

Assessment of Cardiovascular Risk Factors During Pregnancy: A Multicenter Study in West Africa, Dakar, Senegal

Aliou Alassane Ngaidé^{1,2*}, Ngoné Diaba Gaye^{1,2}, Joseph Salvador Mingou^{1,3}, Zineb Zinia², Mouhamadou Bamba Ndiaye^{1,3}, Alassane Diouf^{1,4}, Abdoul Kane^{1,2}

¹Faculty of Medicine, Cheikh Anta Diop University, Dakar, Senegal

²Cardiology Department, Dalal Jamm Hospital, Dakar, Senegal

³Cardiology Department, Aristide Le Dantec Hospital, Dakar, Senegal

⁴Gynecology Department, Pikune Hospital, Dakar, Senegal

Email: *alioualassane.ngaide@ucad.edu.sn

How to cite this paper: Ngaidé, A.A., Gaye, N.D., Mingou, J.S., Zinia, Z., Ndiaye, M.B., Diouf, A. and Kane, A. (2024) Assessment of Cardiovascular Risk Factors During Pregnancy: A Multicenter Study in West Africa, Dakar, Senegal. *World Journal of Cardiovascular Diseases*, 14, 644-655.

<https://doi.org/10.4236/wjcd.2024.1410056>

Received: July 27, 2024

Accepted: October 12, 2024

Published: October 15, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Context: Non-communicable diseases, including hypertension, are major causes of complications during pregnancy, posing significant risks to maternal and fetal health. Pregnancy increases cardiovascular risks, particularly through the development of gestational hypertension and preeclampsia, requiring early screening and close monitoring to prevent adverse outcomes. **Objectives:** This study aimed to evaluate the frequency of cardiovascular risk factors in pregnant women in Senegal and identify associated socio-behavioral and economic determinants. **Methodology:** A descriptive, analytical cross-sectional study with prospective data collection was conducted over three months (April 10 to July 10, 2023). The study included pregnant women aged 15 and older from three public hospital maternity wards in Senegal. We studied sociodemographic aspects, cardiovascular risk factors, and collected information on previous and current pregnancies, including the number of pregnancies, parity, miscarriages, the number of prenatal consultations, and the number of fetuses. Written consent was obtained. A p-value ≤ 0.05 was considered statistically significant. **Results:** A total of 222 pregnant women were enrolled, representing 28% of prenatal consultations. The average age was 29.18 years (range 15 - 47). Most participants (90%) lived in Dakar suburbs, 74.20% had no medical coverage, 84% worked in the informal sector ($p = 0.043$), and 18% had no education. Among them, 30.63% were in their first pregnancy, 34% were nulliparous, and 3.15% were grand multiparous. The average number of prenatal visits was 3.5, with about 40% having more than four visits. Risk factors included hypertension (17%), more prevalent in women

over 30 ($p = 0.043$), diabetes (4%), and smoking (2%). **Conclusion:** The study highlights critical prenatal health needs and socio-economic challenges faced by pregnant women, emphasizing the need for targeted strategies to improve healthcare access and health education.

Keywords

Cardiovascular Risk Factors, Pregnancy, Prenatal Consultation

1. Introduction

Non-communicable diseases (NCDs) are the leading cause of mortality worldwide, accounting for nearly 70% of global deaths, according to the World Health Organization [1]. Pregnancy induces significant physiological changes that increase cardiac load and can reveal or worsen pre-existing cardiovascular conditions. Major risk factors include hypertension, gestational diabetes, obesity, family history of cardiovascular diseases, and socio-behavioral aspects like smoking, excessive alcohol consumption, physical inactivity, and urban-related environmental and socio-economic conditions [2] [3].

Evaluating cardiovascular risk factors during pregnancy is crucial for ensuring maternal and fetal health. Hypertension and strokes have significant incidence during pregnancy. Pregnant women are more likely to develop cardiovascular complications, endangering their health and that of their children. Gestational hypertension and preeclampsia are serious complications requiring close monitoring due to their potential impacts on maternal and fetal health. Moreover, pregnant women with gestational diabetes are at increased risk of developing cardiovascular diseases later in life, necessitating early screening and rigorous monitoring strategies [4]-[6].

A multidisciplinary approach involving obstetricians, cardiologists, endocrinologists, and nutritionists can improve maternal and perinatal outcomes. Proactively identifying and managing these risks can prevent severe complications and ensure optimal pregnancy outcomes [7]. Cardiovascular diseases are the most frequent cause of pregnancy-related maternal mortality in the United States, with a 25% increase in hospital admissions for pregnant women with cardiovascular diseases between 2003 and 2012. Large cohort studies report cardiac complication rates of 10% to 15%, with 4% being severe or life-threatening [8] [9]. Cardiovascular contributions to severe maternal morbidity, including cardiac arrest, arrhythmia, and acute myocardial infarction, are increasing, likely due to the demographic changes in the pregnant population, which includes a greater number of women of advanced maternal age and a higher prevalence of cardiometabolic diseases and structural heart diseases [10].

