Annals of Clinical Obstetrics and Gynecology

ISSN: 2694-491X

Research Article

Variations in Preeclampsia Prevalence among Zambians and Chinese Pregnant Women

Ying Xiao Yan[1], Kasonde Chanda[2] and Kong Yi Yan[2]*

[1]*Department of Obstetrics and Gynecology, 2nd Affiliated Hospital of Nanjing Medical University, China*

[2]*Department of Obstetrics and gynecology, Mansa General Hospital, Zambia*

Abstract

Background: Preeclampsia is one of the hypertensive conditions in pregnancy significantly affecting women worldwide. The definite cause is not yet known, but it has been linked to abnormal placentation. We sought to investigate the prevalence of preeclampsia and its association to maternal age, gravidity, parity and body mass index in black Zambians and Asian Chinese.

Methods: Retrospective cross-sectional observational study of 2030 (Asian Chinese=994 cases, black Zambians=1036 cases) obstetric cases randomly selected for the period January 1 to December 31, 2021. Data was collected from the hard copy and electronic inpatients' records. Analysis was performed using SPSS version 23. Descriptive analysis and logistic regression to determine the association of maternal characteristics with preeclampsia were done as required.

Results: The mean age (SD) in black Zambians was 26.8 (7.33) years and 30.1 (4.27) years in Asian Chinese. Prevalence of preeclampsia was 1.2% and 13.8% in Asian Chinese and black Zambians respectively. In black Zambians, there was significant association between parity and preeclampsia (adjusted odds ratio (AOR)=1.42, 95% CI 0.51-0.97, P=0.029). Significant association of body mass index with preeclampsia in both unadjusted and adjusted odds ratios among black Zambians [(unadjusted odds ratio (OR)=0.89, 95% CI 1.06-1.19, P=0.000), (Adjusted Odds Ratio (AOR)=0.89, 95% CI 1.06-1.19)]. For the Asian Chinese patients, there was significant association between body mass index and preeclampsia in both unadjusted and adjusted odds ratios [(unadjusted odds ratio (OR)=0.51, 95% CI 1.43-2.65, P=0.000), (Adjusted Odds Ratio (AOR)=0.51, 95% CI 1.43-2.65)]. Ethnicity was significantly associated with preeclampsia. The odds are 13.10 times higher (95% CI:7.22-23.78) for black Zambians to have preeclampsia, compared to the Asian-Chinese.

Conclusion: Prevalence rate of preeclampsia was higher in black Zambians than Asian Chinese patients. The association of ethnicity, parity and body mass index to preeclampsia may suggest the critical role by which genetic, social and cultural factors may play in preeclampsia origin. We advocate for more research in these areas to understand potential difference in the pathophysiology of preeclampsia.

Keywords: Preeclampsia; Black Zambians; Asian Chinese; Hypertensive conditions in pregnancy

Abbreviations

AOR: Adjusted Odds Ratio; MGH: Mansa general hospital; NMU: Nanjing Medical University; OR: Odds Ratio; SD: Standard Deviation; SPSS: Statistical Package for the Social Sciences; UTH: University Teaching Hospital; WHO: World Health Organization

Introduction

Preeclampsia is one of the hypertensive diseases in pregnancy causing significant morbidity and mortality. It affects 2% to 8% pregnancies and it's the second cause of maternal morbidity and mortality globally [1-3]. Definite cause of the disease has not been established but research has shown that preeclampsia results from reduced placental perfusion and impaired remodeling of the spiral arteries [2]. Some research has been done worldwide, of which some results have favored the correlation of preeclampsia to ethnicity/race, body mass index and parity [4-6].

Citation: Yan YX, Chanda K, Yan KY. Variations in Preeclampsia Prevalence among Zambians and Chinese Pregnant Women. Ann Clin Obstet Gynecol. 2023;2(1):1011.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Aug 09th, 2023

***Corresponding author:** Ying Xiao Yan, Department of Obstetrics and Gynecology, 2nd Affiliated Hospital of Nanjing Medical University, Jiangsu Province, China

In Zambia, the prevalence of preeclampsia has been reported to be at 12% [5], China at 2.3% [6]. Various factors have been implicated to the genesis of preeclampsia. These factors include nulliparity, ethnicity/race, multi-gestation pregnancy, advanced maternal age greater than 35 years old, *in-vitro* fertilization or other forms of assisted reproductive technology, maternal comorbidities (chronic hypertension, chronic kidney disease, diabetes mellitus, thrombophilia, obstructive sleep apnea, obesity with pre-pregnancy BMI greater than 30), family history, history of placental abruption or preeclampsia in a previous pregnancy, or intrauterine fetal growth restriction [7-8]. Poor management or failure to recognize preeclampsia can lead to long term complications. Survivors face a 2-fold increased risk of cardiovascular disease, and that risk can be seen within 3 to 5 years postpartum [9-11].

