An investigation of factors associated with antenatal care attendance in Gauteng in 2015

J Mostert,[1] MD; **E M Webb**,[1] PhD Epidemiology; **B V Girdler-Brown**,[1] MMed (Community Health); **S Ngcobo**,[2] PhD Public Health

[1] *School of Health Systems and Public Health, Faculty of Health Sciences, University of Pretoria, South Africa*
[2] *Department of Family Medicine, School of Medicine, Faculty of Health Sciences, University of Pretoria, South Africa*

Corresponding author: *J Mostert (janita.mostert@gmail.com)*

Background. Many studies have shown that South African women tend to initiate antenatal care late in their pregnancies. This presents challenges in the provision of quality healthcare to both mother and child. There are several studies on the social and cultural reasons for late booking. However, understanding the factors in a woman's choice to initiate antenatal care is important in informing healthcare strategies and policies.
Methods. This study was an analytical cross-sectional study of household and general health factors associated with attendance of antenatal care by pregnant women in Tshwane in 2015. It was a secondary data analysis from complete data sampling households registered on AitaHealth™. Univariate and multivariate logistic regression was used to assess which factors are associated with antenatal care attendance.
Results. The age of the head of the household was a significant factor in the attendance of antenatal care. The odds of attending antenatal care were 3.3, 2.1 and 1.8 times higher in households where the head of the household was 30 - 39 years of age, 20 - 29 or 40-49 years of age, respectively, than when between 10-19 years of age. Factors that increased the odds of attending antenatal care were living in households that had electricity and piped water, and running a business from home. Residing in a permanent dwelling and being food secure increased the odds of antenatal care attendance.
Conclusion. The identified health and household factors should inform policies and programmes geared towards improving services around antenatal care provision.

S Afr Med J 2024;114(6b):e1332. https://doi.org/10.7196/SAMJ.2024.v114i6b.1332

Many studies over the past decades have shown that South African (SA) women tend to initiate antenatal care (ANC) quite late in their pregnancies.[1-3] Recent studies have shown that <50% of women initiate ANC before the recommended 20 weeks of gestational age.[4] This presents challenges in the provision of quality healthcare to both mother and child, especially in the lack of prevention of mother-to-child transmission (PMTCT) of HIV therapy when ANC is inadequate.[5]

Several studies have been done on the average timing of the first ANC booking and the social and cultural reasons for late booking.[1,6] However, understanding the factors involved in a pregnant woman's choice of whether or not to initiate ANC is important in informing the healthcare strategies and policies geared toward improving utilisation of ANC in this population. Currently, there is a paucity of research investigating these factors.

This study aims to investigate if household, general health and socioeconomic factors influence a pregnant woman's choice to attend ANC or not. Anchored in transformative and pragmatic conceptual frameworks, it will address the research gaps concerning the factors influencing the attendance or non-attendance of ANC services. It also aims to inform health education, disease prevention and public health policies to prevent maternal mortality, the transmission of HIV, syphilis and tuberculosis (TB) to children and to improve pregnancy outcomes for both mother and child,

Methods

This study was an analytical cross-sectional study of household, general health and socioeconomic factors that are associated with attendance or non-attendance of ANC by pregnant women in the community. It was a secondary data analysis from data collected from 1 807 households with pregnancies registered on the AitaHealth™ system by community healthcare workers (CHWs) in the Tshwane district in Gauteng in 2015. Tshwane district covers 6 298 km^2, has an estimated population of 3 275 152 with a total of eight community health centres and 68 clinics. Mamelodi specifically, where many of the household data were collected, is a 45.2 km^2 urban settlement in the east of the City of Tshwane. It has a population of 334 577 people living in approximately 110 703 households. Nearly all residents (98.8%) are black African and 42.5% speak Sepedi as their first language. Other languages include isiZulu (12.2%) and Tsonga (10.7%). One-third of the households are female-headed and 40% live on income of <R20 000 a year. The majority (61%) of people reside in formal dwellings. About two-fifths (38.4%) of the population >20 years of age have completed secondary school.

Data were collected by CHWs in the Tshwane district between 2014 and 2019. Although data were collected for this entire period, the data from 2015 are the most complete and therefore only data from 2015 were used for analysis.

Each CHW is allocated 150 - 200 households in a geographically defined area. They visit each household and register the household on AitaHealth™. If no one was at home or if the head of the household (HH) was not there, the CHW would return at another time. Data were collected over a long period, ensuring that CHWs could return to missed households multiple times to obtain informed consent and perform an AitaHealth™ registration with the HH, ensuring that potential participants were not missed.

The HHs were asked for consent before being registered on the AitaHealth™ system. The CHWs do a household assessment and a triage screening with the help of the HH. The CHW will ask the HH if any members are currently pregnant and, if so, if the

household member (HM) is attending ANC. The questionnaire includes information about the dwelling, food security, energy and water sources, exposure to environmental concerns, household safety and household income. The HH may or may not be the pregnant HM. In this analysis it is assumed that the HH is not the HM with a reported pregnancy.

Complete sampling was done for 1 807 households. All households and their respective individual members, captured on AitaHealth™ by CHWs, who were pregnant at the time of the household screening, were included in the study. Participants in the Tshwane district who registered in the year 2015 were included. Households with no pregnant women were excluded. Those who did not give consent for their data to be used for research purposes were excluded. Participants who registered on AitaHealth™ in any year besides 2015 were excluded. Participants not from the Tshwane District were excluded. Participants with missing data in any of the variable categories were excluded.