In Senegal, NCDs are a major public health concern, with a mortality rate attributed to them estimated at 34%, and cardiovascular diseases accounting for

10% of deaths [11] [12]. Rapid urbanization in Senegal, along with air pollution, stress, and limited access to balanced nutrition, is associated with socio-environmental changes that can affect pregnant women's health and exacerbate cardiovascular risks. However, research on the frequency and determinants of cardiovascular diseases during pregnancy in Senegal remains limited [13].

This study aims to evaluate the frequency of cardiovascular risk factors in pregnant women in Senegal, identify socio-behavioral and socio-economic determinants associated with these risk factors, and assess their implications for maternal and fetal health. A better understanding of these aspects through the evaluation of cardiovascular risk factors during pregnancy is not only a medical necessity but also a major preventive approach for the long-term health of pregnant women and their children in Senegal.

2. Methodology

This was a descriptive, analytical cross-sectional study with prospective data collection conducted over three months (April 10 to July 10, 2023). The study included pregnant women aged 15 and older from the public maternity wards of Dalal Jamm, Pikine, and Abass NDAO hospitals in Dakar, Senegal. The recruitment was conducted during prenatal consultation visits. All women who expressed a desire to participate in the study were enrolled. A pre-test was conducted on pregnant women who were not selected to participate in the survey. The shortcomings of the data collection tools were identified and corrected. The data collection was carried out by us in a designated area to ensure confidentiality.

We studied sociodemographic aspects, cardiovascular risk factors, clinical and paraclinical data. We also collected information on previous and current pregnancies, such as a history of eclampsia, preeclampsia, gestational diabetes, number of pregnancies, parity, miscarriages, date of last menstrual period, end of pregnancy, number of prenatal consultations, and the number of fetuses during the current pregnancy. Blood pressure was measured in all pregnant women while seated for at least 15 minutes, with an empty bladder, and without the consumption of coffee or other stimulants. Three (03) measurements were taken at a minimum interval between each. These parameters were collected using a questionnaire and recorded on a data collection sheet.

This study was conducted in collaboration with the concerned hospitals, with approval from the heads of the maternity centers, who signed the confidentiality agreement. An information note was prepared for the patients, summarizing the survey and made available to each pregnant woman. The two-page information letter included the title, objectives, target population, duration, number of patients to include, advantages and disadvantages of the survey, and contact details of the survey coordinators. Written consent was obtained from participants; those who refused to participate were excluded, which did not affect their care and follow-up. All patients were informed about the confidentiality of the study.

Blood pressure was measured in all pregnant women while seated for at least 15 minutes, with an empty bladder, without coffee or other stimulants. Three measurements were taken at minimum intervals.

Data analysis was performed using Epi Info version 7 and R Studio version 4. In the descriptive analysis, qualitative variables were described in counts and percentages, and quantitative variables in means with standard deviation, extremes, and median. In the bivariate analysis, binary logistic regression was used. All variables with a p-value ≤ 0.05 were included in the modeling of poor prognosis using an ascending modeling approach. Adjusted odds ratios (OR) with 95% confidence intervals were calculated for each variable in the final model. The Hosmer-Lemeshow test was used to assess the model's goodness-of-fit.

3. Results

In our observational study, we enrolled 222 pregnant women admitted for consultations at maternity wards, representing 28% of total admissions in the three gynecological units (Figure 1). The average age was 29.18 years, ranging from 15 to 47 years, with 20% aged 27 - 31 (Figure 2). Most participants (90%) lived in Dakar suburbs, and 74.20% had no financial coverage for medical care.

