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Multilevel modelling of factors influencing eight or more antenatal care visits among women of reproductive age in South Africa

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Abstract

Globally, thousands of women die due to pregnancy-related complications. The World Health Organization recommends at least eight or more antenatal visits during pregnancy to reduce infant and maternal mortality. This study examined the factors influencing eight or more antenatal visits among South African women aged 15-49, using data from the 2016 South Africa Demographic and Health Survey (weighted sample of 3036 women). A two-level binary logistic regression model was used to identify the factors determining the use of eight or more antenatal visits. The findings revealed a low use (17.1%) of eight or more antenatal care visits. Age at birth, birth order, population group, marital status, employment status, media exposure, place of residence, household wealth and province were statistically associated with eight or more antenatal care visits. Women whose age at birth was 20-34, those exposed to the media, those from rich households, and those from the Western Cape had higher odds of eight or more antenatal care visits. Media campaigns may play a valuable role in informing women about the advantages of attending the recommended antenatal care visits. (*Afr J Reprod Health* 2026; 30 [16]: 18-30).

Keywords: antenatal care, eight or more antenatal visits, reproductive age, multilevel analysis, SDG 3, South Africa

Résumé

À l'échelle mondiale, des milliers de femmes meurent de complications liées à la grossesse. L'Organisation mondiale de la Santé recommande d'effectuer au moins huit consultations prénatales au cours de la grossesse afin de réduire la mortalité infantile et maternelle. Cette étude a examiné les facteurs influençant la réalisation de huit consultations prénatales ou plus chez des femmes sud-africaines âgées de 15 à 49 ans, en s'appuyant sur les données de l'Enquête démographique et de santé de 2016 en Afrique du Sud (échantillon pondéré de 3 036 femmes). Un modèle de régression logistique binaire à deux niveaux a été utilisé pour identifier les facteurs déterminant le recours à huit consultations prénatales ou plus. Les résultats ont révélé un faible taux de recours (17,1 %) à huit consultations prénatales ou plus. L'âge à l'accouchement, le rang de naissance, le groupe de population, la situation matrimoniale, la situation professionnelle, l'exposition aux médias, le lieu de résidence, le niveau de richesse du ménage et la province étaient statistiquement associés à la réalisation de huit consultations prénatales ou plus. Les femmes âgées de 20 à 34 ans à l'accouchement, celles exposées aux médias, celles issues de ménages aisés et celles résidant dans la province du Cap-Occidental présentaient une probabilité plus élevée d'effectuer huit consultations prénatales ou plus. Les campagnes médiatiques pourraient jouer un rôle précieux en informant les femmes des avantages liés au respect du nombre recommandé de consultations prénatales. (*Afr J Reprod Health* 2026; 30 [16]:18-30).

Mots-clés: soins prénatals, huit visites prénatales ou plus, âge de procréer, analyse multiniveau, ODD 3, Afrique du Sud

Introduction

Over 800 women die every day due to pregnancy-related complications globally.¹ The Sustainable Development Goals (SDGs) have been recommended by the United Nations to help in decreasing the high number of pregnancy-related deaths worldwide.² The targets established by SDG 3.1 and 3.2 focus on eradicating preventable deaths

among infants and children by the year 2030. All countries are expected to reduce neonatal mortality rates to a maximum of 12 deaths per 1,000 live births, and under-five mortality rates to at least 25 per 1,000 live births.^{3,4} As a result, it is of the utmost importance to guarantee early coverage of antenatal care (ANC) services starting in the first trimester of pregnancy as a way of reaching these SDG targets.⁵ As such, ANC is important for maternal and child

health; it is also necessary for physically preparing women for the delivery process as well as the postpartum period.^{6,7} The utilisation of quality ANC has been noted as one of the most effective methods of reducing maternal mortality.^{8,9} ANC helps women prepare for delivery and also enables them to recognise the signs of pregnancy and childbirth. In addition, ANC provides pregnancy vitamins, treatment for hypertension to stop eclampsia, tetanus vaccination, and treatments that assist prevent the spread of human immunodeficiency virus (HIV) from an HIV-positive mother to her child during pregnancy.¹⁰ For example, ANC is essential during pregnancy, as it supports the healthy growth of the baby and provides protection against infections. Women who have had ANC visits have increased chances of using skilled birth attendants.¹¹ Likewise, the use of skilled birth attendants is quite high in many countries. Studies show that 86% of pregnant women receive ANC from a skilled healthcare provider, at least once or more worldwide, while 65% receive approximately four or more ANC visits.^{8,12}

