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## Postnatal care utilization in the Oshana region of Namibia: Prevalence, associated Factors, and a decision framework

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### ABSTRACT

**Background:** Namibia faces a persistent challenge of high maternal and neonatal mortality, particularly within the postnatal period. This study assessed postnatal care (PNC) utilization prevalence in Namibia's Oshana region, identified influencing factors, and aimed to develop a decision framework for healthcare providers to predict women who are unlikely to utilize PNC.

**Methods:** A quantitative cross-sectional survey employing a systematic random sample (n = 814) and self-administered questionnaires was conducted. Data analysis employed Chi-squared tests, bivariate and multivariate logistic regression, and classification tree analysis.

**Results:** PNC utilization was 43.8 %, 95 % CI 40.3 % – 47.3 %. Respondents who stayed in rural areas and the unemployed were less likely to utilize PNC services, AOR = 0.51, 95 % CI (0.35 – 0.74) and AOR = 0.26, 95 % CI (0.17 – 0.40), respectively. Respondents with poor PNC knowledge and poor PNC perception were less likely to utilize PNC services, AOR = 0.63, 95 % CI (0.41 – 0.98) and AOR = 0.32, 95 % CI (0.21 – 0.49), respectively. Classification analysis revealed mode of delivery, employment status, and marital status as significant predictors of PNC utilization.

**Conclusion:** Expanding healthcare facilities in rural areas, empowering women through education and income-generating projects, and utilizing community health workers for PNC education are crucial strategies to improve utilization rates.

### 1. Introduction

Although there was significant progress in reducing maternal deaths globally between 2000 and 2017 (UNICEF, 2021), many countries now face a resurgence (Khalil, et al., 2023). In 2020, there were 800 maternal deaths daily globally from preventable pregnancy-related complications. The global maternal mortality ratio (MMR) of 223 deaths per 100,000 live births in 2020 is three times higher than the Sustainable Development Goal (SDG) target 3.1 of less than 70 deaths per 100,000 live births by 2030 (WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division, 2023). Sub-Saharan Africa (SSA) bears a disproportionate burden, with an MMR of 545 per 100,000 live births (WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division, 2023). Three countries in SSA, that is, South Sudan, Nigeria,

and Chad, had MMR that exceeded 1,000 maternal deaths per 100,000 live births in 2020 (WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division, 2023). The MMR for Namibia was estimated to be 215 maternal deaths per 100,000 live births in 2020 (WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division, 2023). Direct obstetric causes like postpartum hemorrhage, pre-eclampsia, and hypertensive disorders, as well as pregnancy-related infections and problems from unsafe abortions, are some of the main reasons why mothers die in Namibia and other low-resource settings (Heemelaar, et al., 2023; WHO, 2013). According to estimates, the postnatal period accounts for more than 60 % of maternal deaths worldwide (WHO, 2013). Roughly 45 % of these maternal deaths occur within a day after delivery, 65 % within a week, and 80 % within two weeks (WHO, 2013).

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While global neonatal mortality rates (NMR) have declined significantly, dropping from 37 to 17 per 1,000 live births between 1990 and 2020 (UNICEF, 2021), stark disparities exist across regions. In 2020, there were 27 newborn deaths per 1,000 live births in SSA and less than 5 per 1,000 live births in Europe (UNICEF, 2021). The NMR for Namibia is 19 newborn deaths per 1,000 live births (UNICEF, 2021). The first four weeks of life, known as the neonatal period, account for about one-third of all child deaths worldwide, with three-quarters occurring in the first week of life (Beraki, et al., 2020).

The postnatal period is the period that begins immediately after the delivery of the baby and extends up to six weeks (42 days) after delivery. The World Health Organization (WHO) recommends four postnatal (PNC) visits by a skilled healthcare provider within the first six weeks after delivery. The first PNC visit should be within 24 hours after delivery, the second on day 3, the third between day 7 and day 14, and the last at 6 weeks after delivery (WHO, 2013). PNC is important to both the mother and the newborn since it ensures the detection of maternal problems such as maternal infections, pregnancy-induced hypertension, and postpartum hemorrhage, as well as problems of the newborn such as severe newborn infections and inappropriate feeding practices (WHO, 2013). Healthcare workers can also encourage personal hygiene, exclusive breastfeeding, and childhood immunization during PNC visits (WHO, 2013). Despite its proven benefits, PNC utilization in SSA remains concerningly low, with slow progress in improvement (Tessema, et al., 2020). Whilst 69 % of mothers received PNC within two days of giving birth in 2021 in Namibia, only 20 % of newborn babies received PNC within two days of delivery (UNICEF, n.d).