In 2015, 1 456 of the HHs reported that a HM was attending ANC, and 351 of the pregnant HMs were not receiving ANC.

Data collected by the AitaHealth™ information and communication technology (ICT) tool, from both the household assessment and the triage questionnaire, were used. Data were cleaned and all contradictory information or incomplete questionnaires were excluded.

The outcome of this study was defined as the proportion of households with a member attending ANC (n = 1 456) v. the proportion of households with members not attending ANC (n = 351).

This study used G*power (Fisher's exact test) software to calculate an adequate sample size.[7] For 80% power, setting the alpha- and beta-levels at 0.15 and 0.80 respectively, a sample size of 323 is calculated. For 90% power, setting the alpha- and beta-levels at 0.15 and 0.90 respectively, a sample size of 457 is calculated. The availability of 1 807 individual data entries for 2015 gives this study >99% power to assess the difference in ANC attendance patterns.

Baseline data were analysed using descriptive statistics for sociodemographic and clinical characteristics. Numerical data are presented using median, interquartile range (IQR), or mean and standard deviations (SDs). Categorical variables are presented with absolute numbers and percentages.

Univariate and multivariate logistic regression was used to assess which factors are associated with ANC attendance or non-attendance at the time of the interview. The cut-off p-value for the univariate beta coefficient value, resulting in inclusion in the initial full model, was 0.25 for the univariate (screening) logistic regression.[8] Starting with this initial full model, stepwise hierarchical backwards selection was used to remove explanatory variables that were not making a significant contribution to the model parameter estimates. The likelihood ratio (LR) test p-value was used to make the retention decision, and a critical p-value of 0.15 was used to guide this decision.[7]

Any linear covariables were retained in the final model in the linear form if they were tested for collinearity using the Box-Tidwell test, and the result was found to be statistically non-significant using a p-value of 0.05 as the critical value.[8] If they were found to be non-linear in their association with the logit they were recoded as categorical variables and the model was rerun with them in this categorical form. These remaining variables were included in the final model.

Adjusted odds ratios (aORs) from the final model, with their corresponding 95% confidence intervals (CIs) and z-score p-values were reported. Post-regression analyses included checking for collinearity among the retained variables and also the Pearson's goodness-of-fit test for the final model, as well as estimation of the area under the receiver operating characteristic (ROC) curve, an indication of the proportion of observed outcome states that are correctly predicted by the final model.[7,9] Ethical approval for the original data collection and study was obtained from the Faculty of Health Sciences Research Ethics Committee of the University of Pretoria (ref. no. 102/2011). Ethical approval for the current study was obtained from the Faculty of Health Sciences Research Ethics Committee of the University of Pretoria (ref. no. 262/2022). This study used anonymised data. Participants were the HHs who gave consent for their information to be collected and used for research and study purposes.

Results

Several variables can be used to gain insight into the household and economic factors surrounding the study participants. A summary of all the descriptive statistics is given in Table 1, while a few significant variables are discussed below.

The study participants lived in a range of different types of dwellings. The most common type of dwelling was a house, with 938/1 807 (51.9%) participants, while the second most common was a shack, with 634 (35.1%) participants. For HHs that were house dwellers, 766 (81.7%) of their HMs were attending ANC. Of the HHs that resided in a shack, 500 (78.9%) had HMs that were attending ANC (Table 1, Fig. 1).

In terms of economic factors, 1 567 (86.7%) households did not run a business from home. Of the 240 (13.3%) households who ran a business from home at the time of this study, the most common type of business (100 (5.5%) households) was having a shop or being a vendor. Thirty-six (1.99%) households were running a day-care centre or a crèche, while 20 (1.1%) produced a handicraft. Of the households that did not run businesses from home, 1 329 (84.8%) had HMs that were attending ANC. Of the 240 (13.3%) households who ran a business from home, 127 (52.9%) had HMs that were attending ANC (Table 1, Fig. 2).

Of the 592 (32.8%) married HHs, 484 (81.8%) had HMs attending ANC (Table 1). The median age of the HH was 26 (IQR 22 - 31) years of age, and 999 (55.3%) were in the 20 - 29 years age group. Of those aged 20 - 29 years, 807 (80.8%) had HMs attending ANC (Table 1, Fig. 3). Furthermore, 189 (10.5%) of participants were between 10 and 19 years of age, of whom 115 (60.8%) had HMs attending ANC. Five hundred and thirty-seven HHs (29.7%) were between 30 and 39 years of age, with 468 (87.2%) HMs attending ANC. Lastly, 82 (4.5%) participants were >40 years of age, of whom 66 (80.5%) had HMs attending ANC.

Among the participants of this study, 1 615 (89.4%) reported that they had food security, of whom 1 357 (84.0%) had HMs that were attending ANC (Table 1). Additionally, 192 (10.6%) HHs reported not having food security, and 99 (51.6%) had HMs attending ANC.