The aim of this study was to evaluate the risk of preeclampsia by maternal race/ethnicity, and also to explore the association of maternal age, gravidity, parity and body mass index to preeclampsia in black Zambians and Chinese women admitted at Mansa general hospital and second affiliated hospital of Nanjing medical University.

Methodology

Subjects

This was a two center, cross-sectional observational study of 2030 obstetrical cases. Nine Hundred ninety four patients were Asian Chinese from second affiliated hospital of Nanjing medical university (Nanjing city, China). One thousand thirty-six were black Zambians from Mansa district hospital (Mansa district, Zambia). This was for

the period January 1, 2021 to December 31, 2021. The selection was done by probability sampling methods which included simple random sampling and systematic sampling methods. Our study included all patients admitted to the hospital obstetric ward. Information about the cases was electronically and manually recorded, including general condition, medical history, pregnancy history and complications.

Data extraction

Data was collected from the hard copy files and electronic inpatients' medical records. These records had all the information required for the study including patient history, physical examination, investigations and relevant management. For analysis purposes, pregnancy complications were categorized into infection related, obstetric and medical.

Covariates

Covariates were selected based on their associations with the risk of preeclampsia. They included maternal biological factors i.e., maternal age, gravidity, parity, body mass index and ethnicity. Maternal age was classified in categories as <18 years, 18 to 25 years, 26 to 30 years, 31 to 35 years and >35 years. Gravidity was classified as gravida 1, gravida 2, gravida 3 and gravida >3. Parity was categorized as para o, para 1 and para >1. Body mass index was categorized as <18.5 kg/m^2, 18.5 kg/m^2-24.9 kg/m^2, 25 kg/m^2-29.9 kg/m^2 and ≥ 30 kg/m^2.

Statistical analysis

Statistical analysis was performed using SPSS software version 23. For descriptive analysis, Mean and Standard Deviation (SD) for normally distributed continuous variables were calculated accordingly. Differences in maternal characteristics (continuous variables) by ethnic groups (black and Chinese) was analyzed by the independent sample t test. Prevalence of Preeclampsia by maternal characteristics and ethnicity were expressed using the frequency tables as required. We applied logistic regression model to analyze the association between maternal age, gravidity, parity, body mass index and preeclampsia. The association of ethnicity and preeclampsia was analyzed by the Chi square test. We estimated the ORs and 95% CIs for preeclampsia for each maternal characteristic as required of which later we adjusted the values. Confidence interval was set at 95% and P<0.05 (2-tailed) was considered statistically significant.

Ethics statement

The study and raw patient data access was approved by the hospital research committees. Informed consent for patients was waived because of the retrospective nature of the study. The data used in the study was anonymized before its use.

Results

A total of 2030 pregnant women were analyzed of which 994 were Asian Chinese and 1036 were black Zambian patients. Proportions of preeclampsia was at 1.2% (12/994 cases) and 13.8% (143/1036 cases) for Asian Chinese and black Zambians respectively as shown in Figure 1.

For the black Zambians, majority of preeclampsia cases were in the 18 to 25 years range. For the Chinese, more cases were seen in the 26 to 30-year age category. Black Zambians had higher cases of preeclampsia for extreme age groups (<18 years=1.4%, >35 years= 15.4%) than the Chinese who had no case in these age groups. G>3 black Zambians had high proportion of cases (40/1%) while

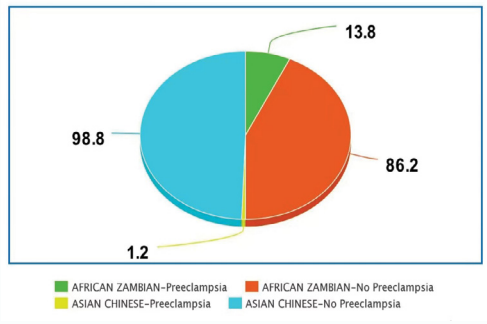

Figure 1: Proportion of preeclampsia by ethnicity/race (%).

the Chinese patients' high preeclampsia cases were seen in G1 category (33.3%). Black Zambians with P>1 had high proportion of preeclampsia (70.6%) than the Chinese who had no case in this category. Underweight (9.1%), overweight (11.2%) and obesity (8.4%) proportions were higher in black Zambians as compared to Chinese. Chinese had higher proportion (83.3) of patients with normal BMI. Detailed preeclampsia distribution by maternal characteristics is shown on Table 1 below.