The woman's age, place of residence, employment status, marital status, parity, delivery site, delivery method, and level of awareness regarding PNC all impact PNC utilization. However, previous studies revealed conflicting findings on how these factors influence PNC utilization. While a younger age for women was an enabler of PNC utilization in some studies conducted in Ethiopia (Chemir, et al., 2018; Gebresslassie, et al., 2020), a study in Malawi (Khaki & Sithole, 2019) and another in Uganda (Dey, et al., 2021) reported an older age as an enabler. While some studies in Ethiopia (Akibu, et al., 2018; Dona, et al., 2022) and another in Sierra Leone (Sserwanja, et al., 2022) revealed that tertiary education is an enabler of PNC utilization, one study in Malawi (Ngwira & Lulin, 2021) revealed that no education among women enabled PNC utilization. Other enablers of PNC utilization identified in Ethiopian studies (Golla, et al., 2018; Ibrahim, et al., 2022; Shibr, et al., 2018) include giving birth at a healthcare facility, and delivering by caesarean section as reported by studies conducted in Ethiopia (Alemu, et al., 2021; Berhe, et al., 2019) and Malawi (Nyondo-Mipando, et al., 2023). One study in Malawi (Nyondo-Mipando, et al., 2023) and another in Rwanda (Kawuki, et al., 2022) revealed being employed as a woman was a barrier to PNC utilization, while one study in Malawi (Ngwira & Lulin, 2021) and another in Mali (Ahinkorah, et al., 2021) reported unemployment as a barrier. Given these conflicting findings in different settings, a study must be conducted in the Oshana region of Namibia to determine how these factors influence PNC utilization in this setting.

The current prevalence of PNC utilization and influencing factors are not well known in the Oshana region of Namibia. Furthermore, there is no method that healthcare workers can use to identify women who are unlikely to utilize PNC services after delivery. This study, therefore, aimed to assess the prevalence of PNC utilization in the Oshana region of Namibia and the associated factors, as well as develop a decision framework to help healthcare workers identify women who are unlikely to utilize PNC services. Once identified, strategies can be implemented to convince the women to utilize PNC services, possibly leading to their utilization of PNC services, ultimately, resulting in a reduction in MMR.

## 2. Methods

### 2.1. Study setting and period

The study was conducted at all 18 public healthcare facilities in the Oshana region of Namibia. Oshana region is one of the 14 regions in the country and has a population of about 175,000 people (Namibia Statistics Agency, 2020). About 55 % of the population in the Oshana region is made up of females, and about 55 % live in rural areas (Namibia Statistics Agency, 2020). Among the public healthcare facilities in the Oshana region, there are five health centres, twelve primary healthcare clinics, and one hospital (Ministry of Health and Social Services, 2018). All pregnant women who utilize public health services are initially attended to at clinics for antenatal care (ANC). However, those women whose pregnancies are considered to be high risk are referred to the hospital for their ANC. Data were collected from October 1, 2023 to January 30, 2024.

### 2.2. Study design

A quantitative cross-sectional survey design was chosen to assess the prevalence and associated factors of PNC utilization.

## 3. Study population

The study population included all women of reproductive age residing in the Oshana region of Namibia.

### 3.1. Sample size

The sample size was determined using EPI INFO version 7.2.4.0. The estimated population size of women who met the inclusion criteria of the study was 8,000 (Namibia Statistics Agency, 2020). The expected PNC utilization used in the calculation was taken from the average PNC utilization rate for SSA in 2018, which was 52.5 % (Tessema, et al., 2020). The confidence interval was assumed to be 95 %, the margin of error was 5 %, and there was an additional contingency of 10 %. The design effect is 2 because the study used a multistage sampling method. Therefore, the sample size was 814.

### 3.2. Inclusion criteria

Respondents included in this study were women who had given birth within five years before the study, who were attending ANC, and women attending PNC at all eighteen public healthcare facilities in the Oshana region.

### 3.3. Exclusion criteria

Respondents who were excluded from this study were women who were seriously ill, unable to communicate, were trained in a health-related field, or were not residents of the Oshana region.

### 3.4. Sampling method

A systematic random sampling method was used to select respondents for the study. Healthcare facility records were used to determine the number of women who attended ANC and PNC every month. The number of respondents at each public healthcare facility was proportional to the percentage it contributed to the total number of potential respondents. The number of respondents from the ANC and PNC depended on the percentage each contributed to the total number of potential respondents. The sampling interval at each healthcare facility was determined by dividing the total number of potential respondents at the healthcare facility by the sample size for the healthcare facility. The first woman selected to participate in the study at each

healthcare facility was chosen randomly between the first patient and the sample interval on each day of data collection until the total for the healthcare facility was reached.

### 3.5. Study variables

The dependent variable in this study was PNC utilization. A woman who attended one PNC visit after delivery was considered to have utilized PNC services. Independent variables included sociodemographic characteristics such as age, place of residence, highest educational level attained, employment status, and the number of children the woman had. Age was measured in intervals from 18 years to 55 years, place of residence as rural or urban, and highest educational level attained as no formal education, primary education, secondary education, or tertiary education. To determine the employment status of the respondents, they stated whether they were employed or not, while the number of children was measured in intervals 1–3, 4–6, and above 6. The other independent variables were the mode of delivery of the last child, ANC attendance in the last pregnancy, knowledge of PNC services, and perceptions of PNC services. The mode of delivery was either normal vaginal delivery or caesarean section delivery, while ANC attendance had yes or no responses. The knowledge and perceptions of PNC services were measured by adding up the total scores of the respondents in sections C and D of the questionnaire, respectively (Refer to Appendix 1).

