

REPUBLIC OF CAMEROON

Paix – Travail - Patrie

MINISTRE DE
L'ENSEIGNEMENT SUPERIEUR

UNIVERSITE DE YAOUNDE I

FACULTE DE MEDECINE ET
DES SCIENCES BIOMEDICALES



REPUBLIC OF CAMEROON

Peace – Work - Fatherland

MINISTRY OF HIGHER
EDUCATION

THE UNIVERSITY OF YAOUNDE I

FACULTY OF MEDICINE AND
BIOMEDICAL SCIENCES

DEPARTMENT OF OBSTETRICS AND GYNAECOLOGY

RISK FACTORS OF COMPLICATIONS OF PREECLAMPSIA IN THE EARLY POST-PARTUM PERIOD: A CASE- CONTROL STUDY IN THREE HOSPITALS IN YAOUNDE

Thesis presented and publicly defended in partial fulfilment of the requirements for the award of
the Medicinae Doctor (MD) degree by:

Leyuga Senka'a Nchunu

Matricule: 17M064

SUPERVISOR

Pr. DOHBIT SAMA

Professor of Obstetrics and Gynaecology

CO-SUPERVISOR

Dr EBONG Cliford EBONTANE

*Senior lecturer of Obstetrics and
Gynaecology*

Dr MBOUA BATOUUM Veronique

*Senior lecturer of Obstetrics and
Gynaecology*

Academic year: 2023-2024

TABLE OF CONTENT

TABLE OF CONTENT.....	i
DEDICATION.....	iv
AKNOWLEDGEMENTS.....	vi
LIST OF THE ADMINISTRATIVE AND TEACHING STAFF OF THE FACULTY OF MEDICINE AND BIOMEDICAL SCIENCES YAOUNDE FOR THE 2023 / 2024 ACADEMIC YEAR.....	ix
THE PHYSICIANS' OATH.....	xxiii
ABSTRACT.....	xxiv
RESUMÉ.....	xxvi
LIST OF ABBREVIATIONS.....	xxix
LIST OF FIGURES.....	xxxii
LIST OF TABLES.....	xxxii
CHAPTER 1: INTRODUCTION.....	1
1.1 BACKGROUND.....	2
1.2 JUSTIFICATION AND RATIONALE OF THE STUDY.....	3
1.3 RESEARCH QUESTION.....	4
1.4 RESEARCH HYPOTHESIS.....	4
1.5 OBJECTIVES.....	4
1.6 DEFINITION OF KEY TERMS.....	4
CHAPTER 2: LITERATURE REVIEW.....	5
2.1. DEFINITION.....	6
2.2. EPIDEMIOLOGY.....	6
2.3. RISK FACTORS FOR PREECLAMPSIA.....	6
2.4. ETIOPATHOGENESIS AND PATHOPHYSIOLOGY.....	8
2.5. CLINICAL PRESENTATIONS AND WORKUP FINDINGS.....	17

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

2.6. MANAGEMENT OF PREECLAMPSIA.....	23
2.7. MONITORING IN POST-PARTUM PERIOD.....	33
2.8. REVIEW OF PUBLICATIONS.....	38
CHAPTER 3: METHODOLOGY.....	42
3.1. TYPE OF STUDY.....	43
3.2. SITE OF STUDY.....	43
3.3. DURATION OF STUDY.....	43
3.4. POPULATION OF STUDY.....	44
3.5. PROCEDURE.....	45
3.6. ETHICAL CONSIDERATIONS.....	48
CHAPTER 4: RESULTS.....	49
4.1. SOCIO-DEMOGRAPHIC PROFILE OF PARTICIPANTS.....	51
4.2. VARIATIONS ACROSS AGE GROUPS.....	52
4.3. OBSTETRIC AND MEDICAL HISTORY.....	55
4.4. CLINICAL AND PARACLINICAL FINDINGS.....	57
4.5. MANAGEMENT IN WOMEN WITH PE.....	59
4.6. OUTCOMES OF WOMEN WITH PE.....	60
4.7. FACTORS ASSOCIATED WITH COMPLICATIONS OF PE.....	62
4.8. PROPORTION OF COMPLICATIONS IN PE.....	65
4.9. RISK FACTORS FOR COMPLICATIONS IN WOMEN WITH PE.....	66
CHAPTER 5: DISCUSSION.....	67
5.1. LIMITATION OF THE STUDY.....	68
5.2. SOCIO-DEMOGRAPHIC DATA.....	68
5.3. OBSTETRIC CHARACTERISTICS.....	69
5.4. CLINICAL AND PARACLINICAL CHARACTERISTICS.....	70
5.5. FOETAL OUTCOMES.....	71

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

5.6. MATERNAL COMPLICATIONS AND PROPORTION OF COMPLICATIONS.....	71
5.6. RISK FACTORS OF COMPLICATIONS IN WOMEN WITH PREECLAMPSIA.....	72
CONCLUSION.....	73
RECOMMENDATIONS.....	75
REFERENCES.....	77
APPENDIX.....	84

DEDICATION

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

I dedicate this work to my lovely parents: Barrister NCHUNU Justice Sama and
Mrs Genkaha Florence epse NCHUNU

AKNOWLEDGEMENTS

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

I wish to extend my sincere appreciation and heartfelt gratitude to:

- ❖ God Almighty, who granted me strength, protection and grace to complete seven years of medical training.
- ❖ Professor DOHBIT Sama who accepted to supervise this study, provided pertinent guidance and mentoring for the realization of the work. Thank you for your endless sacrifices.
- ❖ Dr EBONG Clifford and Dr BATOUR Veronique, my co-supervisors, for their continuous support and diligence in mentoring me. Your rigor, quest for perfection and constant encouragement have been a good door to enter the world of obstetrics and gynaecology and research.
- ❖ Professor ZE MINKANDE Jacqueline, Dean of the Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, and the entire teaching, administrative and support staff.
- ❖ The President and honourable members of the jury for accepting to evaluate and ameliorate this work.
- ❖ The Directors of Yaoundé Central Hospital, Yaoundé Gynaeco-Obstetric and Paediatric and University Teaching Hospital Yaoundé, for giving us the permission and opportunity to carry out this study in these health facilities.
- ❖ My father, Barrister NCHUNU Justice, for being a role model and a strong support system, grooming me to the lady I am today. Thank you for your enormous sacrifice, training me till this stage and through medical school.
- ❖ Mr NCHUNU Alexander, who has always acted as a second father to me. Thank you for your support and timely advice.
- ❖ My mother Mrs NCHUNU Florence, for your support and continuous encouragement.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

- ❖ My siblings Mr Koyiela NCHUNU, Miss Semmamia NCHUNU, Miss Bisona NCHUNU, and my extended family for their presence and unconditional support.
- ❖ My mentors Dr. and Dr. Mrs NZOMETIA, Dr and Dr Mrs EKALI, and all academic seniors who positively impacted my stay at the Faculty of Medicine.
- ❖ Dr SIEWE Joseph for your availability to analyse my data.
- ❖ My classmates of the 49th batch of the Faculty of Medicine for our wonderful camaraderie.
- ❖ My sisters and friends of the Faculty of Medicine: Dr FONDZEWONG Larissa, Dr MENIEMOH Ranebel, Dr SAKE Joliecoeur, Dr KINYUY Faustina, Dr MAKWET Chirifatou, Dr AYENI Doris, Dr THOM Claude, Dr AWA Clavice, Dr EDEGEPANG Ranibelsoft, Dr FORLEMU Verra, and MABANG Yollande.
- ❖ My seniors; Dr EBAH Beckly, Dr SAYAP Elysee, Dr ASHU George, Dr DJONTU Steve, Dr MISSIBI Keren, Dr GWAN Emmanuel, Dr AKELEKE Ndah for your support and for proofreading my work.
- ❖ The entire UNITEJC family under the leadership of Bishop Joshua GHOGOMU.
- ❖ The Cameroon Christian Healthcare Fellowship, the Bible Club Yaoundé and all members of the 49th batch of the group whose impact and supports have been indelible.

**LIST OF THE ADMINISTRATIVE AND
TEACHING STAFF OF THE FACULTY OF
MEDICINE AND BIOMEDICAL SCIENCES
YAOUNDE FOR THE 2023 / 2024 ACADEMIC
YEAR.**

**LIST OF ADMINISTRATIVE AND TEACHING STAFF OF THE FACULTY OF MEDICINE
AND BIOMEDICAL SCIENCES YAOUNDE FOR THE 2023/2024 ACADEMIC YEAR.**

1. ADMINISTRATIVE STAFF :

Dean : Pr ZE MINKANDE Jacqueline

Vice- Dean in charge of Academic Affairs: Pr NTSAMA ESSOMBA Claudine Mireille

Vice- Dean in charge of Co-operation and Research: Pr ZEH Odile Fernande

Vice-Dean in charge of Student Affairs, statistics and student follow-up: Pr NGANOU Chris Nadège épouse GNINDJIO

Director of Student Affairs, academic affairs and Research: Dr VOUNDI VOUNDI Esther

Director of Administrative and Financial affairs: Mme ESSONO Effa Muriel Glawdis

General Coordinator of Specialization Cycle: Pr NJAMNSHI Alfred KONGNYU

Chief of Service, Finance: Mme NGAMLI NGOU Mireille Albertine épouse WAH

Chief of Service, Finance, Assistant: Mme MANDA BANA Marie Madeleine épouse ENGUENE

Chief of Service, Administration and Personnel: Pr SAMBA Odette NGANO épouse TCHOUAWOU

Chief of Service, Certificates: Mme ASSAKO Anne DOOBA

Chief of Service, Certificates, Assistant: Dr NGONO AKAM MARGA Vanina

Chief of Service, Student Affairs and Statistics: Mme BIENZA Aline

Chief of Service, Student Affairs and Statistics, Assistant: Mme FAGNI MBOUOMBO AMINA épouse ONANA

Chief of Service; Materials and Maintenance: Mme HAWA OUMAROU

Chief of Service; Materials and Maintenance, Assistant: Dr MPONO EMENGUELE Pascale épouse NDONGO

Interim Librarian-in-chief: Mme FROUSSILOU née MAME Marie-Claire

Stores accountant: M. MOUMEMIE NJOUNDIYIMOUN MAZOU

2. COORDINATORS OF SPECIALISATION CYCLES

Coordinator of Dentistry: Pr BENGONDO MESSANGA Charles

Coordinator of Pharmacy: Pr NTSAMA ESSOMBA Claudine

Coordinator of Intern cycle: Pr ONGOLO ZOGO Pierre

Coordinator of Specialization Cycle of Morbid Anatomy: Pr SANDO Zacharie

Coordinator of Specialization Cycle of Anaesthesiology and Intensive Care: Pr ZE MINKANDE Jacqueline

Coordinator of Specialization Cycle of General Surgery: Pr NGO NONGA Bernadette

Coordinator of Specialization Cycle of Gynaecology-Obstetrics: Pr DOHBIT Julius SAMA

Coordinator of Specialization Cycle of Internal Medicine: Pr NGANDEU Madeleine

Coordinator of Specialization Cycle of Paediatrics: Pr MAH Evelyn MUNGYEH

Coordinator of Specialization Cycle of Clinical Biology: Pr KAMGA FOUAMNO Henri Lucien

Coordinator of Specialization Cycle of Radiology-Medical Imaging: Pr ONGOLO ZOGO Pierre

Coordinator of Specialization Cycle of Public Health: Pr TAKOUGANG Innocent

Coordinator, Post-Graduate Education Program: Pr KASIA Jean Marie

Point focal project: Pr NGOUPAYO Joseph

Pedagogic Instructor CESSI: Pr ANKOUANE ANDOULO Firmin.

3. HONORARY DIRECTORS OF CUSS:

Pr. MONEKOSSO Gottlieb (1969-1978)

Pr. EBEN MOUSSI Emmanuel (1978-1983)

Pr. NGU LIFANJI Jacob (1983-1985)

Pr. CARTERET Pierre (1985-1993)

4. HONORARY DEANS OF FMBS

Pr. SOSSO Maurice Aurélien (1993-1999)

Pr. NDUMBE Peter (1999-2006)

Pr. TETANYE EKOE Bonaventure (2006-2012)

Pr. EBANA MVOGO Côme (2012-2015)

5. THE TEACHING STAFF

N°	NAME	GRADE	FIELD
DEPARTMENT OF SURGERY AND SPECIALTIES			
1	SOSSO Maurice Aurélien (HOD)	P	General Surgery
2	DJIENTCHEU Vincent de Paul	P	Neurosurgery
3	ESSOMBA Arthur (Interim HOD)	P	General Surgery
4	HANDY EONE Daniel	P	Orthopaedic Surgery
5	MOUAFO TAMBO Faustin	P	Paediatric Surgery
6	NGO NONGA Bernadette	P	General Surgery
7	NGOWE NGOWE Marcellin	P	General Surgery
8	OWONO ETOUNDI Paul	P	Anaesthesiology- Intensive care
9	ZE MINKANDE Jacqueline	P	Anaesthesiology- Intensive care
10	BAHEBECK Jean	AP	Orthopaedic Surgery
11	BANG GUY Aristide	AP	General Surgery
12	BENGONO BENGONO Roddy Stéphan	AP	Anaesthesiology- Intensive care
13	FARIKOU Ibrahima	AP	Orthopaedic Surgery
14	JEMEA Bonaventure	AP	Anaesthesiology- Intensive care
15	BEYIHA Gérard	AP	Anaesthesiology- Intensive care
16	EYENGA Victor Claude	AP	Surgery/Neurosurgery
17	GUIFO Marc Leroy	AP	General Surgery
18	NGO YAMBEN Marie Ange	SL	Orthopaedic Surgery
19	TSIAGADIGI Jean Gustave	SL	Orthopaedic surgery
20	BELLO FIGUIM	SL	Neurosurgery
21	BIWOLE BIWOLE Daniel Claude Patrick	SL	General Surgery
22	FONKOUÉ Loïc	SL	Orthopaedic surgery
23	KONA NGONDO François Stéphane	SL	Anaesthesiology- Intensive care
24	MBOUCHE Landry Oriole	SL	Urology
25	MEKEME MEKEME Junior Barthelemy	SL	Urology
26	MULUEM Olivier Kennedy	SL	Orthopaedic Surgery
27	SAVOM Eric Patrick	SL	General Surgery

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

28	AHANDA ASSIGA	SL	General Surgery
29	AMENGLE Albert Ludovic	SL	Anaesthesiology- Intensive care
30	BIKONO ATANGANA Ernestine Renée	SL	Neurosurgery
31	BWELE Georges	SL	General Surgery
32	EPOUPA NGALLE Frantz Guy	SL	Urology
33	FOUDA Jean Cédrick	SL	Urology
34	IROUME Cristella Raïssa BIFOUNA épouse NTYO'O NKOUOMOU	SL	Anaesthesiology- Intensive care
35	MOHAMADOU GUEMSE Emmanuel	SL	Orthopaedic surgery
36	NDIKONTAR KWINJI Raymond	SL	Anaesthesiology- Intensive care
37	NWAHA MAKON Axel Stéphane	SL	Urology
38	NYANIT BOB Dorcas	SL	Paediatric Surgery
39	OUMAROU HAMAN NASSOUROU	SL	Neurosurgery
40	ARROYE BETOU Fabrice Stéphane	L	Thoracic/ Cardiovascular Surgery
41	ELA BELLA Amos Jean-Marie	L	Thoracic Surgery
42	FOLA KOPONG Olivier	L	Surgery
43	FOSSI KAMGA GACELLE	L	Paediatric Surgery
44	GOUAG	L	Anaesthesiology- Intensive care
45	MBELE Richard II	L	Thoracic Surgery
46	MFOUAPON EWANE Hervé Blaise	L	Neurosurgery
47	NGOUATNA DJEUMAKOU Serge Rawlings	L	Anaesthesiology- Intensive care
48	NYANKOUE MEBOUINZ Ferdinand	L	Orthopaedic/Traumatology

DEPARTMENT OF INTERNAL MEDICINE AND SPECIALTIES

49	SINGWE Madeleine épse NGANDEU (HOD)	P	Internal Medicine /Rheumatology
50	ANKOUANE ANDOULO	P	Internal Medicine/Gastroenterology
51	ASHUNTANTANG Gloria Enow	P	Internal Medicine /Nephrology
52	BISSEK Anne Cécile	P	Internal Medicine /Dermatology
53	KAZE FOLEFACK François	P	Internal Medicine /Nephrology

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

54	KUATE TEGUEU Calixte	P	Internal Medicine /Neurology
55	KOUOTOU Emmanuel Armand	P	Internal Medicine /Dermatology
56	MBANYA Jean Claude	P	Internal Medicine /Endocrinology
57	NDJITOYAP NDAM Elie Claude	P	Internal Medicine/Gastroenterology
58	NDOM Paul	P	Internal Medicine /Oncology
59	NJAMNSHI Alfred KONGNYU	P	Internal Medicine /Neurology
60	NJOYA OUDOU	P	Internal Medicine /Gastroenterology
61	SOBNGWI Eugène	P	Internal Medicine /Endocrinology
62	PEFURA YONE Eric Walter	P	Internal Medicine /Pneumology
63	BOOMBHI Jérôme	AP	Internal Medicine /Cardiology
64	FOUDA MENYE Hermine Danielle	AP	Internal Medicine /Nephrology
65	HAMADOU BA	AP	Internal Medicine /Cardiology
66	MENANGA Alain Patrick	AP	Internal Medicine /Cardiology
67	NGANOU Chris Nadège	AP	Internal Medicine /Cardiology
68	KOWO Mathurin Pierre	AP	Internal Medicine/Gastroenterology
69	KUATE née MFEUKEU KWA Liliane Claudine	AP	Internal Medicine /Cardiology
70	NDONGO AMOUGOU Sylvie	AP	Internal Medicine /Cardiology
71	DEHAYEM YEFOU Mesmin	SL	Internal Medicine /Endocrinology
72	ESSON MAPOKO Berthe Sabine épouse PAAMBOG	SL	Internal Medicine /Oncology
73	ETOA NDZIE épouse ETOGA Martine Claude	SL	Internal Medicine/Endocrinology
74	MAÏMOUNA MAHAMAT	SL	Internal Medicine /Nephrology
75	MASSONGO MASSONGO	SL	Internal Medicine /Pneumology
76	MBONDA CHIMI Paul-Cédric	SL	Internal Medicine /Neurology
77	NDJITOYAP NDAM Antonin Wilson	SL	Internal Medicine/Gastroenterology
78	NDOBO épouse KOE Juliette Valérie Danielle	SL	Internal Medicine /Cardiology
79	NGAH KOMO Elisabeth	SL	Internal Medicine /Pneumology

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

80	NGARKA Léonard	SL	Internal Medicine /Neurology
81	NKORO OMBEDE Grâce Anita	SL	Internal Medicine /Dermatology
82	OWONO NGABEDE Amalia Ariane	SL	Internal Medicine /Interventional Cardiology
83	NTSAMAMA ESSOMBA Marie Josiane épouse EBODE	SL	Internal Medicine /Geriatrics
84	ATENGUENA OBALEMBA Etienne	SL	Internal Medicine /Oncology
85	FOJO TALONGONG Baudelaire	SL	Internal Medicine /Rheumatology
86	KAMGA OLEN Jean Pierre Olivier	SL	Internal Medicine /Psychiatry
87	MENDANE MEKOBE Francine épouse EKOBENA	SL	Internal Medicine /Endocrinology
88	MINTOM MEDJO Pierre Didier	SL	Internal Medicine /Cardiology
89	NTONE ENYIME Félicien	SL	Internal Medicine /Psychiatry
90	NZANA Victorine Bandolo épouse FORKWA MBAH	SL	Internal Medicine /Nephrology
91	ANABA MELINGUI Victor Yves	L	Internal Medicine /Rheumatology
92	EBENE MANON Guillaume	L	Internal Medicine /Cardiology
93	ELIMBY NGANDE Lionel Patrick Joël	L	Internal Medicine /Nephrology
94	KUABAN Alain	L	Internal Medicine /Pneumology
95	NKECK Jan René	L	Internal Medicine
96	NSOUNFON ABDOU WOUOLIYOU	L	Internal Medicine /Pneumology
97	NTYO'O NKOUMOU Arnaud Laurel	L	Internal Medicine /Pneumology
98	TCHOUankeu KOUNGA Fabiola	L	Internal Medicine /Psychiatry

DEPARTMENT OF MEDICAL IMAGING AND RADIOLOGY

99	ZEH Odile Fernande (HOD)	P	Radiology/Medical Imagery
100	GUEGANG GOUJOU. Emilienne	P	Medical Imagery/Neuroradiology
101	MOIFO Boniface	P	Radiology/Medical Imagery
102	ONGOLO ZOGO Pierre	AP	Radiology/Medical Imagery
103	SAMBA Odette NGANO	AP	Biophysics/Medical Physics
104	MBEDE Maggy épouse ENDEGUE	SL	Radiology/Medical Imagery

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

	MANGA		
105	MEKA'H MAPENYA Ruth-Rosine	SL	Radiotherapy
106	NWATSOCK Joseph Francis	SL	Radiology/Medical Imagery Nuclear Medicine
107	SEME ENGOUMOU Ambroise Merci	SL	Radiology/Medical Imagery
108	ABO'O MELOM Adèle Tatiana	L	Radiology/Medical Imagery

DEPARTMENT OF GYNAECOLOGY AND OBSTETRICS

109	NGO UM Esther Juliette épouse MEKA (HOD)	AP	Gynaecology/Obstetrics
110	FOUMANE Pascal	P	Gynaecology/Obstetrics
111	KASIA Jean Marie	P	Gynaecology/Obstetrics
112	KEMFANG NGOWA Jean Dupont	P	Gynaecology/Obstetrics
113	MBOUDOU Émile	P	Gynaecology/Obstetrics
114	MBU ENOW Robinson	P	Gynaecology/Obstetrics
115	NKWABONG Elie	P	Gynaecology/Obstetrics
116	TEBEU Pierre Marie	P	Gynaecology/Obstetrics
117	BELINGA Etienne	AP	Gynaecology/Obstetrics
118	ESSIBEN Félix	AP	Gynaecology/Obstetrics
119	FOUEDJIO Jeanne Hortence	AP	Gynaecology/Obstetrics
120	NOA NDOUA Claude Cyrille	AP	Gynaecology/Obstetrics
121	DOHBIT Julius SAMA	AP	Gynaecology/Obstetrics
122	MVE KOH Valère Salomon	AP	Gynaecology/Obstetrics
123	METO GO NTSAMA Junie Annick	SL	Gynaecology/Obstetrics
124	MBOUA BATOUR Véronique Sophie	SL	Gynaecology/Obstetrics
125	MENDOUA Michèle Florence épouse NKODO	SL	Gynaecology/Obstetrics
126	NSAH LAI Christiane JIVIR FOMU	SL	Gynaecology/Obstetrics
127	NYADA Serge Robert	SL	Gynaecology/Obstetrics
128	TOMPEEN Isidore	SL	Gynaecology/Obstetrics
129	EBONG Cliford EBONTANE	SL	Gynaecology/Obstetrics

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

130	MPONO EMENGUELE Pascale épouse NDONGO	L	Gynaecology/Obstetrics
131	NGONO AKAM Marga Vanina	L	Gynaecology/Obstetrics
DEPARTMENT OF OPHTHALMOLOGY/ ENT			
132	DJOMOU François (HOD)	P	ENT
133	EBANA MVOGO Côme	P	Ophthalmology
134	ÉPÉE Émilienne épouse ONGUENE	P	Ophthalmology
135	KAGMENI Gilles	P	Ophthalmology
136	NDJOLO Alexis	P	ENT
137	NJOCK Richard	P	ENT
138	OMGBWA EBALE André	P	Ophthalmology
139	BILLONG Yannick	AP	Ophthalmology
140	DOHVOMA Andin Viola	AP	Ophthalmology
141	EBANA MVOGO Stève Robert	AP	Ophthalmology
142	KOKI Godefroy	AP	Ophthalmology
143	MINDJA EKO David	AP	ENT/ Maxillo-facial surgery
144	NGABA Olive	AP	ENT
145	ANDJOCK NKOUO Yves Christian	SL	ENT
146	MEVA'A BIOUELE Roger Christian	SL	ENT/CFS
147	MOSSUS Yannick	SL	ENT/CFS
148	MVILONGO TSIMI épouse BENGONO Caroline	SL	Ophthalmology
149	NGO NYEKI Adèle-Rose épouse MOUAHA-BELL	SL	ENT/CFS
150	NOMO Arlette Francine	SL	Ophthalmology
151	AKONO ZOUA épouse ETEME Marie Evodie	SL	Ophthalmology
152	ASMAOU BOUBA Dalil	SL	ENT
153	ATANGA Léonel Christophe	SL	ENT/CFS
154	BOLA SIAFA Antoine	SL	ENT

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

155	NANFACK NGOUNE Chantal	SL	Ophthalmology
-----	------------------------	----	---------------

DEPARTEMENT OF PEDIATRICS

156	ONGOTSOYI Angèle épouse PONDY (HOD)	P	Paediatrics
157	KOKI NDOMBO Paul	P	Paediatrics
158	ABENA OBAMA Marie Thérèse	P	Paediatrics
159	CHIABI Andreas	P	Paediatrics
160	CHELO David	P	Paediatrics
161	MAH Evelyn	P	Paediatrics
162	NGUEFACK Séraphin	P	Paediatrics
163	NGUEFACK épouse DONGMO Félicitée	P	Paediatrics
164	NGO UM KINJEL Suzanne épse SAP	AP	Paediatrics
165	KALLA Ginette Claude épse MBOPI KEOU	AP	Paediatrics
166	MBASSI AWA Hubert Désiré	AP	Paediatrics
167	NOUBI Nelly épouse KAMGAING MOTING	AP	Paediatrics
168	EPEE épouse NGOUE Jeannette	SL	Paediatrics
169	KAGO TAGUE Daniel Armand	SL	Paediatrics
170	MEGUIEZE Claude-Audrey	SL	Paediatrics
171	MEKONE NKWELE Isabelle	SL	Paediatrics
172	TONY NENGOM Jocelyn	SL	Paediatrics