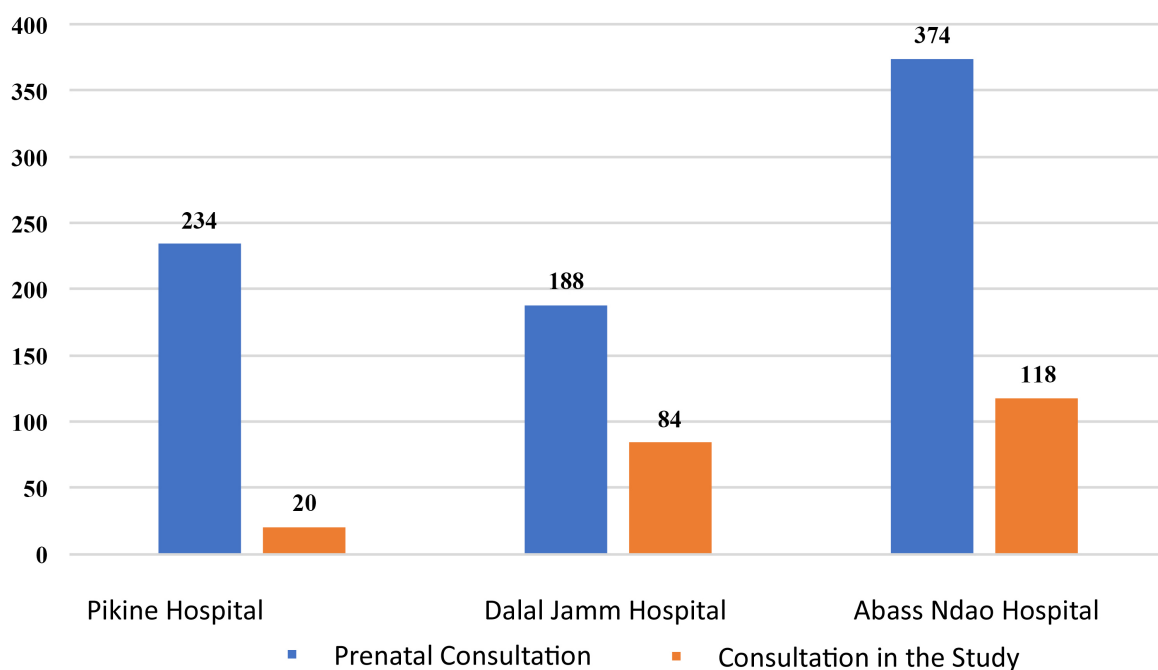


Figure 1. Distribution of the study population by hospitals.

Among the pregnant women, 84% worked in the informal sector, exposing them to higher risk factors ($p = 0.043$). Additionally, 18% (41/222) had no formal education (Table 1). Significant differences were observed for those without schooling ($p = 0.37$) and those with primary education ($p = 0.047$). Most participants (97%) were married ($p = 0.057$).

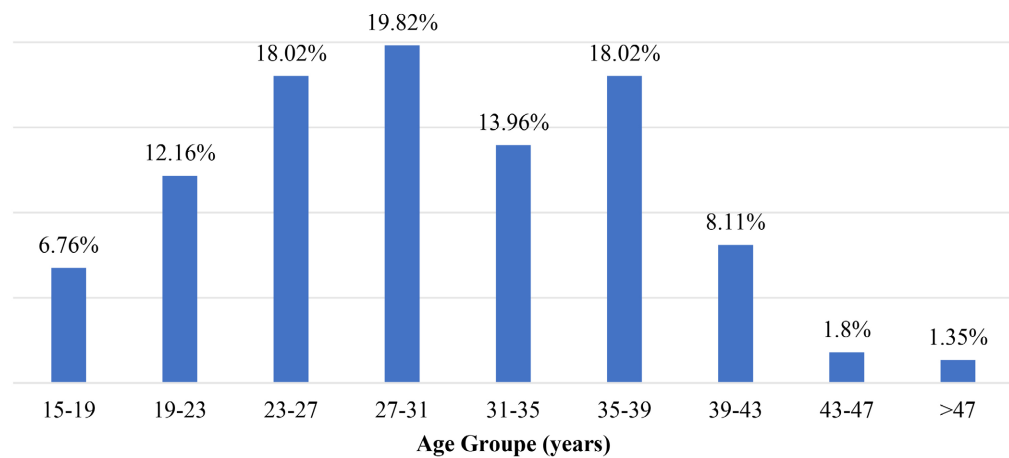


Figure 2. Distribution of the study population by age group (n = 222).

Table 1. Distribution of the study population by education level (n = 222).

Level of education	Number	Percentage (%)	p value
None	41	18%	0.037
Primary	53	24%	0.047
Secondary	77	35%	0.072
University	40	18%	0.12
Not specified	11	5%	-

Consultation data revealed that only 10% had seen a gynecologist outside recommended prenatal visits ($p = 0.071$). Of the participants, 30.63% were in their first confirmed pregnancy, while 42.79% had at least three pregnancies (**Figure 3**). In our study, 34% were nulliparous, and 3.15% were grand multiparous (at least five viable births) (**Figure 4**). Additionally, 21% had experienced at least one miscarriage. Bivariate analysis showed a p-value of 0.047 for women with more than three pregnancies and 0.051 for those with more than three gestations (parity). Among the study population, 51% (113/22) had a pregnancy duration between 31 and 40 weeks of amenorrhea ($p = 0.053$) (**Figure 5**). The average number of prenatal visits was 3.5, with about 40% having more than four visits (**Figure 6**). Compared to those with risk factors, the p-value was 0.059. Additionally, 29.28% had at least four prenatal visits. During our study, 88% had a singleton pregnancy, 4% had twin pregnancies, and 8% were unaware of their status.

