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A Study Design Review: Ophthalmic Artery Doppler in Preeclampsia Study

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Abstract

Preeclampsia screening is a must for all pregnant women. Predicting preeclampsia using the ocular artery Doppler and comparing its efficacy to the uterine artery Doppler, which is now believed to be the most accurate tool in use, have both been the subjects of several studies. Depending on the research design, a number of investigations were conducted using various methods. The research proccess and, naturally, the findings will be impacted by the study design chosen. This study aims to review and evaluate the study designs of numerous recent studies on ocular artery Doppler in preeclamptic patients. It is a literature review that compiles articles from current English-language publications published in the years 2020 to 2023. The articles were found using the PubMed, Wiley, and BMJ search engines. Our findings show that the various study designs that were used had advantages and disadvantages. Future research ought to evaluate the advantages and disadvantages before selecting a study design.

Keywords **:** preeclampsia, ophthalmic artery Doppler, study design

Abstrak

Skrining preeklamsia adalah suatu keharusan bagi semua wanita hamil. Skrining preeklamsia menggunakan Doppler *arteri okular dan membandingkan kemanjurannya dengan* Doppler *arteri uterina, yang sekarang diyakini sebagai alat diagnostik yang paling akurat, telah menjadi subyek dari beberapa penelitian. Sejumlah studi dilakukan dengan menggunakan berbagai metode. Proses penelitian dan, tentu saja, temuannya akan dipengaruhi oleh desain penelitian yang dipilih. Penelitian ini bertujuan untuk meninjau dan mengevaluasi desain penelitian dari berbagai penelitian terbaru mengenai* Doppler *arteri okular pada pasien preeklampsia. Ini adalah tinjauan literatur yang mengumpulkan artikel dari publikasi berbahasa Inggris yang diterbitkan pada tahun 2020 hingga 2023. Artikel tersebut ditemukan menggunakan mesin telusur PubMed, Wiley, dan BMJ. Temuan kami menunjukkan bahwa berbagai desain studi yang digunakan memiliki kelebihan dan kekurangan masing-masing. Penelitian selanjutnya harus mengevaluasi kelebihan dan kekurangan tersebut sebelum memilih desain penelitian.*

Kata kunci **:** *preeklamsia,* Doppler *arteri oftalmika, desain studi*

INTRODUCTION

Based on the existence of particular pregnancy-related hypertension and other organ system problems at gestational ages exceeding 20 weeks, preeclampsia is diagnosed. Historically, pregnancy-related hypertension and proteinuria—also known as "new-onset hypertension with proteinuria"—have always been used to describe preeclampsia. When the blood pressure in the same arm is measured twice, 15 minutes apart, and is at least 140 mmHg systolic or 90 mmHg diastolic, it is considered to be hypertension. If the amount of protein excreted in the urine is greater than 300 mg in 24 hours or the pee

dipstick test is > positive, proteinuria is suspected.[1–3]

Every pregnant woman must undergo screening for preeclampsia at the outset of her pregnancy. Doppler ultrasonography may be used to identify impaired blood flow in maternal arteries in pregnant women before the start of PE and at the time of diagnosis.[4,5] Even though it can be difficult during pregnancy, monitoring cerebral circulation is essential since preeclampsia's severe neurological consequences account for nearly 75% of maternal fatalities.[6] Due to the ocular artery's closeness to intracranial arteries in embryology, morphology, and function, using an ophthalmic artery Doppler during pregnancy is a simple and non-invasive method in assessing and tracking changes in cerebral circulation.[7]

In the last ten years, several studies have attempted to predict preeclampsia using the ocular artery Doppler and compare its effectiveness to the uterine artery Doppler, which is now thought to be the most accurate instrument in use, with promising outcomes of comparable sensitivity and specificity.[8,9] Several studies were performed using different approaches based on the study design. Study design means the methods used in a study to collect the data needed to investigate a question.[10] This process difference will undoubtedly affect the research process and, of course, the results obtained. This literature review summarizes several recent studies on ocular artery Doppler in preeclamptic patients and compares their study designs.

METHODS

This academic paper is a literature review that collects literature from current English-language journals from 2020 to 2023, most of which are research papers. Search using keywords using the PubMed, Wiley, and BMJ search engine. Ophthalmic artery Doppler, predictor, pre-eclampsia are the keywords. The identified literature was then searched to find papers that met the inclusion criteria. Studies with different study designs published between 2020 and 2023 served as inclusion criteria. Six references were identified based on the screening results and are discussed in this article.