DEPARTMENT DE MICROBIOLOGY, PARASITOLOGY, HEMATOLOGY AND INFECTIOUS DISEASES

173	MBOPI KEOU François-Xavier (HOD)	P	Bacteriology/Virology
174	ADIOGO Dieudonné	P	Microbiology/Virology
175	GONSU née KAMGA Hortense	P	Bacteriology
176	LUMA Henry	P	Bacteriology/Virology
177	MBANYA Dora	P	Haematology
178	OKOMO ASSOUМОU Marie Claire	P	Bacteriology/Virology
179	TAYOU TAGNY Claude	P	Microbiology/Haematology

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

180	CHETCHA CHEMEGNI Bernard	AP	Microbiology/Haematology
181	LYONGA Emilia ENJEMA	AP	Medical Microbiology
182	TOUKAM Michel	AP	Microbiology
183	NGANDO Laure épouse MOUDOUTE	SL	Parasitology
184	BEYALA Frédérique	SL	Infectious Diseases
185	BOUM II YAP	SL	Microbiology
186	ESSOMBA Réné Ghislain	SL	Immunology
187	MEDI SIKE Christiane Ingrid	SL	Infectious Diseases
188	NGOGANG Marie Paule	SL	Clinical Biology
189	NDOUMBA NKENGUE Annick épouse MINTYA	SL	Haematology
190	VOUNDI VOUNDI Esther	SL	Virology
191	ANGANDJI TIPANE Prisca épouse ELLA	L	Clinical Biology /Haematology
192	Georges MONDINDE IKOMEY	L	Immunology
193	MBOUYAP Pretty Rosereine	L	Virology

DEPARTMENT OF PUBLIC HEALTH

194	KAMGNO Joseph (HOD)	P	Public Health /Epidemiology
195	ESSI Marie José	P	Public Health /Medical Anthropology
196	TAKOUGANG Innocent	P	Public Health
197	BEDIANG Georges Wylfred	AP	Medical Information Technology / Public Health
198	BILLONG Serges Clotaire	AP	Public Health
199	NGUEFACK TSAGUE	AP	Public Health /Biostatistics
200	EYEBE EYEBE Serge Bertrand	SL	Public Health /Epidemiology
201	KEMBE ASSAH Félix	SL	Epidemiology
202	KWEDI JIPPE Anne Sylvie	SL	Epidemiology
203	MOSSUS Tatiana née ETOUNOU AKONO	SL	Health promotion expert
204	NJOU MEMI ZAKARIAOU	SL	Public Health /Health Economics
205	ABBA-KABIR Haamit-Mahamat	L	Pharmacist

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

206	AMANI ADIDJA	L	Public Health
207	ESSO ENDALLE Lovet Linda Augustine Julia	L	Public Health
208	MBA MAADJHOU Berjauline Camille	L	Public Health /Nutritional Epidemiologist

DEPARTMENT OF MORPHOLOGIC-ANATOMOPATHOLOGIC SCIENCES

209	MENDIMI NKODO Joseph (HOD)	P	Anatomy Pathology
210	SANDO Zacharie	P	Anatomy Pathology
211	BISSOU MAHOP Josue	AP	Sport Medicine
212	KABEYENE OKONO Angèle Clarisse	AP	Histology/Embryology
213	AKABA Désiré	AP	Human Anatomy
214	NSEME ETOUCKEY Georges Eric	AP	Legal Medicine
215	NGONGANG Gilbert Frank Olivier	SL	Legal Medicine
216	MENDOUGA MENYE Coralie Reine Bertine épse KOUOTOU	SL	Anatomy Pathology
217	ESSAME Eric Fabrice	L	Anatomy Pathology

DEPARTMENT OF BIOCHEMISTRY

218	NDONGO EMBOLA épse TORIMIRO Judith (HOD)	P	Molecular Biology
219	PIEME Constant Anatole	P	Biochemistry
220	AMA MOOR Vicky Joceline	P	Clinical Biology/ Biochemistry
221	EUSTACE BONGHAN BERINYUY	SL	Biochemistry
222	GUEWO FOKENG Magellan	SL	Biochemistry
223	MBONO SAMBA ELOUMBA Esther Astrid	L	Biochemistry

DEPARTMENT OF PHYSIOLOGY

224	ETOUNDI NGOA Laurent Serges (HOD)	P	Physiology
225	ASSOMO NDEMBA Peguy Brice	AP	Physiology
226	AZABJI KENFACK Marcel	SL	Physiology
227	DZUDIE TAMDJA Anastase	SL	Physiology
228	EBELL'A DALLE Ernest Remy Hervé	SL	Human Physiology

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

DEPARTMENT OF PHARMACOLOGY AND TRADITIONAL MEDICINE			
229	NGONO MBALLA Rose ABONDO (HOD)	AP	African Pharmaco-therapeutics
230	NDIKUM Valentine	SL	Pharmacology
231	ONDOWA NGUELE Marc Olivier	L	Pharmacology
DEPARTMENT OF ORAL AND MAXILLO-FACIAL SURGERY AND PERIODONTOLOGY			
232	BENGONDO MESSANGA Charles (HOD)	P	Stomatology
233	EDOUMA BOHIMBO Jacques Gérard	AP	Stomatology and Surgery
234	LOWE NANTCHOUANG Jacqueline Michèle épouse ABISSEGUE	SL	Paediatric Dentistry
235	MBEDE NGA MVONDO Rose	SL	Dental medicine
236	MENGONG épouse MONEBOULOU Hortense	SL	Paediatric Dentistry
237	NDJOH Jules Julien	SL	Dental Surgery
238	NOKAM TAGUENNE M.E.	SL	Dental medicine
239	GAMGNE GUIADEM Catherine M	SL	Dental Surgery
240	KWEDI Karl Guy Grégoire	L	Dental Surgery
241	NIBEYE Yannick Carine Brice	L	Bacteriology
242	NKOLO TOLO Francis Daniel	L	Dental Surgery
DEPARTMENT OF PHARMACOGNOSY AND PHARMACEUTICAL CHEMISTRY			
243	NTSAMA ESSOMBA Claudine (HOD)	P	Pharmacognosy /Pharmaceutical Chemistry
244	NGAMENI Bathélémy	P	Phytochemistry/Organic Chemistry
245	NGOUPAYO Joseph	P	Phytochemistry/pharmacognosy
246	GUEDJE Nicole Marie	MC	Ethnopharmacology/Plant Biology
247	BAYAGA Hervé Narcisse	AS	Pharmacy
DEPARTMENT OF PHARMACOTOXICOLOGY AND PHARMACOKINETICS			
248	ZINGUE Stéphane (HOD)	MC	Pharmacy
249	FOKUNANG Charles	P	Molecular Biology
250	TEMBE Estella épse FOKUNANG	MC	Clinical pharmacology

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

251	ANGO Yves Patrick	AS	Chemistry of natural substances
252	NENE AHIDJO épouse NJITUNG TEM	AS	Neuro-pharmacology

**DEPARTMENT OF GALENICAL PHARMACY AND PHARMACEUTICAL
LEGISLATION**

253	NNANGA NGA Emmanuel (HOD)	P	Galenic Pharmacy
254	MBOLE Jeanne Mauricette épse MVONDO M.	CC	Quality Management, Quality Control of Health Production and Food
255	NYANGONO NDONGO Martin	CC	Pharmacy
256	SOPPO LOBE Charlotte Vanessa	CC	Quality Control of Drugs
257	ABA'A Marthe Dereine	AS	Drug Analysis
258	FOUMANE MANIEPI NGOUOPIHO Jacqueline Saurelle	AS	Pharmacology
259	MINYEM NGOMBI Aude Périne épouse AFUH	AS	Pharmaceutical Regulations

KEY

- **HOD**= Head of Department
- **P**= Professor
- **AP**= Associate Professor
- **SL**= Senior Lecturer
- **L**= Lecturer

THE PHYSICIANS' OATH

THE PHYSICIAN'S OATH

Declaration of Geneva adopted by the Geneva Assembly of the World Medical Association in Geneva, Switzerland, September 1948 and amended by the 22nd World Medical Assembly, Sydney, Australia (August 1968)

On admission to the medical profession:

I will solemnly pledge myself to consecrate my life to the service of humanity

I will give my teachers the respect and gratitude which is their due

I will practice my profession with conscience and dignity

The health of my patients will be my first consideration

I will respect secrets confided in me, even after the patient has died

I will maintain by all the means in my power the honour and noble traditions of the medical profession

My colleagues will be my brothers

I will not permit considerations of religion, nationality, race, party politics or social standing to intervene between my duty and my patient

I will maintain the utmost respect for human life from the time of conception, even under threat I will not use my medical knowledge contrary to the laws of humanity

I make these promises solemnly, freely and upon my honour

ABSTRACT

Background

Preeclampsia (PE) is a multisystem hypertensive disorder unique to pregnancy and constitutes one of the leading causes of maternal and foetal morbidity and mortality in developing countries through its complications. Preeclampsia remains a public health challenge, hence the objective of this research was to study the risk factors of complications in PE, specific to the mother.

Methods

We carried out an analytical case-control study with retrospective data collection. This study included all women who were admitted for preeclampsia in the maternities of the Yaoundé Gynaeco-Obstetric and Paediatric Hospital, the Yaoundé University Teaching Hospital and the Yaoundé Central Hospital. All preeclamptic women admitted from January 2022 to December 2023 were included in the study. Our cases were defined as preeclamptic women with maternal complications in the early post-partum period and controls were preeclamptic women without complications during our study period. Data was collected and analysed using R version 4.3.3. Multiple logistic regression model was used to investigate risk factors.

Results

Out of the 344 files of preeclamptic women obtained, we retained 97 cases and 194 controls. The mean age of participants was 28.4 ± 6.7 . Maternal complications were present in 37.8%. The main complications in this study were; eclampsia (79.4%), HELLP syndrome (24.7%) and placenta abruptio (9.3%). The factors that had statistical association with complications in preeclampsia were; older maternal age ($aOR=0.865$, 95% CI: 0.800-0.936]), number of antenatal consultations >5 ($aOR=0.711$, 95% CI: 0.575-0.877), alcohol consumption ($aOR=2.532$, 95% CI: 1.188-5.396) and having a new partner ($aOR=3.634$, 95% CI: 1.141-11.574).

Conclusion

This study identified risk and protective factors for complications in preeclampsia. As risk factors, we had alcohol consumption and having a new partner and the protective factors were; advanced maternal age and >5 antenatal consultations. The proportion of complication was 37.8%. High-risk women should be promptly identified by health personnels and preventive measures should be put in place during antenatal consultations.

Keywords: Risk factors, complications, preeclampsia, Cameroon.

RESUMÉ

Introduction

La prééclampsie (PE) est un trouble hypertensif multi-systémique unique à la grossesse et constitue l'une des principales causes de morbidité et de mortalité maternelles et fœtales dans les pays en développement en raison de ses complications. La prééclampsie reste un problème de santé publique, d'où l'objectif de cette recherche qui était donc d'étudier les facteurs de risque de complications de PE, spécifiques à la mère.

Méthodologie

Nous avons réalisé une étude cas-témoins analytique avec collecte rétrospective de données. Cette étude a inclus toutes les femmes qui ont été admises pour prééclampsie dans les maternités de l'hôpital gynéco-obstétrique et pédiatrique de Yaoundé, du CHU de Yaoundé et de l'hôpital central de Yaoundé. Toutes les femmes pré-éclamptiques admises de janvier 2022 à décembre 2023 ont été inclus dans l'étude. Nos cas ont été définis comme des femmes pré-éclamptiques avec des complications maternelles pendant la période post-partum précoce et les témoins étaient des femmes pré-éclamptiques sans complications pendant notre période d'étude. Les données ont été collectées et analysées à l'aide du logiciel R version 4.3.3. Un modèle de régression logistique multiple a été utilisé pour étudier les facteurs de risque.

Résultats

Sur les 344 dossiers de femmes pré-éclamptiques obtenus, nous avons retenu 97 cas et 194 témoins. L'âge moyen des participants était de $28,4 \pm 6,7$. Les complications maternelles étaient présentes dans 37,8% des participants. Les principales complications de cette étude étaient ; éclampsie (79,4 %), syndrome HELLP (24,7 %) et décollement placentaire (9,3 %). Les facteurs qui avaient une association statistique avec les complications de la prééclampsie étaient ; âge maternel avancer ($aOR = 0,865$, IC à 95 % : 0,800-0,936]), nombre de visites prénatales >5 ($aOR = 0,711$, IC à 95 % : 0,575-0,877), consommation d'alcool ($aOR = 2,532$, IC à 95 % : 1,188-5,396) et avoir un nouveau partenaire ($aOR = 3,634$, IC à 95 % : 1,141-11,574).

Conclusion

Cette étude a identifié les facteurs de risque et de protection des complications de la prééclampsie. Comme facteurs de risque, nous avions la consommation d'alcool et le fait d'avoir

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

un nouveau partenaire et les facteurs de protection étaient ; âge maternel avancé et >5 consultations prénatales. La proportion de complications était de 37,8 %. Les femmes à haut risque doivent être rapidement identifiées par le personnel de santé et des mesures préventives doivent être mises en place lors des consultations prénatales.

Mots-clés : Facteurs de risques, complications, prééclampsie, Cameroun.

LIST OF ABBREVIATIONS

- AKI: Acute Kidney Injury
ALAT: Alanine Amino Transferase
ANC: Antenatal Consultation
APO: Acute Pulmonary Oedema
ASAT: Aspartate Amino Transferase
BMI: Body Mass Index
BUN: Blood Urea Nitrogen
CKD: Chronic Kidney Disease
CVA: Cardiovascular Accident.
DIC: Disseminated Intravascular Coagulation
EGF: Epidermal Growth Factor
Eng: Endogoline
eNOS: Endothelial nitric oxide synthase
EOPE: Early onset Preeclampsia
GFR: Glomerular Filtration Rate
HDP: Hypertensive Diseases in Pregnancy
HELLP: Haemolysis, Elevated Liver enzymes; Low platelet
IUFD: Intra-uterine Foetal Demise
IUGR: Intra-uterine Growth Restriction
IV: Intravenous
kg: kilograms
LDH: Lactate Dehydrogenase
LOPE: Late-onset Preeclampsia
mg: milligram
MgSO₄: Magnesium Sulphate
PE: Preeclampsia
PIGF: Placental Growth Factor

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

SFlt-1: fms-like tyrosine kinase 1

TGF: Transforming Growth Factor

VEGF: Vascular Endothelial Growth Factor

WHO: World Health Organization

LIST OF FIGURES

Figure 1:Endothelial dysfunction and hypertension in PE[23].....	13
Figure 2:Pathophysiology of preeclampsia[24].....	17
Figure 3:Algorithm for antihypertensive treatment of PE[20].....	26
Figure 4:Classification of hypertension in pregnancy.....	37
Figure 5:Triage of participants.....	50

LIST OF TABLES

Table I: Diagnosis of "preeclampsia with severe features"[25].....	19
Table II:Socio-demographic characteristics of participants.....	51
Table III: Clinical findings by age of participants.....	52
Table IV: Paraclinical findings by age.....	53
Table V: Distribution of pregnancy outcome along age groups.....	54
Table VI: Comparison of obstetrics and medical history in both study groups.....	55
Table VII: Comparison of clinical and paraclinical findings in our study groups.....	57
Table VIII: Treatment and outcome in women in the exposed and non-exposed group.....	59
Table IX: Comparison of foetal outcomes in our study participants.....	60
Table X: Maternal complications in participants.....	61
Table XI: Association between sociodemographic characteristics and PE complications.....	62
Table XII: Association between obstetric characteristics and complications of PE.....	63
Table XIII: Distribution of proportion of complications.....	65
Table XIV: Multiple logistic regression model for risk factors of complications in pre-eclampsia	66

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Hypertensive disorders in pregnancy (HDP) are one of the three leading causes of maternal death in the world together with haemorrhage and infection[1]. About 10% of all pregnancies are complicated by hypertensive disorders and they represent the first medical problem according to the American College of Obstetricians and Gynaecologists[1]. Hypertension is defined by the World Health Organization (WHO) as a systolic blood pressure more than or equal to 140 mmHg and/or a diastolic blood pressure more or equal to 90 mmHg[2]. HDP causes approximately 14% of all maternal deaths worldwide and are more frequent in low and middle income countries where their incidence keeps rising[3]. HDP is a global public health concern both in developed and developing countries[4], however, the risk that women in developing countries die of HDP complications is approximately 300 times higher than that for women in developed countries. The World Health Organization (WHO) reported that 14.0% of global maternal deaths are attributed to HDP. In Latin American and Caribbean countries 25.7% of maternal deaths were due to HDP; in Asian and African countries, it contributed to 9.1% of maternal deaths and about 16% in sub-Saharan African countries[5]. In Cameroon, Tebeu *et al.* found 17.5% of maternal deaths related to hypertensive diseases in pregnancy in 2007 while Foumane et al found 22.4% in 2010[1].

Hypertensive disorders of pregnancy (HDP) refer to categories of conditions characterized by elevated blood pressure. It is classified as chronic hypertension, preeclampsia superimposed on chronic hypertension, gestational hypertension (GH), preeclampsia (PE) and eclampsia[6]. In the centre region of Cameroon, Mboudou E. *et al.* reported a prevalence of 8.2% with PE being the most frequent (77.9%), followed by GH (15.4%), superimposed PE (5.8%) and chronic hypertension CH (0.96%), with over 10.7% of the patients developing complications[7].

Preeclampsia is a complex, multi-organ progressive disorder of pregnancy. It affects approximately 2–8% of pregnancies globally[8]. According to the 2018 European Society of Cardiology (ESC) guidelines on the management of cardiovascular diseases during pregnancy, preeclampsia is defined as hypertension (blood pressure $\geq 140/90$ mm Hg) developing after 20 weeks' gestation accompanied by a new onset of significant proteinuria (> 0.3 g/24 H)[9]. It may be categorized as either early-onset (< 34 weeks' gestation) or late-onset (≥ 34 weeks' gestation)[10]. Preeclampsia is a multisystem disorder with a poorly known aetiology and is unique to pregnancy[4]. With a global prevalence of 4.6%, PE complicates about 6% - 10% of all

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

pregnancies in the United States and the incidence is believed to be even higher in underdeveloped countries[11]. A study conducted in Thailand by Kongwattanakul et al. showed an incidence of 9.6% with increased rate of neonatal complications such as low birthweight, neonatal asphyxia and stillbirths[12].

In Africa, PE affects about 10% of pregnancies[13]. Musa and al. found the incidence of PE at 8.8% after a study done at the Jos University Teaching Hospital in Nigeria with increased risk in patients who had previous preeclampsia/eclampsia(5.5%), $BMI > 25 \text{ kg/m}^2$ (3.8%) and nulliparity(0.9%)[14].

In Cameroon, PE occurs in about 4.9% to 7.7% of pregnancies[15]. Some severe features of preeclampsia include: systolic blood pressure $\geq 160 \text{ mmHg}$ or diastolic blood pressure $\geq 110 \text{ mmHg}$ measured on two occasions at least 4 h apart; impaired liver function; progressive renal insufficiency; thrombocytopenia; pulmonary oedema; and new-onset cerebral or visual disturbances[16]. A study carried out by Hortence et al. in Yaoundé found that 44.4% of their study population presented with complications: these complications included; eclampsia(31.8%), HELLP syndrome(8.4%), placenta abruptio(5.6%) and maternal death(3.3%)[17]. Preeclampsia, and the associated complications, remain a leading cause of foetal and maternal morbidity and mortality, and greatly increase the risk of iatrogenic preterm birth[18]. The risk of maternal death is increased by 3.73-fold in women with preeclampsia[19].

Even in high income countries with available resources, the rate of mortality and morbidity linked to PE is high, hence the need to better understand the underlying risk factors for adequate prevention.

1.2 JUSTIFICATION AND RATIONALE OF THE STUDY

Over the years, WHO has resorted to several means of preventing and combatting preeclampsia and its adverse effects on both mother and foetus. Foumane et al. in their study, carried out in Cameroon, reported HDP as the first cause of maternal mortality[7]. The prevalence of HDP in Cameroon is about 8.2% with preeclampsia at the lead with 77%. The complications of preeclampsia still pose a great problem in our setting, as it could have dire repercussions on maternal and foetal health. These complications have far-reaching consequences that extend well beyond the pregnancy and the immediate postpartum period. The pathophysiology of preeclampsia is poorly understood, and there is a need to continue to explore

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

the factors that put women at risk of developing the complications. Knowledge of these factors could constitute a valuable guide to clinicians in the management of these cases.

1.3 RESEARCH QUESTION

What are the risk factors associated with the development of complications in preeclampsia in the early post-partum period?

1.4 RESEARCH HYPOTHESIS

Some factors in preeclamptic women can predispose them to developing complications in the early post-partum period.

1.5 OBJECTIVES

❖ General objective

To study the risk factors of complications of preeclampsia in the early postpartum period.

❖ Specific objectives

1. Describe the socio-demographic and obstetric characteristics of patients with preeclampsia.
2. Determine the proportion of complications of preeclampsia.
3. Identify the risk factors associated with the development of complications in preeclampsia.

1.6 DEFINITION OF KEY TERMS

- **Preeclampsia:** Hypertension that occurs after 20 weeks of gestation in a woman with previously normal blood pressure; Systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg on two occasions at least 6 hours apart with Proteinuria of ≥ 0.3 g protein in a 24-hour urine specimen.
- **Risk factors:** Socio-demographic variables, clinical or paraclinical whose measure of association with complications is statistically significant ($p\text{-value} < 0.05$) with a confidence interval of 95%.
- **Complications:** Unfavourable evolution of a disease, health or medical treatment.
- **Severe PE:** PE with at least one criterion of severity.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

- **Early postpartum period:** This was considered in our study as the period from delivery of the foetus to 7days post-partum

CHAPTER 2: LITERATURE REVIEW

2.1. DEFINITION

Preeclampsia is defined as Hypertension that occurs after 20 weeks of gestation in a woman with previously normal blood pressure; Systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg on two occasions at least 6 hours apart with Proteinuria of ≥ 0.3 g protein in a 24-hour urine specimen[20]. This finding usually correlates with a finding of 1+ or greater on dipstick. However, a significant proportion of women develop systemic manifestations of preeclampsia, such as low platelets or elevated liver enzymes, before the hallmark of proteinuria is detectable resulting in delayed diagnosis. The evolving understanding of preeclampsia as a heterogeneous hypertensive disorder of pregnancy led ACOG's hypertension 2013 task force to revise the definition of preeclampsia to include the presence of severe features with or without proteinuria and to exclude the degree of proteinuria as a criterion of severe features. It is a major cause of maternal mortality and morbidity, preterm birth, perinatal death, and intrauterine growth restriction. Unfortunately, the pathophysiology of this multisystem disorder, characterized by abnormal vascular response to placentation, is still unclear.

2.2. EPIDEMIOLOGY

Pre-eclampsia is a multisystem disorder that complicates 3%–8% of pregnancies in Western countries 10% of first pregnancies and 20-25% of women with chronic hypertension[21,22]. It constitutes a major source of morbidity and mortality worldwide. Overall, 10%–15% of maternal deaths are directly associated with pre-eclampsia[23]. Some epidemiological findings support the hypothesis of a genetic and immunological aetiology. The risk of pre-eclampsia is 2-fold to 5-fold higher in pregnant women with a maternal history of this disorder[20]. Depending on ethnicity, the incidence of pre-eclampsia ranges from 3% to 7% in healthy nulliparas and 1% to 3% in multiparas[24].

2.3. RISK FACTORS FOR PREECLAMPSIA[25].

► Maternal Personal risk factors

- Black race

- Obesity (BMI ≥ 30)
- Nulliparity
- New partner/paternity
- Age younger than 18 years or older than 35 years
- History of preeclampsia
- Age of onset (Early-Onset)
- Family history of preeclampsia in a first-degree relative
- Interpregnancy interval less than 2 years or longer than 10 years

► **Maternal medical risk factors:**

- Chronic hypertension
- Preexisting diabetes
- Renal disease
- Systemic lupus erythematosus
- Thrombophilia
- History of migraine

► **Placental/foetal risk factors for preeclampsia:**

- Multiple gestations
- Hydrops fetalis

- Gestational trophoblastic disease
- Triploidy

➤ **Paternal-specific factors**

- First-time father
- Previously fathered a preeclamptic pregnancy in another woman

2.4. ETIOPATHOGENESIS AND PATHOPHYSIOLOGY

Pre-eclampsia has a complex pathophysiology, the primary cause being abnormal placentation. Defective invasion of the spiral arteries by cytotrophoblast cells is observed during pre-eclampsia[20].

During normal pregnancy, the villous cytotrophoblast invades the inner third of the myometrium, and spiral arteries lose their endothelium and most of their muscle fibres. These structural modifications are associated with functional alterations, such that spiral arteries become low-resistance vessels, and thus less sensitive, or even insensitive, to vasoconstrictive substances.

2.4.1. STRUCTURE AND ROLE OF THE PLACENTA

The placenta and associated extraembryonic membranes are formed from the zygote at the start of each pregnancy, and thus have the same genetic composition as the foetus. The two principal tissue sources are the trophectoderm that forms the wall of the blastocyst, and the underlying extraembryonic mesoderm. The trophectoderm differentiates into trophoblast, which in turn forms the epithelial covering of the placenta and also gives rise to the subpopulation of invasive extra villous trophoblast cells. The extraembryonic mesoderm forms the stromal core of

the placenta, from which originate the fibroblasts, vascular network and resident macrophage population.