Based on the data reported in Table 1, it was decided to recode certain covariables since some of the categories contained very small numbers. The following variables were recoded as binary variables: dwelling type, source of water to the household, the type of toilet the household had, as well as the type of business that was run from the household. The variable 'dwelling type' was recoded to 'house or flat', representing permanent structures, and 'other', representing impermanent structures like shacks and huts combined with communal living arrangements and renting a room. The variable 'source of water' was recoded to 'piped water in the household', representing all piped water sources inside the house, inside the yard and outside the yard; and 'no piped water' representing no sources of piped water to or near the household. The variable 'toilet type' was

Table 1. Sociodemographic characteristics of households with pregnant women

Covariable	Categories	*n* (%)	HMs not in ANC (%)	HMs in ANC (%)
Dwelling	House	938 (51.9)	172 (18.3)	766 (81.7)
	Shack	634 (35.1)	134 (21.1)	500 (78.9)
	Room	164 (9.1)	35 (21.3)	129 (78.7)
	Flat	59 (3.3)	7 (11.9)	52 (88.1)
	Collective living	6 (0.3)	1 (16.7)	5 (83.3)
	Hut	4 (0.2)	2 (50.0)	2 (50.0)
	Other	2 (0.1)	0 (0.0)	2 (100.0)
Water	Piped water inside the dwelling	842 (46.6)	166 (19.7)	676 (80.3)
	Piped water in the yard	721 (39.9)	133 (18.4)	588 (81.6)
	No piped water	156 (8.6)	24 (15.4)	132 (84.6)
	Piped water outside the yard	88 (4.9)	28 (31.8)	60 (68.2)
Toilet	Flush toilet connected to a sewerage system	1 200 (66.4)	202 (16.8)	998 (83.2)
	Pit toilet without ventilation	325 (18.0)	69 (21.2)	256 (78.8)
	Ventilation-improved pit toilet (VIP)	88 (4.9)	34 (38.6)	54 (61.4)
	Flush toilet with septic tank	82 (4.5)	18 (22.0)	64 (78.0)
	Chemical toilet	55 (3.0)	14 (25.5)	41 (74.5)
	Bucket toilet system	48 (2.7)	13 (27.1)	35 (72.9)
	None	9 (0.5)	1 (11.1)	8 (88.9)
Home business	No business from home	1 567 (86.7)	238 (15.2)	1 329 (84.8)
	Shop or vendor	100 (5.5)	58 (58.0)	42 (42.0)
	Other	74 (4.1)	18 (24.3)	56 (75.7)
	Daycare or crèche	36 (2.0)	23 (63.9)	13 (36.1)
	Handicraft	20 (1.1)	8 (40.0)	12 (60.0)
	Office	5 (0.3)	2 (40.0)	3 (60.0)
	Workshop	5 (0.3)	4 (80.0)	1 (20.0)
HH marital status	Unmarried	1 215 (67.2)	243 (20.0)	972 (80.0)
	Married	592 (32.8)	108 (18.2)	484 (81.8)
HH age (years)	10 - 19	189 (10.5)	74 (39.2)	115 (60.8)
	20 - 29	999 (55.3)	192 (19.2)	807 (80.8)
	30 - 39	537 (29.7)	79 (14.7)	468 (87.2)
	>40	82 (4.5)	16 (19.5)	66 (80.5)
Food security	Household is food secure	1 615 (89.4)	258 (16.0)	1 357 (84.0)
	No food security in household	192 (10.6)	93 (48.4)	99 (51.6)c
TB history	No	1 789 (99.0)	346 (19.3)	1 443 (80.7)
	Yes	18 (1.0)	5 (27.8)	13 (72.2)
Chronic illness	No	1 686 (93.3)	336 (19.9)	1 350 (80.1)
	Yes	121 (6.7)	15 (12.4)	106 (87.6)

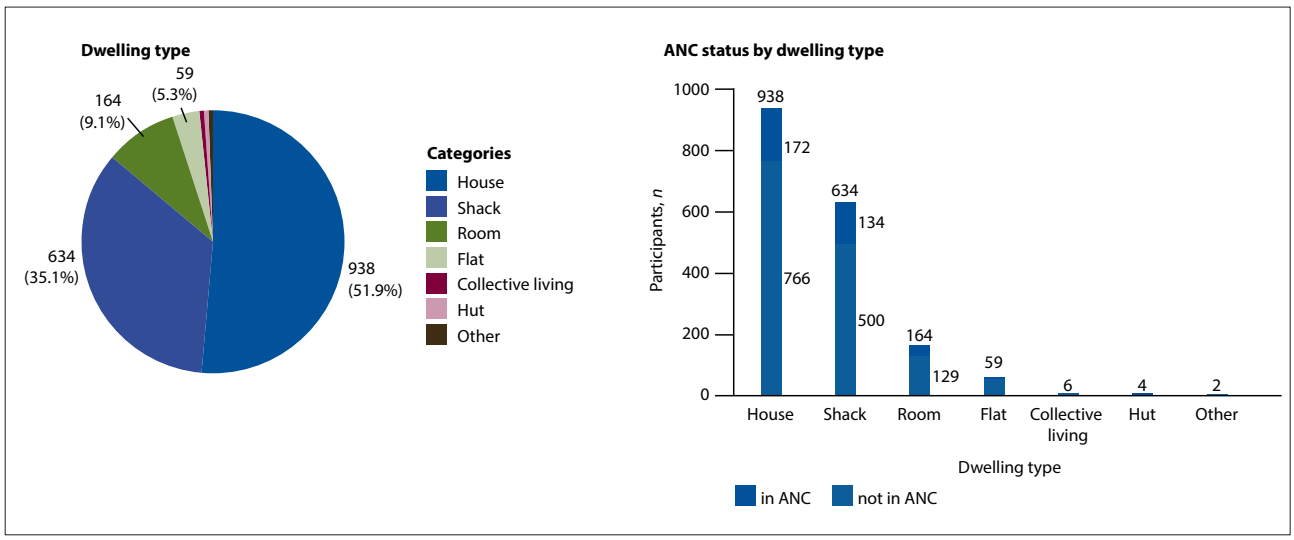

Fig. 1. Characteristics of ANC attendance by household dwelling type.

