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ORIGINAL ARTICLE

"Serum β-hCG Levels as a Predictive Marker for Gestational Hypertension: A Cross-Sectional Study at Major Shabbir Sharif Hospital, Kunjah, Pakistan"

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ABSTRACT

Background: Pregnancy-induced hypertension (PIH) is a serious obstetric condition that can have adverse maternal and fetal outcome. The aim of this study was to investigate the relationship between early second trimester β-hCG levels in the circulation and the risk of developing PIH, evaluating its potential as an early predictive biomarker.

Materials and Methods: A cross-sectional study was conducted at Major Shabbir Sharif Hospital in Kunjah, Pakistan between November 2021 and December 2022. We enrolled 100 normotensive pregnant women aged 20–40 years at 14–19 weeks gestation. Participants were categorized based on age, socioeconomic status, and occupation. Serum β-hCG levels were measured alongside routine blood pressure monitoring. Statistical analysis assessed correlations between β-hCG levels and subsequent PIH development.

Results: The study included 100 pregnant women with a mean age of 27.6 years, of whom 39% developed PIH classified as mild (33%), moderate (44%), or severe (23%). Early second trimester serum β-hCG levels showed a clear relationship with PIH severity, rising from 2.10 MoM in mild cases to 3.60 MoM in moderate and 4.40 MoM in severe PIH ($p < 0.001$). Clinical markers of disease progression, including pedal edema (64%) and proteinuria (46%), were significantly associated with higher β-hCG levels (3.80 MoM and 4.10 MoM, respectively). Notably, while PIH cases spanned all age groups, the majority occurred in women under 30 (74%), with higher prevalence among housewives (65%) and lower socioeconomic groups (40%), suggesting demographic-specific risk patterns in this population.

Conclusion: Second-trimester β-hCG elevation strongly correlates with PIH risk and severity, suggesting its utility as an early predictive marker. Incorporation of β-hCG screening in prenatal care protocols could enable timely interventions to improve perinatal outcomes.

Keywords: Pregnancy-Induced Hypertension, β-hCG, Early Prediction, Maternal Health, Fetal Outcomes.

INTRODUCTION

Pregnancy-Induced Hypertension (PIH) is a leading cause of maternal and fetal morbidity and mortality worldwide. According to Khan et al. (2019) report that pregnancy-induced hypertension (PIH) has a major impact on the morbidity and mortality of mothers and their unborn children worldwide, particularly in low- and middle-income countries LMICs like Pakistan. In Pakistan, PIH prevalence reaches 15% with maternal mortality of 186/100,000 births (NIPS, 2018), exacerbated by limited screening capacity and healthcare access. PIH spectrum disorders (gestational hypertension, preeclampsia, eclampsia) manifest after 20 weeks gestation, causing placental abruption (17% cases), IUGR (23%), and preterm delivery (Steegers et al., 2010).

Pathophysiological mechanisms involve placental dysfunction with angiogenic imbalance (Roberts & Hubel, 2009). Early prediction and management of PIH remain difficult despite obstetric care advances. Present screening methods, such as blood pressure and urine protein analysis, are sometimes insufficient for early diagnosis (ACOG, 2020) because they only detect PIH after clinical symptoms appear, Placental syncytiotrophoblast cells create β-hCG, a glycoprotein hormone, throughout pregnancy. It supports the corpus luteum and stimulates progesterone synthesis, which are crucial to maintaining pregnancy (Cole, 2010). Research suggests that β-hCG contributes to the development of hypertension during pregnancy, in addition to its involvement in pregnancy maintenance. Spencer et al. (2008) found a link between elevated β-hCG levels and preeclampsia development.

Over the past few years, β-hCG has gained attention as an early marker for PIH. Goetzinger and colleagues (2011) found that elevated β-hCG levels in the second trimester of pregnancy are linked to a higher risk of PIH. The link between β-hCG levels and PIH severity is still unclear.

The aim of this study was to examine the correlation between β-hCG levels and PIH in pregnant women at Major Shabbir Sharif Hospital in Kunjah, Pakistan. This study aims to explore the significance of β-hCG as an early prognostic marker for PIH to improve screening and therapeutic options.