The study of cardiovascular risk factors revealed that hypertension (HTN) was present in 17% of pregnant women. Among hypertensive women, 51% developed hypertension before 20 weeks of amenorrhea ($p = 0.043$). HTN was more frequent in patients beyond 24 weeks of amenorrhea, with none observed before 13 weeks. Women over 30 were more prone to HTN, with a frequency of 17% ($p = 0.043$). The number of hypertensive patients seemed to increase with pregnancy term, confirmed by Fisher's test ($p = 0.019$).

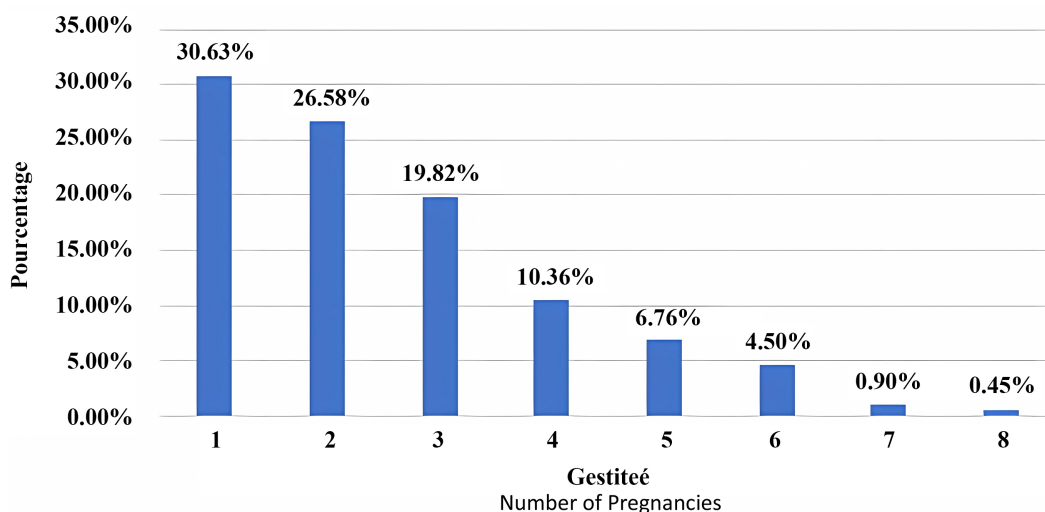


Figure 3. Distribution of the study population by number of pregnancies (n = 222).

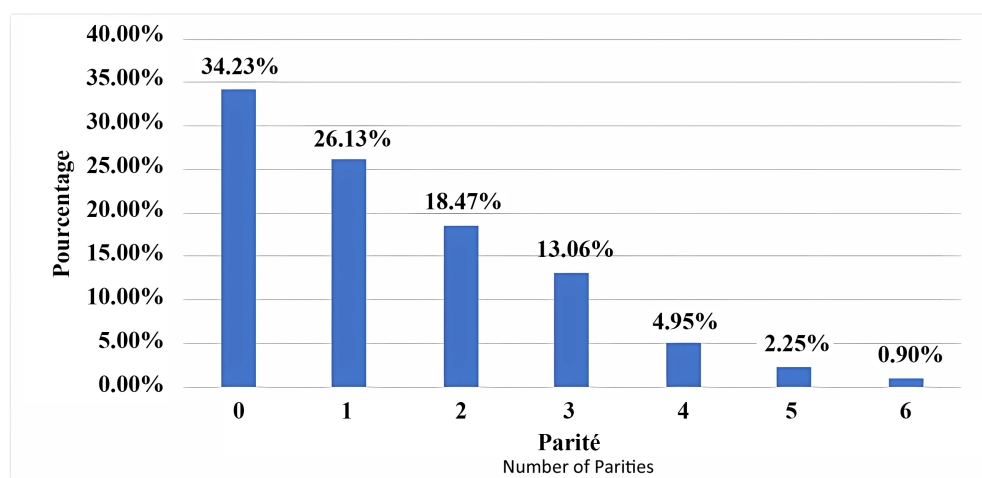


Figure 4. Distribution of the study population by parity (n = 222).