The mature placenta is a roughly discoid organ, on average 22 cm in diameter, 2.5 cm thick at the centre and weighing approximately 500 grams. Its surfaces are the chorionic plate that faces the foetus and to which the umbilical cord is attached, and the basal plate that abuts the maternal endometrium. Between these plates is a cavity, the intervillous space, into which 30–40 elaborately branched foetal villous trees project. Each villous tree arises from a stem villus attached to the deep surface of the chorionic plate, and branches repeatedly to create a globular lobule 1–3 cm in diameter. The centre of a lobule is located over the opening of a maternal spiral artery through the basal plate. Maternal blood released at these openings, percolates between the villous branches before draining into openings of the uterine veins and exiting the placenta. Each lobule thus represents an independent maternal–foetal exchange unit.

The final branches of the villous trees are the terminal villi. These present a surface area of 12–14 m² at term, and are richly vascularized by a foetal capillary network. The capillaries display local dilations, referred to as sinusoids, which bring the endothelium into close approximation to the covering of the trophoblast. This is locally thinned, and the diffusion distance between the maternal and foetal circulations may be reduced to as little as 2–3 µm. The morphological resemblance of these structures, termed vasculosyncytial membranes, to the alveoli of the lung has led to the assumption that they are the principal sites of maternal–foetal exchange. Terminal villi are formed primarily from 20 weeks of gestation onwards, and elaboration of the villous trees continues until term. For effective transplacental exchange, there must be matched perfusion in the maternal and foetal placental circulations, especially for those hydrophobic molecules whose transfer is ‘flow-limited’. Establishing the maternal circulation to a haemochorionic placenta, such as the human, where the maternal–foetal interface is represented by maternal blood bathing the trophoblast surface is a major haemodynamic challenge. It requires the trophoblast to tap into branches of the maternal uterine arteries that carry blood at a higher pressure than the foetus can ever generate. Hence, there is a danger that the foetal capillaries within the terminal villi will be compressed, impeding the umbilical circulation and preventing the formation of vasculosyncytial membranes. Equally, the high velocity of maternal arterial blood flow can potentially cause mechanical damage to the delicate villous trees, with

high shear rates also causing oxidative stress. In many mammals, these dangers are avoided as there is either no or only limited invasion of the maternal tissues by the trophoblast, so-called epitheliochorial and endotheliochorial placentation respectively. The trophoblast is simply opposed to the uterine epithelium or the underlying stromal matrix, and the maternal blood is retained within the uterine vascular network. In all mammals, the uterine arteries undergo dilation during pregnancy to meet the metabolic demands of the foetoplacental unit, and this is mediated by a combination of endocrine and local flow-dependent responses. In addition, in those species with a haemochorionic placenta the final branches that deliver the blood to the placenta undergo considerable remodelling, resulting in their dilation as they approach the organ. In the human, data collected from pregnant hysterectomies near term indicate the diameter of the spiral arteries increases from approximately 0.5 mm at the endometrium/myometrium boundary to approximately 2.4 mm at their opening through the basal plate. Mathematical modelling based on these dimensions predicts that as a consequence the velocity of maternal blood flow will reduce by an order of magnitude, from $2\text{--}3 \text{ m s}^{-1}$ to approximately 10 cm s^{-1}

The remodelling process involves the loss of smooth muscle cells from the walls of the spiral arteries, either through dedifferentiation or apoptosis, and their replacement by an inert, amorphous fibrinoid material. The molecular mechanisms involved are still unclear, but it is now recognized that there is an initial phase of endocrine priming followed by a second phase that is dependent on the presence of extra villous trophoblast cells. The cells proliferate and then migrate away from the placenta, either down the lumens of the spiral arteries or through the endometrial stroma. Along the latter pathway, they interact with maternal immune cells, particularly the uterine natural killer (uNK) cells of the innate immune system. It is thought that upon appropriate stimulation, uNK release proteases and cytokines that regulate trophoblast migration and mediate arterial remodelling.

Deficient remodelling of the spiral arteries has been associated with the “great obstetrical syndromes”. The mechanistic link is strongest in the case of pre-eclampsia, when the resultant malperfusion of the placenta is thought to cause oxidative stress. Oxidative stress can stimulate the release of pro-inflammatory cytokines and angiogenic regulators from the syncytiotrophoblast, which in turn leads to activation of the maternal endothelium and hence the pre-eclamptic syndrome.

2.4.2. PATHOPHYSIOLOGY

Preeclampsia is a systemic syndrome of pregnancy originating in the placenta. It is thought to be caused by inadequate placental cytotrophoblast invasion, followed by widespread maternal endothelial dysfunction. Research has demonstrated that excess quantities of the antiangiogenic factors soluble fms-like tyrosine kinase 1 (sFlt1) and soluble endoglin (sEng) are released by the placenta into maternal blood, causing widespread endothelial dysfunction that results in hypertension[26].

During normal pregnancy, the villous cytotrophoblast invades the inner third of the myometrium, and spiral arteries lose their endothelium and most of their muscle fibres. These structural modifications are associated with functional alterations, such that spiral arteries become low-resistance vessels, and thus less sensitive, or even insensitive, to vasoconstrictive substances.

Pre-eclampsia has a complex pathophysiology, the primary cause being abnormal placentation. Defective invasion of the spiral arteries by cytotrophoblast cells is observed during pre-eclampsia. Recent studies have shown that cytotrophoblast invasion of the uterus is a unique differentiation pathway in which the foetal cells adopt certain attributes of the maternal endothelium they normally replace. In pre-eclampsia, this differentiation process goes awry[27]. The abnormalities may be related to the nitric oxide pathway, which contributes substantially to the control of vascular tone. Moreover, inhibition of maternal synthesis of nitric oxide prevents embryo implantation. Increased uterine arterial resistance induces higher sensitivity to vasoconstriction and thus chronic placental ischemia and oxidative stress. This chronic placental ischemia causes foetal complications, including intrauterine growth retardation and intrauterine death. In parallel, oxidative stress induces release into the maternal circulation of substances such as free radicals, oxidized lipids, cytokines, and serum soluble vascular endothelial growth factor 1. These abnormalities are responsible for endothelial dysfunction with vascular hyperpermeability, thrombophilia, and hypertension, to compensate for the decreased flow in the uterine arteries due to peripheral vasoconstriction.

Endothelial dysfunction is responsible for the clinical signs observed in the mother, that is, impairment of the hepatic endothelium contributing to the onset of the HELLP (Haemolysis, Elevated Liver enzymes and Low Platelet count) syndrome, impairment of the cerebral

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

endothelium inducing refractory neurological disorders, or even eclampsia. Depletion of vascular endothelial growth factor in the podocytes makes the endotheliosis more able to block the slit diaphragms in the basement membrane, adding to decreased glomerular filtration and causing proteinuria. Finally, endothelial dysfunction promotes microangiopathic haemolytic anaemia, and vascular hyperpermeability associated with low serum albumin causes oedema, particularly in the lower limbs or lungs.

The crucial issue to understand is that the prime mover of pre-eclampsia is abnormal placentation. Two common theories appear to be interlinked, that is, a genetic theory and an immunological theory[28]. Several susceptibility genes may exist for pre-eclampsia. These genes probably interact in the haemostatic and cardiovascular systems, as well as in the inflammatory response. Some have been identified, and in candidate gene studies they have provided evidence of linkage to several genes, including angiotensinogen on 1-q42–43 and eNOS on 7q36; other main important loci are 2p12, 2p25, 9p13, and 10q22.1[29].

Pre-eclampsia can be perceived as an impairment of the maternal immune system that prevents it from recognizing the fetoplacental unit. Excessive production of immune cells causes secretion of tumour necrosis factor alpha which induces apoptosis of the extra villous cytotrophoblast[20]. The human leukocyte antigen (HLA) system also appears to play a role in the defective invasion of the spiral arteries, in that women with pre-eclampsia show reduced levels of HLA-G and HLA-E. During normal pregnancies, the interaction between these cells and the trophoblast is due to the secretion of vascular endothelial growth factor and placental growth factor by natural killer cells. High levels of soluble fms-like tyrosine kinase 1 (sFlt-1), an antagonist of vascular endothelial growth factor and placental growth factor, have been found in women with pre-eclampsia. Accordingly, assays of sFlt-1, placental growth factor, endoglin, and vascular endothelial growth factor, all of which increase 4–8 weeks before the onset of the disease, may be useful predictors of pre-eclampsia. Recent data show the protective role of heme oxygenase 1 and its metabolite, carbon monoxide, in pregnancy, and identify this as a potential target in the treatment of pre-eclampsia[30].

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

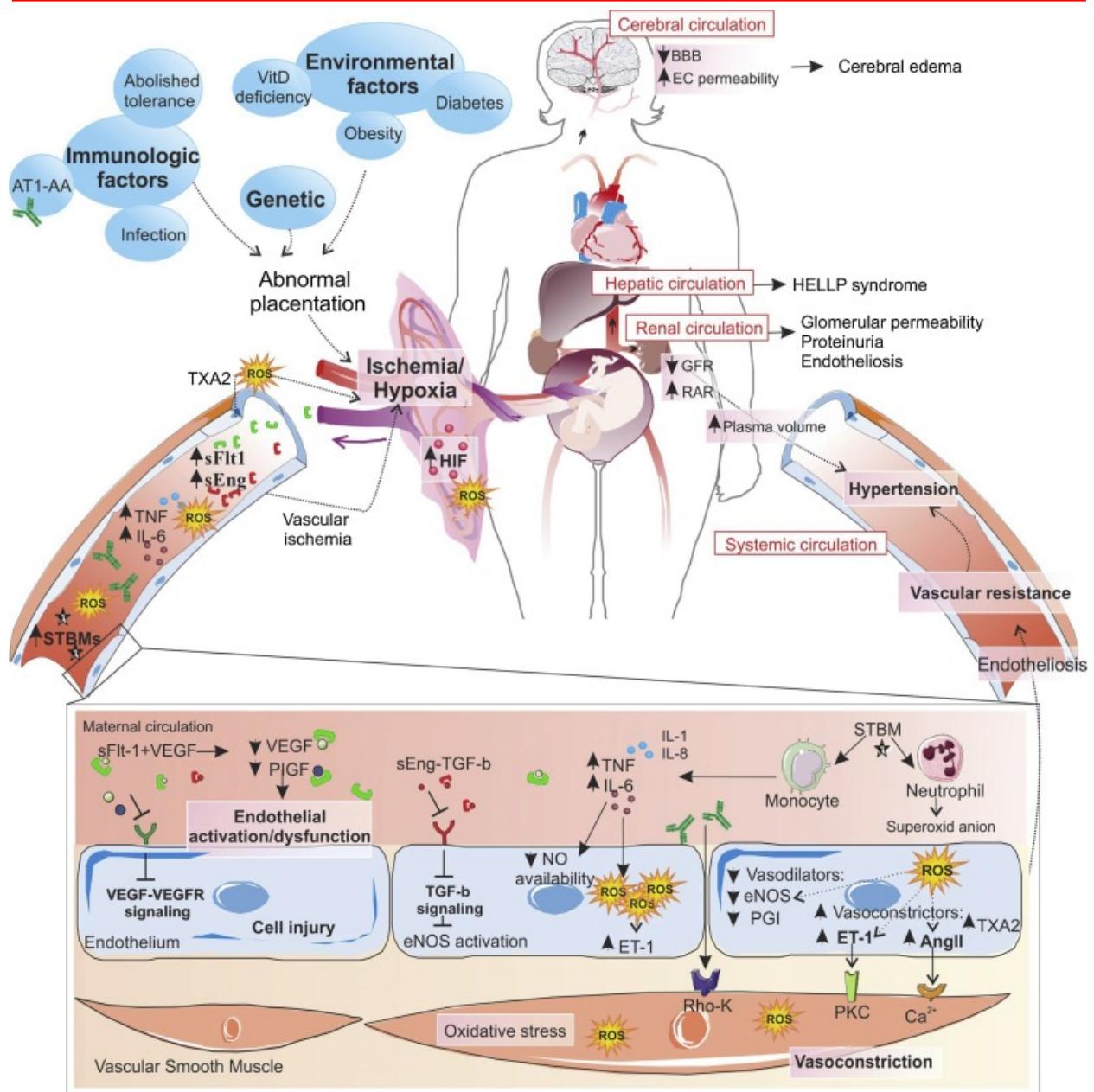


Figure 1: Endothelial dysfunction and hypertension in PE[31].

PLACENTAL VASCULAR DEVELOPMENT

Because the placenta is central to the pathogenesis of preeclampsia, research has focused on the association between abnormal placental vascular development and the development of this disease. During early normal placental development, extra villous cytotrophoblasts of foetal origin invade the uterine spiral arteries of the decidua and myometrium. These invasive

cytotrophoblasts replace the endothelial layer of the maternal spiral arteries, transforming them from small, high-resistance vessels into large-calibre capacitance vessels capable of providing adequate placental perfusion to nourish the foetus[32]. In preeclampsia, this transformation is incomplete. Cytotrophoblast invasion of the spiral arteries is limited to the superficial decidua, and the myometrial segments remain narrow. One group of investigators revealed the importance of adhesion molecules for the cytotrophoblast invasion process by finding that cytotrophoblast expression of adhesion molecules was abnormal in preeclamptic placentas. During normal placental development, cytotrophoblasts undergo pseudovasculogenesis, or vascular mimicry, to assume an endothelial phenotype. Pseudovasculogenesis occurs through the downregulation of adhesion molecules and the adoption of an endothelial cell–surface adhesion phenotype. In preeclampsia, cytotrophoblasts do not undergo this switching of cell-surface molecules and thus are unable to invade the myometrial spiral arterioles effectively. Angiogenic factors are thought to be important in the regulation of placental vascular development. Their receptors, Flt1 [also known as vascular endothelial growth factor receptor 1 (VEGFR-1)], VEGFR-2, Tie-1, and Tie-2, are essential for normal placental vascular development[33]. Alterations in the regulation and signalling of angiogenic proteinuria, and other systemic manifestations of preeclampsia. The molecular basis for placental dysregulation of these pathogenic factors remains unknown. The role of these antiangiogenic proteins in early placental vascular development and trophoblast invasion is just beginning to be explored. Hypoxia is likely to be an important regulator. Additionally, perturbation of the renin–aldosterone–angiotensin II axis, excessive oxidative stress, inflammation, immune maladaptation, and genetic susceptibility may all contribute to the pathogenesis of preeclampsia.

PLACENTAL ISCHEMIA AND HYPOXIA

Although incomplete remodelling of the uterine spiral arteries from partial cytotrophoblast invasion is a known precursor to preeclampsia development, it is unknown whether preeclampsia causes or results from placental hypoxia and ischemia. In pregnant primates and other mammals, constriction of uterine blood flow has been shown to induce hypertension and proteinuria. However, in these animal models, uterine ischemia does not lead to seizures or HELLP syndrome. Conversely, foetal growth restriction secondary to placental insufficiency frequently occurs without preeclampsia. Placental ischemia and hypoxia are often interrelated. Defective

trophoblast invasion and inadequate maternal spiral artery remodelling are common to both intrauterine growth restriction and preeclampsia. Paradoxically, cigarette smoking, an important risk factor for foetal growth restriction, is consistently associated with a reduced risk of preeclampsia[34]. Levels of circulating sFlt1 and sEng are significantly lower in women who smoke. Women with preeclampsia also have alterations in placental hypoxia-inducible factor (HIF) and its targets. Women residing at high altitudes have similar alterations in HIF, and the rates of preeclampsia in populations at high altitudes are two- to fourfold greater. Many angiogenic proteins, including Flt-1, VEGFR-2, Tie-1, and Tie-2, are targets of HIF-1 regulation[35]. These proteins are intimately linked to the regulation of normal placental vascular development. Invasive cytotrophoblasts express several other angiogenic factors regulated by HIF, including VEGF, PIGF, and VEGFR-1; expression of these proteins is altered in preeclampsia[36]. TGF- β 3, which has been shown to block cytotrophoblast invasion, is another HIF target. Hypoxia has been shown to upregulate the expression and secretion of sFlt1 protein in primary trophoblast cultures from first-trimester placentas[35]. In vivo experiments in mice strongly suggest that placental hypoxia contributes.

OXIDATIVE STRESS

From early pregnancy on, the placenta assumes a state of oxidative stress arising from increased placental mitochondrial activity and production of reactive oxygen species (ROS), mainly superoxide anions. In preeclampsia, a heightened level of oxidative stress is encountered. The source had been attributed to the placenta, where free radical synthesis occurs, with maternal leukocytes and the maternal endothelium likely contributors. The superoxide-producing enzyme NADPH oxidase, for example, is present in placental trophoblast[37]. Women with early-onset of preeclampsia have been found to have higher superoxide production compared with those with late-onset disease. However, clinical trials of antioxidant therapy with vitamins C (1000 mg) and E (400 IU) have been disappointing and were associated with an increased number of low-birth weight babies in the treatment arm[38]. It is not entirely clear if these doses, although superphysiologic, would be high enough to affect the ROS system. Higher doses, although permitted, were avoided in pregnancy to avoid unknown side effects.

PATHOLOGICAL CHANGES: LIVER, RENAL, AND CEREBRAL CHANGES

Pathologic analysis of the organs of women suffering from preeclampsia and eclampsia shows changes consistent with widespread hypoperfusion of organs. The liver and adrenals typically show infarction, necrosis, and intraparenchymal haemorrhage. The heart may reveal endocardial necrosis similar to that caused by hypoperfusion in hypovolemic shock. Injury to the maternal endothelium can be most clearly visualized in the kidney, which reveals the characteristic pathologic changes of preeclampsia. The term glomerular endotheliosis has been used to describe the ultrastructural changes in renal glomeruli, including generalized swelling and vacuolization of the endothelial cells and loss of the capillary space. There are subendothelial deposits of fibrin that decrease the filtration surface area. Electron microscopy shows loss of glomerular endothelial fenestrae, which leads to a 40% decline in glomerular filtration rate. In contrast to other nephrotic diseases, in preeclampsia endothelial cells appear primarily to be injured; podocyte injury is usually restricted to the focal fusion of foot processes. Recently, podocyturia was noted in women with preeclampsia; whether this is a cause or an effect of proteinuria is unknown. Although glomerular endotheliosis was once considered pathognomonic for preeclampsia, recent studies have shown that trace to mild glomerular endotheliosis may also occur at term during normal pregnancy. This finding suggests that the endothelial dysfunction of preeclampsia may be an exaggeration of a normal physiological process that occurs near the end of pregnancy. Cerebral oedema and intracerebral parenchymal haemorrhage are common autopsy findings in women who died from eclampsia. However, cerebral oedema in eclampsia does not correlate with the severity of hypertension, suggesting that oedema is secondary to endothelial dysfunction rather than a direct result of blood pressure elevation. Findings from head computed tomography scans and magnetic resonance imaging (MRI) are similar to those seen in hypertensive encephalopathy, with vasogenic cerebral oedema and infarctions in the subcortical white matter and adjacent gray matter, predominantly in the parietal and occipital lobes. An eclampsia-like syndrome with these characteristic MRI findings has been associated with other clinical scenarios, specifically acute hypertensive encephalopathy in the setting of renal disease or immunosuppression and following the use of antiangiogenic agents for cancer therapy. This syndrome is known as reversible posterior leukoencephalopathy or posterior reversible leukoencephalopathy syndrome (PRES). Its association with

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

antiangiogenic therapy supports the involvement of innate antiangiogenic factors in the pathophysiology of preeclampsia and eclampsia.

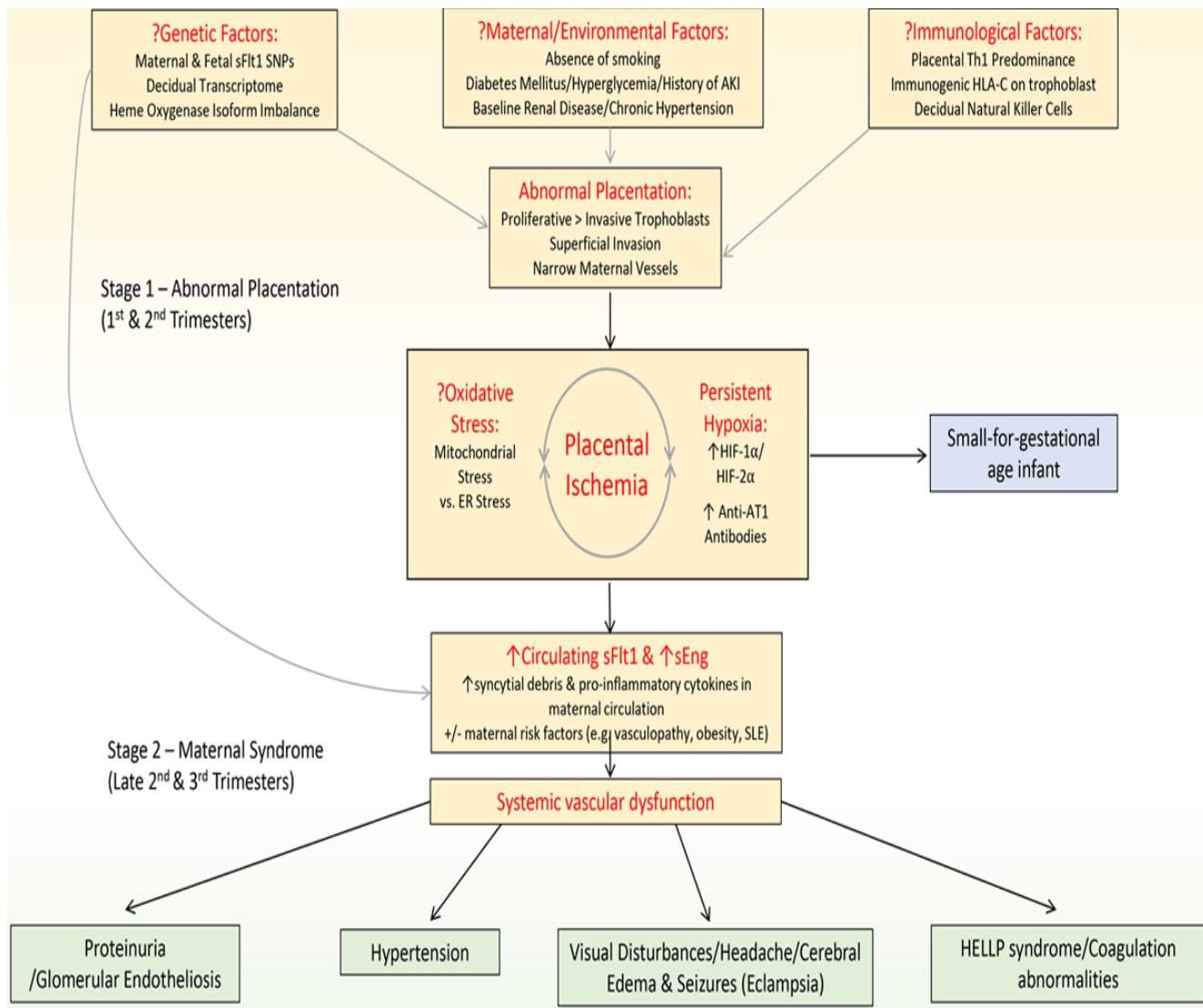


Figure 2: Pathophysiology of preeclampsia[39]

2.5. CLINICAL PRESENTATIONS AND WORKUP FINDINGS

Clinically, PE presents as new-onset hypertension in a previously normotensive woman, with systolic and diastolic blood pressure readings of ≥ 140 and ≥ 90 mmHg, respectively, on 2

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

separate occasions that are at least 6 hours apart, together with proteinuria that develops after 20 weeks of gestation.

The clinical presentation of preeclampsia may be insidious or fulminant. Some women may be asymptomatic at the time they are found to have hypertension and proteinuria; others may present with symptoms of severe preeclampsia, such as visual disturbances, severe headache, or upper abdominal pain.

In the absence of proteinuria, preeclampsia is also diagnosed if pregnant women meet diagnostic criteria for new-onset hypertension and have new onset of any of the following signs of end-organ damage:

- Thrombocytopenia (platelets < 100,000/mcL)
- Renal insufficiency (serum creatinine > 1.1 mg/dL or doubling of serum creatinine in women without renal disease)
- Impaired liver function (aminotransferases > 2 times normal)
- Pulmonary oedema
- New-onset headache (unresponsive to medication and not accounted for by alternative diagnoses)
- Visual symptoms

Preeclampsia with severe features may cause organ damage; these features may include;

- Severe headache
- Visual disturbances
- Confusion
- Hyperreflexia
- Epigastric or right upper quadrant abdominal pain (reflecting hepatic ischemia or capsular distention)
- Nausea and/or vomiting
- Dyspnoea (reflecting pulmonary oedema, acute respiratory distress syndrome [ARDS], or cardiac dysfunction secondary to increased afterload)
- Oliguria (reflecting decreased plasma volume or ischemic acute tubular necrosis)
- Stroke (rarely)

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

Laboratory tests include: a complete blood count with platelets, haptoglobin, and lactate dehydrogenase; a blood smear to test for schistocytes; bilirubin, aspartate transaminase, and alanine transaminase to identify potential HELLP syndrome; electrolyte, urea, and creatinine assessment to check for acute renal failure or uraemia; 24-hour proteinuria; prothrombin, activated thrombin time, and fibrinogen (microangiopathic haemolytic anaemia); blood group; and irregular antibody screening. The foetus should be assessed by electrocardiotocography. Other examinations include foetal ultrasound with Doppler velocimetry of the umbilical, cerebral, and uterine arteries, estimation of foetal weight, assessment of foetal well-being by Manning score, and examination of the placenta.