To ensure sufficient and appropriate care for women during the gestational period, the World Health Organization (WHO) previously recommended four ANC visits for every pregnant woman, which was subsequently raised to eight appointments during pregnancy.⁸ From around 2016, the WHO encouraged the use of eight or more (8+) ANC visits among pregnant women, the first of which should occur during the first month of pregnancy.^{5,12} In Africa, the frequency of having at least eight or more antenatal visits differs by country. The prevalence ranges between 8% in the Republic of Benin and 17% in Nigeria.^{13,14} Likewise, South Africa implemented the WHO recommendation of at least eight ANC visits for women in gestation.¹⁵ The South African Department of Health recommends that pregnant women attend ANC services immediately upon confirming pregnancy or as soon as they miss their menstrual period.¹⁶ Despite the WHO's recommendation that women receive at least eight ANC visits during their pregnancy to strengthen the outcome of delivery; there is a dearth of studies available that demonstrate the number of South African women adhering to this recent guideline. Moreover, the current information on ANC visits is based on the outdated endorsement of four or more ANC visits.^{17,18}

Andersen's Behavioural Model of Health Care Utilisation was adapted as the analytical framework for this study.^{19,20} The model was used in selecting the study variables. The model looks at three factors related to health utilisation: predisposing factors, enabling factors, and need-based factors. The predisposing factors comprise individual socioeconomic and demographic factors including age, gender, education, marital status, occupation, and family size.²¹ The enabling factors are resources from both the family and the wider community.²² Some examples of family resources consist of the family's socioeconomic status and geographical location. Community resources may consist of the presence of medical professionals and access to medical centres.²² The need-based factors take into account individual's views of their medical requirements, whether private, social, or professionally assessed.²³ This demonstrates that a woman's perception of the importance of contemporary maternal services compared to traditional practices can influence her choice to seek maternity care at a healthcare facility. This study focuses on the predisposing and enabling factors. This study aimed to examine the individual and contextual determinants of using 8+ ANC visits among women of reproductive age in South Africa.

Methods

Study design, setting, and source of data

Secondary data from the 2016 South Africa Demographic and Health Survey (SADHS) was used for the study. South Africa is the southernmost country in the African continent; the country has nine provinces. The SADHS collects data on various maternal and health indicators, which makes it suitable for the present study. The SADHS data collection took place between late June and early November 2016.¹⁷ Before the commencement of data collection, about 300 fieldworkers were trained, between mid-May and mid-June of 2016, to prepare them for the data collection.¹⁷ Not many surveys containing rich information, such as that in the SADHS, are conducted in the country. The 2016 SADHS made use of a two-stage stratified sample method; in the first stage primary sampling units (PSUs) were sampled utilizing the probability proportional to size sampling and systematic random sampling was used in the second stage to

select dwelling units (DUs).¹⁷ In the selected households, 9878 women were identified and approached to participate in the interviews. Interviews were completed among 8514 women, resulting in an 86.2% participation rate.¹⁷ The sample for this study included 3036 women of reproductive age (15–49 years). The study included women who had a live birth in the five years preceding the survey and excluded those who never had a birth in the five years preceding the survey. This study is conducted in accordance with the Declaration of Helsinki.

Outcome variable

The outcome variable used in this study was the use of 8+ ANC visits. The outcome variable is derived from asking women "How many times did you receive antenatal care during this pregnancy? Based on their response, women who reported attending 8+ ANC visits were coded as 1, otherwise 0.