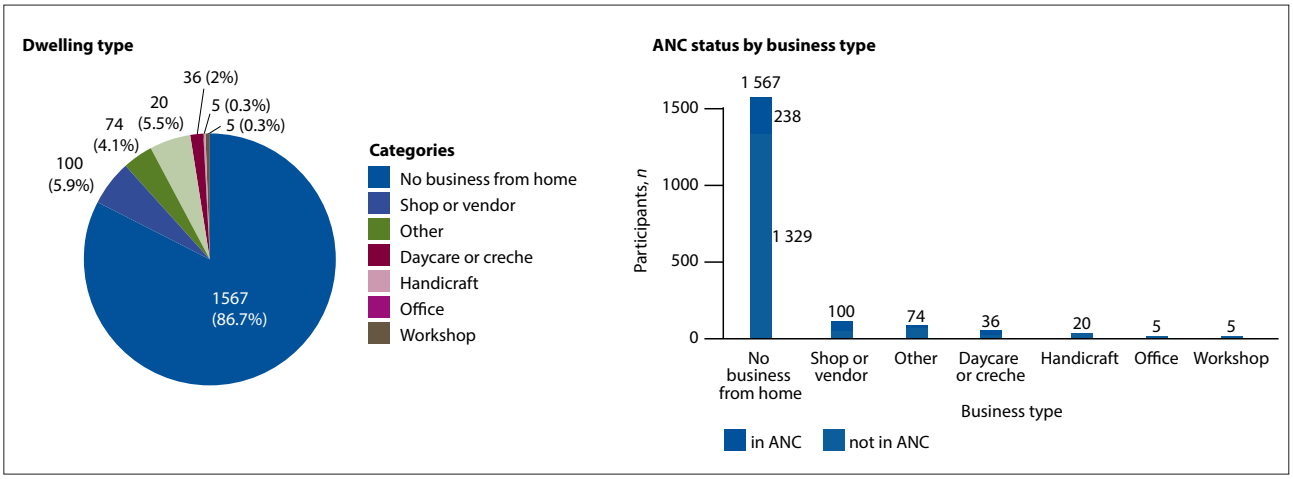

Fig. 2. Characteristics of ANC attendance by the type of business run from home.

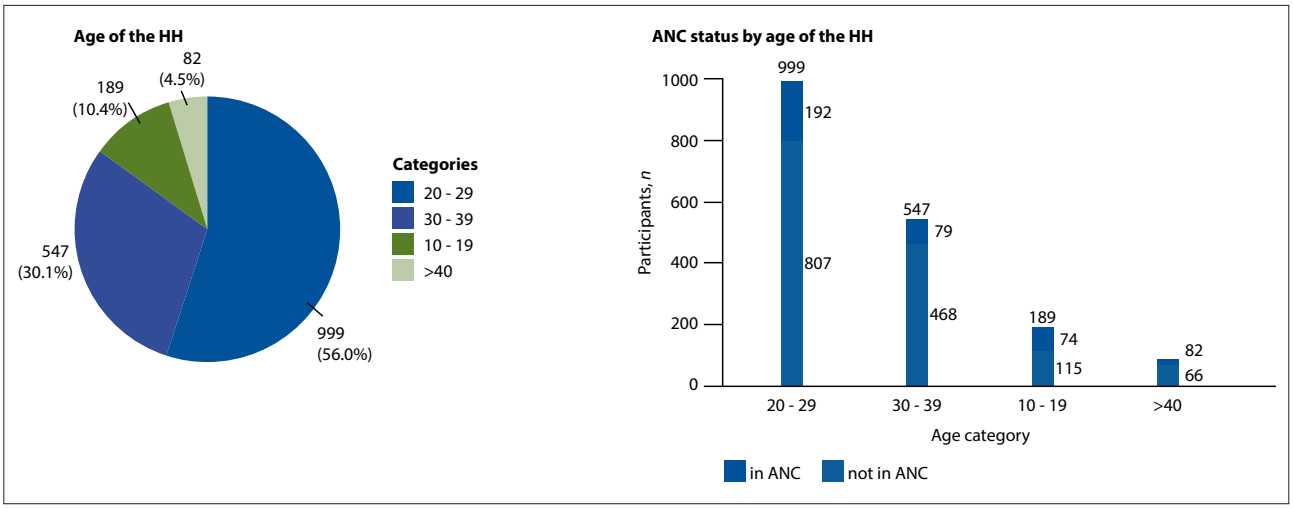

Fig. 3. Characteristics of ANC attendance by age of HH.

recoded to 'flush toilet in the household' which included flush toilets connected to a sewerage system and a septic tank, and 'no flush toilet' representing pit toilet without ventilation, ventilation-improved pit toilet (VIP), chemical toilet, bucket toilet system, or no toilet at all. The variable 'business from home' was recoded to 'no business from home' if the household did not run a business from home and 'business from home' if there was a business present in the household. These changes are summarised in Table 2.