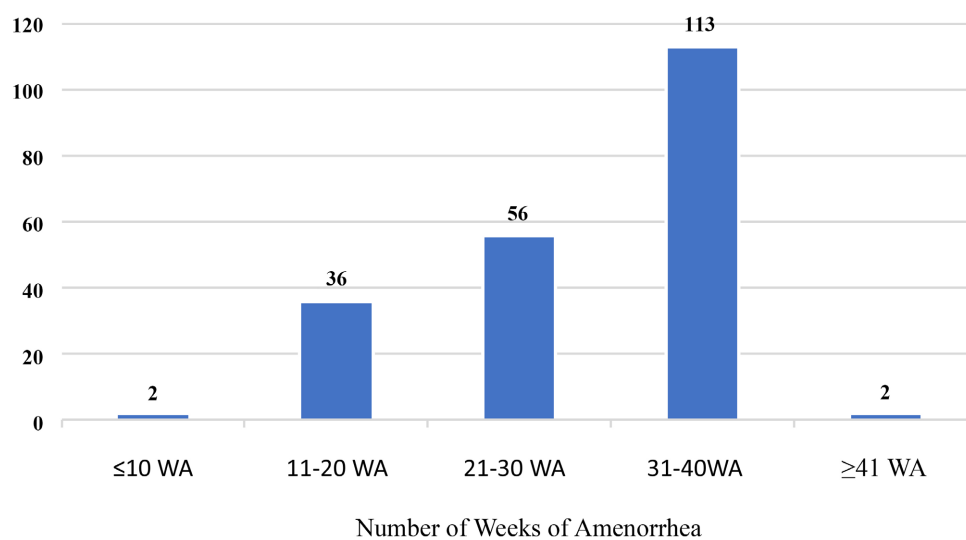


Figure 5. Distribution of the study population by pregnancy duration (n = 222).

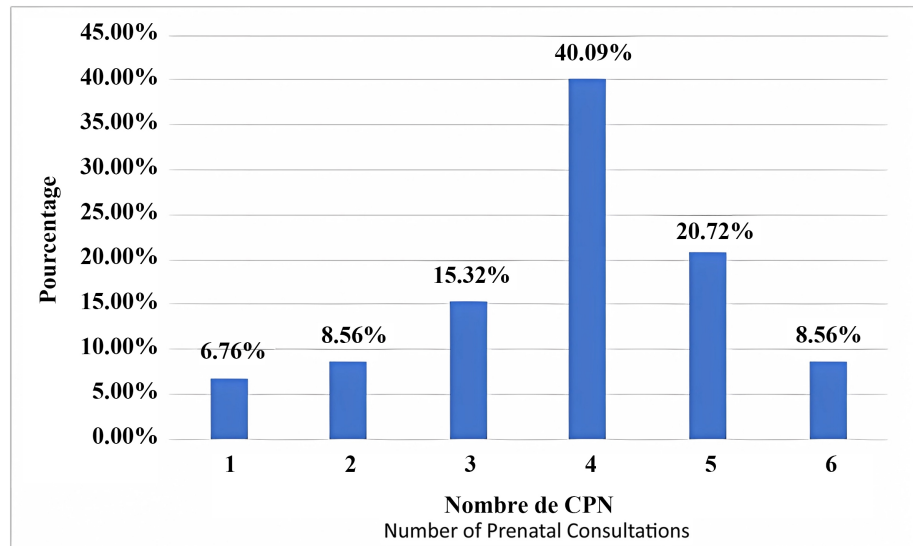


Figure 6. Distribution of the study population by number of prenatal visits (n = 222).

Other identified risk factors included diabetes (4%), with an average blood glucose of 0.85 g/ml, and 4% with fasting hyperglycemia ($p = 0.72$). Smoking was noted in 2% ($p = 0.57$), with no alcohol consumption reported before or during pregnancy. Average daily fruit consumption was 5.45 servings and vegetables 5.81 servings. However, 67.65% of patients consuming a lot of salt had HTN, while almost none consuming very little salt had HTN, showing statistical significance ($p < 0.001$). Additionally, 25% of those consuming vegetable oils had HTN, whereas none consuming olive oil developed HTN ($p = 0.002$) (Table 2).

Table 2. Summary of the cardiovascular risk factors during pregnancy.