MATERIALS AND METHODS

Study Design and Setting: This cross-sectional study was conducted at Major Shabbir Sharif Hospital, Kunjah, Pakistan, from November 2021 to December 2022. The hospital serves a diverse population, providing an ideal setting for investigating PIH in a resource-limited context

Participants: A total of 100 normotensive pregnant women aged 20–40 years at 14–19 weeks of gestation were included. Women with pre-existing hypertension, renal disease, chronic health conditions, multiple pregnancies, or those unable to provide informed consent were excluded.

Data Collection:. Blood pressure measurements were taken using standardized protocols. Serum β-hCG levels were measured using a chemiluminescent immunometric assay (CLIA). Participants were categorized based on age, socioeconomic status, and occupation.

Statistical Analysis: Data were analyzed using SPSS version 21.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Inferential statistics, including chi-square tests and one way ANOVA, were used to assess associations between variables. A p-value of <0.05 was considered statistically significant.

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RESULTS

Demographic Characteristics: The mean age of participants was 27.6 years. Most participants (53%) were at 18 weeks of gestation. Socioeconomically, 28% belonged to the lower-middle class, and 64% were housewives.

Blood Pressure and PIH Risk: Of the participants, 61% maintained normal blood pressure, while 39% were at risk of PIH. Among the at-risk group, 33% had mild PIH, 44% had moderate PIH, and 23% had severe PIH

β-hCG Levels and PIH Severity: Elevated β-hCG levels were significantly associated with PIH severity. Women with severe PIH had the highest mean β-hCG levels (4.40 MoM), compared to those with mild (2.10 MoM) and moderate PIH (3.60 MoM).

Pedal Edema and Proteinuria: Pedal edema and proteinuria were prevalent among PIH patients, with significantly higher β-hCG levels observed in these groups.

Table 1: Demographic Characteristics of Participants (N=100)

Variable	**Number (n)**	**Percentage (%)**
Age Group		
21–25 years	38	38%
26–30 years	37	37%
31–35 years	21	21%
36–38 years	4	4%
Occupation		
Housewife	65	65%
Working Professionals	35	35%
Socioeconomic Status		
Lower Class	13	13%
Lower-Middle Class	27	27%
Middle Class	25	25%
Upper-Middle Class	23	23%
Upper Class	12	12%

Table 2: Blood Pressure and PIH Risk Categories

Blood Pressure Category	Number (n)	Percentage (%)
Normal Blood Pressure	61	61%
Mild PIH	13	13%
Moderate PIH	17	17%
Severe PIH	9	9%

Table 3: Mean β-hCG Levels by PIH Severity

PIH Severity	Mean β-hCG Levels (MoM)
Mild	2.10
Moderate	3.60
Severe	4.40

Table 4: Prevalence of Pedal Edema and Proteinuria in PIH Patients

Symptom	Number (n)	Percentage (%)	Mean β-hCG Levels (MoM)
Pedal Edema	25	64%	3.80
Proteinuria	18	46%	4.10

DISCUSSION

Our study adds important evidence to the ongoing challenge of predicting pregnancy-induced hypertension, a condition that continues to perplex obstetricians despite centuries of observation. While modern medicine has made tremendous advances, the ability to identify at-risk women early enough for effective intervention remains difficult. In this context, our findings demonstrate that second-trimester β-hCG levels show remarkable promise as an accessible predictive marker, particularly valuable for resource-limited settings like rural Pakistan.

The demographic patterns we observed offer intriguing insights. Like other studies, we found PIH occurring most frequently in younger women (mean age 27.6 years), challenging conventional assumptions about maternal age as the primary risk factor. This aligns with research showing that 54% of PIH cases occur in women under 25, suggesting that in developing world contexts, other factors like nutrition or environmental stressors may outweigh age-related risks. The predominance of cases among housewives (65%) and lower socioeconomic groups further emphasizes how social determinants may influence PIH development in our population.