Table I: Diagnosis of "preeclampsia with severe features"[40]

Severe blood pressure elevation:
Systolic blood pressure ≥ 160 mmHg and/or diastolic blood pressure ≥ 110 mmHg on 2 occasions at least 4 hours apart while the patient is on bed rest; however, antihypertensive therapy generally should be initiated upon confirmation of severe hypertension, in which case criteria for severe blood pressure elevation can be satisfied without waiting until 4 hours have elapsed
Symptoms of central nervous system dysfunction:
New-onset cerebral or visual disturbance, such as: <ul style="list-style-type: none">▪ Photopsia, scotomata, cortical blindness, retinal vasospasm and/or▪ Severe headache (that is incapacitating, "the worst headache I've ever had") or headache that persists and progresses despite analgesic therapy with acetaminophen and is not accounted for by alternative diagnoses
Hepatic abnormality
Impaired liver function not accounted for by another diagnosis and characterized by serum transaminase concentration >2 times the upper limit of the normal range and/or Severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by an alternative diagnosis
Thrombocytopenia:
<ul style="list-style-type: none">• Platelet count $<100,000$ platelets/microL
Pulmonary oedema

Kidney function impairment:

- Serum creatinine >1.1 mg/dL [97.2 micromol/L]
and/or
- Doubling of the serum creatinine concentration in the absence of other kidney disease

✓ POTENTIAL LABORATORY FINDINGS

- Proteinuria – Proteinuria in preeclampsia can be defined as any of the following: ≥ 0.3 g protein in a 24-hour urine specimen. The completeness of the 24-hour urine collection can be estimated from creatinine excretion, which should be 15 to 20 mg/kg (133 to 177 micromol/kg) of lean body weight in females' Random urine protein to creatinine ratio ≥ 0.3 mg protein/mg creatinine (30 mg/mmol) (some clinicians opt to confirm the presence of ≥ 0.3 g protein with a 24- hour collection).
- The urine protein concentration in a spot sample is measured in mg/dL and is divided by the urine creatinine concentration, also measured in mg/dL. This value can be used to estimate the 24-hour protein excretion. Protein $\geq 2+$ on a paper test strip dipped into a fresh, clean voided midstream urine specimen (only if one of the above quantitative methods is not available. (2+ is equivalent to 100 to 300 mg/dL and performs better than 1+, which does not accurately detect or exclude the protein threshold for preeclampsia.
- Measurement of proteinuria is discussed in detail separately. Proteinuria generally increases as preeclampsia progresses, but increased urinary protein excretion may be a late finding. It usually remains 10 g/day and may be seen. Preeclampsia is the most common cause of severe proteinuria in pregnancy. Proteinuria is due, in part, to impaired integrity of the glomerular filtration barrier and altered tubular handling of filtered proteins (hypofiltration) leading to increased nonselective protein excretion. Both the size and charge selectivity of the glomerular barrier are affected. Using special studies, podocyturia (urinary excretion of podocytes) has been observed in patients with preeclampsia. Urinary shedding of podocytes may indicate podocyte loss from the glomerulus, which may lead to a disruption of the glomerular filtration barrier and consequent proteinuria. Deficient vascular endothelial growth factor (VEGF) signalling appears to account, at least in part, for these findings.
- Elevated creatinine

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

The physiologic increase in GFR during a normal pregnancy result in a decrease in serum creatinine concentration, which falls by an average of 0.4 mg/dL (35 micromol/L) to a range of 0.4 to 0.8 mg/dL (35 to 70 micromol/L). The serum creatinine concentration in patients with preeclampsia generally remains in this range or only slightly elevated. A creatinine level >1.1 mg/dL (97.3 micromol/L) concentration indicates the severe end of the disease spectrum. Some guidelines also include doubling of the patient's baseline creatinine in the absence of other renal disease as indicative of the severe end of the disease spectrum. Although creatinine levels remain severe bleeding, or severe liver dysfunction.

- Elevated liver chemistries

Liver chemistries are increased in patients at the severe end of the disease spectrum, which is characterized by elevated transaminase levels (defined as twice the upper limit of normal for the local laboratory). Abnormalities in liver chemistries are due to reduced hepatic blood flow from periportal and sinusoidal fibrin deposition and micro-vesicular fat deposition, potentially resulting in ischemia, necrosis, and periportal haemorrhage. Infrequently, subcapsular hematoma, hepatic failure, or rupture occurs.

- Elevation in the serum indirect bilirubin level suggests haemolysis. Hyperuricemia – The association between hyperuricemia and preeclampsia has been known for decades. The cause is most likely related to a reduction in GFR. However, the increase in serum uric acid is often greater than expected for mild reductions in GFR, leading to the hypothesis that decreased tubular secretion or increased reabsorption in the proximal renal tubules plays a role.
- Although meta-analyses have concluded that uric acid levels are not an accurate predictor of complications associated with preeclampsia, this issue remains controversial because of inconsistency among studies. For example, data from a prospective international study of patients admitted to the hospital with preeclampsia showed that serum uric acid corrected for gestational age is clinically useful in predicting adverse perinatal, but not maternal, outcomes.
- Other Troponin – Several studies have reported that cardiac troponin I can be elevated above the normal threshold. A very small subgroup of patients with severe preeclampsia may develop myocardial damage or global diastolic dysfunction.
- Urine sediment – The urine sediment is typically benign.

- Lipids – Total cholesterol and triglyceride levels are higher than in normotensive pregnant patients
- Neutrophilia – The white blood count may be slightly higher due to neutrophilia.
- Hypocalciuria – Hypocalciuria has been attributed to increased tubular reabsorption of calcium. Lower levels of parathyroid hormone, compared with normal pregnancy, have also been reported.

✓ **POTENTIAL SONOGRAPHIC FINDINGS**

- Foetal ultrasound – Preeclampsia that develops clinically before term is often associated with suboptimal foetal growth due to reduced uteroplacental perfusion. Foetal growth restriction (FGR) may be accompanied by oligohydramnios due to redistribution of the foetal circulation away from the kidneys and toward more vital organs, particularly the brain. Foetal hydrops are rarely observed and are the cause rather than the result of preeclampsia. Hydrops of any aetiology can be associated with preeclampsia-like symptoms and are called Mirror syndrome.
- Uterine and umbilical artery Doppler – Increased impedance to flow in the uterine arteries due to uteroplacental maldevelopment is manifested by elevation of the pulsatility index accompanied by uterine artery notching on uterine artery Doppler velocimetry. However, this finding is neither sensitive nor specific for preeclampsia.

Increased resistance in placental blood vessels is reflected by rising Doppler indices of the umbilical artery. Absent and reversed end diastolic flow are the most severe abnormalities and are associated with a poor perinatal outcome.

- Maternal hemodynamic imaging studies – Preeclampsia can be associated with a highly variable hemodynamic profile, including cardiac failure. Changes in cardiac function and morphology may be seen on echocardiography at an asymptomatic early stage and progress with increasing disease severity. Preeclampsia does not affect the myocardium directly, but the heart responds to physiologic changes induced by the disease. Left ventricular ejection fraction usually remains within normal limits, but reductions in longitudinal, circumferential, and radial systolic strain have been observed. Intravascular volume may be reduced in preeclampsia (especially with severe features) compared with a normal pregnancy. Activation of the renin-angiotensin-aldosterone system (RAAS)

increases vascular tone and renal reabsorption of sodium and water. In normal pregnancy, despite lower blood pressure compared with the nonpregnant state, the RAAS is upregulated, an appropriate physiologic response to vasodilation.

PREECLAMPSIA WITH SEVERE FEATURES

Preeclampsia with severe features is differentiated from mild forms by new onset of one or more of the following:

- Systolic BP > 160 mm Hg or diastolic BP > 110 mm Hg on 2 occasions \geq 4 hours apart
- Thrombocytopenia, platelet count < 100,000/mcL
- Serum aspartate aminotransferase (AST) or alanine aminotransferase (ALT) > 2 times normal
- Symptoms of liver capsule distention (right upper quadrant or epigastric pain)
- Progressive renal insufficiency (serum creatinine > 1.1 mg/dL or doubling of serum creatinine in women without renal disease)
- Pulmonary oedema
- Central nervous system (CNS) dysfunction (blurred vision, scotomata, altered mental status, severe headache unrelieved by acetaminophen)

2.6. MANAGEMENT OF PREECLAMPSIA

Delivery is the only curative treatment for pre-eclampsia. Management is multidisciplinary, involving an obstetrician, an anaesthetist, and a paediatrician. In some cases, consultation with maternal foetal medicine and hypertension or nephrology subspecialists may be required. Management decisions must balance the maternal risks of continued pregnancy against the foetal risks associated with induced preterm delivery. The criteria for delivery are based on two often interrelated factors, that is, gestational age at diagnosis (estimated foetal weight) and severity of pre-eclampsia.

2.6.1. TREATMENT OF MILD PREECLAMPSIA

- Hospitalization for further evaluation and delivery.

❖ \geq 37 weeks. Cervical status is assessed and, if favourable, induction is initiated.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

- ❖ GA = 34 – 36 weeks. Bed rest, antepartum foetal surveillance and close monitoring of maternal condition.
- ❖ ≤ 34 Weeks. Foetal lung maturation with corticosteroid. Bed rest, antepartum foetal surveillance and Close monitoring of maternal condition.
- Outpatient management is reasonable in carefully selected, reliable, asymptomatic patients with minimal proteinuria and normal laboratory test results.

Monitoring of outpatient:

- bed rest at home,
- daily foetal movement counts,
- twice-weekly antepartum testing,
- serial evaluation of foetal growth,
- frequent assessment of blood pressure, proteinuria, weight gain, patellar reflexes, and symptoms.

Any evidence of disease progression constitutes an indication for hospitalization and consideration of delivery

2.6.2. TREATMENT OF SEVERE PREECLAMPSIA

Aim of treatment:

- Reduce blood pressure values progressively till we have a systolic blood pressure value between 140-150 mmHg and a diastolic blood pressure value between 90-100mmHg.
- Prevent the onset of complications.
- Prolong pregnancy to prevent foetal complications such as prematurity.

Means and methods

1. Admission and Nursing care (Monitoring and Assessment of severity); Positioning, monitoring of vital signs, take IV-line, start collecting sample for laboratory investigation, Urinary catheter in place
2. Prevention of convulsion: Magnesium Sulphate is the drug of choice (Pritchard Regimen). It is indicated in the treatment of eclamptic convulsions as well as for secondary prevention of eclampsia, thus replacing treatment with diazepam, phenytoin, or the combination of chlorpromazine, promethazine, and pethidine. The efficacy of MgSO₄ in the reduction of maternal and neonatal complications of eclampsia is well established. It is administered as follows;

Loading Dose = 14g [4g IVD slowly (5 minutes), 5g IM per buttocks].

Maintenance Dose = 5g / 6 hours IM.

MgSO₄ treatment must be monitored because of the risk of organ failure. This monitoring is based on repeated checking for a Glasgow score of 15, tendon reflexes, respiratory frequency >12 per minute, and diuresis >30 mL/hour. Any manifestation of overdose requires stopping the infusion, considering injection of calcium gluconate (1g IVD), and measuring blood magnesium levels

3. Control of hypertension (Systolic < 160 mmHg and Diastolic < 110mmHg): The reduction of BP ensures the safety of the mother and child. The anti-hypertensive drugs recommended are;

- Calcium channel blockers: Nicardipine (Loxen®) by IV route and Nifedipine (Adalate®), whose sublingual form is contra-indicated in the treatment of PE.
- Beta-blockers and alpha-blockers: Labetalol (Trandate®) which permits the reduction of maternal BP without modification of the foetal heart rate.
- Central-acting antihypertensives: Methyldopa (Aldomet®) whose efficacy is inconstant in the severe state of PE.

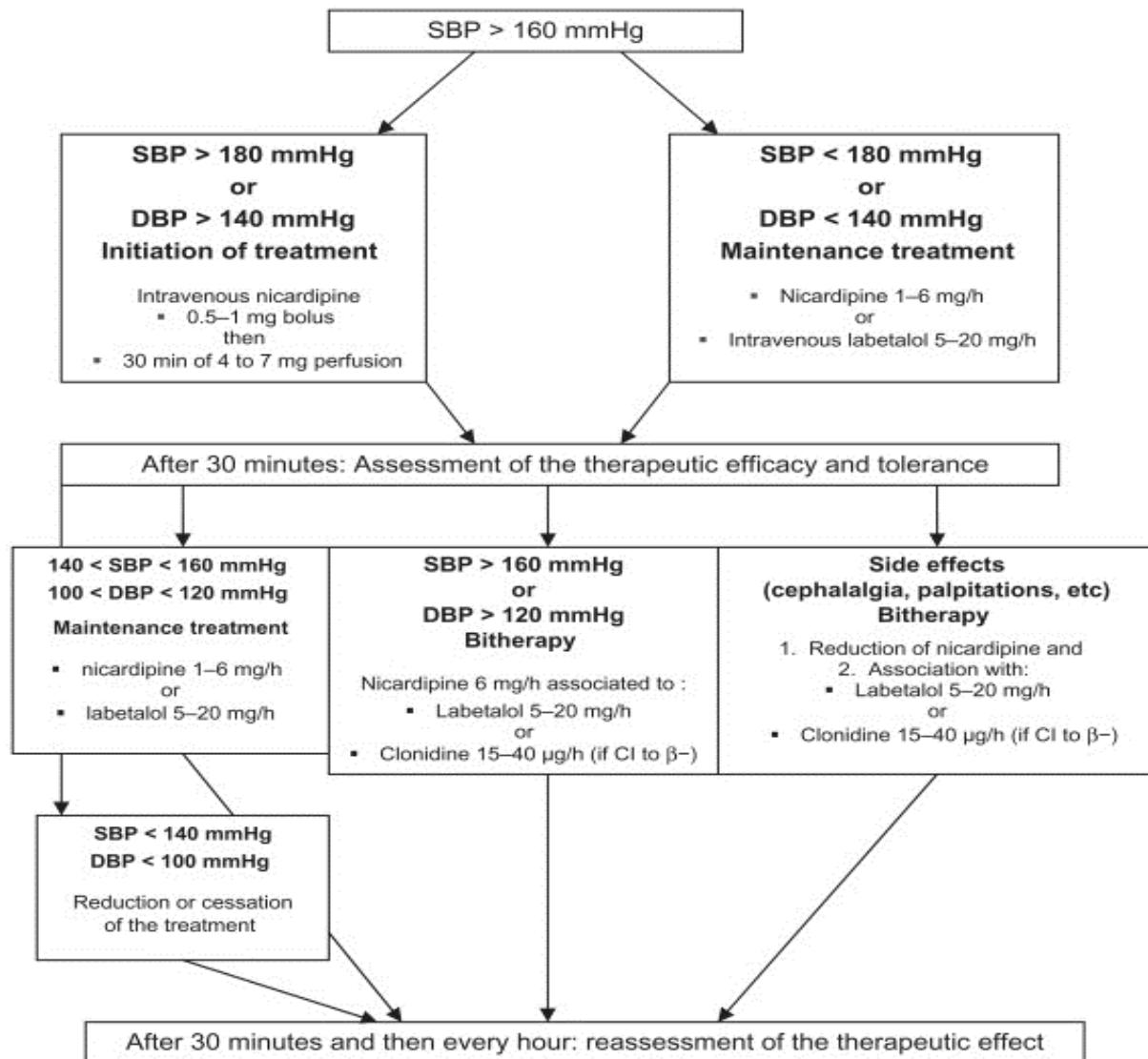


Figure 3:Algorithm for antihypertensive treatment of PE[20].

4 - Fluid balance (Rehydration): Not used Hypotonic or hyperosmolar solution (No dextrose). Limited rehydration 80-100ml/hours. Ringer lactate is the solution of choice.

5 - Delivery of the foetus +++++: The only definitive treatment for preeclampsia and should be done through the fastest route;

- Severe preeclampsia = Delivery within 24 hours

- Eclampsia = Delivery within 12 hours
 - Vaginal delivery through induction if the cervix is mature (bishop ≥ 7). It's the preferred approach
 - Caesarean section if the cervix is not mature enough and if there is a contraindication for vaginal delivery
- ❖ Pulmonary maturation using corticosteroids must be considered, taking gestational age into account. Betamethasone remains the gold standard at a dosage of two injections of 12 mg 24 hours apart; this treatment reduces the risk of hyaline membrane disease, intraventricular haemorrhage, and neonatal mortality.

2.6.3. COMPLICATIONS OF PREECLAMPSIA

a. Maternal complications

They could reveal the presence of the disease or complicate its evolution. The most frequent complications could be classified as short-term and long-term complications.

- Short-term: This includes; eclampsia, HELLP syndrome, DIC, AKI, placenta abruptio and pulmonary oedema[41].
- Long-term: It increases the risk of CKD and is a risk factor for cardiovascular diseases such as chronic hypertension, ischemic cardiopathies and stroke[41].

❖ Short-term complications

a) Eclampsia

It is the most dreadful neurological complication of preeclampsia. Eclampsia is a uniquely pregnancy-related disorder that manifests as a new onset of generalized tonic colonic seizures and/or disturbances of consciousness. It typically occurs after 20 weeks of concluded gestation

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

and can be observed up to the 60th day after delivery; 30% antepartum, 45% per partum and 20% postpartum[42].

Its pathophysiology results from hypertensive encephalopathy characterized by impaired regulation of cerebral blood flow; This loss of self-regulation will promote hyper-perfusion and the formation of cerebral oedema.

It is often preceded by signs such as digestive disorders (epigastric pain in the bar, nausea, vomiting), visual disorders (flying flies, sudden amaurosis) and visual disorders (flying flies, sudden amaurosis) and nervous disorders (drowsiness, obtundation, headaches, osteotendinous hyperreflexia).

At the para-clinical level;

- The scanner can highlight bilateral asymmetrical hypo-dense lesions predominating posteriorly at the parieto-occipital level
- While brain MRI will detect hypersignals in the cortico-subcortical areas of the occipital areas.

Management of eclampsia is similar to that of severe PE. It first involves resuscitation measures, then the administration of an anticonvulsant, in particular magnesium sulphate and an antihypertensive and then delivery.

b) HELLP syndrome

First described by Weinstein in 1982, HELLP Syndrome is an acronym for Haemolysis, Elevated Liver enzymes and Low Platelets count. It is the expression of a disseminated systemic microangiopathy caused by PE and associates' haemolysis, hepatic cytolysis, and thrombocytopenia. It complicates 4 to 14% of cases of severe preeclampsia. Its pathophysiology arises from that of PE; the endothelial lesion is responsible for vasoconstriction and activation of coagulation, leading to the formation of disseminated micro-thrombi by accumulation of fibrin deposits. The microangiopathy thus created will generate ischemic lesions then secondarily necrosis and haemorrhage. This necrosis, particularly in the liver, will be responsible for the

cytolysis found in HELLP syndrome while the haemorrhagic lesion may be responsible for the formation of a subcapsular hematoma of the liver. Fibrin deposits in the sinusoidal vessels will be responsible for mechanical type haemolysis (appearance of schistocytes, collapsed haptoglobin, the elevation of LDH)[43]. The excessive consumption of platelets at the level of lesions of the endothelium of the sinusoidal vessels will explain the thrombocytopenia.

Clinically, the diagnosis of HELLP syndrome is difficult, however, we may have the presence of epigastric pain, nausea or vomiting. It is diagnosed with certainty using biological tests: haemolysis defined by the presence of schistocytes; Thrombocytopenia defined by a platelet level $< 100,000$ cells/mm³, hepatic cytolysis: AST > 70 IU/l; total bilirubin > 12 mg/l or LDH > 600 IU/l. Ultrasound can highlight an enlarged, heterogeneous liver and can reveal a subcapsular hematoma of the liver.

There are two forms: complete and incomplete HELLP syndrome. Incomplete forms are forms in which one or two diagnostic criteria are present and whose prognosis is more favourable. In practice, the logical attitude in the event of HELLP syndrome is the termination of the pregnancy whatever the mode of delivery, if the term is equal to or greater than 34 weeks or if pulmonary maturity is acquired. The same applies to an unstable maternal hemodynamic state, foetal distress or the presence of DIC, regardless of gestational age.

c) **Abruptio placentae**

It corresponds to the premature separation of a normally inserted placenta. It is a very serious complication because it is responsible for massive haemorrhage developing between the placenta and the uterus. It affects approximately 0.4 to 1% of pregnancies and complicates 3 to 5% of severe pre-eclampsia. The initial anatomical lesion is a basal decidua hematoma which interrupts maternal-foetal circulation, and quickly results in a non-reassuring foetal state as well as maternal haemostasis disorders.

Clinically the symptomatology is very variable. In its typical form, the patient complains of intense stabbing pain of sudden onset, associated with permanent uterine contracture "wooden uterus" and light blackish metrorrhagia. In 30 to 50% of cases, the foetus dies. Macroscopic examination of the placenta reveals a blackish clot on the maternal side of the placenta.

d) Renal failure

The occurrence of isolated AKI remains relatively rare in pregnancy. It appears in pre-eclamptic women most often in the context of obstetric complications (placenta abruptio, HELLP syndrome, haemostasis disorders, DIC). Due to frequent hypovolemia in PE patients, there is a reduction in glomerular filtration thus, functional renal failure can set in. This will gradually evolve towards oliguria or even anuria with biologically a progressive rise in serum creatinine. Renal histological abnormalities during PE are acute tubular necrosis associated with glomerular endotheliosis lesions. There is total recovery of renal function in 67% of cases.

e) Acute pulmonary oedema (APO)

It is defined by the presence of fluid in the interstitial space and pulmonary alveoli linked to excessive pulmonary capillary pressure or an increase in capillary permeability. It is a rare complication in obstetrics and in the context of PE, its incidence is 3%. APO generally occurs in the context of certain complications such as DIC (49%), sepsis (46%), placenta abruptio (32%) or in cases of renal failure. Its diagnosis can be made in the presence of dyspnoea, orthopnoea, nocturnal cough, foamy whitish-pink expectoration or laryngeal crackling. On physical examination, we find pulmonary crackles on the rising tide on pulmonary auscultation and an alveolar-interstitial syndrome on chest x-ray.

f) Disseminated intravascular coagulation (DIC)

It is a pathological activation of coagulation. It results in excess generation of thrombin and fibrin in the circulation. This allows the formation of micro-thrombi and the activation of plasmin (fibrinolysis and haemorrhage) which leads to multi-system failure. Depending on their evolution, we distinguish between acute and chronic DIC.

Acute DIC, also called decompensated, progresses rapidly and mainly induces haemorrhagic manifestations. The diagnosis of acute DIC can be made in the presence of cutaneous and mucosal haemorrhages (petechiae, sloping bruises, epistaxis, gingival bleeding), gastrointestinal haemorrhages. Biologically, its diagnosis can be made in the presence of

thrombocytopenia, an increase in aPTT and PT, an increase in d-dimer (and fibrin degradation products) and a decrease in plasma fibrinogen levels. Chronic or compensated DIC progresses slowly (over weeks or months) and mainly results in venous thromboembolic manifestations. The most common causes of DIC in developed countries are preeclampsia and HELLP syndrome, while in developing countries they are HRP and postpartum haemorrhage.

❖ Long-term complications

These are thought to be due to the persistence of endothelial dysfunction after normalization of blood pressure. Thus, PE would represent a cardiovascular risk factor.

- a) **Chronic hypertension:** generally, BP returns to normal within 16 days following delivery except in cases of early severe PE, where BP takes 3 months to return to its normal value. A proportion of PE patients will remain hypertensive forever. Indeed Bellamy et al. found that 1885 out of 3658 women with PE, or 51%, developed chronic hypertension in the 14 years following the PE episode with a relative risk of 3.70 [2.70-5.05; CI=95%][44].
- b) **Ischemic heart disease:** also called coronary artery disease is due to poor oxygenation of the heart, due to a narrowing of the diameter of the coronary arteries by atherosclerotic plaques. In general, PE patients have 02 times more risk of developing coronary heart disease than women with normal BP during pregnancy. PE would increase the risk of ischemic heart disease by approximately 2.16 [1.86 – 2.52; CI=95%] after approximately 11 years. This risk increases depending on whether the patient had moderate or severe PE: 2.99 [2.51 – 3.58; CI=95%] versus 5.36[3.96–7.27; CI=95%] for severe PE[45].
- c) **Renal disease:** The most common renal lesion in PE is focal segmental glomerulosclerosis. It manifests itself clinically by the insidious onset of proteinuria, haematuria, hypertension and uraemia. PE is associated with a 4 times higher risk of developing chronic kidney disease within 10 years compared to normotensive patients after a first pregnancy. This risk increases with the number of pregnancies complicated by pre-eclampsia PE. Balen et al. found that in the follow-up of 775 PE patients: 1.4% of women had a high risk of chronic kidney disease and 13.7% needed to have their kidney function monitored annually[46]. Therefore, any woman presenting with

proteinuria after childbirth should benefit from close monitoring until the proteinuria disappears or another cause is identified.

d) **Venous thrombosis:** pregnancy is accompanied by a state of physiological hypercoagulability due to an increase in Von Willebrand factor and VIIIc, factor II, VII, IX, X and fibrinogen. Therefore, it is normal for women to be at high risk of developing venous thrombosis up to 6 weeks postpartum. Hypercoagulability is also part of a metabolic syndrome which will later lead to arteriosclerosis and PE. This is why after severe PE, the risk of thrombosis is twice as high as after a normotensive pregnancy. Indeed, Bellamy et al. found that the risk of developing a venous thrombosis is 1.79 times greater than in normotensive pregnancies [1.37 – 2.33; CI=95%] after approximately 5 years[44].

f) **Type 2 diabetes:** Compared to normotensive women, women who develop PE are more insulin resistant during pregnancy and a few years after pregnancy. Feig et al. found that women with PE have twice the risk of developing type 2 diabetes even after 16 years.

g) **Hypothyroidism:** Patients with PE have a higher blood TSH level than in normotensive patients, suggesting hypothyroidism. A high level of Soluble fms tyrosine kinase (1sFlt-1) observed in PE would reduce thyroid activity and be responsible for hypothyroidism in the future.

b. Foetal complications

a) **Intrauterine foetal demise:** It could be defined as the death of a foetus between 28 weeks of gestation and the onset of labour. Its sudden onset occurs when there's a retro-placenta hematoma, rarely during an eclamptic crisis or in the case of foetal distress. It occurs in the absence of appropriate management and is characterized by the absence of active foetal movements and the absence of foetal heartbeat, confirmed with an ultrasound with sometimes macerations.

b) **Intrauterine growth restriction:** It is defined by an insufficient growth less than the 10th percentile for gestational age. It could be harmonious or disharmonious. Hypoperfusion of the placenta which occurs during PE is responsible for 20% to 30% of cases of IUGR. Clinically, we

could have a non-evolving fundal height which is better diagnosed with the help of an ultrasound using the Manning score.

c) **Prematurity:** Mostly induced with the aim of ameliorating mother and child vital prognosis.