### 3.6. Data collection

A self-administered questionnaire with closed-ended questions developed by the researchers was used to collect data in this study. The questionnaire was developed using information from several publications (Appiah, et al., 2021; Beraki, et al., 2020; Kiragu, et al., 2021; Tiruneh, et al., 2021; WHO, 2013; Wudineh, et al., 2018). Most of the population in the Oshana region speaks Oshikwanyama, so the questionnaire was available in both English and Oshikwanyama. An expert in the Oshikwanyama language translated the questionnaire from English to Oshikwanyama. Forward and backward translation of the questionnaire was carried out to ensure the accuracy of the Oshikwanyama version. The questionnaire consisted of 80 questions grouped into four different sections that had questions on the socio-demographic profile of the respondents, PNC knowledge, PNC service perceptions of respondents, and PNC service utilization among the respondents. The English version of the questionnaire is attached as Appendix 1. The lead author and trained research assistants approached potential respondents and explained the purpose of the study, and the benefits, and potential harms of the study. They also explained that the study was voluntary and respondents could withdraw anytime. Those who agreed to take part in the study were asked to sign the informed consent form and were provided with private space at the healthcare facilities where they completed the questionnaires. After completion, the respondents submitted the questionnaires to the lead author or trained research assistants. Respondents took 30–45 min to complete the questionnaire.

### 3.7. Reliability

The reliability of the questionnaire was determined during the pilot study. The pilot study was conducted at one of the public health facilities in the Oshana region. Convenience sampling was used to select 73 women attending ANC and PNC services at the facility. Women who participated in the pilot study were excluded from the main study. The Cronbach's alpha for each construct in the questionnaire was determined. The knowledge score items had a Cronbach's alpha of 0.96 while the perception score items had a value of 0.83.

### 3.8. Validity

The face validity of the questionnaire was measured during the pilot

test. Respondents were asked to comment on the readability, consistency of style and formatting, and clarity of the questions and language used in the questionnaire. The respondents confirmed the face validity of the questionnaire. The use of a judgmental approach ensured the questionnaire's content validity. This involved conducting a literature review on knowledge, perceptions, and utilization of PNC services among women (Appiah, et al., 2021; Beraki, et al., 2020; Kiragu, et al., 2021; Tiruneh, et al., 2021; WHO, 2013; Wudineh, et al., 2018), as well as consulting experts in the field of PNC services. The consulted PNC experts agreed that the questionnaire was valid.

### 3.9. Data analysis

Data were coded before being entered into IBM Statistical Package for Social Sciences (SPSS) version 29. Questionnaires with missing data were removed from the analysis. Descriptive statistics like percentages and frequencies were used to analyze nominal and ordinal data. The frequency of each response was expressed as a percentage. PNC knowledge and PNC perceptions among participants were measured numerically by adding the total scores of each respondent in the relevant sections of the questionnaire. These were classified into three groups, and the groups were poor, moderate, and good. If a respondent's total PNC knowledge score was between 216 and 270, it was considered good PNC knowledge; if it was between 162 and 215, it was moderate knowledge; and if it was less than 162, it was low knowledge. Respondents who scored between 40 and 50 total PNC perception scores were deemed to have good PNC perception; those who scored between 30 and 39 had moderate PNC perception; and those whose total score fell below 30 had poor PNC perception. Postnatal care utilization was defined as attending at least one PNC visit after the last delivery in this study.

Chi-square tests determined the associations between PNC utilization and respondents' characteristics. The characteristics that had statistically significant associations with PNC utilization in Chi-square tests were used in bivariate logistic regression to determine the extent of the associations. The characteristics that showed statistically significant associations with PNC utilization at a p-value of less than 0.05 in bivariate logistic regression were then used in multivariate logistic regression to determine the adjusted odds ratios. Furthermore, the Chi-Squared Automatic Interaction Detection (CHAID) algorithm in SPSS was used to come up with a classification tree that can be used to identify women who are unlikely to utilize PNC services. The dataset was split into 70 % for training and 30 % for testing to avoid overfitting or underfitting the sample data. A 95 % confidence level and a p-value of less than 0.05 were used to determine the statistical significance of the results.