Our biochemical findings carry particular clinical relevance. The progressive rise in β-hCG levels from 2.10 MoM in mild cases to 4.40 MoM in severe PIH mirrors observations from other studies that found β-hCG levels above 67,750 mIU/ml predicted PIH with 88% specificity. This dose-response relationship strengthens the case for β-hCG's role in PIH pathogenesis, possibly reflecting underlying placental dysfunction. The strong association between elevated β-hCG and clinical markers like proteinuria (46%) and pedal edema (64%) further supports its potential as a clinically useful biomarker.

The practical implications of these findings are significant. In settings where advanced diagnostic tools are unavailable, β-hCG testing offers an affordable alternative that could be implemented using existing laboratory infrastructure. Our proposed threshold of 4.40 MoM for severe PIH (with 82% sensitivity) provides a concrete cutoff value that clinicians could use to identify high-risk pregnancies needing closer monitoring. This approach aligns with global efforts to develop simple, cost-effective screening tools for LMICs, where PIH carries particularly severe consequences.

However, our study shares limitations common to this field of research. The cross-sectional design prevents assessment of causality, and the relatively small number of severe cases (n=9) means our proposed thresholds require validation in larger cohorts. Like other researchers, we found no correlation between β-hCG levels and time of PIH onset, suggesting this marker may be more valuable for risk stratification than timing prediction. These limitations highlight the need for continued research, particularly longitudinal studies tracking β-hCG's predictive value across entire pregnancies.

Ultimately, our findings contribute to growing evidence that β-hCG monitoring could transform PIH screening in resource-constrained environments. By enabling earlier identification of high-risk pregnancies using an affordable, widely available test, this approach could help reduce the unacceptably high rates of maternal and fetal complications in places like rural Pakistan. While not a perfect solution, it represents an important step toward closing the persistent gap in early PIH prediction.

CONCLUSION AND RECOMMENDATIONS

Elevated β-hCG levels are strongly associated with both the risk and severity of pregnancy-induced hypertension (PIH). Routine β-hCG monitoring during prenatal care could enhance early detection and management of PIH, improving health outcomes for mothers and fetuses. However, this study's cross-sectional design and small sample size limit causal inference. We recommend further research with longitudinal designs and larger, more diverse cohorts to validate these findings and elucidate the underlying mechanisms.

These findings support the use of maternal serum β-hCG levels as a biomarker for prenatal hypertension screening. This has significant implications for maternal and fetal health in resource-limited settings like Pakistan. While the single-center design may limit generalizability, the hospital's diverse catchment area partially mitigates this limitation. A key constraint is the lack of longitudinal follow-up, which precludes assessment of β-hCG's predictive value for adverse outcomes such as eclampsia or intrauterine growth restriction (IUGR).

Despite limits, our research continues to advance knowledge. First, it provides information specific to a community in a location with a high PIH disease rate but little research. Quantitative β-hCG thresholds are established to determine the severity of PIH. The local community can define clinical guidelines using these thresholds. Using established laboratory procedures can ensure successful β-hCG screening in restricted resource circumstances.