Of the 997 participants who lived in a house or flat, 82.05% had HMs attending ANC. Of the 810 participants who lived in other types of dwellings like shacks, huts, rented rooms or communal living residences, 78.77% had HMs that were attending ANC. Of the 500 HHs that were not the owners of the dwellings, 82.80% had HMs who were attending ANC. Of the 1 307 participants who were owners of the dwellings, 79.72% had members who were attending ANC. HMs who attended ANC were present in 81.69% of the 84.95% of household dwellings that had access to electricity. In the households that did not have access to electricity (15.05%), 74.26% had HMs that attended ANC. Of the 91.37% of households with piped water, 80.19% had HMs that attended ANC. Of the 8.63% of households without piped water, 84.61% had HMs that attended ANC. Of the 70.95% of dwellings that had a flush toilet, 82.84% had HMs that attended ANC. The 29.05% of dwellings without flush toilets had 75.05% of HMs attending ANC. Of the 13.17% of households with a business from home, only 52.94% had HMs that attended ANC. In the 86.83% of households that did not run a business from home, 84.77% had HMs that attended ANC (Table 2).

Furthermore, looking at the variables for household, general health and socioeconomic factors, 67.24% of HH were unmarried, of whom 80.00% had HMs that were attending ANC. Of the 592 (32.76%) married participants, 484 (81.76%) had HMs attending ANC. The median age of the participants was 26 years of age (IQR 22 - 31 years), and 55.29% were in the 20 - 29 age group. Of those aged 20 - 29 years of age, 80.78% had HMs attending ANC. Eighty-nine percent of participants reported that they did have food security, of whom 84.02% had HMs that were attending ANC (Table 1).

In terms of general health, 99.00% of households did not have an HM treated for TB in the past 12 months, and of those, 80.66% had HMs that were attending ANC. Of the 1.00% that had someone in the household treated for TB, 72.22% had HMs that were attending ANC. One thousand six hundred and six (93.30%) households did not have someone with a chronic condition. Of those without chronic condition, 80.07% had HMs that were attending ANC. In the 6.70% of households with chronic illnesses present, 87.60% had HMs that were attending ANC (Table 1).

The results of the univariate analysis are summarised in Table 3. A discussion about the significant variables is given below.

Table 2. Household characteristics

Covariable	Category	*N* (%)	HMs not in ANC (%)	HMs in ANC (%)
HH is homeowner	No	500 (27.7)	86 (17.2)	414 (82.8)
	Yes	1 307 (72.3)	265 (20.3)	1 042 (79.7)
Dwelling type	Other	810 (44.8)	172 (21.2)	638 (78.8)
	House or flat	997 (55.2)	179 (18.0)	818 (82.0)
Electricity	No	272 (15.1)	70 (25.7)	202 (74.3)
	Yes	1 535 (84.9)	281 (18.3)	1 254 (81.7)
Water	No piped water	156 (8.6)	24 (15.4)	132 (84.6)
	Piped water	1 651 (91.4)	327 (19.8)	1 324 (80.2)
Flush toilet	No flush toilet	525 (29.1)	131 (25.0)	394 (75.0)
	Flush toilet	1 282 (70.9)	220 (17.2)	1 062 (82.8)
Home business	No	1 569 (86.8)	239 (15.2)	1 330 (84.8)
	Yes	238 (13.2)	112 (47.1)	126 (52.9)

Table 3. Results of the univariate analysis

Outcome: HM attends ANC	*n*	OR	95% CI	SE	*p*-value*
HH is partnered	595	1.1	0.9 - 1.4	0.14	0.37
Age of HH					
10 - 19	189	Reference			
20 - 29	999	2.7	1.9 - 3.8	0.46	<0.001
30 - 39	537	4.4	3 - 6.4	0.86	<0.001
>40	82	2.6	1.4 - 4.9	0.84	0.002
Not food secure	192	0.2	0.1 - 0.3	0.03	<0.001
History of TB	18	0.6	0.2 - 1.8	0.33	0.39
Has a chronic illness	121	1.8	1 - 3.1	0.5	0.033
HH is homeowner	1 307	0.8	0.6 - 1.1	0.11	0.136
House or flat dweller	997	1.2	1 - 1.6	0.15	0.08
Has electricity	1 535	1.5	1.1 - 2.1	0.24	0.006
Has piped water	1 651	0.7	0.5 - 1.2	0.17	0.171
Has flush toilet	1 282	1.6	1.3 - 2.1	0.2	<0.001
Has home business	238	0.2	0.2 - 0.3	0.03	<0.001

*p-value is the χ^2 test p-value.

Concerning socioeconomic factors, HHs who were married had 1.1 higher odds of having HMs attending ANC than unmarried HHs (95% CI 0.9 - 1.4; p=0.37). The HH age group 30 - 39 years of age had 4.4 higher odds of having HMs attending ANC than HHs who were between the ages of 10 and 19 (95% CI 3.0 - 6.4; p<0.001). HHs in the age group 20 - 29 years, had 2.7 higher odds of having HMs attending ANC than those HHs who were between 10 and 19 years of age (95% CI 1.9 - 3.8; p<0.001). HHs who were over the age of 40 years, had 2.6 higher odds (95% CI 1.4 - 4.9, p=0.002) of HMs attending ANC than the reference group (10 - 19 years of age).

HMs from households that reported being food insecure had 0.2 lower odds (95% CI 0.1 - 0.3; p<0.001) of attending ANC than HMs from households with food security.

Concerning general health characteristics, women from households who had a member with a chronic illness (diabetes or hypertension), had 1.6 higher odds of attending ANC than women from households without chronic illnesses (95% CI 1.0 - 3.1; p=0.033).

In terms of household factors, HMs from households where the HH was the owner of the dwelling had 1.8 times higher odds of attending ANC than those who came from households where the HH did not own the dwelling (95% CI 0.6 - 1.1; p=0.136).

The odds of attending ANC were 1.2 times higher for women from households in permanent structures like houses or flats than those living in other kinds of dwellings (95% CI 1.0 - 1.6; p=0.080).