## 4. Results

### 4.1. Characteristics of respondents

A total of 814 respondents were selected for this study. However, only 780 respondents returned completed questionnaires, making the response rate 95.8 %. The majority of the respondents were attending ANC services (n = 546; 70 %), stayed in urban areas (n = 507; 65 %), were single (n = 473; 60.6 %), had 1–3 children (n = 614; 78.7 %), delivered their last child at a healthcare facility (n = 734; 94.1 %), delivered their last child vaginally (n = 631; 80.9 %), knew about PNC services (n = 681; 87.3 %), had good knowledge of PNC (n = 434; 55.7 %), but had poor perception of PNC (n = 417; 53.5 %). More details are in Table 1.

### 4.2. Postnatal care utilization among respondents

Overall, 342 respondents (43.8 %) attended at least one PNC visit after their last delivery, 95 % confidence interval (CI) (40.3 % – 47.3 %),

**Table 1**  
Frequency distribution of characteristics of respondents.

Characteristics	Frequency n (%)
<b>Age group (years)</b>	
18 – 25	171 (21.9)
26 – 30	170 (21.8)
31 – 35	128 (16.5)
36 – 40	125 (16.0)
41 – 45	119 (15.3)
46 – 50	66 (8.5)
<b>Place of residence</b>	
Rural	273 (35.0)
Urban	507 (65.0)
<b>Service being attended</b>	
Postnatal care (PNC)	234 (30.0)
Antenatal care (ANC)	546 (70.0)
<b>Highest level of education</b>	
No formal education	114 (14.6)
Primary education	252 (32.3)
Secondary education	263 (33.7)
Tertiary education	151 (19.4)
<b>Employment status</b>	
Employed	560 (71.8)
Not employed	220 (28.2)
<b>Number of children</b>	
1 – 3	614 (78.7)
4 – 6	118 (15.1)
>6	48 (6.2)
<b>Marital status</b>	
Single	473 (60.6)
Married	152 (19.5)
Divorced	106 (13.6)
Widowed	49 (6.3)
<b>Place of delivery of last child</b>	
Home	46 (5.9)
Healthcare facility	734 (94.1)
<b>Mode of delivery of last child</b>	
Caesarean section	149 (19.1)
Vaginal delivery	631 (80.9)
<b>Antenatal care attendance during last pregnancy</b>	
No	98 (12.6)
Yes	682 (87.4)
<b>Know about postnatal care (PNC) services</b>	
Yes	99 (12.7)
No	681 (87.3)
<b>PNC knowledge group</b>	
Poor	199 (25.5)
Moderate	147 (18.8)
Good	434 (55.7)
<b>Perception of PNC group</b>	
Poor	417 (53.5)
Moderate	150 (19.2)
Good	213 (27.3)

while 438 (56.2 %) did not, 95 % CI (52.7 % – 59.7 %). More details are in [Fig. 1](#).

Among the 342 respondents who attended at least one PNC visit after their last delivery, the majority attended the first PNC visit (n = 288; 87.1 %), the second PNC visit (n = 276; 80.7 %), the third PNC visit (n = 283; 82.7 %), and the fourth PNC visit (n = 303; 88.6 %). The most attended visit was the fourth while the least attended was the second visit. More details are in [Table 2](#).

#### 4.3. Factors associated with PNC utilization among respondents

The Chi-square tests revealed that there were associations between PNC utilization and age group, place of residence, highest level of education, employment status, parity, marital status, place of delivery of last child, mode of delivery of last child, ANC attendance during the last pregnancy, knowledge of PNC services, PNC knowledge group, and perception of PNC (p < 0.05). Using the age group 18 – 25 years as the reference group, the odds of PNC utilization were statistically significantly higher for age groups 26 – 30 years and 41 – 45 years, Adjusted odds ratio (AOR) = 1.94, 95 % CI (1.12 – 3.34), and AOR=2.04 (1.13 – 3.67), respectively. Respondents who stayed in rural areas were statistically significantly less likely to utilize PNC services compared to those who stayed in urban areas, AOR=0.51, 95 % CI (0.35 – 0.74). Respondents who were not employed were statistically significantly less likely to utilize PNC compared to those who were employed, AOR=0.26, 95 % CI (0.17 – 0.40). Using single as the reference group for marital status, married respondents had statistically significantly higher odds of utilizing PNC services, AOR=2.95, 95 % CI (1.82 – 4.78).

Respondents who had 4 – 6 children were statistically significantly less likely to utilize PNC services compared to those who had 1 – 3 children, AOR=0.45, 95 % CI (0.26 – 0.76). Respondents who delivered their last child by caesarean section were about seven times more likely to utilize PNC services compared to those who delivered vaginally, AOR=7.21, 95 % CI (4.29 – 12.10). Respondents who did not attend ANC during their last pregnancy were statistically significantly less likely to utilize PNC compared to those who attended ANC, AOR=0.44, 95 % CI (0.25 – 0.80). Respondents with poor PNC knowledge were less likely to utilize PNC services compared to those who had good PNC knowledge, AOR=0.63, 95 % CI (0.41 – 0.98). Furthermore, respondents who had poor perceptions of PNC were less likely to utilize PNC services compared to those who had good perceptions, AOR=0.32, 95 % CI (0.21 – 0.49). More details are in [Table 3](#).