Table 1: Distribution of preeclampsia cases by maternal characteristics.

	Black Zambians	Asian Chinese
	143 cases	12 cases
Variables	n (%)	n (%)
Age group (years)		
<18	2 (1.4)	0 (0.0)
18-25	72 (50.3)	1 (8.3)
26-30	29 (20.3)	6 (50.0)
31-35	18 (12.6)	5 (41.7)
>35	22 (15.4)	0 (0.0)
Gravidity		
Gravida 1	24 (16.8)	4 (33.3)
Gravida 2	23 (16.1)	4 (33.3)
Gravida 3	38 (26.6)	1 (8.3)
Gravida >3	58 (40.1)	3 (25.0)
Parity		
Para 0	24 (16.8)	7 (58.3)
Para 1	18 (12.6)	5 (41.7)
Parity >1	101 (70.6)	0 (0.0)
BMI (kg/m^2)		
<18.5-underweight	13 (9.1)	1 (8.3)
18.5-24.9-normal	102 (71.3)	10 (83.3)
25-29.9-0verweight	16 (11.2)	0 (0.0)
≥ 30-obese	12 (8.4)	1 (8.3)

Differences in maternal characteristics by ethnicity/race

For our study, all maternal characteristics were significantly different between the black Zambians and the Asian Chinese (P=0.000). Maternal mean age SD was lower in black Zambians 26.8 (7.33) years than in Asian Chinese 30.1 (4.27) years. Significant extreme age groups for our study were seen in black Zambians (<18 years=6.1%, >35=40.6%) compared to Asian Chinese (<18=0.3%, >35=11.2%). Black Zambians had more gravida 3 (40.6%) and parity >1 (60.8%) compared to the Chinese with gravida >3 (16.5%) and parity >1 (2.5%). Chinese had more gravida 1 (40.0%) and para 0 (58.2%) compared to black Zambians with gravida 1 (24.3%) and para 0 (24.3%). Underweight and obesity were more in black Zambians (<18.5 kg/m^2=2.7%, ≥ 30 kg/m^2=5.4%) than for Asian-Chinese (<18.5 kg/m^2=0.5%, ≥ 30 kg/m^2=0.9%). Details for the differences in maternal characteristics by ethnicity are shown in Table 2.

Table 2: Differences in maternal characteristics by ethnicity/race.

Variables	Overall N=2030 n (%)	Black Zambians N=1036 n (%)	Asian Chinese N=994 n (%)	x̄±SD Black Zambian	x̄±SD Asian Chinese	P value
Age group (years)				26.8±7.33	30.1±4.27	0
<18	66 (3.3)	63 (6.1)	3 (0.3)			
18-25	594 (29.3)	465 (44.9)	129 (13.0)			
26-30	599(29.5)	176 (17.0)	423 (42.6)			
31-35	497 (24.5)	169 (16.3)	328 (33.0)			
>35	274 (13.5)	421 (40.6)	111 (11.2)			
Gravidity				3.4 ± 2.06	2.2 ± 1.37	0
G 1	650 (32.0)	252 (24.3)	398 (40.0)			
G 2	437 (21.5)	154 (14.9)	283 (28.5)			
G 3	358 (17.6)	209 (20.2)	149 (15.0)			
G >3	585 (28.8)	421 (40.6)	164 (16.5)			
Parity				2.1 ± 1.66	0.4 ± 0.55	0
P 0	831 (40.9)	252 (24.3)	579 (58.2)			
P 1	544 (26.8)	154 (14.9)	390 (39.2)			
P >1	655 (32.3)	630 (60.8)	25 (2.5)			
BMI (kg/m^2)				24.7 ± 4.54	23.8 ± 2.65	0
<18.5-underweight	33 (1.6)	28 (2.7)	5 (0.5)			
18.5-24.9-normal	1247 (61.4)	553 (53.4)	694 (69.8)			
25-29.9-0verweight	685 (33.7)	399 (38.5)	286 (28.8)			
≥ 30-obese	65 (3.2)	56 (5.4)	9 (0.9)			