Risk Factor	Prevalence (%)	Associated Factors	Statistical Significance
Hypertension	17%	More common in women > 30 years old, advanced pregnancy terms	$p = 0.043$
Diabetes	4%	Average blood glucose: 0.85 g/ml higher in older age groups	$p = 0.72$
Smoking	2%	Low prevalence, no significant alcohol consumption reported	$p = 0.57$
High salt consumption	67.65% of hypertension cases	Strong correlation with hypertension	$p < 0.001$
Type of oil consumption	25% hypertension with vegetable oil; none with olive oil	Diet impacts prenatal hypertension risks	$p = 0.002$

4. Discussion

During our study, we encountered various challenges, primarily due to the non-receptivity of the women surveyed. Most refused to answer our questions. This is linked to mystical beliefs, as some pregnant women prefer not to disclose the

number of pregnancies and living children. This reluctance may also be due to shyness.

The study parameters included public hospitals in the outskirts of the capital, primarily serving pregnant women from low- and middle-income groups. Thus, the results cannot be extrapolated to pregnant women from higher socio-economic groups due to differences in psychosocial factors and living standards.

This observational study of pregnant women reveals significant trends and risk factors in prenatal consultations at three gynecological units. The 28% incidence rate, representing 222 women over three months, indicates a high demand for prenatal services. This is significantly higher than an American study where 130 pregnant women completed their baseline visit on average over three months, totaling 783 over 18 months [14]. This variation suggests that prenatal consultation frequency depends on the country's development level.

Sociodemographically, the average age of participants was 29.18 years, with most aged 27 - 31 (20%), indicating a relatively young population. In contrast, Anita Nath in the USA found a younger average age of 23.6 ± 4.47 years with a mean gestational age of 16.7 ± 4.4 weeks, and 88.8% of participants were 28 or younger [14]. Most women resided in Dakar suburbs (90%), highlighting a crucial need for accessible medical services in these areas. The lack of financial coverage for 74.20% of patients is concerning, suggesting significant financial barriers to adequate medical care. Additionally, 84% of women working in the informal sector were most at risk ($p = 0.043$), highlighting socio-economic vulnerabilities affecting prenatal health. Education plays a crucial role, with 18% of patients having no formal education and significant differences for those with primary education ($p = 0.047$). In Anita Nath's study, about 90% of respondents were housewives, and more than one-third had high school education, with 43.9% belonging to the lower-middle class and 50% receiving high social support from their families [14].

Regarding parity, Anita Nath found 46.4% of participants were nulliparous [14], while in our study, 34% of women were nulliparous, and 3.15% were grand multiparous, with 21% having at least one miscarriage. The high number of multiple pregnancies and miscarriages requires increased medical attention. Additionally, consultation rates outside prenatal appointments were low (10%, $p = 0.071$), indicating a potential lack of awareness or access to care.

Our study revealed a hypertension prevalence of 17%, more frequent in women over 30 ($p = 0.043$) and with advanced pregnancies ($p = 0.019$). Anita Nath found a prevalence of 13.9% [14], matching exactly the rate observed by Ganguly and Begum in a hospital-based study in Dhaka, Bangladesh [15]. Hypertension significantly contributes to up to 15% of pregnancy and postpartum complications [16]. Hypertensive disorders in pregnancy include pre-existing hypertension, gestational hypertension, preeclampsia, and eclampsia, with an estimated prevalence of 5% to 10% among women of reproductive age [17] [18]. These disorders are significant contributors to maternal and perinatal morbidity and mortality, accounting for 10% to 15% of maternal deaths in low- and middle-income countries [19] [20]. A multicentric study in four developing countries (India, Nigeria,

Pakistan, and Mozambique) revealed that one in ten pregnant women had hypertension [21]. Dietary factors, such as salt and oil consumption, show significant correlations with hypertension, underscoring the importance of diet in managing prenatal risks.

In our study, diabetes prevalence was 4%, with an average blood glucose of 0.85 g/ml. However, according to an American study, 14.9 million women in the United States suffer from diabetes mellitus [22]. The prevalence of diabetes mellitus among women of reproductive age has been reported between 3.1% and 6.8%, with pregestational diabetes observed in 1% to 2% of all pregnancies [23] [24]. Although 90% of diabetes cases encountered during pregnancy are gestational, more than half of these women develop type 2 diabetes mellitus later in life. There are racial and ethnic disparities among women with pregestational diabetes [25], with higher rates found among Black women compared to women of other races [24].

5. Conclusions

Non-communicable diseases are the leading cause of mortality worldwide. The physiological changes induced by pregnancy can reveal or exacerbate pre-existing cardiovascular conditions. Growing urbanization in Senegal is associated with socio-environmental changes that affect pregnant women's health and increase cardiovascular risks. However, research on the frequency and determinants of cardiovascular diseases during pregnancy in Senegal remains limited.