RESULTS

From the literature search results, six studies were found that met the inclusion criteria and will be reviewed in this article. These studies were published ranging from 2020 to 2023 with different study designs. A prospective cohort study was conducted by Eman *et al*. in 2022[11] and Zhu *et al*.[12] in 2021. Sarno *et al*., 2020[13] conducted a study with a cross-sectional approach. The study meta-analysis by Dai *et al*., 2022[8] included an analysis of five case-control studies and three cross-sectional studies. Naemi *et al*.[14] in 2023 and Kusuma *et al*.[15] in 2022 will also conduct a study with a cross-sectional approach. All studies revealed similar results; it was concluded that ophthalmic artery Doppler could be used to predict preeclampsia. However, there are several research limitations in carrying out the studies above.

Eman *et al*. and Zhu *et al*. conducted their research with a prospective observational cohort study design. On 120 normotensive singleton pregnant women between June 2020 and September 2021, a research by Eman *et al*. was carried out. In a prospective study, Eman *et al*. discovered that 24 of 120 pregnant women developed preeclampsia (16 had moderate preeclampsia and 8 had severe

preeclampsia). The limitation of this study is the requirement for prior research with the same racial group; hence, trustworthy comparative studies are also absent. In a research by Zhu *et al*., 926 pregnant women with singletons under 14 weeks of gestation participated. From September 2010 to October 2014, a prospective strategy was used, and it was discovered that 20 out of 926 pregnant women developed preeclampsia. The impact of white coat hypertension and the study's generally modest incidence of preeclampsia are its weaknesses.

Cross-sectional research was used to perform the study by Sarno *et al*., Naemi *et al*., and Kusuma *et al*. During a regular hospital visit between 35+0 and 36+6 weeks' gestation, 2287 pregnant women participated in a research by Sarno *et al*. Only 60 pregnant women were determined to have preeclampsia out of the 2287 samples. This is a flaw in the Sarno *et al*. study. For a precise evaluation of the impact of the kind and amount of measures on the screening performance, the number of PE cases required to be more substantial. In a research by Naemi *et al*., 148 pregnant women between 35 and 37 weeks gestation participated. 48 out of the 148 samples were positive for preeclampsia. The study's weaknesses were not mentioned. In the research by Kusuma *et al*., 946 pregnant women participated, 71 of whom developed preeclampsia. In this study, the rates of preterm and early-onset PE were 1% and 2.2%, respectively. The study's main drawback is that it only looked at the ophthalmic PR in the prediction model.

The study by Dai *et al*. used a meta-analysis methodology. Until July 31, 2022, Dai *et al*.'s searched PubMed, Embase, Web of Science, and the Cochrane Library. This analysis includes three cross-sectional studies and five case-control studies. Using the random effects model, the pooled standardized mean difference (SMD) and 95% confidence intervals (CIs) were computed. The Q test and I2 statistics were used to assess heterogeneity among the included studies. The study's limitations include the requirement for a meta-regression or subgroup analysis and the lack of data necessary to determine how OA Doppler affects determining the severity of pre-eclampsia at various stages.

A summary of the studies above can be seen in Table 1.

DISCUSSION

The procedures and methodologies used in research to collect the data required to examine a certain subject are referred to as study design. Only data collected using a valid scientific design and the appropriate statistical methods will yield meaningful results in biomedical research. The proper study design must be chosen in order to provide an unbiased and scientific evaluation of the research topics.[10]

Different research designs may be seen in the studies that we have located. Six investigations yielded three different research types: prospective cohort studies, cross-sectional studies, and meta-analysis studies.

A cohort study is one in which two or more groups of participants are monitored over time to see if they experience an event or a condition. Cohort studies can be either prospective or retrospective. Prospective cohort studies, commonly referred to as follow-up studies, track collections of cells, animals, or patients exposed to various conditions until a particular point in time, at which point something occurs or the study is stopped. Retrospective cohort studies examine risk variables or exposures prior to

Table 1. Studies Comparison Table.