Explanatory variables

The chosen explanatory variables for this research consisted of age at birth, birth order, population group, marital status, education, employment status, media exposure, household wealth, place of residence and province. Table 1 provides a brief explanation of these variables. Moreover, these variables were chosen because of previous statistically significant correlations with the use of ANC in previous studies.²⁴⁻²⁶

Statistical analysis

Stata version 14 was used to analyse the data. There are three types of analyses in the study, namely univariate, bivariate, and multivariate analysis. The bivariate analysis utilised a chi-square test (χ^2) to assess the estimation of the factors influencing the use of 8+ ANC visits. Multilevel logistic regression analysis was used to estimate the individual and community factors determining 8+ ANC visits. To mitigate the effects of under- or over-sampling, the data was weighted during the analysis. Due to the hierarchical structure of the data, multilevel modelling was employed because it provides insight into how individual-level outcomes can be shaped by the interplay between individual and contextual factors²⁷. Due to the nature of the

data, a two-level model was fitted, where individuals (level 1) are grouped within communities (level 2). The level 1 model looks at the interactions between individual factors and the use of 8+ ANC visits, while the level 2 model looks at the effects of community-level factors on the use of 8+ ANC visits. The two-level model is represented as:

$$\begin{aligned} \text{logit}(\pi_{ij}) &= \log \left[\frac{\pi_{ij}}{1 - \pi_{ij}} \right] \\ &= \beta_0 + \beta_1 x_{ij} + \beta_2 x_{ij} \dots + u_{0j} \\ &\quad + e_{0ij} \end{aligned}$$

where π_{ij} is the probability of an i th woman in the j th community using 8+ ANC visits, β_0 is the intercept, β_n is the regression coefficient, x_{ij} specifies the explanatory variables, u_{0j} is the community-level errors and e_{0ij} shows the individual-level errors.

Four models were used in the study. Model 0 is the null model, in which no explanatory variables were added. Individual-level factors were added to Model 1. The community-level factors were added to Model 2. Individual and community-level factors were included in Model 3 (the full model). To assess the presence of clustering, we utilised the intra-class correlation (ICC), median odds ratio (MOR), and proportional change in variance (PCV). Model fitness was estimated using the Akaike Information Criterion (AIC) and deviance (-2 log-likelihood). A multicollinearity test was done, and no collinearity was found between the explanatory variables; the mean VIF was 1.30. The methods and reporting of findings followed the Strengthening the Reporting of Observational Studies in Epidemiology statement [STROBE checklist for cross-sectional studies].

Ethical consideration

Data from Measure DHS is publicly accessible. The SADHS survey protocol was reviewed and approved by the South African Medical Research Council (SAMRC) Ethics Committee and the ICF Institutional Review Board before data collection commenced.¹⁷ Informed consent was requested and obtained from all those who participated in the study.¹⁷ Because the SADHS collected information (biological and personal) from minors younger than

Table 1: Description of the study variables

Variable	Variable definition	Variable coding
<i>Individual-level factors</i>		
Age at birth (years)	Age of respondents at birth	1= <20 2= 20–34 3= 35–49
Birth order	Birth order of respondents	1= 1 2= 2–3 3= 4–5 4= 6+
Population group	Population group (race) of the respondents (other includes Indian/Asian as well as white population groups)	1= Black, 2= Coloured 3= Other
Marital status	Respondents were asked whether they were married/in a union or not	0= Never in union 1= Currently in union 2= Formerly in union
Education level	The highest level of education attained by the respondents	0= No education 1= Primary 2= Secondary+
Employment status	Current employment status of the respondents	0= Not employed 1= Employed
Household wealth	Household socioeconomic status	1= Poor 2= Average 3= Rich
Media exposure	Respondents were asked whether they were exposed to the media (radio, TV, newspaper) or not	0= No, 1= Yes
<i>Community-level factors</i>		
Place of residence	Respondent's place of residence	1= Urban 2= Rural
Province	Respondent's province of residence	1= Western Cape 2= Eastern Cape 3= Northern Cape 4= Free State 5= KwaZulu-Natal 6= North West 7= Gauteng 8= Mpumalanga 9= Limpopo

18 years of age, written consent was “required from both the respondent and the parent/guardian”.¹⁷ Permission to download the dataset, in a de-identified format, was requested from Measure DHS, and the dataset was accessed once permission was granted. The dataset used has no personal information that can be used to identify the respondents. Further details about the ethical standards of the DHS data can be found here: <https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm>.