Other foetal complications include; broncho-dysplasia, neonatal thrombocytopenia (platelet count $<150,000/\text{mm}^3$) and neutropenia. PE is a risk factor for the foetus to develop diabetes.

2.7. MONITORING IN POST-PARTUM PERIOD

- Hypertension due to preeclampsia may worsen or even present in the postpartum period.
- BP $\geq 160/110 \text{ mm Hg}$ should be urgently treated with IV antihypertensives.
- If improvement, switch to oral and progressive weaning.
- Persistent hypertension $\geq 12 \text{ weeks}$ represents chronic hypertension.
- Laboratory abnormalities related to preeclampsia are to be monitored.
- Increase risk for future cardiovascular disease. Screening for cardiovascular and other risk factors. Counselling regarding smoking cessation, diet, exercise, glucose control, weight loss, and appropriate medical treatment

2.7.1. MANAGEMENT FOLLOWING DELIVERY

Although delivery is the only effective treatment for pre-eclampsia, and even though clinical symptoms and laboratory abnormalities usually regress in the hours afterward, the risk of complications persists for some time following delivery[47]. Pre-eclampsia is associated with long-term morbidity and mortality. Approximately 20% of women with pre-eclampsia develop hypertension or microalbuminuria during long-term follow-up, and the risk of subsequent cardiovascular and cerebrovascular disease is doubled in women with pre-eclampsia and gestational hypertension compared with age-matched controls. Hemodynamic, neurological, and laboratory monitoring is necessary following delivery for patients with severe preeclampsia and

includes; frequent blood pressure measurements to enable adjustment of antihypertensive treatment and frequent monitoring of diuresis and weight according to intake (oliguria should prompt progressive fluid resuscitation and sometimes diuretic use). Neurological monitoring consists of checking for signs of imminent eclampsia, including headaches, phosphene signals, tinnitus, and brisk tendon reflexes. Clinical monitoring must be done several times daily during the week after delivery, a period considered at high risk for complications. If necessary, monitoring can be performed in an intensive care unit. Laboratory monitoring should be done several times daily in the first 72 hours after delivery and thereafter adapted according to the progress of the indices. It must include a complete blood count, liver function tests, and measurement of lactate dehydrogenase. Discharge from the hospital cannot be considered until all clinical and laboratory indices have returned to normal, and regular monitoring by the patient's general practitioner as necessary if treatment for hypertension is to be continued after discharge. The risk of recurrence of pre-eclampsia during a subsequent pregnancy has to be considered. This risk is estimated to be less than 10% for all cases of pre-eclampsia, but is greater when pre-eclampsia is discovered before 28 weeks. Three months after delivery, screening for underlying renal or hypertensive disease may be requested by the patient's primary physician. Such screening is intended to check for normalization of blood pressure values and disappearance of proteinuria, and if abnormalities persist, a referral should be made to a nephrologist or a hypertension expert to determine the cause. This examination is important because pre-eclampsia may unmask previously undiagnosed systemic or kidney disease or thrombophilia. It should include a specific set of questions, blood pressure measurements, a clinical examination looking for signs of autoimmune conditions, and a urinary dipstick test. Testing for antiphospholipid antibodies is recommended after severe pre-eclampsia. Percutaneous needle biopsy of the kidney should be performed only if kidney failure persists at three months postpartum or if signs of a systemic underlying condition or proteinuria persist at 6 months. Patients who have had severe pre-eclampsia may share predispositions with nonpregnant patients who have cardiovascular risk factors. Accordingly, long-term monitoring of cardiovascular, renal, and metabolic risk factors is recommended after severe pre-eclampsia.

2.7.2. PREVENTION OF PREECLAMPSIA

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

Primary prevention of pre-eclampsia is based on the detection of modifiable risk factors. The literature is plentiful regarding the risk factors for pre-eclampsia, but should be interpreted with caution. Women at high risk are those with a personal history of severe pre-eclampsia, while those at low risk are defined as those who have never had pre-eclampsia but have at least one risk factor. There are numerous risk factors, including genetic risk factors, family history of pre-eclampsia, immunologic factors, nulliparity, a new partner, and demographic factors such as a maternal age >35 years, the woman's own gestational age and birth weight (with elevated risks for women born before 34 weeks or weighing less than 2500 g at birth), factors related to the pregnancy, such as multiple pregnancy, congenital or chromosomal anomalies, a hydatidiform mole, or urinary infection, risk factors associated with maternal disease, including chronic hypertension, kidney disease, obesity, insulin resistance, and diabetes, as well as thrombophilia, and environmental factors such as living at a high altitude and stress. Although the search for these risk factors is important, they may not effectively predict this pre-eclampsia by themselves[48].

However, accurate prediction of pre-eclampsia would enable early and optimal management of women at high risk. Several predictive tests are being assessed currently. These include clinical tests, such as blood pressure measurement during the second trimester or 24-hour ambulatory blood pressure monitoring, but these lack sensitivity and specificity. Laboratory tests for oxidative response have been assessed, including assays for uric acid, urinary kallikrein, and fibronectin, but no evidence of their relevance has so far been found. Among the markers used to screen for trisomy 21 during the second trimester (beta human chorionic gonadotropin, alpha-fetoprotein, and unconjugated estriol), elevated alpha-fetoprotein is associated with a higher risk of pre-eclampsia (unless there are neural tube abnormalities, as when beta-human chorionic gonadotropin is elevated). Frequent monitoring of women with elevated levels could be useful, but these tests may not be carried out for screening purposes due to their low negative predictive value. Serum markers for trisomy 21 in the first trimester (pregnancy- associated plasma protein A, inhibin A, corticotropin-releasing hormone, and activin) have been tested, but their likelihood ratios seem to be insufficient.

Imaging tests have been evaluated, including uterine artery Doppler ultrasound. Uterine artery Doppler ultrasound is not advised during the first or second trimester in low-risk

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

populations due to the excessive variability of likelihood ratios in this population, which allows for the prediction of only one-third of pre-eclampsia cases. In a high-risk population, the definition of which is often imprecise, uterine artery Doppler can be performed during the second trimester morphologic ultrasound examination and checked 1 month later in case of abnormal results (resistance index >0.58 or 90–95th percentile, unilateral or bilateral notch). The combination of a uterine artery Doppler examination during the first trimester and a three-dimensional ultrasound assessing placental volume may predict the risk of pre-eclampsia as early as the first trimester.

In clinical practice, because no single marker effectively predicts the risk of pre-eclampsia, the current trend is to test a combination of markers. The most commonly used combination of markers assesses sFlt-1, placental growth factor, endoglin, and vascular endothelial growth factor during the first or second trimester. Increased vascular endothelial growth factor and endoglin levels, combined with increased sFlt-1 and decreased placental growth factor during the first trimester are associated with a significantly increased risk of pre-eclampsia.

Improved prediction of pre-eclampsia has been noticed when serum markers are combined with Doppler indices. In a recent nested case-control study, second-trimester maternal serum cystatin C, C-reactive protein, and uterine artery mean resistance index were observed to be independent predictors of pre-eclampsia.

Secondary prevention is based on antiplatelet aspirin therapy, which reduces the risk of pre-eclampsia by 10% in women who have at least one risk factor. No study currently allows the determination of the exact dosage or the best time for the initiation of aspirin. However, aspirin should be initiated as early as possible, that is, before 12–14 weeks, which corresponds to the beginning of the first phase of trophoblast invasion. The efficacy of aspirin has been shown only in women with previous pre-eclampsia associated with intrauterine growth retardation and without thrombophilia. Low molecular weight heparin is indicated only in cases of complicated thrombophilia (history of thromboembolic complications or pre-eclampsia). Calcium supplementation at a dosage of 1.5 g/day, beginning at 15 weeks and continued throughout the pregnancy, is recommended for prevention of pre-eclampsia in women with a daily calcium intake <600 mg/day. The statins, which stimulate HO-1 expression and inhibit sFlt-1 release,

could have the potential to ameliorate early-onset pre-eclampsia. Other treatments, such as antioxidant treatment by vitamins C and E, oligo-elements, and nitric oxide have no proven efficacy.

2.7.3. OTHER CLINICAL FORMS OF HYPERTENSIVE DISORDERS IN PREGNANCY

- Chronic hypertension is identified if hypertension precedes pregnancy, is present at < 20 weeks gestation, or persists for > 6 weeks (usually > 12 weeks) postpartum (even if hypertension is first documented at > 20 weeks gestation). Chronic hypertension may be masked during early pregnancy by the physiologic decrease in BP.
- Gestational hypertension is new-onset hypertension at > 20 weeks gestation without proteinuria or other findings of preeclampsia; it resolves by 12 weeks (usually by 6 weeks) postpartum.
- Preeclampsia superimposed on chronic hypertension is diagnosed when new unexplained proteinuria develops or proteinuria worsens after 20 weeks in a woman known to have hypertension with BP elevations above baseline or when preeclampsia with severe features develops after 20 weeks in a woman known to have hypertension and proteinuria. Women with chronic hypertension are at high risk of preeclampsia and should be monitored closely.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

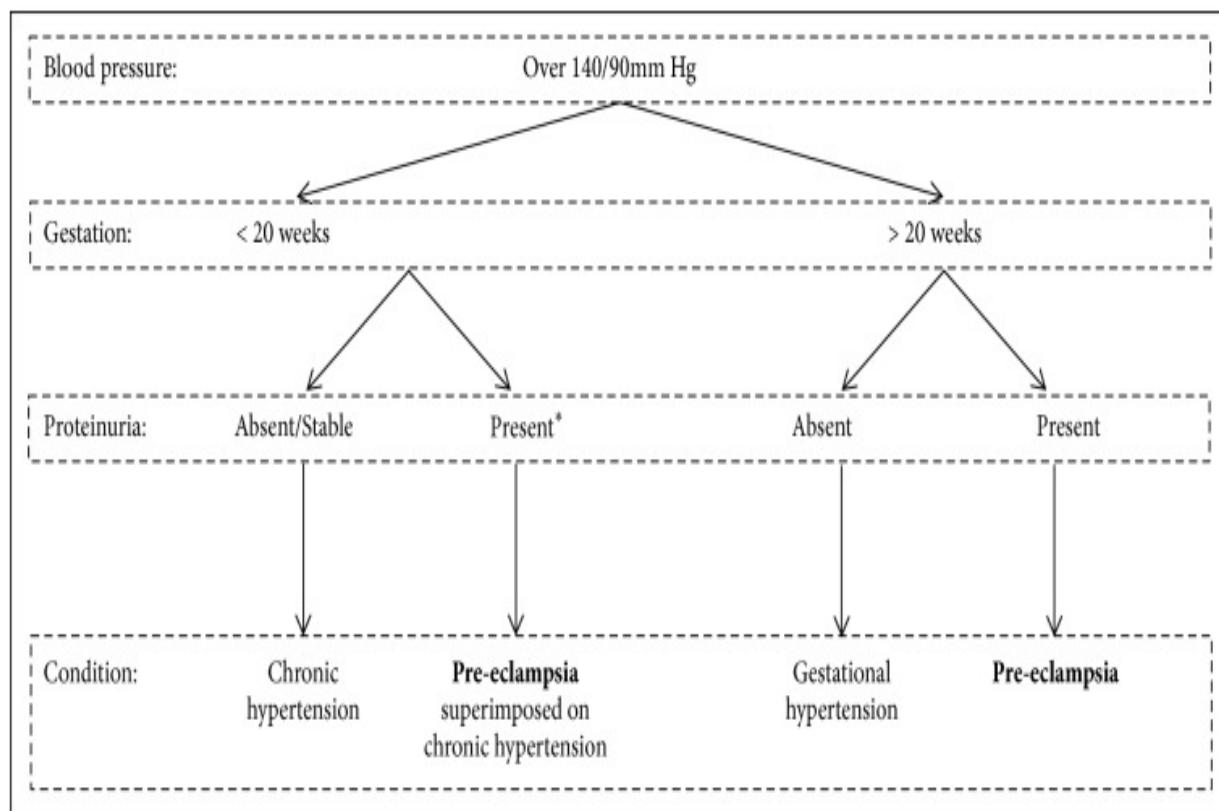


Figure 4: Classification of hypertension in pregnancy[49].

2.8. REVIEW OF PUBLICATIONS

2.8.1. IN THE WORLD

In 2017, a study was carried out in Australia titled “Maternal and neonatal complications in women with comorbidities and preeclampsia”. A retrospective cohort study was done aimed at evaluating how medical comorbidities such as chronic hypertension, pre-gestational or gestational diabetes and obesity, influence maternal and neonatal complications from preeclampsia. They found out that; women with comorbidities delivered at a median (interquartile range) of 37.0 (36.0–39.0) weeks gestation, earlier than women without comorbidities (38.0 (36.0–39.0) weeks, $p < 0.001$). Women with comorbidities were less likely than those without to suffer any pregnancy complication before delivery (adjusted relative risk 0.78, 95% confidence interval 0.72–0.86); however, their neonates suffered more respiratory distress syndrome (aRR 1.43, 95% CI 1.31–1.57), neonatal sepsis (aRR 1.42, 95% CI 1.17–1.72) and NICU admission (aRR 1.37, 95% CI 1.23–1.53). Earlier delivery was a major contributor to worse neonatal outcomes[50].

In 2018, Reddy et al. published a study titled “Preeclampsia: risk factors, complications and management” in India, aimed to evaluate risk factors, complications and management of Preeclampsia. They carried out a prospective observational study for 6 months duration in inpatient department of Gynaecology and Obstetrics in a Tertiary Care Hospital. The results showed preeclampsia was more prevalent in the age group 21-22 years (24%) followed by 25-26years (22%) and 43% of patients were diagnosed with Severe Preeclampsia followed by 17% with Preeclampsia. Predominant risk factor was first Pregnancy (46%), followed by Hypothyroidism (18%). The Predominant complication was Foetal Death (28%), followed by eclampsia (24%). Nifedipine was the most effective drug for the management of Preeclampsia and Magnesium sulphate was used in combination with Nifedipine in severe conditions[51].

2.8.2. IN AFRICA

In 2017, a retrospective descriptive cohort study was carried out at Mpilo Central Hospital, a tertiary teaching referral government hospital in a low-resource setting in Bulawayo, Zimbabwe which included patients who had a diagnosis of severe preeclampsia or eclampsia. They found that the incidence of severe preeclampsia/eclampsia was 1.3% with the most common major complication being HELLP syndrome (9.1%). Maternal mortality was 1.7%.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

There were 127 babies born with six sets of twins, 49.6% of the babies were lost through stillbirths and early neonatal deaths[52].

In 2019, a study was done titled “Determinants of adverse maternal and perinatal outcomes in severe preeclampsia and eclampsia in a low-resource setting in Zimbabwe”. The results of the study showed that; mothers who had a baby born at $27\text{--}29^{+6}$ weeks of gestation were 8 times more likely to be associated with adverse maternal outcomes compared to mothers who gave birth at $37\text{--}39^{+6}$ weeks of gestation (OR 8.187, 95% CI 1.680–39.911, $p = 0.02$), holding other variables constant. Platelet count was also statistically significant for adverse maternal outcomes. Mothers with platelet counts of $0\text{--}49 \times 10^9/\text{l}$ were 46 times more likely to be associated with adverse maternal outcome compared to mothers with normal counts of more than $150 \times 10^9/\text{l}$ (OR 46.429, 95% CI 17.778–121.253, $p = 0.001$). Mothers with platelet counts of $0\text{--}49 \times 10^9/\text{l}$ were 4 times more likely to be associated with adverse perinatal outcomes compared to mothers with platelet counts of above $150 \times 10^9/\text{l}$ (OR 3.690, 95% CI 1.752–7.775, $p = 0.001$)[53].

In Guinea Conakry, a study was carried out in 2020 titled “Management of pre-eclampsia and its complications in the department of gynaecology and obstetrics at Donka national hospital Conakry, Guinea” and had as objectives to analyse the management of vascular-renal syndromes, calculate their frequency, describe the sociodemographic characteristics of patients, describe the clinical and biological signs of patients, evaluate the maternal-foetal prognosis. This was a prospective, descriptive, cross-sectional, including 217 cases of pre-eclampsia. The results showed the proportion of pre-eclampsia was high in patients aged between 15 and 19 years, housewife (73.68%), married (98%), primary. The predisposing factors were nulliparity (39.82%), obesity and twinkling. The clinical presentation was dominated by headaches (70.18%), followed by visual disorders (67.54%); epigastric pain (63.16%), oedema in (33.33%), and tonico-clonic seizures (24.56%). Severe preeclampsia in 78.49%, eclampsia in 21.65% or simple hypertension in 1.75%. Maternal complications were dominated by eclampsia 26.26%, retroplacental hematoma (6.88%), maternal death (2.63%), renal failure (0.88%), and eclamptic coma (0.46). foetal death in utero (11.40%). Foetal complications were dominated by a poor Apgar score in 40.35% requiring resuscitation, acute foetal suffering 27.19% and perinatal deaths 11.52%[54].

2.8.3. IN CAMEROON

Fouedjio et al. in 2016 published a study titled “Predictors of eclampsia among preeclamptic patients: a case control study in Yaoundé, Cameroon”. This was a case-control study carried out in six health facilities in Yaoundé and had as aim to identify clinical predictors of eclampsia among preeclamptic patients. After univariable analysis, headache (uOR: 2.9; 95% CI: 1.4-6.2) and absence of stable income (uOR: 17.6; 95% CI: 6.2-49.8) were found to be associated with eclampsia. After multivariate analysis predictors of eclampsia among pre-eclamptic patients were: age <20 years (aOR: 2.5; 95% CI: 1.0-5.9), family history of high blood pressure in the mother (aOR: 4.8; 95% CI: 1.2-19.3), antenatal care by a nurse auxiliary (aOR: 9.3; 95% CI: 2.4-35.9), right upper abdominal quadrant pain (aOR: 9.9; 95% CI: 1.2-77.9) visual disturbances (aOR: 7.9; 95% CI: 2.3-26.9)[55].

In 2019, a study was published titled “Maternal Complications and Prognostic Factors of Severe Pre-Eclampsia in Three University Hospitals of Yaoundé: A Study of 115 Cases” by Henri-Leonard et al. This was a descriptive cross-sectional study with data collected in both retrospective and prospective phase in the intensive care units of the University Teaching Hospital of Yaoundé, the Central Hospital of Yaoundé and the Gynaeco Obstetric and Paediatric Hospital of Yaoundé. Results. This study concerned 115 cases with a sex ratio of 2,33 and the most represented age group being [30-34] years old. The main complications found were; eclampsia (39%), HELLP syndrome (14%) and acute kidney injury (12%). They had one case of haemorrhagic stroke. Caesarean section was performed in 69% of cases. Nicardipine (92%) and magnesium sulphate (81%) were the main drugs used. The maternal mortality rate was 3.5%. They also found out that the main factors of poor prognosis were acute pulmonary oedema, Glasgow Coma score < 8, altered liver function and haemoglobin level < 7g/dl[56].

In 2020, a study was carried out titled “Factors Associated with Maternal and Perinatal Complications of Preeclampsia at the Central Hospital of Yaoundé: A Cross-Sectional Analytical Study”. This was an analytical cross-sectional study with prospective and retrospective data collection including all patients, pregnant or postpartum, admitted for preeclampsia to the maternity ward of the Yaoundé Central Hospital. This study took place over a period of seven (07) months. 214 cases of preeclampsia were recruited in this study. There were maternal complications in 44.4% of cases, dominated by eclampsia (31.8%), maternal lethality of 3.3%.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

There was at least one perinatal complication in 105 cases (49.1%). The predominant perinatal complication was prematurity, 32 cases of intrauterine foetal demise and 13 cases of early neonatal death, giving a perinatal lethality of 21%. After logistic regression, the factors associated with maternal complications were residing in a rural area ($OR = 2.217 [1.054 - 3.09]$; $p < 0.036$); a nurse-aid as prenatal consultation provider (PNC) ($OR = 5.059 [2.175 - 36.162]$; $p < 0.001$) and a number of PNCs < 4 ($OR = 1.154 [2.330 - 4.029]$) [17].

CHAPTER 3: METHODOLOGY

3.1. TYPE OF STUDY

We carried out a cross-sectional case-control study with retrospective data collection.

3.2. SITE OF STUDY

This study was conducted in three referral hospitals in the city of Yaoundé, Cameroon; The Yaoundé Gynaeco-Obstetric and Paediatric Hospital, the Yaoundé University Teaching Hospital and the Yaoundé Central Hospital.

a) Yaoundé Central Hospital

This reference hospital located in the heart of Yaoundé has one of the biggest and most specialized maternity unit with over 72 in-patient beds, 6 delivery tables, 2 service operating theatres and a large highly trained staff.

b) Yaoundé Gynaeco-Obstetric and Paediatric Hospital

This hospital was inaugurated on March 28, 2002 and it is located in the Ngouesso district in Yaoundé. There is an administrative and financial department, which coordinates several services in the hospital; Obstetrics and Gynaecology, Paediatrics, Paediatric Surgery, Anaesthesia and Reanimation, Ophthalmology, ENT, Emergencies, Medical imaging and physiotherapy.

The Obstetrics and Gynaecology service comprising of three parts; maternity ward, hospitalisation rooms and outpatient consultations, has over the years had high rate of patient influx.

c) Yaoundé University Teaching Hospital

This is a tertiary reference hospital in the heart of Yaoundé and accredited to the Faculty of Medicine and Biomedical Sciences. It consists of several services; Internal Medicine and specialties, General surgery, Anaesthesia and Reanimation, Obstetrics and Gynaecology, Paediatrics and Emergency unit

3.3. DURATION OF STUDY

This study was carried out for a duration of 7 months (November 2023 - May 2024). The medical records of all pre-eclamptic women from January 2022- December 2023 were considered.

3.4. POPULATION OF STUDY

Our study population consisted of the medical records of postpartum women in the hospitals aforementioned, targeting all those diagnosed with PE.

3.4.1. INCLUSION CRITERIA

Cases

- Medical records of women diagnosed with PE, who developed maternal complications.
- Clear and complete medical records.

Control

- Medical records of women diagnosed with PE without maternal complications.
- Clear and complete medical records.

3.4.2. EXCLUSION CRITERIA

- Medical records of women with comorbidities which could explain the complications.
- Incomplete medical records

3.4.3. SAMPLE SIZE ESTIMATION

Based on our study design, we calculated our sample size using Schlesselmann's formula as shown below.

$$n =$$

Where;

P_0 - proportion of women with preeclampsia who will develop complications

P_1 - proportion of women with preeclampsia who will not develop complications

$$P = (P_0, P_1) / 2$$

$$= 0.05$$

$$= 1.96$$

= 0.1

=1.28

F= 10%

Therefore n = 79 participants

Using a ratio of 1:2, n=79 and n= 158 is the sample size for the exposed and non-exposed group respectively.

3.5. PROCEDURE

3.5.1. DATA COLLECTION

After obtaining administrative approval, we were introduced to the hospitals generally and specifically to the maternities and the archives unit. We were then introduced to the staff and were briefed on the flow of patients in the hospital, then granted access to patients' medical records. We accessed all women's medical records who passed through the maternity units of our study hospitals from January 2022 to December 2023. Most files were gotten from the maternity archives; however, a little proportion was gotten from the reanimation archives.

On examining the medical records, we excluded all incomplete files, files of women who were discharged without medical authorisation and women with comorbidities which could clearly explain the complications they developed. From the eligible files, we then grouped our participants in to two groups; cases and controls.

Relevant information from the eligible files, from the time of admission to seven days postpartum, were filled in pre-established questionnaires. These questionnaires were internally validated, pre-tested and later adjusted and adapted for the study.

3.5.2. VARIABLES OF STUDY

Maternal variables

1. Sociodemographic data

- Age, marital status, ethnicity, residence, profession, level of education and religion.

2. Obstetric data

- Parity
- Gravidity
- Past history of PE or eclampsia
- Age of onset/diagnosis of PE
- Family history of PE or hypertension
- Data on ANC: Number of ANC, presiding personnel, prophylaxis of PE received.

3. Medical past history

- History of chronic diseases such as; chronic hypertension, diabetes or kidney failure
- Comorbidities; obesity
- Toxicology; alcohol consumption, and tobacco intake.