Having access to electricity increased the odds of an HM attending ANC by 1.5 times in comparison with those households who did not have access to electricity (95% CI 1.1 - 2.1; p=0.006).

Having piped water available either in the house, in the yard or outside the yard, decreased the odds of a woman attending ANC by 0.7 in comparison with households who did not have access to piped water (95% CI 0.5 - 1.2; p=0.171).

Women living in households with a flush toilet had 1.6 times higher odds of attending ANC than those households without flush toilets (95% CI 1.3 - 2.1; p=0.0002).

Women from households that ran a business had 0.2 lower odds of attending ANC than households without businesses (95% CI 0.2 - 0.3; p<0.001).

All variables that had a p-value <0.25 were included in the multiple logistic regression model. Variables selected were HH age, having food security, having a household member with a chronic illness, HH is the owner of the dwelling, the type of dwelling, having electricity in the household, the source of water in the household, the type of toilet and if a business was run from home.

Stepwise hierarchal backwards elimination was done for multiple logistic regression, with the p-value cut-off set at p<0.15. The final

Table 4. Results of multiple logistic regression analysis (N=1 807)

Outcome: attends ANC	uOR	aOR	95% CI	SE	*p*-value*
HH age					
10 - 19	Reference				
20 - 29	2.7	2.1	1.2 - 3.7	0.62	0.015
30 - 39	4.4	3.3	1.9 - 5.7	0.94	<0.001
>40	2.6	1.8	0.9 - 3.7	0.66	0.121
Not food secure	0.2	0.3	0.2 - 0.4	0.05	<0.001
House or flat dweller	1.2	1.4	1.3 - 1.5	0.06	0.024
Has electricity	1.5	1.7	1.4 - 2.0	0.17	<0.001
Piped water	0.7	0.5	0.3 - 0.9	0.14	0.019
Has home business	0.2	0.3	0.3 - 0.5	0.08	<0.001

uOR = unadjusted odds ratio; aOR = adjusted odds ratio; CI = confidence interval for the multivariate odds ratio estimates; SE = standard error for the multivariate-aOR estimates.
* Wald test *p*-value for the multivariate analysis

model included variables for maternal age, food security, running a business from home, having electricity at home, dwelling type and the source of water and were adjusted for the clustering of subdistricts in Tshwane. Results of the multivariate logistic regression analysis are shown in Table 4.

After adjusting for other variables, the age of the HH was a significant factor in whether or not a pregnant woman attended ANC or not. The odds of an HM attending ANC were 3.3 times higher in households where the HH age was between 30 and 39 years of age than when the HH age was between 10 and 19 years of age (95% CI 1.9 - 5.7; standard error (SE) 0.9; $p<0.001$).

Furthermore, if the HH age was 20 - 29, the odds of an HM attending ANC were 2.1 times higher (95% CI 1.2 - 3.7; SE 0.6; $p=0.015$) than the reference group. The aOR was non-significant when the HH age was between 40 and 49 years.

The odds of HMs attending ANC were 1.7 times higher in households that had electricity (95% CI 1.4- 2.0; SE 0.2; $p<0.001$). HMs who lived in a house or flat had 1.4 times higher odds of attending ANC than those who lived in shacks, huts, rented a room or lived in communal living spaces (95% CI 1.3 - 1.5; SE 0.1; $p=0.024$). HMs from households who had access to piped water had 0.5 lower odds of attending ANC than households with no piped water (95% CI 0.3 - 0.9; SE 0.1; $p=0.019$)

Households that were food insecure and ran a business from home had 0.3 lower odds of attending ANC (95% CI 0.2 - 0.4; SE 0.1; $p<0.001$) and (95% CI 0.2 - 0.5; SE 0.1; $p<0.001$) respectively than households who were food secure or had home businesses.

Post-regression analyses for the final model included the Pearson's goodness-of-fit test and the area under the ROC curve. The *p*-value for the Pearson's goodness-of-fit test was $p=0.209$, indicating that the null hypothesis is not rejected and the difference between the observed and model-predicted outcomes in each covariate group could have plausibly arisen just by chance. The area under the ROC curve was calculated as 0.703, indicating that the model correctly predicted the outcomes for approximately 70% of the participants in this data set (Fig. 4).

Discussion

The study aimed to identify which household, general health and sociodemographic factors influenced an HM's choice to attend ANC or not. Of the 1 807 HH in the study, 1 456 (80.58%) had HMs that were attending ANC and 351 (19.42%) were not. Factors positively associated with ANC attendance were the age of the HH, having electricity and living in a house or flat. Factors negatively associated with ANC attendance were having access to piped water, being food insecure and running a business from home.

The age of the HH is a significant factor reflected in other studies in southern Africa. Westaway and Cooper[3] (1998) reported that teenagers were more likely to book ANC late in their pregnancy. In our study, women from households where the HH was between the ages of 30 and 39 years of age had 3.3 higher odds of attending ANC than women who were from households where the HH was between the ages of 10 and 19. It might be that teenagers face more barriers to attending ANC, like being financially dependent, not having the means to get to a clinic, still attending school and stigmatisation about teenage pregnancy. A study by Worku and Woldesenbet[10] in 2016 found that a mother's age negatively affected ANC attendance in that women aged 20 years and above were 2.1 times more likely to attend ANC than women aged 13 - 19 years. Further qualitative studies by Kaswa *et al.*[11] determined that 5 out of their 20 participants, who were all still at school, were afraid to disclose their pregnancies to a parent and therefore also avoided attending ANC. Since this study did not have access to the age of the pregnant HM, we can only suggest that the results would be similar for the ages of the HH. If the HH was a teenager herself, it would seem likely that there would be decreased support for a pregnant HM to attend ANC.