Results

Prevalence of 8+ ANC visits

Table 2 illustrates the prevalence of 8+ ANC visits by background characteristics. The findings show that age at birth, birth order, population group,

marital status, employment status, media exposure, household wealth, place of residence and province were statistically associated with 8+ ANC visits ($p < 0.05$). The results revealed that the use of 8+ ANC visits differs by age at birth. The findings indicated that having eight or more ANC visits was lower among women whose age at birth was at a young age. However, the prevalence of 8 or more ANC visits was higher among women who had their first birth at ages 20–34 years (18.5%) compared to those who had their first birth at ages 35–49 years (16.0%). The prevalence of 8+ ANC visits generally decreased as birth order increased. Women with a birth order of 2–3 exhibited a higher prevalence of 8 or more ANC (18.4%), while those with a birth order of 1 followed closely at 16.8%. Regarding population group, women from the Black population group had the lowest rate of 8 or more

Table 2: Distribution of respondents and prevalence of ANC use by explanatory factors

Variable	Use of 8+ ANC visits				N (%)	χ^2 Value	P-value
	No %	CI	Yes %	CI			
<i>Individual level factors</i>							
Age at birth (years)						15.1	0.001
<20	89.0	[85.5–91.7]	11.0	[8.3–14.5]	432 (14.2)		
20–34	81.5	[79.3–83.5]	18.5	[16.5–20.7]	2200 (72.5)		
35–49	84.0	[78.9–88.0]	16.0	[12.0–21.1]	404 (13.3)		
Birth order						9.3	0.025
1	83.2	[80.2–85.8]	16.8	[14.2–19.8]	1040 (34.3)		
2–3	81.6	[79.0–83.9]	18.4	[16.1–21.0]	1586 (52.2)		
4–5	86.6	[81.5–90.5]	13.4	[9.5–18.5]	326 (10.7)		
6+	89.3	[79.4–94.8]	10.7	[5.2–20.6]	84 (2.8)		
Population group						11.3	0.004
Black	84.0	[82.1–85.7]	16.0	[14.3–17.9]	2751 (90.6)		
Coloured	74.1	[66.7–80.3]	25.9	[19.7–33.3]	206 (6.8)		
Other	68.8	[54.7–80.2]	31.2	[19.8–45.3]	80 (2.6)		
Marital status						10.5	0.005
Never in union	84.7	[82.4–86.8]	15.3	[13.2–17.6]	1576 (51.9)		
Currently in union	80.8	[77.6–83.6]	19.2	[16.4–22.4]	1343 (44.2)		
Formerly in union	82.1	[72.4–88.9]	17.9	[11.1–27.6]	118 (3.9)		
Education level						1.8	0.403
No education	90.1	[77.5–96.0]	9.9	[4.0–22.5]	42 (1.4)		
Primary	84.9	[79.0–89.4]	15.1	[10.6–21.0]	249 (8.2)		
Secondary+	82.6	[80.7–84.4]	17.4	[15.6–19.3]	2745 (90.4)		
Employment status						12.0	0.001
Not employed	85.1	[83.1–86.9]	14.9	[13.1–16.9]	2027 (66.8)		
Employed	78.6	[75.0–81.7]	21.4	[18.3–25.0]	1009 (33.2)		
Media exposure						23.9	0.000
No	84.9	[82.9–86.7]	15.1	[13.3–17.1]	2184 (71.9)		
Yes	77.7	[73.9–81.0]	22.3	[19.0–26.1]	851 (28.0)		
Household wealth						36.5	0.000
Poor	86.8	[84.5–88.8]	13.2	[11.2–15.5]	1389 (45.8)		
Average	85.2	[81.5–88.3]	14.8	[11.7–18.5]	671 (22.1)		
Rich	75.8	[72.1–79.1]	24.2	[20.9–27.9]	975 (32.1)		
<i>Community level factors</i>							
Place of residence						10.1	0.001
Urban	82.3	[79.7–84.6]	17.7	[15.4–20.3]	1942 (64.0)		
Rural	84.0	[81.5–86.2]	16.0	[13.8–18.5]	1094 (36.0)		
Province						83.3	0.000
Western Cape	66.2	[59.0–72.6]	33.8	[27.4–41.0]	276 (9.1)		
Eastern Cape	83.1	[78.4–86.9]	16.9	[13.1–21.6]	335 (11.0)		
Northern Cape	88.5	[84.3–91.7]	11.5	[8.3–15.7]	61 (2.0)		
Free State	70.8	[64.8–76.2]	29.2	[23.8–35.2]	145 (4.8)		
KwaZulu-Natal	86.5	[82.0–90.0]	13.5	[10.0–18.0]	555 (18.3)		
North West	76.6	[71.3–81.2]	23.4	[18.8–28.7]	244 (8.0)		
Gauteng	89.7	[85.1–93.0]	10.3	[7.0–14.9]	842 (27.7)		
Mpumalanga	84.0	[80.2–87.2]	16.0	[12.8–19.8]	278 (9.2)		
Limpopo	81.0	[76.8–84.6]	19.0	[15.4–23.2]	301 (9.9)		
Total	82.9	[81.1–84.6]	17.1	[15.4–18.9]	3036 (100.0)		