This study shows a high prevalence of hypertension (17%) among women over 30 and those with advanced pregnancies. Dietary factors, such as salt and vegetable oil consumption, show significant correlations with hypertension, highlighting the importance of diet in managing prenatal risks. The study underscores critical prenatal health needs and socio-economic challenges faced by pregnant women, emphasizing the need for targeted strategies to improve healthcare access and health education.

Evaluating cardiovascular risk factors during pregnancy is crucial for ensuring maternal and fetal health. A better understanding of these aspects is essential for a major preventive approach to improve the long-term health of pregnant women and their children in Senegal. Additionally, a multidisciplinary approach involving obstetricians, cardiologists, endocrinologists, and nutritionists can improve maternal and perinatal outcomes. By proactively identifying and managing these risks, severe complications can be prevented, ensuring optimal pregnancy outcomes.

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of Cheikh Anta Diop University of Dakar. All patients included in the study signed a written informed consent.

Consent for Publication

Not Applicable.

Availability of Data and Materials

The data and materials of this study are available upon request and ready to be shared. For further information, please contact the corresponding author, Aliou Alassane NGAIDE.

Funding

The study did not receive any funding.

Authors and Contributors

Aliou Alassane Ngaidé and Abdoul Kane designed the study protocol, participated in the data collection and writing of the draft manuscript.

Ngoné Diaba Gaye and Alassane Diouf oversaw the execution of the study, participated in data analysis and critically revised the manuscript for important intellectual content.

Zineb Zinia and Mouhamadou Bamba Ndiaye participated in study design and in data analysis.

Joseph Salvador Mingou participated in statistical analysis and interpretation of results.

Acknowledgements

Sincere thanks to Professor Abdoul Kane for his unwavering support, his foresight, and his exemplary management.

Conflicts of Interest

None of the other authors have any conflicts of interest or relevant disclosures.

References

- [1] Organisation Mondiale de la Santé (2017) Maladie cardiovasculaire dans le monde. <https://www.who.int/fr/news-room/fact-sheets/detail/cardiovascular-diseases-cvds>
- [2] Anderson, K. (1997) Les jeunes, l'alcool, la drogue et le tabac. OMS, Publications régionales, Série européenne.
- [3] Chen, J., Cox, S., Kuklina, E.V., Ferre, C., Barfield, W. and Li, R. (2021) Assessment of Incidence and Factors Associated with Severe Maternal Morbidity after Delivery Discharge among Women in the US. *JAMA Network Open*, **4**, e2036148. <https://doi.org/10.1001/jamanetworkopen.2020.36148>
- [4] Graves, M., Howse, K., Pudwell, J. and Smith, G.N. (2019) Indicateurs du risque cardiovasculaire liés à la grossesse: Approche des soins de première ligne pour la gestion et la prévention postnatales de maladies futures. *Canadian Family Physician*, **65**, e505-e512.
- [5] Kilpatrick, S.K. and Ecker, J.L. (2016) Severe Maternal Morbidity: Screening and Review. *American Journal of Obstetrics and Gynecology*, **215**, B17-B22. <https://doi.org/10.1016/j.ajog.2016.07.050>
- [6] Creanga, A.A., Syverson, C., Seed, K. and Callaghan, W.M. (2017) Pregnancy-Related

