFTs was significant as the levels of ALT, AST, ALP, serum bilirubin, serum creatinine, serum uric acid, blood urea, and proteinuria were higher in pregnant hypertensive females as compared to non-pregnant females and pregnant non-hypertensive females.

Authors Contribution

Conceptualization: FA
Methodology: FA, MB
Formal analysis: AN, SH
Writing-review and editing: FA, MB, AN, FB, HA, AA, SH

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

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REFERENCES

[1] Butar SB, Gamayana Y, Yemina L. The Effect of Deep Breathing Relaxation on Changes of Blood Pressure on Hypertention Patients. Jurnal Keperawatan Komprehensif (Comprehensive Nursing Journal). 2022 Oct 31;8(4): doi: 10.33755/jkk.v8i4.427.

[2] Lamirault G, Artifoni M, Daniel M, Barber-Chamoux N. Resistant hypertension: novel insights. Current Hypertension Reviews. 2019 Oct; 16(1): 61-72. doi: 10.2174/1573402115666191011111402.

[3] Nguyen TN and Chow CK. Global and national high blood pressure burden and control. The Lancet. 2021 Sep; 398(10304): 932-3. doi: 10.1016/S0140-

DOI: : https://doi.org/10.54393/pbmj.v6i12.997

6736(21)01688-3.

[4] Scott J, Hauspurg A, Muldoon MF, Davis EM, Catov JM. Neighborhood deprivation, perceived stress, and pregnancy-related hypertension phenotypes a decade following pregnancy. American Journal of Hypertension. 2023 Sep: hpad090. 10.1093/ajh/hpad090. doi: 10.1093/ajh/hpad090.

[5] Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, *et al*. Global causes of maternal death: a WHO systematic analysis. The Lancet Global Health. 2014 Jun; 2(6): e323-33. doi: 10.1016/S2214-109X(14)70227-X.

[6] Khan A, Nasrullah FD, Jaleel R. Frequency and risk factors of low birth weight in term pregnancy. Pakistan Journal of Medical Sciences. 2016 Jan; 32(1): 138. doi: 10.12669/pjms.321.8120.

[7] Khalid MA, Ejaz A, Arif U, Jaffery TH, Mahmood A, Arif S. Prevalence of Pregnancy-Induced Hypertension and Pregnancy Outcomes. Pakistan Journal of Medical & Health Sciences. 2023 Jun; 17(04): 495. doi: 10.53350/pjmhs2023174495.

[8] Farhan A, Tariq S, Tasneem M, Khan D, Chachar S, Baqai HS, *et al*. Frequency of Low Birth Weight in Patients with Gestational Hypertension: Frequency of Low Birth Weight. Pakistan Journal of Health Sciences. 2023 Sep: 4(9): 81-4. doi: 10.54393/pjhs.v4i09.1019.

[9] Hutcheon JA, Lisonkova S, Joseph KS. Epidemiology of pre-eclampsia and the other hypertensive disorders of pregnancy. Best Practice & Research Clinical Obstetrics & Gynaecology. 2011 Aug; 25(4): 391-403. doi: 10.1016/j.bpobgyn.2011.01.006.

[10] Weissgerber T. Effects of Pregnancy and Physical Activity on Angiogenesis and Endothelial Function: Implications for the Development of Preeclampsia. Doctoral dissertation. Canada: Queen's University; 2009.

[11] Korejo R, Bhutta S, Noorani KJ, Bhutta ZA. An audit and trends of perinatal mortality at the Jinnah Postgraduate Medical Centre, Karachi. The Journal of the Pakistan Medical Association. 2007 Apr; 57(4): 168-72.

[12] Health Direct. Liver Function Tests. [Last cited: 27th Dec 2023]. Available at: https://www.healthdirect.gov.au/liver-function-tests.

[13] Martínez-Mesa J, González-Chica DA, Bastos JL, Bonamigo RR, Duquia RP. Sample size: how many participants do I need in my research?. Anais Brasileiros de ermatologia. 2014 Jul; 89: 609-15. doi: 10.1590/abd1806-4841.20143705.

[14] Physiopedia. Renal Function Test (RFT). [Last cited: 27th Dec 2023]. Available at: https://www.physiopedia.com/Renal_Function_Test_(RFT).

[15] Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, *et al*. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. Hypertension. 2003 Dec; 42(6): 1206-52. doi: 10.1161/01.HYP.0000107251.49515.c2.

[16] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMI. 2000 May; 320(7244): 1240. doi: 10.1136/bmj.320.7244.1240.

[17] Schall JI. Sex differences in the response of blood pressure to modernization. American Journal of Human Biology. 1995; 7(2): 159-72. doi: 10.1002/ajhb.1310070204.

[18] Bezerra PC, Leão MD, Queiroz JW, Melo EM, Pereira FV, Nóbrega MH, *t al*. Family history of hypertension as an important risk factor for the development of severe preeclampsia. Acta Obstetricia et Gynecologica Scandinavica. 2010 May; 89(5): 612-7. doi: 10.3109/00016341003623720.

[19] Humayun A, Shah AS, Sultana R. Relation of hypertension with body mass index and age in male and female population of Peshawar, Pakistan. Journal of Ayub Medical College Abbottabad. 2009 Sep; 21(3): 63-5.

[20] Leenen FH, Dumais J, McInnis NH, Turton P, Stratychuk L, Nemeth K, *et al*. Results of the Ontario survey on the prevalence and control of hypertension. CMAJ. 2008 May; 178(11): 1441-9. doi: 10.1503/cmaj.071340.

[21] Kozic JR, Benton SJ, Hutcheon JA, Payne BA, Magee LA, von Dadelszen P. Abnormal liver function tests as predictors of adverse maternal outcomes in women with preeclampsia. Journal of Obstetrics and Gynaecology Canada. 2011 Oct; 33(10): 995-1004. doi: 10.1016/S1701-2163(16)35048-4.

[22] Girling JC, Dow E, Smith JH. Liver function tests in pre-eclampsia: importance of comparison with a reference range derived for normal pregnancy. BJOG: An International Journal of Obstetrics & Gynaecology. 1997 Feb; 104(2): 246-50. doi: 10.1111/j.1471-0528.1997.tb11054.x.

[23] Haymanot T, Abebe E, Mistire W. Assessment of renal function tests, serum total protein, and lipid profile concentrations among pregnancy-induced hypertension attending women in Asrade Zewudie Memorable Hospital (ASZMPH), Gojjam, Ethiopia: Case-control study. International Journal of Medicine and Medical Sciences. 2020 Nov; 12(2): 33-45. doi: 10.5897/IJMMS2020.1431.

[24] Annam V, Srinivasa K, Yatnatti SK. Evaluation of

DOI: : https://doi.org/10.54393/pbmj.v6i12.997

platelet indices and platelet counts and their significance in pre-eclampsia and eclampsia. International Journal Biological and Medical Research. 2011 Jan; 2(1): 425-8.

[25] Cunningham FG and Gant NF. Prevention of preeclampsia—a reality? New England Journal of Medicine. 1989 Aug; 321(9): 606-7. doi: 10.1056/NEJM198908313210908.