Note: CI = confidence interval

Table 3: Multilevel determinants of 8+ ANC visits among women of reproductive age

Variable	Model 0 AOR [95% CI]	Model 1 AOR [95% CI]	Model 2 AOR [95% CI]	Model 3 AOR [95% CI]
<i>Individual level factors</i>				
Age at birth (years)				
<20 [®]		1		1
20–34		1.59** [1.13–2.24]		1.58** [1.13–2.23]
35–49		1.5 [0.94–2.38]		1.44 [0.90–2.28]
Birth order				
1 [®]		1		1
2–3		0.95 [0.75–1.22]		0.97 [0.76–1.23]
4–5		0.7 [0.46–1.05]		0.72 [0.48–1.09]
6+		0.5 [0.23–1.07]		0.51 [0.24–1.10]
Population group				
Black [®]		1		1
Coloured		0.92 [0.64–1.33]		0.83 [0.54–1.29]
Other		1.31 [0.72–2.41]		1.49 [0.81–2.73]
Marital status				
Never in union [®]		1		1
Currently in union		1.24 [1.00–1.54]		1.24 [0.99–1.54]
Formerly in union		0.9 [0.53–1.53]		0.8 [0.47–1.35]
Education level				
No education [®]		1		1
Primary		1.08 [0.41–2.85]		1 [0.38–2.63]
Secondary+		0.97 [0.39–2.45]		0.91 [0.36–2.29]
Employment status				
Not employed [®]		1		1
Employed		1.20** [0.97–1.49]		1.19 [0.96–1.48]
Media exposure				
No [®]		1		1
Yes		1.38 [1.09–1.73]		1.32* [1.05–1.68]
Household wealth				
Poor [®]		1		1
Average		1.11 [0.85–1.45]		1.06 [0.81–1.40]
Rich		1.55*** [1.19–2.00]		1.49** [1.11–2.00]
<i>Community level factors</i>				
Place of residence				
Urban [®]			1	1
Rural			0.76* [0.6–0.97]	0.98 [0.74–1.29]
Province				
Western Cape			4.33*** [2.59–7.25]	4.23*** [2.4–7.45]
Eastern Cape			2.10* [1.28–3.46]	2.55*** [1.54–4.23]
Northern Cape			1.28 [0.74–2.24]	1.49 [0.82–2.69]
Free State			3.79*** [2.34–6.14]	4.13*** [2.54–6.72]
KwaZulu-Natal			1.49 [0.91–2.45]	1.73* [1.04–2.86]
North West			2.93*** [1.79–4.79]	3.25*** [1.98–5.33]
Gauteng [®]			1	1
Mpumalanga			1.77* [1.07–2.92]	2.01** [1.22–3.34]
Limpopo			2.51*** [1.5–4.21]	2.88*** [1.71–4.85]
Random effects result				
PSU variance (95% CI)	0.363 [0.19–0.70]	0.281 [0.13–0.62]	0.183 [0.06–0.55]	0.158 [0.05–0.54]
ICC %	9.94	7.88	5.28	4.57
MOR	1.78	1.66	1.5	1.46
PCV %	[®]	22.59	49.59	56.47
Model fitness				
-2LL (deviance)	2843	2778	2769	2714
AIC	2847	2812	2791	2766
PSU	671	671	671	671