Women from households where the HH was between 30 and 39 years of age had the highest odds of attending ANC, possibly because of increased awareness of the of the benefits of ANC and increased supportive measures for the pregnant HM to attend ANC. This was also seen in a systematic review by Okedo-Alex *et al.* in 2019.[12]

Women from households where the HH was between the ages of 20 and 29 years of age had 2.1 higher odds than those aged 10 - 19 years of attending ANC. There is currently no literature on how the age of the HH can influence an HM's ANC attendance. The relationship between the HH and the HM and what effect it can have on ANC attendance could be a new field of investigation.

Socioeconomic factors like the availability of electricity and the type of dwelling had a significant positive effect on ANC attendance. Both Muhwava *et al.* [4] and Kaswa *et al.* [11] found that a lack of finances negatively affected attending ANC. Possibly, HMs that have access to electricity and are living in a household within a permanent dwelling have a higher income or increased financial stability. This could mean that a pregnant HM is then in a better position to afford the hidden costs of ANC, like travel to and from the clinic, administrative fees and missing work attending ANC, thus increasing the odds of attending ANC. Similar findings were reported by Okedo-Alex *et al.*[12]

Other socioeconomic factors like access to piped water, food insecurity and home businesses had a significant negative effect on ANC attendance. It might be that having a home business and food

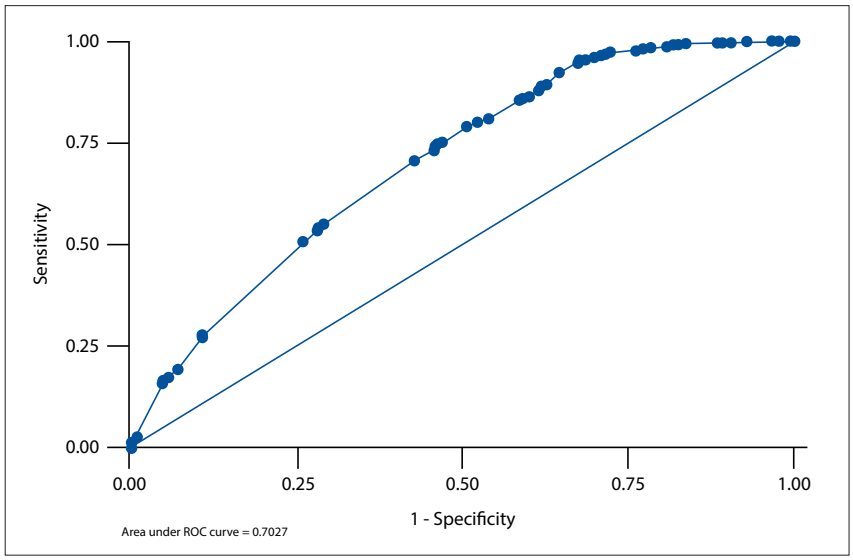

Fig. 4. ROC curve for goodness-of-fit modelling.

insecurity in the household could make a woman reluctant to leave the business or her place of employment to attend ANC since this would harm household finances. Kaswa *et al.*[11] determined that for women who are financially dependent on partners or parents, ANC attendance is delayed since others determine decisions about pregnancy.

General health status, like having an HM that had been treated for TB in the last 12 months or having a chronic illness, did not make a statistically significant difference in HMs' choice to attend ANC in the final analysis. However, the proportion of HMs attending ANC who also had an HM who regularly attends the clinic for other reasons (TB and chronic illness) was higher than those who did not. It might be that HMs who are already attending a clinic for other reasons, or who have a household member that is a regular clinic user, will be more likely to make use of the clinic's ANC services. If the HM was getting treated for TB or chronic illness herself, it might mean that she would be more likely to attend ANC at the same clinic. The pregnancy might have been diagnosed during routine screening while attending the clinic for other health reasons, leading to her booking for ANC at the clinic. Since there is currently no literature about general health factors that affect ANC, this study suggests that further qualitative research be done to address this knowledge gap.

HH marital status, household ownership and sanitation were factors that had no significant association with ANC utilisation or not. Kaswa *et al.*[11] also found that marital status was not a significant factor in ANC attendance. After a careful review of the literature, no prior research was found about household ownership and the type of sanitation. Further research needs to be done to address the paucity of research.

This unique study setting means that results will not be generalisable to populations with different ethnic and/or socioeconomic compositions. There is a possibility of selection bias on household registration since the households were not chosen at random. Instead, CHWs were allocated certain households by the local PHC centre. As this is a secondary analysis, data were not collected with this particular analysis in mind. As a result, several possibly relevant covariables are not available for analysis, e.g. the gestational age at the time of the interview, the age and parity of the pregnant woman, or the net family monthly income. Also, with this precollected data set, there is no opportunity to perform test-retest data validation.

There is no guarantee that all possible pregnant women participated in this study, since the HH may not have wanted to disclose the pregnancy of another HM to the CHW, or the pregnancy may not yet have been confirmed.

The timing of the registration may also have influenced whether the woman was reported to be attending ANC or not. For instance, if the registration took place early in the pregnancy, women might not have had a chance to go to the clinic for ANC yet, although they might have planned to attend ANC later in the pregnancy. This could be a potential bias, since no follow-up data collection was done that might have reported ANC attendance differently, depending on the interplay of the gestational period and the timing of the registration on AitaHealth™.