Association of maternal characteristics with preeclampsia

For the black Zambians, there was significant association between parity and preeclampsia (adjusted odds ratio (AOR)=1.42, 95% CI 0.51-0.97, P=0.029). There was also significant association between body mass index and preeclampsia in both unadjusted and adjusted odds ratios among black Zambians [(unadjusted odds ratio (OR)=0.89, 95% CI 1.06-1.19, P=0.000), (Adjusted Odds Ratio (AOR)=0.89, 95% CI 1.06-1.19)]. For the Asian Chinese patients, there was significant association between body mass index and preeclampsia in both unadjusted and adjusted odds ratios [(unadjusted Odds Ratio (OR)=0.51, 95% CI 1.43-2.65, P=0.000), (Adjusted Odds Ratio (AOR)=0.51, 95% CI 1.43-2.65)]. Summary is shown in Table 3 below. For the association of ethnicity and preeclampsia, significant results have shown that odds are 13.10 times higher (95% CI:7.22-23.78) for black Zambians, compared to the Asian-Chinese as shown in Table 4.

Table 3: Logistic regression for the association of maternal characteristics with Preeclampsia.

	OR (95% CI)	P value	AOR (95% CI)	P value
African-Zambian				
No preeclampsia	Ref	Ref	Ref	Ref
Age	1.00 (0.98-1.02)	0.882	0.98 (0.96-1.08)	0.511
Gravidity	1.02 (0.90-1.06)	0.595	0.82 (0.89-1.68)	0.217
Parity	1.06 (0.85-1.04)	0.235	1.42 (0.51-0.97)	0.029
BMI	0.89 (1.06-1.19)	0	0.89 (1.06-1.19)	0
Asian-Chinese				
No preeclampsia	Ref	Ref	Ref	Ref
Age	0.93 (0.94-1.23)	0.313	0.93 (0.93-1.26)	0.327
Gravidity	1.03 (0.65-1.44)	0.873	1.26 (0.52-1.21)	0.289
Parity	0.67 (0.48-4.67)	0.485	0.70 (0.35-5.88)	0.622
BMI	0.51 (1.43-2.65)	0	0.51 (1.43-2.65)	0

Table 4: Association of Ethnicity with preeclampsia.

	OR	95% Confidence Interval Lower	95% Confidence Interval Upper	P value
Odds Ratio for				
(preeclampsia / no preeclampsia)	13	7.22	23.78	
				0
ETHNICITY	1.9	1.81	2.07	
African-Zambians				
Asian-Chinese	0.2	0.09	0.26	

Discussion

Prevalence of preeclampsia

The prevalence of preeclampsia was 13.8% for black Zambians similar to the findings of 12% [5]. For Asian Chinese, it was 1.2% similar to other studies which found the prevalence to be at 2.3% [6]. The differences in preeclampsia proportions in our study may reflect a high prevalence of risk factors among black Zambians than Asian Chinese patients. Mansa general hospital is located in Luapula province of Zambia where the majority of people in the catchment area live in rural areas. So poor socioeconomic status of people, cultural beliefs/myths, poverty and lack of education may lead to poor health seeking behaviors [12-15]. Community based programs to enhance awareness on the importance of preventing preeclampsia and other obstetric complications are paramount. Prophylaxis of preeclampsia with aspirin and calcium supplements can reduce the prevalence of preeclampsia [16]. Daily vegetable intake, fruit intake, and nutritional counseling during antenatal care have shown to be protective against preeclampsia [17].

Maternal characteristics

Overall, biological maternal factors differed significantly between the two groups. Black Zambians had mean (SD) maternal age of 26.8 (7.33) similar to other studies with mean of 28 years [18]. For the Asian Chinese, the maternal age mean (SD) was 30.1 (4.27) similar to the findings 27.4 for China [12]. Some of the reasons why Asian Chinese patients get pregnant at an older age could be to improve financial stability, completion of tertiary education and improve mental strength. There is also family pressure to get married and have children.