Note: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$; [®] = reference category; AOR = adjusted odds ratio; CI = confidence interval; ICC = intra-cluster correlation coefficient; MOR = median odds ratio; PCV = proportional change in variance; -2LL = deviance [-2 log-likelihood]; AIC = Akaike Information Criterion; PSU = Primary Sampling Unit

ANC, with a prevalence of just 16.0%. Concerning marital status, women who were currently in union had a higher prevalence of 8+ ANC visits (19.2%), while it was lower for those who were never in union (15.3%).

Furthermore, the findings showed that socioeconomic status was an important factor in the use of 8+ ANC visits. The results indicated that the prevalence of 8 or more ANC visits increased with education. Women who had completed secondary education or higher had a higher prevalence of 8 or more ANC visits (17.4%), compared to those with primary education, who had a prevalence of 15.1%, while it was lower among those with no education. Moreover, employed women had a higher incidence (21.4%) of having eight or more ANC, and it was lower (14.9%) among those who were unemployed. Women who had been exposed to the media had the highest prevalence of 8+ ANC visits (22.3%). The results also showed that the prevalence of 8+ ANC visits increased with household wealth status. Women from wealthy households had a higher prevalence of 8 or more ANC, at 24.2%, compared to just 13.2% among women from low-income households. Regarding the place of residence, women from urban areas had a higher prevalence (17.7%) of 8+ ANC visits, whereas it was lower (16.0%) among those from rural areas. Interestingly, the two main economic hubs in the country were opposites of each other regarding the use of 8+ ANC visits. Women from the Western Cape had a higher probability of 8+ ANC visits (33.8%), while it was lowest (10.3%) among those from the Gauteng province. Northern Cape and KwaZulu-Natal also had a lower prevalence of 8+ ANC visits.

Determinants of 8+ ANC visits

Table 3 shows the multilevel model for the individual and contextual factors influencing the use of 8+ ANC visits among South African women of reproductive age. The intra-class correlation coefficient (ICC) in the null model was 9.94%, suggesting that most of the variation in 8+ ANC visits was attributed to between-community variations. The null model's median odds ratio (MOR) of 1.78 showed the heterogeneity of unexplained clusters. The unexplained community-level difference in 8+ ANC visits declined to a MOR of 1.46 in the final model when accounting

for both individual and community-level factors. This proved that the impact of clustering remained consistent throughout the entire model (model 3), even after all the factors were taken into consideration. After integrating both individual and community-level factors into the full model, the proportional change in variance (PCV) revealed that both individual and community-level factors accounted for about 56.47% of the variation in the use of 8+ ANC visits. Based on the model fitness statistics (AIC and deviance), model three was the best-fitting model due to its lowest AIC and deviance values.