#### 4.4. Framework for identifying women who are unlikely to utilize PNC services

The testing sample model used to develop the decision tree on PNC utilization accurately predicted 69.6 % of those who utilized and those who did not utilize PNC. However, the model was better at predicting respondents who were unlikely to utilize PNC compared to those who were likely to utilize PNC (86.3 % vs 46.7 %). More details are in [Table 4](#).

The total number of nodes in the model was 7, the total number of terminal nodes was 4, and the tree depth was 3. Among all the independent variables that were included in the classification analysis (respondents' characteristics except for PNC knowledge and perception groups), only three were considered to be significant predictors of PNC utilization. These variables are mode of delivery, employment status, and marital status. The mode of delivery was identified as the primary splitting factor, that is, the factor that distinguishes between utilization and non-utilization of PNC. Among respondents who had vaginal delivery, employment status was a key differentiating factor. The differentiating factor among those employed was marital status, with a higher proportion of those single, divorced, or widowed unlikely to utilize PNC compared to those who were married (64.8 % vs. 33.3 %). More details are in [Fig. 2](#).



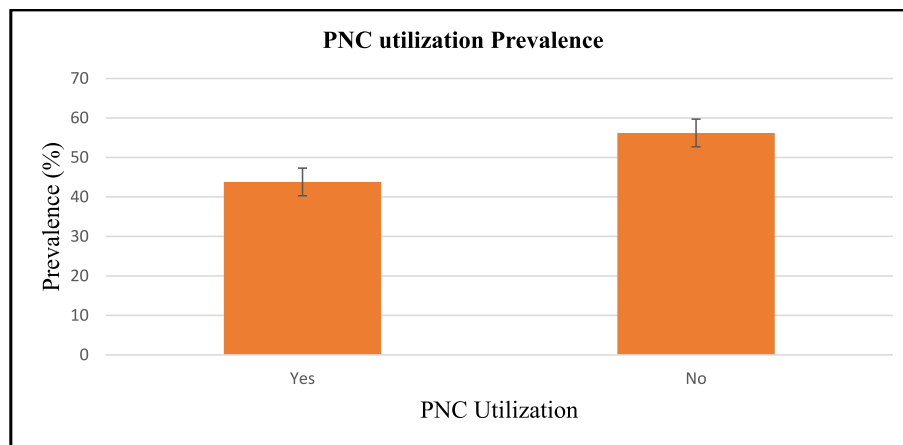


Fig. 1. PNC Utilization Prevalence.

Table 2

Frequency distribution of attendance of PNC visits among respondents who utilized PNC services.

PNC visit	Frequency n (%)
<b>First visit</b>	
Yes	288 (87.1)
No	44 (12.9)
<b>Second visit</b>	
Yes	276 (80.7)
No	66 (19.3)
<b>Third visit</b>	
Yes	283 (82.7)
No	59 (17.3)
<b>Fourth visit</b>	
Yes	303 (88.6)
No	39 (11.4)

## 5. Discussion

This study revealed that the PNC utilization rate in the Oshana region of Namibia was 43.8 %. This rate is almost similar to that of a study conducted in several countries in SSA, which reported a rate of 42.9 % (Habte, et al., 2023). Several factors, including the proximity of healthcare facilities, the lack of resources to travel there, and participation in other economic activities like farming, particularly for rural women, can explain these results. The current study revealed that the fourth PNC visit at six weeks was the most attended. This might be a result of the second immunization doses for children given at the same time. Additionally, the study revealed that older women were more likely to utilize PNC services compared to women in the 18 – 25 years age group. This finding concurs with a study conducted in Malawi (Khaki & Sithole, 2019). This contrasts with an Ethiopian study that found that younger women used PNC services more (Chemir, et al., 2018). Older women are more likely to have had PNC experience and recognize its relevance, which may explain the current study's findings.

The current study revealed that women who stay in rural areas were less likely to utilize PNC compared to those who stay in urban areas. This result concurs with a study conducted in Zambia (Chungu, et al., 2018). The proximity of urban healthcare facilities may make it easier for urban women to access them than for rural women. Urban women can access healthcare more easily due to better transport networks (Samuel, et al., 2021). It was revealed in this study that women who had no formal

education were less likely to utilize PNC services compared to those who had a secondary education. This result is similar to that of a study conducted in Benin, which reported that women with no formal education were less likely to utilize PNC services (Roméo, et al., 2018). This contradicts a Malawian study that found women without formal education were more likely to use PNC services (Ngwira & Lulin, 2021). Illiterate women may fail to process health-related information effectively, which may explain this study's finding (Khaki & Sithole, 2019).