3. Clinical variables

- Blood pressure on admission
- Presenting symptoms: Headaches, blurry vision, epigastric pain, convulsion, lumbo-pelvic pain.
- Management on entry

4. Paraclinical data

- Full blood count: Searching for;

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

- Anaemia: we considered normal, a haemoglobin count greater than 10g/dl, we classify anaemia as severe when haemoglobin count was <7g/dl
 - Thrombocytopenia: Platelet count was considered normal when value was >150,000/mm³
 - Renal workup: we considered blood levels of creatinine and BUN greater than 13mg/L and 0.55g/L as abnormal
 - Liver workups: we considered elements of liver cytology; ASAT/ALAT. The normal is >70UI/L and values 2 times greater than the normal were considered too high.
5. Maternal complications: Eclampsia, acute kidney injury, HELLP syndrome, pulmonary oedema, maternal death.
 6. Foetal data
 - Sex of foetus: male or female
 - Birth weight
 - Gestational age at delivery
 - Foetal complications: Prematurity, still birth, asphyxia, IUGR.
 - Mode of delivery

3.5.4. MATERIALS FOR DATA COLLECTION

In this study, we used well-structured questionnaires, medical records, pens, admission registers at each maternity, a laptop, USB key, Rim of A4 papers, mobile phone.

3.5.5. STATISTICAL ANALYSIS

Data extracted from hospital files were documented in paper questionnaires (see Appendix), and then transferred to Microsoft Excel spreadsheets. We used R version 4.3.3 for analysis. Categorical variables were expressed as frequencies and percentages, and compared using the chi-squared test or Fisher exact test as appropriate. Continuous variables were summarized as mean with standard deviation (SD) and compared across categories using t-test or ANOVA as appropriate.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

To investigate risk factors to experience complications among women with pre-eclampsia and risk factors for foetal complications in the recruited women, we constructed multiple logistic regression models. The variables included in the final models were purposively selected based on their relevance in existing literature and in line with our study objectives. All analyses considered $p < 0.05$ as statistically significant.

3.5.6. MATERIALS FOR DATA MANAGEMENT

- A laptop
- A smart phone
- A USB flash drive

3.5.7. HUMAN RESOURCES

- Myself
- The Supervisor and co-supervisors
- The Statistician

3.6. ETHICAL CONSIDERATIONS

We obtained an Ethical clearance from the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences, University of Yaoundé I. We also obtained authorisation from the administrative bodies of the three hospitals mentioned in our study.

CHAPTER 4: RESULTS

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

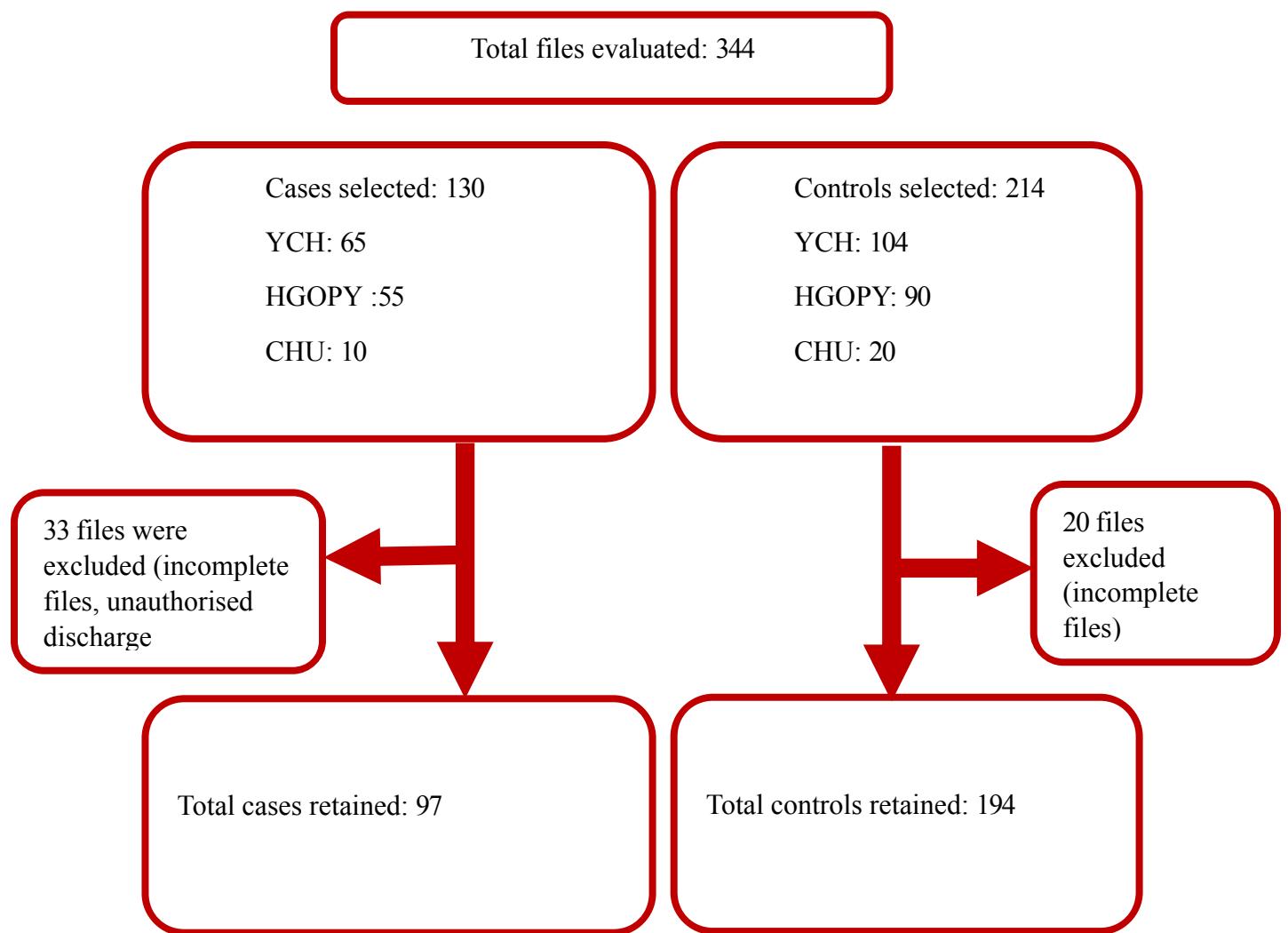


Figure 5: Triage of participants

4.1. SOCIO-DEMOGRAPHIC PROFILE OF PARTICIPANTS

In total, 291 women were included in our study from all three participating hospitals. Majority of the participants (>90%), had attained at least secondary education level. We had a mean age of 28.4 ± 6.7 in our study population, 71.8% of the women were single. Majority of the participants were housewives (32.3%). Participants hailed from different ethnic groups as shown in Table II.

Table II: Socio-demographic characteristics of participants

Variables	Frequency (%)
Level of education: n (%)	
Primary	25 (8.6)
Secondary	174 (59.8)
University	92 (31.6)
Marital status: n (%)	
Single	209 (71.8)
Married	81 (27.8)
Widow	1 (0.3)
Profession: n (%)	
Civil servant	29 (10.0)
Housewife	94 (32.3)
Informal sector	89 (30.6)
Student	79 (27.1)
Ethnic group: n (%)	
Bamileke	62 (21.3)
Beti	44 (15.1)
Eton	32 (11.0)
Ewondo	33 (11.3)
Mbam	23 (7.9)
Other*	97 (33.4)

*hausa, bulu, bassa, bamoun, maka'a

4.2. VARIATIONS ACROSS AGE GROUPS

a. Clinical findings by age

In general, women who were younger tended to have a higher proportion of more severe clinical features compared to the older age groups (Table III).

Table III: Clinical findings by age of participants

	16 to 20y (n=48)	21 to 30y (n=127)	31 to 40y (n=108)	>40y (n=8)	p-value	N
Diagnosis of pre-eclampsia: n (%)					0.196	291
Clinically	20 (41.7)	46 (36.2)	26 (24.1)	2 (25.0)		
Using laboratory tests	1 (2.1)	1 (0.8)	2 (1.9)	0 (0)		
No data available	27 (56.2)	80 (63.0)	80 (74.1)	6 (75.0)		
Severity criteria: n (%)						
Clinical	21 (43.8)	46 (36.5)	27 (25.2)	2 (25.0)	0.093	289
Laboratory	4 (8.3)	10 (7.9)	7 (6.5)	0 (0)	0.929	291
Ultrasound	0 (0)	2 (1.6)	0 (0)	0 (0)	0.675	291
Convulsion: n (%)	18/22 (81.8)	39/41 (95.1)	14/18 (77.8)	0/0 (0)	0.092	81
Headache: n (%)	23/27 (85.2)	62/67 (92.5)	46/49 (93.9)	5/5 (100)	0.570	148
Epigastric pain: n (%)	4/14 (28.6)	19/21 (90.5)	17/22 (77.3)	1/1 (100)	<0.001	58
Blurred vision: n (%)	8/11 (72.7)	17/21 (81.0)	22/25 (88.0)	1/1 (100)	0.572	58
Systolic blood pressure: Mean (SD)	172 (22.1)	170 (19.9)	175 (20.6)	173 (12.2)	0.304	291
Systolic pressure ≥140: n (%)	47 (97.9)	124 (97.6)	106 (98.1)	8 (100)	1.000	291
Diastolic blood pressure: Mean (SD)	113 (19.8)	111 (14.3)	115 (19.3)	113 (8.7)	0.580	291
Diastolic pressure ≥90: n (%)	46 (95.8)	125 (98.4)	102 (94.4)	8 (100)	0.347	291
Both systolic and diastolic high blood pressure: n (%)	45 (93.8)	122 (96.1)	100 (92.6)	8 (100)	0.676	291

b. Paraclinical findings

Mean platelet count decreased with increasing age. Creatinine levels were significantly higher in the older group (0.038).

Table IV: Paraclinical findings by age

	16 to 20y (n=48)	21 to 30y (n=127)	31 to 40y (n=108)	>40y (n=8)	p-value	N
Urea blood levels: n (%)					1.000	15
Elevated	0 (0)	2 (28.6)	1 (14.3)	0 (0)		
Normal	1 (100)	5 (71.4)	6 (85.7)	0 (0)		
Creatinine blood levels: n (%)					0.038	17
Elevated	1(50.0)	0 (0)	4 (57.1)	0 (0)		
Normal	1 (50.0)	8 (100)	3 (42.9)	0 (0)		
Proteinuria:					0.131	200
1+	5(13.5)	8 (9.1)	6 (8.5)	0 (0)		
2+	13(35.1)	43 (48.9)	41 (57.7)	4 (100)		
3+	17(45.9)	37 (42.0)	23 (32.4)	0 (0)		
4+	2 (5.4)	0 (0)	1 (1.4)	0 (0)		
Haemoglobin levels: Mean (SD)	10.0 (3.1)	10.9 (3.1)	10.7 (2.5)	9.2 (0)	0.807	58
Severity of anaemia: n(%)						
No anaemia	6 (60.0)	11 (61.1)	20 (69.0)	0 (0)	0.355	58
Mild anaemia	0 (0)	3 (16.7)	3 (10.3)	1 (100)		
Moderate anaemia	2 (20.0)	3 (16.7)	2 (6.9)	0 (0)		
Severe anaemia	2 (20.0)	1 (5.6)	4 (13.8)	0 (0)		
Platelets (in thousands): Mean (SD)	158 (97.4)	133 (65.7)	134 (79.3)	98.0 (100)	0.680	94
ASAT levels: n (%)						
Normal	3 (42.9)	3 (20.0)	4 (19.0)	0 (0)	0.631	45
Moderately high	0 (0)	1 (6.67)	0 (0)	0 (0)		
High	4 (57.1)	7 (46.7)	11 (52.4)	1 (50.0)		
Very high	0 (0)	4 (26.7)	6 (28.6)	1 (50.0)		
ALAT levels: n (%)						

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

Normal	4 (57.1)	5 (33.3)	7 (31.8)	0 (0)	0.743	46
Moderately high	0 (0)	1 (6.7)	0 (0)	0 (0)		
High	1 (14.3)	4 (26.7)	5 (22.7)	0 (0)		
Very high	2 (28.6)	5 (33.3)	10 (45.5)	2 (100)		

c. Outcome of pregnancy

Those younger in age presented with greater gestational age of PE onset. Frequency of eclampsia significantly decreased with increasing age ($p=0.002$). The age range 16 – 20years presented more complications than the other age groups (41.7%)

Table V: Distribution of pregnancy outcome along age groups

	16 to 20y (n=48)	21 to 30y (n=127)	31 to 40y (n=108)	>40y (n=8)	p-value
Present with severity features for pre-eclampsia: n (%)	20 (41.7)	46 (36.2)	21 (19.4)	1 (12.5)	0.006
Gestational age at onset of pre-eclampsia, in weeks: Mean (SD)	36.5 (4.3)	34.7 (4.8)	33.9 (5.6)	31.6 (2.9)	0.008
Pre-eclampsia complications: n (%)	21 (43.8)	47 (37.0)	28 (25.9)	1 (12.5)	0.063
Eclampsia: n (%)	20 (41.7)	39 (30.7)	18 (16.7)	0 (0)	0.002
HELLP Syndrome: n (%)	2 (4.2)	10 (7.9)	11 (10.2)	1 (12.5)	0.499
Acute kidney injury: n (%)	1 (2.1)	4 (3.2)	3 (2.8)	0 (0)	1.000
Other maternal complications: n (%)					
Maternal death	0 (0)	1 (0.8)	1 (0.9)	1 (12.5)	0.373
Placenta abruptio	3 (6.3)	2 (1.6)	4 (3.7)	0 (0)	
Pulmonary oedema	0 (0)	4 (3.2)	1 (0.9)	0 (0)	
Pulmonary embolism	0 (0)	1 (0.8)	0 (0)	0 (0)	
Retinal detachment	0 (0)	2 (1.6)	0 (0)	0 (0)	
Stroke	0 (0)	1 (0.8)	0 (0)	0 (0)	
No other complication	45 (93.8)	116(91.3)	102 (94.4)	7 (87.5)	

4.3. OBSTETRIC AND MEDICAL HISTORY

Upon comparing these two groups of participants, we found that women with recorded complications of pe-eclampsia had a mean age of 26.2(SD), notion of a new partner (52.6%) unlike 27.8% in the non-exposed group. Calcium and aspirin intake during pregnancy; 95.8% and 5.0% respectively were protective factors to the development of complications in PE.

Table VI: Comparison of obstetrics and medical history in both study groups

	Controls (n=194)	Cases (n=97)	p-value
Age: Mean (SD)	29.4 (6.7)	26.2 (6.2)	<0.001
Gravidity: Mean (SD)	3.7 (2.3)	2.6 (2.0)	<0.001
Primigravida, G1: n (%)	47 (24.2)	41 (42.3)	0.003
Parity: Mean (SD)	2.0 (1.9)	1.2 (1.5)	<0.001
Primiparous, P0: n (%)	61 (31.4)	43 (44.3)	0.042
History of previous pre-eclampsia: n (%)	68 (35.1)	26 (26.8)	0.199
Ectopic pregnancy: n (%)	8 (4.12)	2 (2.06)	0.505
Alcohol consumption: n (%)	42 (21.6)	30 (30.9)	0.113
Smoking: n (%)	0 (0)	0 (0)	1.000
Has new partner: n (%)	54 (27.8)	51 (52.6)	<0.001
Comorbidities: n (%)			0.855
None	181 (93.3)	93 (95.9)	
Diabetes	3 (1.6)	0 (0)	
Hypertension	5 (2.6)	2 (2.1)	
Obesity	5 (2.6)	2 (2.1)	
Number ANC visits: Mean (SD)	4.1 (1.8)	2.8 (1.9)	<0.001
ANC staff qualification: n (%)			<0.001
Doctor	53 (27.3)	9 (9.3)	
Nurse	112 (57.7)	74 (76.3)	
Nurse assistant	25 (12.9)	5 (5.2)	
No ANC attended	4 (2.1%)	9 (9.3%)	

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

	Controls (n=194)	Cases (n=97)	p-value
Calcium intake during pregnancy: n (%)	68 (35.1)	28 (28.9)	0.355
Aspirin intake during pregnancy: n (%)	8 (4.1)	1 (1.0)	0.280

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

4.4. CLINICAL AND PARACLINICAL FINDINGS

The mean systolic blood pressure was higher in the cases compared to the control group. Those in the cases group presented with early-onset PE unlike the control group. Laboratory findings were more severe in the cases group.

Table VII: Comparison of clinical and paraclinical findings in our study groups

	Controls (N=194)	Cases (N=97)	P-value	N
Diagnosis of pre-eclampsia: n (%)			<0.001	291
Clinically	1 (0.5)	93 (95.9)		
Using laboratory tests	0 (0)	4 (4.12)		
No data available	193 (99.5)	0 (0)		
Present with severity features for pre-eclampsia: n (%)	0 (0.00)	88 (90.7)	<0.001	291
Severity criteria: n (%)				289
Clinical	1 (0.5)	95 (100)	<0.001	
Laboratory	0 (0)	21 (21.6)	<0.001	
Ultrasound	0 (0)	2 (2.1)	0.110	
Gestational age at onset of pre-eclampsia, in weeks: Mean (SD)	34.9 (5.1)	34.1 (5.1)	0.193	291
Convulsion: n (%)	3/3 (100)	68/78 (87.2)	1.000	81
Headache: n (%)	74/74 (100)	62/74 (83.8)	0.001	148
Epigastric pain: n (%)	17/17 (100)	24/41 (58.5)	0.001	58
Blurred vision: n (%)	26/26 (100)	22/32 (68.8)	0.001	58
Systolic blood pressure: Mean (SD)	171 (19.3)	174 (22.5)	0.251	291
Systolic pressure ≥140: n (%)	189 (97.4)	96 (99.0)	0.667	291
Diastolic blood pressure: Mean (SD)	113 (17.0)	113 (17.5)	0.782	291
Diastolic pressure ≥90: n (%)	187 (96.4)	94 (96.9)	1.000	291
Both systolic and diastolic high blood pressure: n (%)	182 (93.8)	93 (95.9)	0.649	291
Urea blood levels: n (%)			0.516	15
Elevated	3 (27.3)	0 (0)		
Normal	8 (72.7)	4 (100)		
Creatinine blood levels: n (%)			1.000	17
Elevated	4 (33.3)	1 (20.0)		
Normal	8 (66.7)	4 (80.0)		
Proteinuria: n (%)				200
1+	11 (10.7)	8 (8.3)	0.432	
2+	56 (54.4)	45 (46.4)		
3+	34 (33.0)	43 (44.3)		
4+	2 (1.9)	1 (1.0)		

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

Haemoglobin levels: Mean (SD)	10.6 (2.7)	10.7 (2.8)	0.847	58
Severity of anaemia: n (%)			0.965	58
No anaemia	12 (63.2)	25 (64.1)		
Mild anaemia	2 (10.5)	5 (12.8)		
Moderate anaemia	3 (15.8)	4 (10.3)		
Severe anaemia	2 (10.5)	5 (12.8)		
Platelets (in thousands): Mean (SD)	160 (80.3)	116 (67.2)	0.006	94
ASAT levels: n (%)			0.037	45
Normal	3 (23.1)	7 (21.9)		
Moderately high	0 (0)	1 (3.1)		
High	10 (76.9)	13 (40.6)		
Very high	0 (0)	11 (34.4)		
ALAT levels: n (%)			0.031	46
Normal	8 (57.1)	8 (25.0)		
Moderately high	0 (0)	1 (3.1)		
High	0 (0)	10 (31.2)		
Very high	6 (42.9)	13 (40.6)		

4.5. MANAGEMENT IN WOMEN WITH PE

Participants without complications had more often received some form of medication compared to their counterparts who experienced pre-eclampsia complications ($p<0.001$). The drugs administered to the pre-eclamptic women included analgesics, antibiotics, corticoids, antihypertensives, and transfusion (shown on Table VIII). Magnesium sulphate and nicardipine were the most frequently used drugs in both groups.

Table VIII: Treatment and outcome in women in the exposed and non-exposed group

	Controls (n=194)	Cases (n=97)	p-value	N
Received magnesium sulphate: n (%)	161 (83.0)	89 (91.8)	0.065	291
Received nicardipine: n (%)	137 (70.6)	74 (76.3)	0.378	291
Received methyldopa: n (%)	29 (14.9)	11 (11.3)	0.508	291
Other treatment received: n (%)			<0.001	139
Analgesics	1 (2.4)	0 (0)		
Antibiotics	1 (2.4)	0 (0)		
Betamethasone	2 (4.8)	0 (0)		
Dexamethasone	2 (4.8)	1 (1.0)		
Diazepam	1 (2.4)	1 (1.0)		
Hydralazine	2 (4.8)	0 (0)		
Misoprostol	1 (2.4)	0 (0)		
Transfusion	2 (4.8)	0 (0)		
Nursing care	30 (71.4)	95 (97.9)		

4.6. OUTCOMES OF WOMEN WITH PE

a. Foetal outcomes

While maternal outcomes were often worse among women with complications, foetal outcomes did not significantly differ across groups. We found 6.2% of twin pregnancies in the exposed group as compared to 5.7% in the unexposed group. Caesarean section was the frequent mode of delivery in both exposed and non-exposed groups 62.9% and 60.8% respectively.

Table IX: Comparison of foetal outcomes in our study participants

	Controls (n=194)	Cases (n=97)	p-value	N
Twin pregnancy: n (%)	11 (5.7)	6 (6.2)	1.000	291
Gestational age at delivery: Mean (SD)	37.7 (3.1)	35.3 (4.2)	<0.001	291
Birth weight of the baby: Mean (SD)	2589 (726)	2204 (823)	<0.001	289
Low birth weight, <2500g: n (%)	85 (44.0)	64 (66.7)	<0.001	289
Foetal complications: n (%)	72 (37.1)	67 (69.1)	<0.001	291
Mode of delivery: n (%)				291
Vaginal delivery	76 (39.2)	36 (37.1)	0.831	
Caesarean section	118 (60.8)	61 (62.9)		
Pre-eclampsia complications: n (%)	0 (0)	97 (100)	<0.001	291
Specific foetal complications: n (%)				
Foetal death	24 (33.3)	18 (26.9)	0.717	139
Asphyxia	1 (1.4)	2 (3.0)		
Intrauterine growth retardation	7 (9.7)	8 (11.9)		
Malformation	2 (2.8)	0 (0)		
Prematurity and survived	36 (50.0)	38 (56.7)		
Prematurity and death	2 (2.8)	1 (1.5)		

b. Maternal outcomes

The most frequent maternal complication found was eclampsia (79.4%), followed by HELLP syndrome (24.7%), placenta abruptio (9.3%), AKI (8.3%). In our study, we recorded three maternal death (3.1%).

Table X: Maternal complications in participants

Variable	Cases (n=97)
Specific maternal complications: n(%)	
Maternal death	3 (3.1)
Eclampsia	77 (79.4)
HELLP Syndrome	24 (24.7)
Acute Kidney Injury	8 (8.3)
Placenta abruptio	9 (9.3)
Pulmonary oedema	5 (5.2)
Pulmonary embolism	1 (1.0)
Retinal detachment	2 (2.1)
Stroke	1 (1.0)

4.7. FACTORS ASSOCIATED WITH COMPLICATIONS OF PE

a. Sociodemographic factors

Women aged >20years had reduced odds for developing complications. University level of education significantly doubled the odds ($OR=2.35 [1.40-3.95]$, $p=0.002$) of complications. Women who were single were more at risk of developing complications ($OR=1.37 [0.79-2.43]$, $p\text{-value}=0.331$).

Table XI: Association between sociodemographic characteristics and PE complications

Variables	Categories	Cases (n=97)	Controls (n=194)	OR [95% CI]	p-value
Maternal age	≤20 years	21 (21.6%)	27 (13.9%)	Ref.	0.132
	>20 years	76 (78.4%)	167 (86.1%)	0.59 [0.31-1.11]	
Education level	Secondary and below	54 (55.7%)	145 (74.7%)	Ref.	0.002
	University level	43 (44.3%)	49 (25.3%)	2.35 [1.40-3.95]	
Marital status	Married	23 (23.7%)	58 (29.9%)	Ref.	0.331
	Single/Widow	74 (76.3%)	136 (70.1%)	1.37 [0.79-2.43]	
Profession	Housewife	32 (33.0%)	62 (32.0%)	Ref.	0.965
	Other profession	65 (67.0%)	132 (68.0%)	0.95 [0.57-1.62]	
Religion	Christian	89 (91.8%)	158 (81.4%)	Ref.	0.032
	Other	8 (8.3%)	36 (18.6%)	0.40 [0.17-0.86]	

b. Obstetric factors

Those who were diagnosed of PE after 34 weeks of gestation had lower risk of developing complications compared to those diagnosed before 34 weeks of gestation. Multiple gestation had higher odds for developing complications ($OR=1.11 [0.36-3.05]$). Having an old partner ($OR=0.19$, $p=0.001$) and ≥ 5 ANC visits ($OR= 0.26$, $p=<0.001$) were significantly protective for complications of PE. ANC provided by a nurse, primigravida and primiparity were found to be associated with complications.