The findings revealed that women whose age at birth was between 20–34 years had higher odds [AOR: 1.58, 95% CI: 1.13–2.23] of using 8+ ANC visits than women younger than 20 years at birth. Women who were exposed to the media had higher odds [AOR: 1.32, 95% CI: 1.05–1.68] of using 8+ ANC visits than those who were not exposed. Furthermore, the odds of attending 8+ ANC visits increased with household wealth status. Women from rich households [AOR: 1.49, 95% CI: 1.11–2.00] had higher odds of using 8+ ANC visits than women from poor households. The results also revealed provincial variations in the use of 8+ ANC. Regarding province, women from the Western Cape [AOR: 4.23, 95% CI: 2.4–7.45], Eastern Cape [AOR: 2.55, 95% CI: 1.54–4.23], Free State [AOR: 4.13, 95% CI: 2.54–6.72], KwaZulu-Natal [AOR: 1.73, 95% CI: 1.04–2.86], North West [AOR: 3.25, 95% CI: 1.95–5.33], Mpumalanga [AOR: 2.01, 95% CI: 1.22–3.34] and Limpopo [AOR: 2.88, 95% CI: 1.71–4.85] had higher odds of using 8+ ANC visits compared to those from the Gauteng province.

Discussion

This study aimed to examine the individual and contextual determinants of using 8+ ANC visits among women of reproductive age in South Africa. The study found that there was variation in the use of 8+ ANC visits suggesting that the multilevel modelling technique was suitable for the study. The utilisation of 8+ ANC visits was found to be low among reproductive-age women in South Africa. The finding is consistent with recent studies from various developing countries which also discovered a low prevalence of 8+ ANC visits use²⁸⁻³¹. Moreover, the use of 8+ ANC visits was associated with various factors, including birth order,

population group, employment status, media exposure, place of residence, household wealth as well as province; several studies have reported that some of these factors play a significant role in the use of antenatal care (ANC)³²⁻³⁵. The multilevel analysis revealed community variations in the use of 8+ ANC visits, supporting the need to consider the community in explaining ANC use. Moreover, the findings of the multivariate analysis revealed a statistical correlation between age at birth, media exposure, household wealth, province, and the use of 8+ ANC visits.

The study found that women whose age at birth was 20–34 years had higher odds of 8+ ANC visits. In South Africa, this age group is regarded as part of the youth cohort³⁶. Studies conducted in other nations, particularly among the youth, also found that the likelihood of using maternal health services was higher among younger women^{30,37,38}. The higher odds of using ANC service among younger women indicates that they are motivated by the fact that they generally have no prior experience with the process of pregnancy and delivery, tend to be more careful regarding their prenatal period, and are normally expecting their first child; therefore, they attend more ANC visits to improve their knowledge of the pregnancy and better prepare for the birth process³⁹⁻⁴¹. Furthermore, the estimates of the prevalence showed that 8+ ANC visits decreased with birth order for women who had two or more children. This result is consistent with preceding studies, which found that as women's birth order changed, their chances of achieving the proposed eight ANC visits declined⁴²⁻⁴⁴. This might be due to having higher confidence in their ability to handle the process of pregnancy based on past pregnancies or an absence of resources for ANC utilisation, in turn endangering their own lives and the well-being of the babies they are carrying.^{6,45,46}

Additionally, the study showed that the use of 8+ ANC visits increased a woman's socioeconomic status. This finding was in line with various studies which found that women from rich households and those with the highest levels of education had higher odds of using 8+ ANC visits^{13,31}. This could be explained by the fact that those with better socioeconomic status have the advantage of private medical coverage and high-quality care⁴⁷ and educated women tend to better recognise the importance of maternal healthcare use for a child's survival^{48,49}. Employed women had a

higher prevalence of 8+ ANC use. Studies conducted in other countries also found that employed women were more likely to use maternal healthcare services compared to those who were unemployed^{50,51}. One potential reason for the higher prevalence of ANC use among employed women is that they have the financial means to pay for the service^{52,53}. Although maternal healthcare services are free in South Africa, many women have to travel some distance to get to those services, thus incurring some costs which employed women can better afford. Women who were exposed to the media were more inclined to use eight or more ANC visits. This finding is similar to other studies, which revealed that media exposure improved the utilisation of ANC services among pregnant women⁵⁴⁻⁵⁶. This is possibly due to the idea that conversing via smartphones, radios, television, and other forms of media has advantages for health-promoting initiatives.⁵⁷⁻⁵⁹