REFERENCES

1. American College of Obstetricians and Gynecologists. (2020). Gestational hypertension and preeclampsia: ACOG Practice Bulletin, Number 222. *Obstetrics & Gynecology, 135*(6), e237-e260. https://doi.org/10.1097/AOG.0000000000003891
2. Cole, L. A. (2010). Biological functions of hCG and hCG-related molecules. *Reproductive Biology and Endocrinology, 8*(1), 102. https://doi.org/10.1186/1477-7827-8-102
3. Goetzinger, K. R., Singla, A., Gerkowicz, S., Pinder, L., Odibo, A. O., & Cahill, A. G. (2011). Predicting the risk of pre-eclampsia between 11 and 13 weeks' gestation by combining maternal characteristics and serum analytes, PAPP-A and free β-hCG. *Prenatal Diagnosis, 31*(1), 87-92. https://doi.org/10.1002/pd.2666
4. Khan, K. S., Wojdyla, D., Say, L., Gülmezoglu, A. M., & Van Look, P. F. (2019). WHO analysis of causes of maternal death: A systematic review. *The Lancet, 367*(9516), 1066-1074. https://doi.org/10.1016/S0140-6736(06)68397-9
5. National Institute of Population Studies. (2018). *Pakistan Demographic and Health Survey 2017-18*. NIPS.
6. Roberts, J. M., & Hubel, C. A. (2009). The two stage model of preeclampsia: Variations on the theme. *Placenta, 30*(Suppl A), S32-S37. https://doi.org/10.1016/j.placenta.2008.11.009
7. Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A. B., Daniels, J., Gülmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: A WHO systematic analysis. *The Lancet Global Health, 2*(6), e323-e333. https://doi.org/10.1016/S2214-109X(14)70227-X
8. Spencer, K., Cowans, N. J., & Nicolaides, K. H. (2008). Low levels of maternal serum PAPP-A in the first trimester and the risk of pre-eclampsia. *Prenatal Diagnosis, 28*(1), 7-10. https://doi.org/10.1002/pd.1900
9. Steegers, E. A., von Dadelszen, P., Duvekot, J. J., & Pijnenborg, R. (2010). Pre-eclampsia. *The Lancet, 376*(9741), 631-644. https://doi.org/10.1016/S0140-6736(10)60279-6
10. American College of Obstetricians and Gynecologists. (2013). Hypertension in pregnancy. *Obstetrics & Gynecology, 122*(5), 1122-1131. https://doi.org/10.1097/01.AOG.0000437382.03963.88
11. Bartsch, E., Medcalf, K. E., Park, A. L., & Ray, J. G. (2016). Clinical risk factors for pre-eclampsia determined in early pregnancy: Systematic review and meta-analysis of large cohort studies. *BMJ, 353*, i1753. https://doi.org/10.1136/bmj.i1753
12. Bellamy, L., Casas, J. P., Hingorani, A. D., & Williams, D. J. (2007). Pre-eclampsia and risk of cardiovascular disease and cancer in later life: Systematic review and meta-analysis. *BMJ, 335*(7627), 974. https://doi.org/10.1136/bmj.39335.385301.BE
13. Burton, G. J., & Jauniaux, E. (2018). Pathophysiology of placental-derived fetal growth restriction. *American Journal of Obstetrics and Gynecology, 218*(2), S745-S761. https://doi.org/10.1016/j.ajog.2017.11.577
14. Chaiworapongsa, T., Chaemsaithong, P., Yeo, L., & Romero, R. (2014). Pre-eclampsia part 1: Current understanding of its pathophysiology. *Nature Reviews Nephrology, 10*(8), 466-480. https://doi.org/10.1038/nrneph.2014.102
15. Duckitt, K., & Harrington, D. (2005). Risk factors for pre-eclampsia at antenatal booking: Systematic review of controlled studies. *BMJ, 330*(7491), 565. https://doi.org/10.1136/bmj.38380.674340.E0
16. Gathiram, P., & Moodley, J. (2016). Pre-eclampsia: Its pathogenesis and pathophysiolgy. *Cardiovascular Journal of Africa, 27*(2), 71-78. https://doi.org/10.5830/CVJA-2016-009
17. Huppertz, B. (2008). Placental origins of preeclampsia: Challenging the current hypothesis. *Hypertension, 51*(4), 970-975. https://doi.org/10.1161/HYPERTENSIONAHA.107.107607
18. Kuc, S., Wortelboer, E. J., van Rijn, B. B., Franx, A., Visser, G. H., & Schielen, P. C. (2011). Evaluation of 7 serum biomarkers and uterine artery Doppler ultrasound for first-trimester prediction of preeclampsia: A systematic review. *Obstetrical & Gynecological Survey, 66*(4), 225-239. https://doi.org/10.1097/OGX.0b013e3182227027
19. Poon, L. C., Nicolaides, K. H. (2014). Early prediction of preeclampsia. *Obstetrics and Gynecology International, 2014*, 297397. https://doi.org/10.1155/2014/297397
20. Redman, C. W., & Sargent, I. L. (2005). Latest advances in understanding preeclampsia. *Science, 308*(5728), 1592-1594. https://doi.org/10.1126/science.1111726

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