This study revealed that unemployed women were 74 % less likely to utilize PNC services compared to the employed. This finding concurs with a study conducted in Uganda (Kyabaishiki & Omona, 2021). This finding differs from a study conducted in Sierra Leone, which revealed that employed women were less likely to utilize PNC services (Sserwanja, et al., 2022). The findings of the current study may be a result of unemployed women lacking the resources to travel to healthcare facilities for PNC. They may rely on their partners or family for financial support. However, the employed may have economic independence that allows them to seek PNC services when required. The current study revealed that married women were more likely to utilize PNC services compared to those who were single. A similar finding was reported in a study conducted in Ghana (Appiah, et al., 2021). However, a study conducted in Ethiopia did not find any association between marital status and PNC utilization (Abota & Atenafu, 2018). The findings of the current study may be attributed to the financial support married women may receive from their partners, which allows them to pay for transport and other required fees at the PNC facilities. It was revealed in this study that women who had more than 1 – 3 children were likely to utilize PNC services. A similar finding was also reported in a study conducted in Ethiopia (Gebreslassie, et al., 2020). This finding differs from a study conducted in Ethiopia, which revealed that women with more than three children were less likely to utilize PNC services (Saol, et al., 2021). The current study's finding may be because women with more children may regard PNC as irrelevant if their older children did not experience health problems despite the non-utilization of PNC services. In addition, women with more children may have more responsibilities at home, which makes it difficult for them to find time to attend PNC services.

Women who did not attend ANC visits were less likely to utilize PNC services in this study. This finding is similar to that reported in a study conducted in Ethiopia (Adane, et al., 2020). A possible reason for this is that factors influencing women not to utilize ANC services may be the same factors that influence them not to utilize PNC services. Another reason may be that women who do not attend ANC services are unlikely to have adequate information about other maternal healthcare services, such as PNC services, and their importance. The current study revealed that women who had good PNC knowledge and who were aware of PNC services were more likely to utilize PNC services. This was also reported

**Table 3**  
Association between PNC utilization and characteristics of respondents.

Characteristics	Crude Odds ratio (95 % CI *)	Crude Odds ratio p-value	Adjusted ** Odds ratio (95 % CI *)	Adjusted ** Odds ratio p-value	Chi-square test p-value
<b>Age group (years)</b>					<0.01
18 – 25	Reference		Reference		
26 – 30	<b>2.78 (1.78 – 4.33)</b>	<0.01	<b>1.94 (1.12 – 3.34)</b>	<b>0.018</b>	
31 – 35	<b>2.11 (1.31 – 3.40)</b>	<0.01	1.44 (0.80 – 2.57)	0.223	
36 – 40	<b>2.39 (1.48 – 3.86)</b>	<0.01	1.59 (0.88 – 2.86)	0.123	
41 – 45	<b>2.65 (1.63 – 4.31)</b>	<0.01	<b>2.04 (1.13 – 3.67)</b>	<b>0.018</b>	
46 – 50	0.52 (0.26 – 1.06)	0.069	0.65 (0.29 – 1.47)	0.304	
<b>Place of residence</b>					<0.01
Rural	<b>0.51 (0.38 – 0.69)</b>	<0.01	<b>0.51 (0.35 – 0.74)</b>	<0.01	
Urban	Reference		Reference		
<b>Service being attended</b>					0.682
Postnatal care (PNC)					
Antenatal care (ANC)					
<b>Highest level of education</b>					0.045
No formal education	<b>0.63 (0.40 – 0.99)</b>	<b>0.044</b>	0.78 (0.44 – 1.37)	0.386	
Primary education	0.75 (0.53 – 1.06)	0.106	0.99 (0.64 – 1.54)	0.967	
Secondary education	Reference		Reference		
Tertiary education	1.14 (0.76 – 1.70)	0.533	1.37 (0.82 – 2.28)	0.226	
<b>Employment status</b>					<0.01
Employed	Reference		Reference		
Not employed	<b>0.23 (0.16 – 0.33)</b>	<0.01	<b>0.26 (0.17 – 0.40)</b>	<0.01	
<b>Parity</b>					<0.01
1 – 3	Reference		Reference		
4 – 6	<b>0.33 (0.21 – 0.52)</b>	<0.01	<b>0.45 (0.26 – 0.76)</b>	<0.01	
>6	<b>0.53 (0.29 – 0.99)</b>	<b>0.042</b>	0.77 (0.36 – 1.66)	0.502	
<b>Marital status</b>					<0.01
Single	Reference		Reference		
Married	<b>3.51 (2.38 – 5.19)</b>	<0.01	<b>2.95 (1.82 – 4.78)</b>	<0.01	
Divorced	0.88 (0.57 – 1.36)	0.559	0.96 (0.57 – 1.61)	0.876	
Widowed	0.69 (0.37 – 1.31)	0.255	0.52 (0.24 – 1.13)	0.096	
<b>Place of delivery of last child</b>					0.332
Home	0.74 (0.40 – 1.37)	0.332			
Healthcare facility	Reference		Reference		
<b>Mode of delivery of last child</b>					<0.01
Caesarean section	<b>8.44 (5.39 – 13.21)</b>	<0.01	<b>7.21 (4.29 – 12.10)</b>	<0.01	
Vaginal delivery	Reference		Reference		
<b>Antenatal care attendance during last pregnancy</b>					<0.01
No	<b>0.42 (0.26 – 0.67)</b>	<0.01	<b>0.44 (0.25 – 0.80)</b>	<0.01	
Yes	Reference		Reference		
<b>Know about postnatal care (PNC) services</b>					<0.01
Yes	Reference		Reference		
No	<b>0.49 (0.31 – 0.77)</b>	<0.01	0.61 (0.35 – 1.07)	0.083	
<b>PNC knowledge group</b>					<0.01
Poor	<b>0.60 (0.43 – 0.85)</b>	<0.01	<b>0.63 (0.41 – 0.98)</b>	<b>0.038</b>	
Moderate	<b>0.64 (0.44 – 0.94)</b>	<b>0.021</b>	0.66 (0.41 – 1.07)	0.091	
Good	Reference		Reference		
<b>Perception of PNC group</b>					<0.01
Poor	<b>0.31 (0.22 – 0.44)</b>	<0.01	<b>0.32 (0.21 – 0.49)</b>	<0.01	
Moderate	<b>0.58 (0.38 – 0.88)</b>	<b>0.011</b>	0.60 (0.36 – 1.01)	0.055	
Good	Reference		Reference		