- Mortality in the United States, 2011-2013. *Obstetrics & Gynecology*, **130**, 366-373. <https://doi.org/10.1097/aog.0000000000002114>
- [7] Windram, J. and Siu, S.C. (2021) "Cardio-Obstetrics": A Burgeoning Field in Need of Increased Awareness, Training, and Collaboration. *Canadian Journal of Cardiology*, **37**, 2076-2079. <https://doi.org/10.1016/j.cjca.2021.09.019>
- [8] Graves, M., Howse, K., Pudwell, J. and Smith, G.N. (2019) Pregnancy-Related Cardiovascular Risk Indicators. *Canadian Journal of Cardiology*, **65**, 883-889.
- [9] Declercq, E.R., Cabral, H.J., Cui, X., Liu, C., Amutah-Onukagha, N., Larson, E., *et al.* (2022) Using Longitudinally Linked Data to Measure Severe Maternal Morbidity. *Obstetrics & Gynecology*, **139**, 165-171. <https://doi.org/10.1097/aog.0000000000004641>
- [10] Thakkar, A., Hameed, A.B., Makshood, M., Gudenkauf, B., Creanga, A.A., Malhamé, I., *et al.* (2023) Assessment and Prediction of Cardiovascular Contributions to Severe Maternal Morbidity. *JACC: Advances*, **2**, Article 100275. <https://doi.org/10.1016/j.jacadv.2023.100275>
- [11] Sénégal Division de la lutte contre les MNT (2017) Plan stratégique de lutte contre les mala-dies non transmissibles 2017-2020. DLMNT\MSAS\Sénégal, 77.
- [12] Mbaye, A., Babaka, K., Ngaidé, A.A., Gazal, M., Faye, M., Niang, K., *et al.* (2018) Prévalence des facteurs de risque cardio-vasculaire en milieu semi-rural au Sénégal. *Annales de Cardiologie et d'Angéiologie*, **67**, 264-269. <https://doi.org/10.1016/j.ancard.2018.04.005>
- [13] Sénégal Centre de Suivi Ecologique (2020) Rapport sur l'état de l'environnement au Sénégal. CSE\MEDD\Sénégal, 280.
- [14] Nath, A., Sheeba, B., Raj, S. and Metgud, C.S. (2021) Prevalence of Hypertension in Pregnancy and Its Associated Factors among Women Attending Antenatal Clinics in Bengaluru. *Journal of Family Medicine and Primary Care*, **10**, 1621-1627. https://doi.org/10.4103/jfmfc.jfmfc_1520_20
- [15] Ganguly, S. and Begum, A. (2007) Rate of Caesarean Operation and Complications in Hypertensive Disorders of Pregnancy. *The Orion Medical Journal*, **27**, 463-466.
- [16] Callaghan, W.M., Creanga, A.A. and Kuklina, E.V. (2012) Severe Maternal Morbidity among Delivery and Postpartum Hospitalizations in the United States. *Obstetrics & Gynecology*, **120**, 1029-1036. <https://doi.org/10.1097/AOG.0b013e31826d60c5>
- [17] Regitz-Zagrosek, V., Roos-Hesselink, J.W., Bauersachs, J., Blomström-Lundqvist, C., Cifková, R., De Bonis, M., *et al.* (2018) 2018 ESC Guidelines for the Management of Cardiovascular Diseases during Pregnancy. *European Heart Journal*, **39**, 3165-3241. <https://doi.org/10.1093/eurheartj/ehy340>
- [18] Umesawa, M. and Kobashi, G. (2016) Epidemiology of Hypertensive Disorders in Pregnancy: Prevalence, Risk Factors, Predictors and Prognosis. *Hypertension Research*, **40**, 213-220. <https://doi.org/10.1038/hr.2016.126>
- [19] Hafez, S.K., Dorgham, L.S. and Sayed, S.A. (2014) Profile of High Risk Pregnancy among Saudi Women in Taif-KSA. *World Journal of Medical Sciences*, **11**, 90-97.
- [20] Wu, P., Haththotuwa, R., Kwok, C.S., Babu, A., Kotronias, R.A., Rushton, C., *et al.* (2017) Preeclampsia and Future Cardiovascular Health: A Systematic Review and Meta-Analysis. *Circulation: Cardiovascular Quality and Outcomes*, **10**, e003497. <https://doi.org/10.1161/circoutcomes.116.003497>
- [21] Magee, L.A., Sharma, S., Nathan, H.L., Adetoro, O.O., Bellad, M.B., Goudar, S., *et al.* (2019) The Incidence of Pregnancy Hypertension in India, Pakistan, Mozambique, and Nigeria: A Prospective Population-Level Analysis. *PLOS Medicine*, **16**, e1002783.

<https://doi.org/10.1371/journal.pmed.1002783>

- [22] Centers for Disease Control and Prevention (2017) National Diabetes Statistics Report, 2017: Estimates of Diabetes and Its Burden in the United States. CDC, (Level II-3).
- [23] Peterson, C., Grosse, S.D., Li, R., Sharma, A.J., Razzaghi, H., Herman, W.H., *et al.* (2015) Preventable Health and Cost Burden of Adverse Birth Outcomes Associated with Pregestational Diabetes in the United States. *American Journal of Obstetrics and Gynecology*, **212**, 74.E1-74.E9. <https://doi.org/10.1016/j.ajog.2014.09.009>
- [24] Britton, L.E., Hussey, J.M., Crandell, J.L., Berry, D.C., Brooks, J.L. and Bryant, A.G. (2018) Racial/Ethnic Disparities in Diabetes Diagnosis and Glycemic Control among Women of Reproductive Age. *Journal of Women's Health*, **27**, 1271-1277. <https://doi.org/10.1089/jwh.2017.6845>
- [25] Louis, J.M., Menard, M.K. and Gee, R.E. (2015) Racial and Ethnic Disparities in Maternal Morbidity and Mortality. *Obstetrics & Gynecology*, **125**, 690-694. <https://doi.org/10.1097/aog.0000000000000704>