Table XII: Association between obstetric characteristics and complications of PE

Variables	Categories	Cases (n=97)	Controls (n=194)	OR [95% CI]	p-value	N
Gestational age at pre-eclampsia onset	≤ 34 weeks	46 (47.4%)	73 (37.6%)	Ref.	0.140	291
	> 34 weeks	51 (52.6%)	121 (62.4%)	0.67 [0.41-1.10]		
Number of foetuses	One	91 (93.8%)	183 (94.3%)	Ref.	1.000	291
	Two or more	6 (6.2%)	11 (5.7%)	1.11 [0.36-3.05]		
Nature of partner*	New Partner	12 (21.4%)	7 (4.8%)	Ref.	0.001	203
	Old Partner	44 (78.6%)	140 (95.2%)	0.19 [0.06-0.50]		
Past pre-eclampsia*	No	38 (67.9%)	95 (64.6%)	Ref.	0.789	203
	Yes	18 (32.1%)	52 (35.4%)	0.87 [0.44-1.66]		
Alcohol consumption	No	67 (69.1%)	152 (78.4%)	Ref.	0.113	291
	Yes	30 (30.9%)	42 (21.6%)	1.62 [0.93-2.81]		
Number of ANC visits	< 5 visits	82 (84.5%)	114 (58.8%)	Ref.	<0.001	291
	≥ 5 visits	15 (15.5%)	80 (41.2%)	0.26 [0.14-0.48]		
ANC provider**	Doctor	9 (10.2%)	53 (27.9%)	Ref.	0.002	278
	Other ¹	79 (89.8%)	137 (72.1%)	3.34 [1.63-7.63]		
Baby sex	Boy	56 (57.7%)	108 (55.7%)	Ref.	0.834	291
	Girl	41 (42.3%)	86 (44.3%)	0.92 [0.56-1.51]		
Primigravida	No	56 (57.7%)	147 (75.8%)	Ref.	0.003	291
	Yes	41 (42.3%)	47 (24.2%)	2.28 [1.36-3.85]		
Primiparous	No	54 (55.7%)	133 (68.6%)	Ref.	0.042	291

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

	Yes	43 (44.3%)	61 (31.4%)	1.73 [1.05-2.87]		
Calcium intake during pregnancy	No	69 (71.1%)	126 (64.9%)	Ref.	0.355	291
	Yes	28 (28.9%)	68 (35.1%)	0.75 [0.44-1.27]		
Aspirin intake during pregnancy	No	96 (99.0%)	186 (95.9%)	Ref.	0.280	291
	Yes	1 (1.03%)	8 (4.12%)	0.27 [0.01-1.55]		

*Calculated only for women with at least one past pregnancy (gravidity>1)

**Calculated only for those who attended at least 1 ANC visit

¹other (nurse, nurse assistant)

4.8. PROPORTION OF COMPLICATIONS IN PE

From the total 344 PE files evaluated, the overall proportion of complications in the 130 selected cases was 37.8% distributed as shown in table XII.

Table XIII: Distribution of proportion of complications

Maternal complication	N= 97	Frequency %
Eclampsia	77	22.4
HELLP syndrome	24	6.9
Acute kidney injury	8	2.3
Placenta abruptio	9	2.6
Maternal death	3	0.9
Pulmonary oedema	5	1.5
Retinal detachment	2	0.6
Pulmonary embolism	1	0.3
Stroke	1	0.3

4.9. RISK FACTORS FOR COMPLICATIONS IN WOMEN WITH PE

The multiple logistic regression model for multivariate analysis showed that age was inversely associated with the occurrence of pre-eclampsia complications, implying that a lower age was a risk factor to experience complications (Table XIII). A history of alcohol consumption and having a new partner were also associated with increased odds for complications. Meanwhile, attending more ANC visits lowered the odds for complications. No significant association with the odds of PE complications were found for the variables “onset of PE>34weeks of gestation” and “baby sex”.

Table XIV: Multiple logistic regression model for risk factors of complications in pre-eclampsia

Model* covariates	aOR (95% CI)	P-value
Age >20years	0.865 (0.800 – 0.936)	<0.001
Education level		
Primary	Reference	
Secondary	1.094 (0.360 – 3.324)	0.875
University	3.276 (0.973 – 11.029)	0.055
Profession		
Civil Servant	Reference	
Student	0.297 (0.086 – 1.033)	0.056
Housewife	0.817 (0.265 – 2.521)	0.726
Informal sector	0.462 (0.144 – 1.480)	0.193
Primigravida	0.495 (0.116 – 2.103)	0.340
Primiparous	0.539 (0.171 – 1.700)	0.291
Onset of pre-eclampsia after 34 weeks	0.632 (0.327 – 1.220)	0.172
Previous pre-eclampsia	0.724 (0.365 – 1.435)	0.354
Calcium intake during pregnancy	0.872 (0.454 – 1.674)	0.680
Aspirin intake during pregnancy	0.246 (0.023 – 2.608)	0.244
Number of ANC visits attended >5	0.711 (0.575 – 0.877)	0.001
Staff qualification during ANC visits		
No ANC visits done	Reference	
Seen by nurse assistant	0.165 (0.025 – 1.091)	0.062
Seen by nurse	0.674 (0.142 – 3.201)	0.620
Seen by doctor	0.312 (0.045 – 2.181)	0.240
Alcohol consumption	2.532 (1.188 – 5.396)	0.016
New partner	3.634 (1.141 – 11.574)	0.029
Female sex of baby	1.235 (0.670 – 2.278)	0.499

*n=291, Pseudo-R² (Cragg-Uhler) = 38.8%, AIC = 316.6

CI: Confidence Interval

CHAPTER 5: DISCUSSION

Preeclampsia has been estimated to affect 2-8% of pregnancies[57]. This has been associated with adverse maternal and foetal outcomes. We therefore aimed to study the risk factors of complications in preeclampsia. Specifically, we sought to 1) Describe the socio-demographic obstetrical characteristics of patients with preeclampsia; 2) Determine the proportion of complications of preeclampsia and 3) Identify and compare the risk factors associated with the development of complications in preeclampsia.

5.1. LIMITATION OF THE STUDY

Even though we managed to attain our objectives and set sample size, we do acknowledge the following limitations;

- We carried out a retrospective study, so access to files was difficult with so many incomplete patient medical records. Majority had the absence of important variables such as BMI which is hypothesised to affect the outcome of PE and couldn't be assessed in our study.
- Our study focused more on maternal complications even though just superficially assessing foetal outcomes

5.2. SOCIO-DEMOGRAPHIC DATA

a) Age

From our study, we found the mean age of our participants was 28.4 ± 6.7 years with the exposed group at 26.2 ± 6.2 years and the unexposed group at 29.4 ± 6.7 years. This was similar to two studies carried out in Cameroon by Hortence et al.[17] and Henry Leonard et al.[56] who had 28 ± 7 years and 28.4 ± 7.1 years respectively. We found out that women within the age range 16-20 years presented more complications than the other age groups. This value was similar to those found by Fouedjio et al.[55] in 2016 in their study carried out in Cameroon, who found a significant association between age <20 years and eclampsia. However, this was in contrast to Stitterich et al.[58] who had a predominant age range of 20-32 years and a study carried out in Cameroon had a prevalence in 29-33 years[59]. Logan et al.[60] also had 35-49 years as a risk for

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

developing complications in PE. Our findings could be explained by that, this early age is associated with early trophoblast invasion and higher risk of placenta dysfunction.

b) Profession

We found out that being a student or in the informal sector lowered the odds for complication ($OR=0.95[0.57;1.62]$), implying housewives had increased odds for complications. This was in line with a study done by Boubacar et al.[54] and Tebeu et al.[61] who found an increased risk in housewives. This could be explained by the low economic status and stress-related factors such as psychosocial stress in these women[62].

c) Level of education

Our participants had attained at least a primary education level in both exposed and non-exposed groups. We didn't record any illiterates in our study. Those who had attained a university level of education had significantly higher odds ($OR=2.35 [1.40-3.95]$) for developing complications. This was in line with Logan et al.[60] and could be explained by the fact that our study was carried out in an urban setting (Yaoundé) and women of these group may feel self-sufficient with knowledge and in turn not attend ANCs.

5.3. OBSTETRIC CHARACTERISTICS

According to our study, women who were primiparous were at an increased risk of developing complication same as primigravida. This is in line with seral studies which have been carried out[60],[12],[4],[63]. This could be explained by maternal immune maladaptation following early trophoblastic invasion and also from the hypothesis that nulliparity is strongly associated with complications due to the immunological theory of PE stating the conflict between the mother and paternal genes during first gestation.

The notion of a new partner was significantly associated with an increased risk of developing complications in PE ($p=0.001$). this was concurrent with the findings of Stitterich et al[58].

Consumption of alcohol increased the odds of developing complications in PE ($OR=1.62 [0.93-2.81]$). This was in line with Grum et al.[64], Haille et al.[65] who also had a significant

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

association between alcohol and eclampsia. Gong et al. found no significant association between alcohol and preeclampsia complications[66]. This could be explained by the difference in study designs which could have led to confounding and bias in their study. Also, in our setting, we've had an increased rate of consumption of alcohol in the past year. Literature has it that, alcohol is associated with placenta dysfunction, which could explain our results[67].

We found that women who did less than 5 ANCs were significantly associated with the development of complications ($p=<0.001$). Similarly, those who had their ANC conducted by a nurse had higher odds for complications ($OR=3.34 [1.63-7.63]$, $p= 0.002$). This is in line with Logan et al.[60], Fouedjio et al.[55]. This could be because in our setting, Cameroon, ANCs are mostly conducted by nurses or other hospital personnels who may have little and inadequate training on such procedures. Lack of knowledge on ANC by some pregnant women and low socio-economic status could also explain these findings. These health personnels should be offered quality training to improve the quality of ANC. Also, the awareness of ANCs has to be made to women of reproductive age to encourage them participate more in ANCs.

In this study, though not statistically significant, LOPE (>34 weeks of gestation) reduced the odds of developing complications in PE compared to those with EOPE. This is in line to Nguefack et al. who concluded that EOPE was more associated with adverse maternal and foetal outcomes[68]. Literature has it that EOPE is associated with adverse maternal outcomes in PE due to the increase in superoxide production leading to oxidative stress.

WHO recommends the use of aspirin in high-risk individuals for the prevention of PE and its complications, initiated between 12-16 weeks of gestation[69]. Also, studies have shown Calcium to be effective in the prevention of PE[70]. This wasn't significant in our study, but we found that the population who took calcium and aspirin more, were less likely to develop complications in PE.

Women with multiple foetus (>2) had increased odds of developing complications ($OR=1.11 [0.36;3.05]$) than those with single foetus. Furthermore, male sex of foetus represented more in the group of women with maternal complications but we found no significant association between sex of the baby and complications in PE.

5.4. CLINICAL AND PARACLINICAL CHARACTERISTICS

The most used drug therapy was magnesium sulphate, which is an anti-convulsant, followed by anti-hypertensive drug therapy; nicardipine and methyldopa. A study carried out by Cicero et al. focused on the clinical and paraclinical predictors of adverse outcomes in PE[71]. They also had same hypertensive agents as the most frequently used and came to a conclusion that antihypertensive drug therapy was an important predictor of positive maternal and foetal outcomes. However, this was not significant in our study. The women on admission frequently presented with headaches, convulsion, blur vision. The group of cases had a higher mean systolic blood pressure (174mmHg) and opposed to the control group. Metogo et al.[72], found a higher systolic and diastolic mean BP, 184.2mmHg and 105.1mmHg respectively. Monitoring of blood pressure during pregnancy is valuable for the prevention of complications as higher values affect PE outcome.

5.5. FOETAL OUTCOMES

According to our studies, foetal outcomes were worse in the exposed group who had maternal complications such as, foetal death (26.9%), prematurity (56.7%), IUGR (11.9%). Ngwenya et al. also reported that women with complications were 4 times more likely to present with adverse foetal outcomes[53]. Fouedjio et al., Tshabu et al.[73], also had these three as the most frequent complications. Melese et al. reported higher proportion of stillbirths in women with PE/eclampsia[74]. This could be due to placenta ischemia in the preeclamptic state[17]. There was a significant higher frequency of low birth weight in the exposed group (66.7%). PE remains an emergency in our context and requires the immediate delivery of the foetus as soon as possible, through the fastest route. The delay in management could have dire effects on foetus.

5.6. MATERNAL COMPLICATIONS AND PROPORTION OF COMPLICATIONS

From our study, the most frequent complications were; Eclampsia (79.7%), HELLP syndrome (24.7%), placenta abruptio (9.3%), acute kidney injury (8.3%), pulmonary oedema (5.2%). Henry-Leonard et al. recorded same complications as we did, with eclampsia (39%) being the most frequent maternal complication in their study, followed by HELLP syndrome (14%), same with Tshabu-Aguemon et al. found eclampsia with (36.8%) followed by placenta

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

abruption[73] and Ngbale et al. who recorded eclampsia (29.3%) and renal failure (19.5%) as the most frequent complications[75]. These values were however lower than that in our study. This shows that complications in PE are becoming more and more frequent, hence the need for rapid intervention. The difference could also be because of the difference in population size.

We recorded 3 maternal deaths in our study with 3.1%. This was lower than that recorded by Halle-Ekane who had 4.4%[59]. In contrast, Ngowa et al., Kitchou et al. recorded lower values 1.8% and 2% respectively[76],[4]. We had similar values with Ze Minkande et al. and Hortence et al., who recorded 3.5% and 3.3% respectively. These deaths occurred in combination with other maternal complications in PE.

The proportion of complications of PE in our study population was 38.8%. This was lower than the 42.3% found by Fouedjio et al.[17], in 2020 in Cameroon. This could be due to better awareness of the adverse outcomes in PE and more prophylactic measures put in place.

5.6. RISK FACTORS OF COMPLICATIONS IN WOMEN WITH PREECLAMPSIA

According to our multivariate analysis result, using multiple logistic regression the factors associated with complications in PE were; maternal age >20years [OR=0.863 (0.798 – 0.933); p<0.001], being a housewife [OR=0.798 (0.259-2.460)], number of ANC>5 [OR=0.706(0.572-0.871); p=0.001], alcohol consumption [OR=2.481(1.168-5.271); p=0.018] and new partner [OR=1.261(1.158-11.720); p=0.027]. Hortence et al.[17], Benjelloun et al.[77], and Daillo et al., found same risk factors in their studies. According to Hortence et al., having a nurse preside over ANC increased the risk of having complications by 5 and <4 ANC had increased odds for complications. This could be explained by the lack of qualifications of these personnels.

According to the study carried out by Grum et al., the additional risk factors they found were; history of preeclampsia in prior pregnancy (AOR: 4.28, 95% CI: 1.61, 11.43), multiple pregnancy (AOR: 8.22, 95% CI: 2.97, 22.78), nutritional counselling during pregnancy (AOR: 0.22, 95% CI: 0.1, 0.48). These factors have been documented in literature to be predisposing factors of complications in PE. However, they were not significant in our study. This could be because of the difference in study designs and study population.

The body mass index (BMI) has been found to greatly influence adverse outcomes in PE[77], but this was not measured in our study. The absence of data on weight and height could be explained

by the fact that majority of the patients were admitted in an emergency state and measure focused on management.

CONCLUSION

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

Preeclampsia remains a major health concern in our setting as it is associated with adverse maternal and perinatal outcomes. From our study, we could draw the following conclusions;

- The mean age of preeclamptic women with complications was 28.4 ± 6.7 years, with most attaining the university level of education, single and having an occupation as housewife.
- The proportion of complications in PE was 37.8%. Maternal complications were headed by eclampsia, HELLP syndrome, placenta abruptio and acute kidney injury.
- The risk factors associated with complications were; lower maternal age, number of ANC<5, alcohol consumption and primipaternity.

RECOMMENDATIONS

From our results, we humbly make the following recommendations;

❖ **To the Minister of Public Health**

- Provide adequate and quality training to auxiliary health staffs on ANC
- Organize sensitization programs to the community on preeclampsia and its complications

❖ **To clinicians**

- Diagnose preeclampsia early, identify high-risk groups and administer prophylactic treatment in the prevention of preeclampsia and its complications.
- Offer timely and quality management to patients who present with preeclampsia

❖ **To the scientific community**

- To carry out more research on a larger population using a prospective cohort and experimental study design
- To carry out further research evaluating specific risk factors

❖ **To pregnant women**

- Respect the guidelines of antenatal consultations provided by WHO during pregnancy.

REFERENCES

REFERENCES

1. Amougou SN, Mbita SMM, Danwe D, Tebeu PM. Factor associated with progression to chronic arterial hypertension in women with preeclampsia in Yaoundé, Cameroon. *Pan Afr Med J.* 2019;33:200.
2. WHO. A global brief on hypertension. [Internet]. 2013 [cited 2024 Jan 5]. Available from: <https://iris.who.int/bitstream/handle/10665/79059/W?sequence=1>
3. WHO recommendation on calcium supplementation before pregnancy for the prevention of pre-eclampsia and its complications.2020. Available from: <https://www.who.int/publications-detail-redirect/9789240003118>
4. Ngowa JDK, Kasia JM, Alima J, Domgue JF, Ngassam A, Bogne JB, et al. Maternal and Perinatal Complications of Severe Preeclampsia in Three Referral Hospitals in Yaoundé, Cameroon. *Open J Obstet Gynecol.* 2015;05(12):723.
5. Kasiye SG, Nega A, Bizatu M. Prevalence of hypertensive disorders of pregnancy and pregnancy outcomes in Sub-Saharan Africa: A systematic review and meta-analysis. *Women's Health.* 2020 October 23;(16): 1-25.
6. Njukang NE, Egbe TO, Sama M, Yoah TA, Kamgno J. Prevalence and Risk Factors of Hypertensive Disorders in Pregnancy: Case of Mezam Division, NWR Cameroon. *J Women's Health Dev.* 2020 Aug 13;3(3):247–67.
7. Foumane P, Dohbit JS, Meka ENU, Nkada MN, Minkande JZ, Mboudou ET. Etiologies de la mortalité maternelle à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé: une série de 58 décès. *Health Sci Dis.* 2015 Aug 17;16(3).
8. Shahd AK, Peter LH Preeclampsia - StatPearls - NCBI Bookshelf [Internet]. [cited 2023 Dec 4]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK570611/>
9. Pankiewicz K, Szczerba E, Maciejewski T, Fijałkowska A. Non-obstetric complications in preeclampsia. *Menopause Rev Menopauzalny.* 2019;18(2):99–109.
10. Li B, Yang H. Comparison of clinical features and pregnancy outcomes in early- and late-onset preeclampsia with HELLP syndrome: a 10-year retrospective study from a tertiary hospital and referral center in China. *BMC Pregnancy Childbirth.* 2022 Mar 8;22(1):186.
11. Wilkerson RG, Ogunbodede AC. Hypertensive Disorders of Pregnancy. *Emerg Med Clin North Am.* 2019 May;37(2):301–16.
12. Kongwattanakul K, Saksiriwuttho P, Chaiyarak S, Thepsuthammarat K. Incidence, characteristics, maternal complications, and perinatal outcomes associated with preeclampsia with severe features and HELLP syndrome. *Int J Womens Health.* 2018 Jul 17;10:371–7.

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

13. Nakimuli A, Chazara O, Byamugisha J, Elliott AM, Kaleebu P, Mirembe F, et al. Pregnancy, parturition and preeclampsia in women of African ancestry. *Am J Obstet Gynecol.* 2014 Jun 1;210(6):510-520.e1.
 14. Musa J, Mohammed C, Ocheke A, Kahansim M, Pam V, Daru P. Incidence and risk factors for pre-eclampsia in Jos Nigeria. *Afr Health Sci.* 2018 Aug 14;18(3):584–95.
 15. Mboudou ET, Foumane P, Priso EB, Dohbit J, Minkande JZ, Nkengafac WM, et al. Hypertension au cours de la grossesse: Aspects cliniques et épidémiologiques à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé, Cameroun. *Clin Mother Child Health.* 2009 December 7;6(2). 1087-1093.
 16. Obstetricians ACo G. Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists' task force on hypertension in pregnancy. *Obstet Gynecol.* 2013;122(5):1122.
 17. Hortence FJ, Manuella MW, Cliford EE, Agnès E, Elodie TN, Florent FY, et al. Factors Associated with Maternal and Perinatal Complications of Preeclampsia at the Central Hospital of Yaoundé: A Cross-Sectional Analytical Study. *Open J Obstet Gynecol.* 2022 Dec 26;12(12):1245–57.
 18. Jenifer AH, Sarka L, Joseph KS. Epidemiology of pre-eclampsia and the other hypertensive disorders of pregnancy - ScienceDirect. 2011; 24(4): 391-403.
 19. Abalos E, Cuesta C, Carroli G, Qureshi Z, Widmer M, Vogel JP et al. Pre-eclampsia, eclampsia and adverse maternal and perinatal outcomes: a secondary analysis of the World Health Organization Multicountry Survey on Maternal and Newborn Health. *BJOG: An International Journal of Obstetrics & Gynaecology.* 2014 March; 121(1): 14-24.
 20. Uzan J, Carbonnel M, Piconne O, Asmar R, Ayoubi JM. Pre-eclampsia: pathophysiology, diagnosis, and management. *Vasc Health Risk Manag.* 2011; 7: 467–74.
 21. Duley L. The global impact of pre-eclampsia and eclampsia. *Semin Perinatol.* 2009 Jun;33(3):130–7.
 22. Carty DM, Delles C, Dominiczak AF. Preeclampsia and future maternal health. *J Hypertens.* 2010 Jul;28(7):1349–55.
 23. Duley L. The Global Impact of Pre-eclampsia and Eclampsia. *Semin Perinatol.* 2009 Jun 1;33(3):130–7.
 24. Aabidha PM, Cherian AG, Paul E, Helan J. Maternal and fetal outcome in pre-eclampsia in a secondary care hospital in South India. *J Fam Med Prim Care.* 2015 Jun;4(2):257.
 25. Wagner LK. Diagnosis and Management of Preeclampsia. *Am Fam Physician.* 2004 Dec 15;70(12):2317–24.
-

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

26. Maynard SE, Min JY, Merchan J, Lim KH, Li J, Mondal S, et al. Excess placental soluble fms-like tyrosine kinase 1 (sFlt1) may contribute to endothelial dysfunction, hypertension, and proteinuria in preeclampsia. *J Clin Invest.* 2003 Mar 1;111(5):649–58.
 27. Roberts JM, Cunningham GF, Lindheimer MD. Chesley's Hypertensive Disorders in Pregnancy. Academic Press; 2009. 443 p.
 28. Saito S, Nakashima A, Shima T, Ito M. REVIEW ARTICLE: Th1/Th2/Th17 and Regulatory T-Cell Paradigm in Pregnancy. *Am J Reprod Immunol.* 2010;63(6):601–10.
 29. Mütze S, Rudnik-Schöneborn S, Zerres K, Rath W. Genes and the preeclampsia syndrome. 2008 Jan 1;36(1):38–58.
 30. George EM, Granger JP. Heme oxygenase in pregnancy and preeclampsia. *Curr Opin Nephrol Hypertens.* 2013 Mar;22(2):156.
 31. Moghaddas Sani H, Zununi Vahed S, Ardalan M. Preeclampsia: A close look at renal dysfunction. *Biomed Pharmacother Biomedecine Pharmacother.* 2019 Jan;109:408–16.
 32. Tomimatsu T, Mimura K, Endo M, Kumasawa K, Kimura T. Pathophysiology of preeclampsia: an angiogenic imbalance and long-lasting systemic vascular dysfunction. *Hypertens Res.* 2017 Apr;40(4):305–10.
 33. Tomimatsu T, Mimura K, Matsuzaki S, Endo M, Kumasawa K, Kimura T. Preeclampsia: Maternal Systemic Vascular Disorder Caused by Generalized Endothelial Dysfunction Due to Placental Antiangiogenic Factors. *Int J Mol Sci.* 2019 Aug 30;20(17):4246.
 34. Alpoim PN, Godoi LC, Pinheiro M de B, Freitas LG, Carvalho M das G, Dusse LM. The unexpected beneficial role of smoking in preeclampsia. *Clin Chim Acta.* 2016 Aug 1;459:105–8.
 35. Matsubara K. Hypoxia in the pathogenesis of preeclampsia. *Hypertens Res Pregnancy.* 2017;5(2):46–51.
 36. Zhu X, Wu S, Dahut WL, Parikh CR. Risks of Proteinuria and Hypertension With Bevacizumab, an Antibody Against Vascular Endothelial Growth Factor: Systematic Review and Meta-Analysis. *Am J Kidney Dis.* 2007 Feb 1;49(2):186–93.
 37. Aouache R, Biquard L, Vaiman D, Miralles F. Oxidative Stress in Preeclampsia and Placental Diseases. *Int J Mol Sci.* 2018 May;19(5):1496.
 38. Basaran A, Basaran M, Topatan B. Combined Vitamin C and E Supplementation for the Prevention of Preeclampsia: A Systematic Review and Meta-Analysis. *Obstet Gynecol Surv.* 2010 Oct;65(10):653.
 39. Rana S, Lemoine E, Granger JP, Karumanchi SA. Preeclampsia. *Circ Res.* 2019 Mar 29;124(7):1094–112.
-