\* CI is the 95% confidence intervals.

\*\* Adjusted for age, place of residence, highest level of education, employment status, parity, marital status, mode of delivery of last child, ANC attendance during last pregnancy, knowledge of PNC services, PNC knowledge group, and perception of PNC group.

**Table 4**  
Testing sample model classification summary.

Classification			
Observed	Predicted		Percent Correct
	No	Yes	
No	107	17	86.3 %
Yes	48	42	46.7 %
Overall Percentage	72.4 %	27.6 %	69.6 %

Growing Method: CHAID Dependent Variable: Did you utilize PNC services after your last delivery?

in a study conducted in Malawi (Sagawa, et al., 2021). These findings highlight the importance of providing PNC information to women so they decide to utilize the services.

Women who delivered by caesarean section were more likely to utilize PNC services compared to those who delivered vaginally in this study. Similar findings were reported in a study conducted in several countries in SSA (Habte, et al., 2023). A possible explanation for this finding is that women who deliver by caesarean section may be more worried about developing complications, which would increase their health-seeking behavior (Caughey, et al., 2014). The caesarean section rate among the respondents in the current study was 19.1 %, which is higher than the WHO’s recommended upper limit of 15 % (WHO,

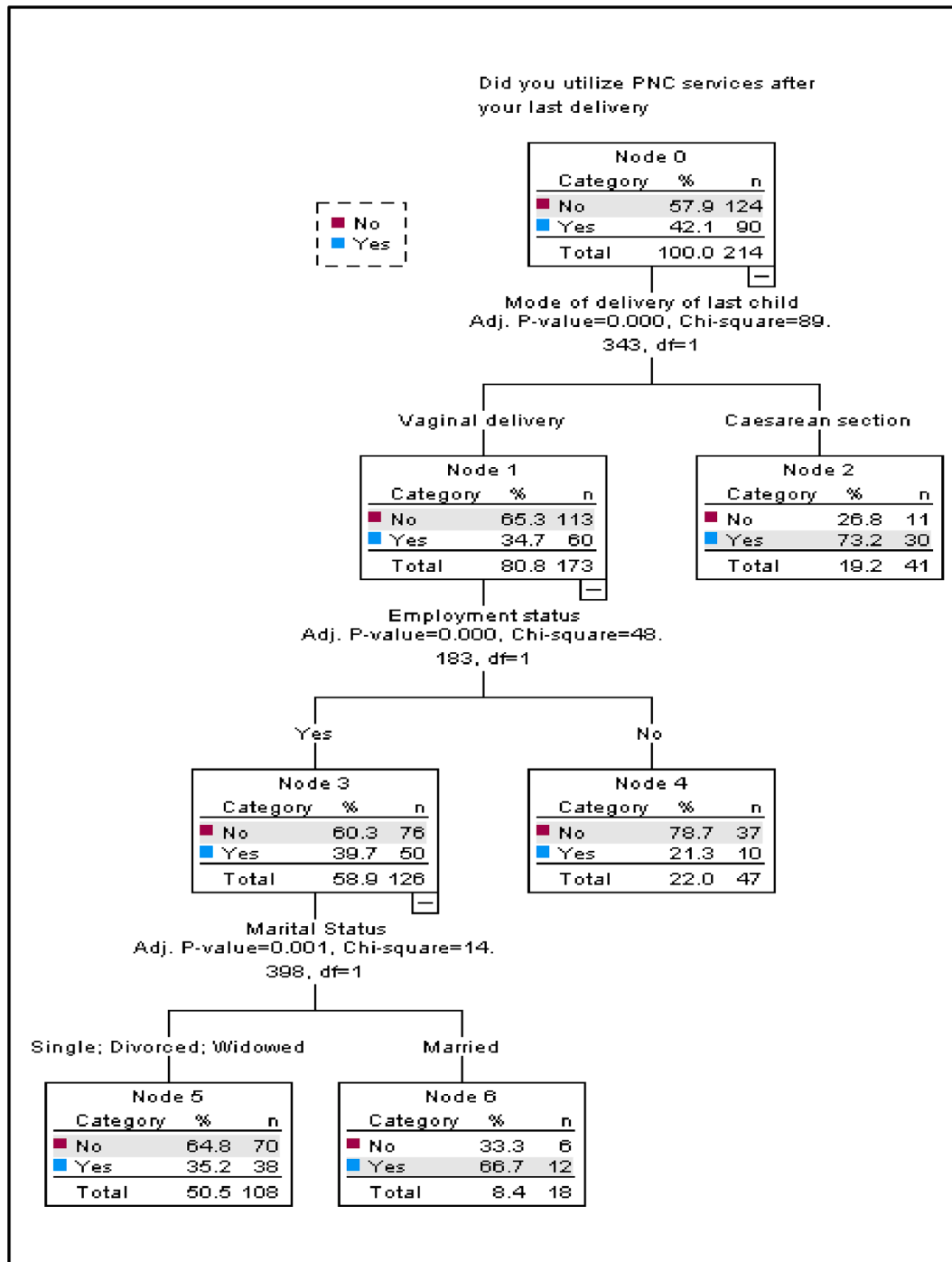


Fig. 2. Decision tree for identifying women who are unlikely to utilize PNC services.

UNFPA, UNICEF, AMDA, 2009). Healthcare workers in the region should, therefore, be encouraged to consider the potential hazards of a caesarean section to a woman's future pregnancies when they offer caesarean section, and only offering caesarean section when there are clinical indications.

The results of the current study revealed that identifying women who are unlikely to utilize PNC services can be done using the mode of delivery, employment status, and marital status of women. This framework, if implemented in the region, may help identify women who are unlikely to utilize PNC services. Once these women are identified, strategies can be formulated and implemented to increase PNC knowledge among them, which may in turn increase PNC utilization in the region, ultimately leading to a decrease in MMR and NMR. Implementation research is, therefore, required to determine the usefulness of this framework.

## 6. Strengths and limitations of the study

This study had several strengths. One of the strengths is that all public healthcare facilities were included as study sites, making the results generalizable to the Oshana region. The other strength is that the study had a large sample size, which was selected randomly, making it possible to conclude that the results are representative of the study population. However, since the study was conducted only in one region of the country, future research that covers all the regions of the country may be