In terms of sociodemographic factors, the households were generally of a lower economic status, since more affluent people did not use the local PHC centre and would therefore not be allocated to a CHW for a household follow-up; this might also introduce bias into the study. Misclassification bias is also possible, since some women might have been pregnant but would not have been aware of it or would not have wanted to disclose it. No confirmatory diagnostic pregnancy test was performed at the household level; information about pregnancies in the household was given by the HH. Finally, we have no detailed information about absentee pregnant women or women who declined to participate in the data collection process. As a result, it is unclear what the extent and nature of any selection bias might be.

Additionally, cross-sectional studies of this nature are prone to type I errors (exclusion of relevant variables) if a stringent *p*-value such as 0.05 is used to exclude covariables from the final model (Vittinghoff *et al.*[7]). As a result, a critical *p*-value of 0.15 was used. This results in fewer type I errors, but more type II errors (inclusion of irrelevant covariables). As a result, the final aORs must be treated with caution.

The household, general health and socioeconomic characteristics of a household could be used to identify women who are less likely to attend ANC and to design programmes and policies that are geared towards encouraging them to attend ANC earlier and more frequently. CHWs in the study area could be equipped to look for women who fit the profile of less likely ANC attendance and provide them with health and pregnancy education and encouragement to attend ANC.

Conclusion

In this study, it was found that almost 20% of the 1 807 participating pregnant women were not attending ANC. This disrupts the provision of PMTCT for HIV, as well as reducing the best pregnancy outcomes for the mother and child.

Factors associated with higher odds of ANC attendance were the age of the HH, the household availability of electricity and the type of dwelling being a permanent structure. Factors lowering the odds of ANC attendance were household food insecurity, having piped water and the household running a home business.

These factors should inform policies and programmes geared towards improving education about and attendance of ANC in communities. CHWs and their Ward-based

Primary Healthcare Outreach Teams (WBPHCOTs) could receive specific training in identifying at-risk households based on the factors that lower the odds of attending ANC, like having a home business and not having food security. CHWs could specifically reach out to community members and households that meet these criteria and have increased screening and early testing services available at these households. These households and areas with high prevalence of ANC non-attendance should be included in ANC education strategies and community drives, which should include youth-friendly services.

Effort should also be made to encourage the HHs and pregnant women to utilise ANC services earlier and for every pregnancy, in order to continue the trend of earlier ANC first-visit booking and increasing ANC utilisation. CHWs can assist by regular follow-up at households with reproductive-age women and regular screening and referral for confirmatory pregnancy testing and ANC booking.

Declaration. None.

Acknowledgements. The UP COPC Research Unit at the University of Pretoria for the use of their original study data.

Author contributions. JM - research and manuscript; EMW, BVG-B and SG - contributions as supervisors of MSc dissertation.

Funding. None.

Conflicts of interest. None.

1. Myer L. Why do women seek antenatal care late? Perspectives from rural South Africa. J Midwifery Women's Health 2003;48(4):268-272.
2. Wilkinson DD. Examination of attendance patterns before and after introduction of South Africa's policy of free health care for children aged under 6 years and pregnant women. BMJ 1997; 314(7085):940-941.
3. Westaway MS, Cooper PA. Monitoring utilisation, quality & effectiveness of free antenatal care in an informal settlement in Gauteng. Curationis 1998;21(2):57-59.
4. Muhwava LS, Morojele N, London L. Psychosocial factors associated with early initiation and frequency of antenatal care (ANC) visits in a rural and urban setting in South Africa: A cross-sectional survey. BMC Pregnancy Childbirth 2016;16:18. https://doi.org/10.1186/s12884-016-0807-1
5. National Department of Health. Guidelines for maternity care in South Africa: A manual for clinics, community health centres and district hospitals. Pretoria: NDoH, 2016. https://knowledgehub.health.gov.za/elibrary/guidelines-maternity-care-south-africa-2016 (accessed 11 March 2024).
6. Jinga N, Mongwenyana, C, Moolla A, et al. Reasons for late presentation for antenatal care: Healthcare providers' perspective. BMC Health Serv Res 2019;19:1019. https://doi.org/10.1186/s12913-019-4855-x
7. Vittinghoff E, Glidden DV, Shiboski SC, McCulloch CE. Regression Methods in Biostatistics. New York: Springer, 2011.
8. Hilbe JM. Logistic Regression Models. Boca Raton, FL: CRC Press, 2009.
9. Hosmer DW, Lemeshow S, Sturdivant RX. Applied Logistic Regression. Hoboken, NJ: John Wiley & Sons, 2013.
10. Worku EB, Woldesenbet SA. Factors that influence teenage antenatal care utilisation in John Taolo Gaetsewe (JTG) district of Northern Cape Province, South Africa: Underscoring the need for tackling social determinants of health. Int J MCH AIDS 2016;5(2):134-145.
11. Kaswa R, Rupesinghe GFD, Longo-Mbenza B. Exploring the pregnant woman's perspective of late booking of antenatal care services at Mbekweni health centre in Eastern Cape, South Africa. Afr J Prim Health Care Fam Med 2018;10(1):1-9. https://doi.org/ 10.4102/phcfm.v10i1.1300
12. Okedo-Alex IN, Akamike IC, Ezeanosike OB, et al. Determinants of antenatal care utilisation in sub-Saharan Africa: A systematic review. BMJ Open 2019;9:e031890. https://doi.org/10.1136/bmjopen-2019-031890

Accepted 29 January 2024.