Black Zambians had higher proportions of patients who were <18 years and >35 years; increased gravidity of >3; increased parity of >1 and getting pregnant at an early age than the Asian Chinese patients. This may be due to various factors. About 17 percent of women begin sexual activity before they attain 15 years of age; while 69% begin sexual activity before they reach the age of 18, 34% of women have had a child by age 18 [13]. In many rural parts of black Zambia, many teenagers commence sexual activities due to culture, lack of education,

poverty, and family pressure.

In our research, we also noticed an increase in the number of primigravida patients among the Chinese (40.0%) than the black Zambians (24.3%). This could have been attributed to change of policy by the Chinese government in allowing couples to have more children.

Underweight and obesity were high among the black Zambians with underweight at 2.7% and obesity at 5.4% than the Chinese with underweight at 0.5% and obesity at 0.9%. The proportion of obesity among the Zambians was lower compared to the findings done in Lusaka urban region [14]. One possible explanation for the differences in BMI between black Zambians and Asian Chinese could be due to genetic, social and cultural variations. The type of food or diet and differences in physical maybe contributing factors. Promoting healthy living among communities is key.

Association of maternal characteristics with preeclampsia

According to our results, there was significant association between parity and preeclampsia after adjusting the odds ratio among the black Zambian patients. This means every increase in parity among the Zambians is associated with an increase of 1.42 in the odds of having preeclampsia. Our findings are similar to other studies which has shown that primiparity was approximately 2.4-fold elevated risk of causing pre-eclampsia [16,19,20]. Possible causes maybe complex pathways like immune maladaptation, angiogenic factor balance, oxidative stress and others.

Both unadjusted (crude) and adjusted models showed consistent significant association of body mass index and preeclampsia among the Zambian and Chinese patients. The odds of a Zambian patient having preeclampsia increased by 89% for every increase in body mass index. For the Chinese patients, the odds of having preeclampsia increased by 51% for every increase in body mass index. Many other studies have been done concerning this parameter and their results are similar to our findings [20,21]. Apart from being a risk of preeclampsia, many studies have shown that obesity is associated with other pregnancy complications, including fetal overgrowth, fetal malformations, spontaneous miscarriage, gestational diabetes, thromboembolic complications, stillbirth, preterm deliveries, cesarean section, and hypertensive complications [6]. Complex mechanisms in lipid profile alterations and insulin resistance are involved in the development of preeclampsia by obese pregnant women [22,23].

Our study has shown that odds of having preeclampsia are 13.10 times higher in black Zambian patients compared to Asian Chinese patients. Significant association of preeclampsia in black Zambians is seen. Relative risk was 1.94 for black Zambians and 0.15 for Asian Chinese. Our findings are similar to other research findings in the same context [17,24]. No concrete connection has been concluded in relation to ethnicity and preeclampsia. The causes may be multifactorial. A number of genetic variants, like Apo lipoprotein L1 are being studied as possible risk modifiers.

To the best of our knowledge, this is the first study comparing the association of maternal age, gravidity, parity, BMI and ethnicity to preeclampsia between black Zambians and Asian Chinese patients [25].

Conclusion

Findings showed high prevalence of preeclampsia in black Zambian than in Asian Chinese patients. Significant association of parity with preeclampsia was seen among the Zambian patients. Odds of having preeclampsia were higher in black Zambians than in Asian Chinese patients. Significant association of body mass index with preeclampsia was seen in each of the ethnic group. These variations between these groups could be due to differences in genetic, environmental or social factors in each particular region. We advocate for more research in these areas to understand potential difference in the pathophysiology of preeclampsia.

Ethics Approval and Consent to Participate

The study and raw patient data access was approved by the hospital research committees. Informed consent for patients was waived because of the retrospective nature of the study. The data used in the study was anonymized before its use.

Availability of Data and Materials

Data presented in this study can be provided upon request from the corresponding author. Due to public restrictions, data is not publicly available.

Competing Interests

There are no conflicts of interest regarding the publication of this paper.

Author Contribution

Concept, design and data analysis with interpretation were done by KC and YXY. Original draft of the manuscript was done by KC. KYY was involved in the interpretation of clinical data from Chinese language to English language. KC was responsible in the collection and organization of patient data for Mansa general hospital cases. After the review of the manuscript content by all authors, it was agreed that the final version be submitted for publication.

Acknowledgement

We are thankful to all the doctors and nurses in the department of Obstetrics and Gynecology at second affiliated hospital of Nanjing Medical University for the support rendered in this study.

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