required to come up with a decision framework that applies to the whole country. This study also had several limitations. The responses of the respondents could not be independently verified, making it possible that some of the responses were affected by social desirability bias. However, to mitigate social desirability bias, we explained to the respondents that they would remain anonymous. Given that some of the respondents had given birth up to five years before the study, recall bias may have also impacted the results. To mitigate recall bias, we encouraged the respondents to refer to their health cards when they were not sure.

## 7. Conclusion

This study revealed that PNC utilization in the Oshana region of Namibia was less than 50 %. The most attended visit was the fourth, while the least attended was the second visit. Individual factors that influence PNC utilization include age, place of residence, level of education, marital status, parity, the level of PNC knowledge, and the level of PNC perception of the woman. Healthcare factors influencing PNC utilization among women include ANC attendance and the mode of delivery of the woman. In classification analysis, independent variables that were considered to be significant predictors of PNC utilization among women were the mode of delivery, employment status, and marital status.

## 8. Recommendations

Based on the findings of this study, we came up with several recommendations. One of the recommendations is to increase healthcare accessibility in rural areas and bring services closer to where people live, as this will ensure that women do not incur an unbearable financial burden to access PNC services. Women should also be empowered through education and income-generating projects so that they can effectively process the PNC information they receive and have adequate financial resources to pay for expenses related to PNC. Strategies to increase ANC utilization, such as the provision of quality patient-centered care, should be encouraged since ANC utilization influences PNC utilization. Another recommendation is ensuring that community health workers are trained to provide ANC and PNC education so that women, especially those who deliver vaginally, are young, and have few children, are aware of these services and have adequate knowledge of them.

Men's involvement in caring for children at home should be encouraged, as this may result in women with many children finding time to attend PNC services.

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## CRedit authorship contribution statement

**Enos Moyo:** Writing – original draft, Methodology, Investigation, Conceptualization. **Perseverance Moyo:** Writing – review & editing. **Tafadzwa Dzinamarira:** Writing – review & editing. **Grant Murwanhema:** Writing – review & editing. **Andrew Ross:** Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijans.2024.100770>.

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