Author, Year	Title	Source	Study Design	Sample	Summary of Findings	Limitation
Eman *et al*., 2022	Role of Ophthalmic Artery Doppler in Prediction of Preeclampsia	Wiley	Prospective observational cohort study	120 pregnant women	OA Doppler is an easy, reliable and unbiased technique with a standalone predictive diagnostic value for the development of PE. The curve for the peak ratio (PR) and the second systolic peak (P2) indices were more than 90%.	Lack of comparison with studies on the same race.
Sarno *et al*., 2020	Ophthalmic artery Doppler in prediction of pre-eclampsia at 35 – 37 weeks' gestation	Wiley	Cross sectional study	2287 pregnant women attending for a routine hospital visit at 35+0 to 36+6 weeks' gestation	Ophthalmic artery PSV ratio at 35 – 37 weeks' gestation can predict subsequent delivery with PE, especially if this occurs within 3 weeks after assessment.	The number of cases of PE was too small (n=60).
Zhu *et al*., 2021	Mean arterial pressure for predicting preeclampsia in Asian women: a longitudinal cohort study	BMJ	Prospective observational cohort study	926 women with singleton pregnancy less than 14 weeks of gestation	MAP is a good predictor for preeclampsia, especially in Asian women	The effect of white coat hypertension and relatively low incidence of preeclampsia in this cohort might impact the performance of biomarkers in predicting preeclampsia.
Dai *et al*., 2022	Doppler parameters of ophthalmic artery in women with preeclampsia: A meta-analysis	PubMed	Meta-Analysis	Five case-control and 3 cross-sectional studies	MV, PI, and EDV showed significant differences between patients with preeclampsia and non-hypertensive pregnant participants.	• No meta-regression or subgroup analysis • Insufficient data to analyse the effect of OA Doppler on assessing the severity of pre-eclampsia at different stages.
Naemi *et al*., 2023	Ophthalmic Artery Doppler Indices Changes in Preeclampsia	PubMed	Cross sectional study	148 pregnant women with gestation age 35 to 37 weeks	OA Doppler PR and PI between the two eyes were statistically different in those with PE.	None.
Kusuma *et al*., 2022	Ophthalmic artery Doppler for pre-eclampsia prediction at the first trimester: a Bayesian survival-time model	PubMed	Cross sectional study	946 pregnant women	Combination ophthalmic artery Doppler PR with the previously established biomarkers could improve the accuracy of early and preterm PE prediction at the first trimester screening.	Analyzed only the ophthalmic PR in prediction model.

the incident using historical data.[16,17]

Eman *et al*. and Zhu *et al*. conducted their research with a prospective observational cohort study design. There are various benefits and drawbacks to this prospective cohort research that need to be taken into account. The ability to match participants within groups to reduce the impact of confounding variables as well as the possibility, accessibility, and affordability of standardizing criteria and outcomes over randomized controlled trials (RCT) are benefits of this study. This study, however, contains flaws as well. Specifically, there is no randomization, thus patient features may be imbalanced, the group might be difficult to identify due to confounding study variables, and it takes longer to see results.[11,12,16,17]

A distinct form of case-control research is one that uses a cross-sectional study design. If patients cannot be recognized beforehand or if it is necessary to estimate the prevalence of the disease or condition, this form of design is utilized. Random samples of subjects are taken, and they are then categorized based on whether or not they have the ailment. The study then proceeds as though it were a standard case-control study from that point on. The prevalence odds ratio, often known as the odds ratio, may be calculated using prevalence statistics.[18,19]

Cross-sectional research was used to perform the study by Sarno *et al*., Naemi *et al*., and Kusuma *et al*. There are benefits and drawbacks to this study design. The study's advantages include its affordability, completeness with regard to important data points, accessibility to a range of results and exposure for researchers, information for descriptive analysis, and the fact that it lays the groundwork for future research opportunities. The drawbacks of this study include the fact that it is only useful if it accurately reflects the complete population, that a larger sample size is necessary for accuracy, that bias can impact results, that it provides no control over objectives or choices, and that it is unable to assess incidence.[18,19]

A statistical method called meta-analysis combines the findings of two or more research that are comparable in order to provide a combination of quantitative data. Systematic reviews, which include rigorous statistical analysis, are another name for meta-analysis. The study by Dai *et al*. used a meta-analysis methodology. The ability to promote methodical thinking regarding techniques, classification, population, interventions, results, and strategies to integrate evidence is one of this study's advantages. Additionally, combining data from different studies will improve generalization ability and statistical power, allowing for more confident interpretation of data about safety or danger. Finally, the results of a meta-analysis can help direct future research, including the necessary sample size.[20,21]

As a result of publication bias, meta-analyses that only include research that have been published may not accurately represent the state of the field because many studies with contradictory findings are either not published or are not submitted for publication. Additionally, the number of accessible pertinent papers significantly constrained the sample size in the meta-analysis.[21]

CONCLUSION

Study design refers to the procedures employed in a study to gather the data required to answer a question. This review of the literature analyzes the study designs of many recent investigations on ocular

artery Doppler in preeclamptic individuals. Six papers that satisfied the inclusion criteria and were located in the literature search results were evaluated in this study. Between 2020 and 2023, these investigations were published using a variety of research methods, including prospective observational cohort studies, cross-sectional studies, and meta-analysis studies. According to our findings, there are benefits and drawbacks to the various research designs that were employed. Future research should evaluate the benefits and drawbacks while choosing the study design.

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