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

40. Vaidakis D. Preeclampsia: Clinical features and diagnosis - UpToDate. 2022 September.
 41. Nkwabong E, Djientcheu Deugoue F, Fouedjio J. Pre-eclampsia in a Sub-Saharan African country and maternal-perinatal outcome. *Trop Doct.* 2023 Jan 1;53(1):61–5.
 42. Knight M. Eclampsia in the United Kingdom 2005. *BJOG Int J Obstet Gynaecol.* 2007;114(9):1072–8.
 43. Ducloy-Bouthors AS. Hémostase et prééclampsie. *Ann Fr Anesth Réanimation.* 2010 May 1;29(5):e121–34.
 44. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. *BMJ.* 2007 Nov 8;335(7627):974.
 45. McDonald SD, Malinowski A, Zhou Q, Yusuf S, Devereaux PJ. Cardiovascular sequelae of preeclampsia/eclampsia: A systematic review and meta-analyses. *Am Heart J.* 2008 Nov 1;156(5):918–30.
 46. Lopes van Balen VA, Spaan JJ, Cornelis T, Spaanderman MEA. Prevalence of chronic kidney disease after preeclampsia. *J Nephrol.* 2017 Jun 1;30(3):403–9.
 47. Barton JR, Sibai BM. Prediction and Prevention of Recurrent Preeclampsia. *Obstet Gynecol.* 2008 Aug;112(2 Part 1):359.
 48. Phipps E, Prasanna D, Brima W, Jim B. Preeclampsia: Updates in Pathogenesis, Definitions, and Guidelines. *Clin J Am Soc Nephrol CJASN.* 2016 Jun 6;11(6):1102.
 49. Ramos JGL, Sass N, Costa SHM. Preeclampsia. *Rev Bras Ginecol E Obstetrícia RBGO Gynecol Obstet.* 2017 Sep;39(9):496–512.
 50. Tanner MS, Malhotra A, Davey MA, Wallace EM, Mol BW, Palmer KR. Maternal and neonatal complications in women with medical comorbidities and preeclampsia. *Pregnancy Hypertens.* 2022 Mar 1; 27:62–8.
 51. Prithi A, Reddy AD, Deepthi YS, Venkatesh RR. PREECLAMPSIA: RISK FACTORS, COMPLICATIONS AND MANAGEMENT. *World J Pharm Res.* 7(13).
 52. Ngwenya S. Severe preeclampsia and eclampsia: incidence, complications, and perinatal outcomes at a low-resource setting, Mpilo Central Hospital, Bulawayo, Zimbabwe. *Int J Womens Health.* 2017 May 17; 9:353–7.
 53. Ngwenya S, Jones B, Mwembe D. Determinants of adverse maternal and perinatal outcomes in severe preeclampsia and eclampsia in a low-resource setting, Mpilo Central Hospital, Bulawayo, Zimbabwe. *BMC Res Notes.* 2019 May 28;12(1):298.
 54. Boubacar DA, Bah OH, Conté I, Sow IS, Bah IK, Touré S, et al. Management of pre-eclampsia and its complications in the department of gynecology and obstetrics at Donka
-

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

- national hospital Conakry, Guinea. *Int J Reprod Contracept Obstet Gynecol.* 2020 Apr 28;9(5):1858.
55. Fouedjio J, Foumane P, Fouogue J, Ndenga V, Fouelifack F, Bissene A, et al. Predictors of eclampsia among preeclamptic patients: a case control study in Yaounde, Cameroon. *Int J Reprod Contracept Obstet Gynecol.* 2016;2204–9.
56. Henri-Leonard M, Junie MN, Ange NDM, Junette MM, Félix E, Hector MC, et al. Complications Maternelles et Facteurs Pronostiques de la Pré-Éclampsie Sévère dans Trois Hôpitaux Universitaires de Yaoundé: à Propos de 115 Cas. *Health Sci Dis.* 2024 Apr 4 ;25(4). 85-89.
57. Roberge S, Villa P, Nicolaides K, Giguère Y, Vainio M, Bakthi A, et al. Early Administration of Low-Dose Aspirin for the Prevention of Preterm and Term Preeclampsia: A Systematic Review and Meta-Analysis. *Fetal Diagn Ther.* 2012 Mar 21;31(3):141–6.
58. Stitterich N, Shepherd J, Koroma MM, Theuring S. Risk factors for preeclampsia and eclampsia at a main referral maternity hospital in Freetown, Sierra Leone: a case-control study. *BMC Pregnancy Childbirth.* 2021 Jun 2;21(1):413.
59. Halle-Ekane G. Complications et prise en charge de la prééclampsie sévère et de l'éclampsie à l'hôpital général de Douala. 2015 Jan 1;
60. Logan GG, Njoroge PK, Nyabola LO, Mweu MM. Determinants of preeclampsia and eclampsia among women delivering in county hospitals in Nairobi, Kenya. *F1000Research;* 2020 Marach 18; 9:192
61. Tebeu PM, Foumane P, Mbu R, Fosso G, Biyaga PT, Fomulu JN. Risk Factors for Hypertensive Disorders in Pregnancy: A Report from the Maroua Regional Hospital, Cameroon. *J Reprod Infertil.* 2011;12(3):227–34.
62. Schneider S, Freerksen N, Maul H, Roehrig S, Fischer B, Hoeft B. Risk groups and maternal-neonatal complications of preeclampsia – Current results from the national German Perinatal Quality Registry. 2011 May 1;39(3):257–65.
63. Nankali A, Malek-khosravi Sh, Zangeneh M, Rezaei M, Hemati Z, Kohzadi M. Maternal Complications Associated with Severe Preeclampsia. *J Obstet Gynaecol India.* 2013 Apr;63(2):112–5.
64. Grum T, Seifu A, Abay M, Angesom T, Tsegay L. Determinants of pre-eclampsia/Eclampsia among women attending delivery Services in Selected Public Hospitals of Addis Ababa, Ethiopia: a case control study. *BMC Pregnancy Childbirth.* 2017 Sep 15;17(1):307.
65. Haile TG, Assefa N, Alemayehu T, Mariye T, Geberemeskel GG, Bahrey D, et al. Determinants of Preeclampsia among Women Attending Delivery Services in Public Hospitals of Central Tigray, Northern Ethiopia: A Case-Control Study. *J Pregnancy.* 2021 Jun 2;2021:e4654828.
-

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

66. Gong W, Zeng N, Corsi D, Wen SW. Association Between Alcohol use in Pregnancy and Preeclampsia or Hypertension in Pregnancy: A Systematic Review. Research square. 2020 June 25. <https://doi.org/10.21203/rs.3.rs-36772/v1>.
 67. Burd L, Roberts D, Olson M, Odendaal H. Ethanol and the placenta: A review. *J Matern Fetal Neonatal Med.* 2007 Jan 1;20(5):361–75.
 68. Nguefack CT, Ako MA, Dzudie AT, Nana TN, Tolefack PN, Mboudou E. Comparison of materno-fetal predictors and short-term outcomes between early and late onset pre-eclampsia in the low-income setting of Douala, Cameroon. *Int J Gynecol Obstet.* 2018;142(2):228–34.
 69. Roberge S, Bujold E, Nicolaides KH. Aspirin for the prevention of preterm and term preeclampsia: systematic review and metaanalysis. *Am J Obstet Gynecol.* 2018 Mar;218(3):287-293.e1.
 70. Patrelli TS, Dall'Asta A, Gizzo S, Pedrazzi G, Piantelli G, Jasonni VM, et al. Calcium supplementation and prevention of preeclampsia: a meta-analysis. *J Matern Fetal Neonatal Med.* 2012 Dec 1;25(12):2570–4.
 71. Cicero AFG, Degli Esposti D, Immordino V, Morbini M, Baronio C, Rosticci M, et al. Independent Determinants of Maternal and Fetal Outcomes in a Sample of Pregnant Outpatients With Normal Blood Pressure, Chronic Hypertension, Gestational Hypertension, and Preeclampsia. *J Clin Hypertens.* 2015;17(10):777–82.
 72. Annick MNJ, Arlette MMJ, Charles BB, Sone P, Gertrude MS, Jacqueline ZM. Profil Clinique de la Pré Éclampsie Sévère et ses Complications en Réanimation dans deux Hôpitaux de la Ville de Douala: Clinical Profile of Severe Preeclampsia and its Complications in Intensive Care Unit in two Hospitals of the City of Douala. *Health Sci Dis.* 2024 May 15; 25(3).
 73. Tshabu-Aguemon C, Ogoudjobi OM, Lokossou S, Hounkpatin B, Denakpo JL, Kottin W, et al. Journal de la Société de Biologie Clinique du Bénin page 59. 2017;
 74. Melese MF, Badi MB, Aynalem GL. Perinatal outcomes of severe preeclampsia/eclampsia and associated factors among mothers admitted in Amhara Region referral hospitals, North West Ethiopia, 2018. *BMC Res Notes.* 2019 Mar 15;12(1):147.
 75. Ngbale NR, Gaunefet CE, Koirokpi A, Matoulou S, Kogboma-Gongo G, Mbano-Dede K, et al. Epidemiological Aspects and Prognosis of Severe Pre-eclampsia in Bangui, Central African Republic. *Gynecol Obstet.* 2019; 09(02).
 76. Kichou B, Henine N, Kichou L, Benbouabdellah M. Épidémiologie de la prééclampsie dans la région de Tizi-ouzou (Algérie). *Ann Cardiol Angéiologie.* 2015 Jun;64(3):164–8.
 77. Benjelloun AT, Benchrif Y, Mahdaoui S, Samouh N. Epidemiologie de la preeclampsie dans la region du grand Casablanca. *PAMJ - Clin Med.* 2020 Mar 16 ;2(112).
-



APPENDIX

APPENDIX I: PATIENT QUESTIONNAIRE FORM

TOPIC: RISK FACTORS OF COMPLICATIONS IN PREECLAMPSIA: A CASE-CONTROL STUDY

Date of interview:

Hospital:

Questionnaire number:

CODE:

1. IDENTIFICATION

Number	Variables	Answers
1.	Group: 1=case, 2=control	
2.	Age(in years):	
3.	Profession:	
4.	Marital status: Single=1; Married=2; Divorced=3; Widow=4	
5.	Level of education: Primary=1; Secondary=2; High school=3; University=4; Bachelor's degree=5; Masters=6; Doctorate=7; None=8	
6.	Religion: Christain=1; Muslim=2; Atheist=3; None=4; Other(specify)	
7.	Residence: Ethnic group:	

2. PAST HISTORY

8.	Gravida: Parity:	
9.	How many pregnancies have you had?	
10.	How many pregnancies arrived at term?	
11.	How many were premature?	
12.	How many miscarriages or induced abortions have you had?	
13.	Have you had an ectopic pregnancy before? Yes=1; No=2	

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

14.	How many children are alive?	
15.	History preeclampsia, eclampsia or HELLP syndrome in previous pregnancy or in the family? Yes = 1; No = 2	
16.	If yes, what was the management? Immediate delivery=1; outpatient management=2; just BP monitoring=3; Others=.....	
17.	What was the outcome of the pregnancy?	
18.	Do you have any history of kidney failure? Yes=1; No=2	
19.	Do you have hypertension? Yes = 1; No = 2 If yes, are you on any treatment? Yes=1; No=2 (specify)	
20.	Do you have any comorbidities? Diabetes=1; Obesity=2; Others(specify)	
21.	Any chronic diseases? Yes=1; No=2 Specify.....	
22.	Do you consume alcohol? Yes = 1; No = 2	
23.	Do you smoke? Yes=1; No=2	
3. PRESENT PREGNANCY		
24.	Did you present with severe features? Yes=1; No=2	
25.	How was the complication diagnosed? Lab tests=1; Ultrasound=2; Others(specify).....	
26.	At what gestational age was it diagnosed?..... <34 weeks = 1 >34 weeks =2	
27.	Use of low dose aspirin = 1 Use of calcium = 2 None = 3	
28.	BMI	
29.	New partner; Yes=1, No=2	
30.	Number of ANC <5 =1	

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

	>5 = 2	
31.	Presiding personnel for ANC Nurse=1; Doctor=2; Nurse assistant=3	
32.	Symptoms on entry	
33.	Blood pressure on entry	
34.	Management on entry	

4. FETAL OUTCOME

30.	Birth weightg	
31.	Multiple foetus; yes=1, no=2	
32.	Foetal sex Male=1 Female= 2	
33.	Gestational age at deliveryweeks	
34.	Foetal Complications: Yes=1; No=2	
35.	If yes, Which? Prematurity=1 Foetal demise=2 Asphyxia=3 Intrauterine growth restriction=4 Low birth weight=5 Others(specify)	
36.	Mode of delivery Caesarean section= 1 Vagina delivery=2 Other	

5. MATERNAL COMPLICATION

37.	Cerebro-vascular accident =1 Retinal detachment =2 Pulmonary oedema=3 Acute renal injury=4	
-----	---	--

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

Eclampsia=5 Maternal death=6 DIVC=7 HELLP Syndrome=8 Pulmonary oedema=9 Placenta abruptio=10	
---	--

6. LABORATORY FINDINGS

38.	Platelet count	
39.	Creatinine	
40.	ASAT	
41.	ALAT	
42.	BUN	
43.	Proteinuria	
44.	Haemoglobin level	

APPENDIX II: RESEARCH AUTHORISATIONS

REPUBLIC DU CAMEROUN
Paix-Travail-Patrie

MINISTERE DE LA SANTE PUBLIQUE

SECRETARIAT GENERAL

DIRECTION DE L' HOPITAL CENTRAL DE YAOUNDE

SECRETARIAT MEDICAL

N° 087/20 /AP/DHCY/CM/SM



REPUBLIC OF CAMEROUN
Peace-Work-Fatherland

MINISTRY OF PUBLIC HEALTH

GENERAL SECRETARY

DIRECTORATE OF CENTRAL HOSPITAL OF YAOUNDE

MEDICAL SECRETARY

Yaoundé, le 12 9 JAN 2020

ACCORD DE PRINCIPE

Je soussigné Professeur FOUDA Pierre Joseph, Directeur de l'Hôpital Central de Yaoundé, marque mon Accord de Principe à Monsieur LEYUGA SENKA'A NCHUNU , étudiant en 7^{ème} année de Médecine Générale à la Faculté de Médecine et des Sciences Biomédicales de l'Université de Yaoundé I , sous le thème « RISK FACTORS OF COMPLICATIONS IN PREECLAMPSIA: A CASE-CONTROL STUDY » dans le service de Gynécologie et Obstétrique à l'Hôpital Central de Yaoundé, sous la codirection du docteur EBONG Cliford EBONTANE .

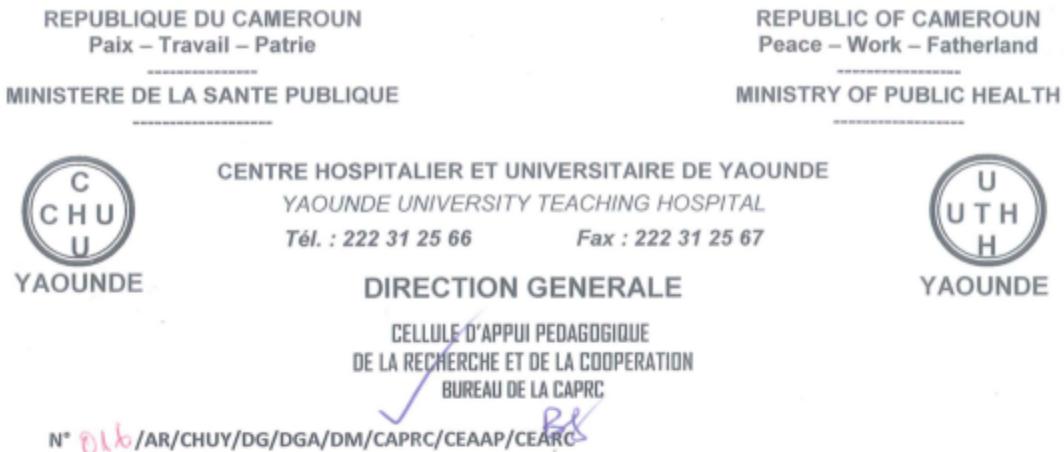
Ampliations :

- Conseiller Médical ;
- Chef service concerné ;
- Intéressé;
- Chrono/Archives.



P. Dr. Pierre Angelo Leyuga

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé



AUTORISATION DE RECHERCHE

Dans le cadre de la rédaction d'un mémoire de fin d'études, en vue de l'obtention du diplôme de Doctorat en Médecine Générale, Madame LEYUGA SENKA'A NCHUNU est autorisée à mener une recherche au CHUY sur le thème : « Risk factors of complications in preeclampsia : a case-control study ».

Ces travaux se dérouleront dans le service de Gynécologie-Obstétrique sous la supervision du Dr MBOUA BATOUUM Véronique, Gynécologue.

Toutefois, elle devra obligatoirement déposer un exemplaire de mémoire au CHUY (Bureau de la CAPRC).

En foi de quoi la présente autorisation dont la durée de validité est de 03 mois à compter de la date de signature, lui est délivrée pour servir et valoir ce que de droit. /-

Yaoundé, le 15 FÉV 2024

LE DIRECTEUR GENERAL

COPIE :

- CAPRC
- BCAPRC
- SUPERVISEUR
- CHRONO



Dr Monse Enyime
Félicien

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé

REPUBLIC DU CAMEROUN
Paix-Travail-Patrie

MINISTERE DE LA SANTE PUBLIQUE

HOPITAL GYNECO-OBSTETRIQUE
ET PEDIATRIQUE DE YAOUNDÉ

HUMILITE – INTEGRITÉ – VÉRITÉ – SERVICE



REPUBLIC OF CAMEROON
Peace-Work-Fatherland

MINISTRY OF PUBLIC HEALTH

YAOUNDE GYNAECO-OBSTETRIC
AND PEDIATRIC HOSPITAL

HUMILITY – INTEGRITY – TRUTH – SERVICE

COMITE INSTITUTIONNEL D'ETHIQUE DE LA RECHERCHE POUR LA SANTE HUMAINE (CIERSH)

Arrêté n° 0977 du MINSANTE du 18 avril 2012 portant création et organisation des Comités d'Ethiques de la Recherche pour la santé Humaine. (CIERSH).

AUTORISATION N° 605 /CIERSH/DM/2024

CLAIRANCE ETHIQUE

Le Comité Institutionnel d'Ethique de la Recherche pour la Santé Humaine (CIERSH) a examiné le 24 janvier 2024, la demande d'autorisation et le Protocole de recherche intitulé « **Risk factors of complications in preeclampsia : a case control study** » soumis par l'étudiant LEYUGA SENKA'A NCHUNU.

Le sujet est digne d'intérêt. Les objectifs sont bien définis. La procédure de recherche proposée ne comporte aucune méthode invasive préjudiciable aux participants. Le formulaire de consentement éclairé est présent et la confidentialité des données est préservée. Pour les raisons qui précèdent, le CIERSH de HGOPY donne son accord pour la mise en œuvre de la présente recherche.

LEYUGA SENKA'A NCHUNU, devra se conformer au règlement en vigueur à HGOPY et déposer obligatoirement une copie de ses travaux à la Direction Médicale de ladite formation sanitaire./-

Yaoundé, le 08 FEV 2024

Prof MBU Robinson
Directeur Général
HGOPY

N°1827 ; Rue 1564 ; Ngousso ; Yaoundé 5ème
BP : 4362 Tél. : 242 05 92 94 / 222 21 24 33 / 222 21 24 31 Fax : 222 21 24 30
E-mail : hgopy@hotmail.com / hgopy@hgopy.cm

APPENDIX III: ETHICAL CLAIRANCE

APPENDIX IV: ANTI-PLAGIARISM TEST



Report: LEY_THEESIS_thesis[1]

LEY_THEESIS_thesis[1]

by Haggai

General metrics

46,173	6,804	1360	27 min 12 sec	52 min 20 sec
characters	words	sentences	reading time	speaking time

Score



71

Writing Issues

381
Issues left

194
Critical

187
Advanced

This text scores better than 71%
of all texts checked by Grammarly

Plagiarism



4
%

22
sources

4% of your text matches 22 sources on the web
or in archives of academic publications

Report was generated on Thursday, Jun 13, 2024, 08:08 AM

Page 1 of 98

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé



Report: LEY_THEESIS_thesis[1]

367.	measure →	Faulty subject-verb agreement	Correctness
368.	major →	Word choice	Engagement
369.	26year →	Misspelled words	Correctness
370.		Comma misuse within clauses	Correctness
371.	housewife →	Incorrect noun number	Correctness
372.	by,	Punctuation in compound/complex sentences	Correctness
373.	abruptie →	Misspelled words	Correctness
374.		Comma misuse within clauses	Correctness
375.		Comma misuse within clauses	Correctness
376.	primipaternity →	Misspelled words	Correctness
377.	staffs →	Incorrect noun number	Correctness
378.	to →	Wrong or missing prepositions	Correctness
379.		Comma misuse within clauses	Correctness
380.		Closing punctuation	Correctness
381.	Respect the guidelines of antenatal consultations provided by WHO during pregnancy.	Incorrect phrasing	Correctness
382.	one of the leading causes of maternal and foetal morbidity and mortality in	White blood cell treatment could prevent leading cause of foetal death https://www.medicalnewstoday.com/releases/314927	Originality

Report was generated on Thursday, Jun 13, 2024, 08:08 AM

Page 95 of 98

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé



Report: LEY_THESES_thesis[1]

383.	<i>Hypertension is defined by the World Health Organization (WHO) as a systolic</i>	Interaction between dietary factors and genetic risk for lipoprotein traits and cardiovascular disease	Originality
384.	<i>HDP is a global public health concern both in developed and developing countries</i>	Determinants of Behavioral Risk Factors of Hypertensive Disorders in Pregnancy https://fortuneonline.org/articles/determinants-of-behavioral-risk-factors-of-hypertensive-disorders-in-pregnancy.html	Originality
385.	<i>The World Health Organization (WHO) reported that 14.0% of global maternal deaths are attributed to HDP. In Latin-American and Caribbean countries 25.7% of maternal deaths were due to HDP; in Asian and African countries, it contributed to 9.1% of maternal deaths and in fact about 16% in sub-Saharan...</i>	Determinants of Behavioral Risk Factors of Hypertensive Disorders in Pregnancy https://fortuneonline.org/articles/determinants-of-behavioral-risk-factors-of-hypertensive-disorders-in-pregnancy.html	Originality
386.	<i>Society of Cardiology (ESC) guidelines on the management of cardiovascular diseases during pregnancy,</i>	https://www.archivestsc.com/jvi.aspx?un=TKDA-00568&volume=	Originality
387.	<i>systolic blood pressure > 160 mmHg or diastolic blood pressure > 110 mmHg</i>	Tenecteplase: Indication, Dosage, Side Effect, Precaution MIMS Malaysia https://www.mims.com/malaysia/drug/info/tenecteplase?mtype=generic	Originality
388.	<i>measured on two occasions at least 4 h apart;</i>	Chapter 38: Pregnancy https://www.clinical-laboratory-diagnostics.com/k38.html	Originality
389.	<i>a leading cause of foetal and maternal morbidity and mortality,</i>	Pre-eclampsia and maternal placental syndromes: an indicator or cause of long-term cardiovascular disease? Heart https://heart.bmjjournals.org/content/98/15/1109	Originality

Report was generated on Thursday, Jun 13, 2024, 08:08 AM

Page 96 of 98

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé



Report: LEY_THESIS_thesis[1]

390.	<i>The pathophysiology of preeclampsia is poorly understood, and</i>	On renal pathophysiology in preeclampsia	Originality
391.	<i>Identify the risk factors associated with the development of</i>	Radiation complications and tumor control after >125I plaque brachytherapy for ocular melanoma — Mayo Clinic https://mayoclinic.pure.elsevier.com/en/publications/radiation-complications-and-tumor-control-after-sup125ipi-plaque	Originality
392.	<i>Hypertension that occurs after 20 weeks of gestation in a woman with previously normal blood pressure;</i>	Determinants of Preeclampsia Among Pregnant Women in Chiro Referral Hospital, Oromia Regional State, Ethiopia: Unmatched Case–Control Study	Originality
393.	<i>Systolic blood pressure > 140 mm Hg and/or diastolic blood pressure > 90 mm Hg on</i>	Hypertensive Disorders During Pregnancy and Offspring Retinal Microvasculature During Adolescence	Originality
394.	<i>two occasions at least 6 hours apart with Proteinuria</i>	OBGYN-study-guide-1 https://studyres.com/doc/24481499/obgyn-study-guide-1	Originality
395.	<i>p-value<0,05) with a confidence interval of 95</i>	Prevalence of overweight and obesity and associated factors in school going adolescents in the south region of Brazil	Originality
396.	<i>frequencies and percentages, and compared using the chi-squared test or Fisher exact test</i>	Human Leukocyte Antigen (HLA) Typing Study Identifies Maternal DQ2 Susceptibility Alleles among Infertile Women: Potential Associations with Autoimmunity and Micronutrients	Originality
397.	<i>Continuous variables were summarized as mean with standard deviation (SD) and</i>	Young Women with PAD are at High Risk of Cardiovascular Complications	Originality

Report was generated on Thursday, Jun 13, 2024, 08:08 AM

Page 97 of 98

Risk factors of complications in preeclampsia in the early post-partum period: a case-control study in three hospitals in Yaoundé



Report: LEY_THEESIS_thesis[1]

398.	<i>The variables included in the final models were</i>	Low Physical Performance is Associated with a Poor Health-Related Quality of Life (HRQOL) in Community-Dwelling Older Mexicans" https://cgjonline.ca/index.php/cgj/article/download/560/834?inline=1	Originality
399.	<i>from the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences,</i>	Validity of four clinical prediction scores for pulmonary embolism in a sub-Saharan African setting: a protocol for a Cameroonian multicentre cross-sectional study	Originality
400.	<i>analysis showed that age was inversely associated with the</i>	Effects of Age on Insulin Resistance and Secretion in Subjects without Diabetes	Originality
401.	<i>Identify and compare the risk factors associated with</i>	Cross-sectional and longitudinal assessments of risk factors associated with hypertension and moderately increased albuminuria comorbidity in patients with type 2 diabetes: a 9-year open cohort study	Originality
402.	<i>be explained by the fact that our study was carried out in an urban setting</i>	https://file.scirp.org/Html/1-1431309_76160.htm	Originality
403.	<i>was significantly associated with an increased risk of developing complications</i>	Effects of diabetes and smoking on lumbar spinal surgery outcomes	Originality

Report was generated on Thursday, Jun 13, 2024, 08:08 AM

Page 98 of 98