Moreover, women living in urban areas had a higher prevalence of 8+ ANC visits. This finding is supported by other studies, which showed higher use of 8+ ANC visits by women in urban areas^{30,60}. The lower use of ANC visits among women in rural areas is related to their socioeconomic disadvantage, inadequate healthcare options, and challenges related to accessing medical facilities due to insufficient transportation services^{30,61,62}. There were provincial differences evident in the use of 8+ ANC visits. Previous research revealed that the use of ANC services differed between the regions of various countries^{63,64}. Although both provinces can be considered as the economic hubs of South Africa, the Western Cape province had increased odds of 8+ ANC visits compared to Gauteng. One feasible explanation is that the Western Cape possesses more effective healthcare facilities compared to most of the other provinces^{65,66}. Healthcare delivery in Gauteng is generally poor; clinic appointment processes, including prolonged queues and operating hours, tend to worsen the problem^{67,68}. Similarly, pregnant women are sent away from clinics due to not having enough personnel who can examine every patient.^{16,68}

Strengths

The strength of this study is that it used nationally representative data from the SADHS. This allows us

to generalise the findings to all women in the country. Among the limitations is the cross-sectional nature of the study, which cannot measure causality between the variables. Furthermore, a pregnant woman's use of ANC services may be under-reported or over-reported, leading to reporting bias.

Implications for policy and practice

The study highlights the need for policies and programs that improve access to antenatal care, especially among high-risk groups in South Africa. Health programs should target young mothers, unemployed women, women with low socioeconomic status, and women with little or no media exposure to increase the uptake of the eight recommended antenatal care contacts. Media-based health promotion using radio, television, and mobile platforms can help raise awareness about the benefits of antenatal care, while expanding community-based and mobile services may reduce geographic and transportation barriers, particularly in rural and underserved areas. Maternal health programs should also emphasise the importance of antenatal care in every pregnancy, regardless of previous childbirth experience. A stronger collaboration between health, transport, and social development sectors is needed to address structural barriers and improve maternal health outcomes.

Conclusion

This study examined the individual and contextual factors influencing ANC use among women of reproductive age in South Africa. The use of 8 or more antenatal care visits among women of reproductive age in South Africa is relatively low. The factors influencing 8+ ANC use are age at birth, birth order, population group, marital status, employment status, media exposure, household wealth, place of residence, and province. Furthermore, the findings highlight the need for the government and policymakers in South Africa to implement targeted policies focusing on women at risk; that is, women whose age at birth was at younger ages, those with no media exposure, those with a lower socioeconomic status, and those from the Gauteng province. The low prevalence rate identifies a need to target women from Gauteng, as well as the Northern Cape and KwaZulu-Natal.

Media campaigns could be advantageous in teaching women about the benefits of attending the recommended ANC visits. Additionally, it is important to build more health centres in rural areas because these will assist in improving accessibility and use in these areas. There is a need for future studies, both qualitative and quantitative, focusing on identifying the barriers to the use of 8+ ANC, particularly among women from the groups specified at risk.

Availability of data and materials

The datasets used in this study can be obtained from the DHS Program website - one needs to seek permission to gain access to the data; the data is available at <https://dhsprogram.com/data/available-datasets.cfm>.

Conflicts of interest

The authors declare no competing interests.

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Authors' contributions

MMM and MT conceptualised the study. MMM and MT worked on the draft of this paper. MMM contributed to the data analysis and interpretations. MMM worked on the discussions. MT supervised this study. Both authors read and approved the final draft of this paper.

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