J Antimicrob Chemother 2020; **75**: 473–481
doi:10.1093/jac/dkz427 Advance Access publication 21 October 2019

Journal of Antimicrobial Chemotherapy

Antibiotic use in pregnancy: knowledge, attitudes and practices among pregnant women in Cape Town, South Africa

Andre N. H. Bulabula[1,2]*, Angela Dramowski[2,3] and Shaheen Mehtar[1,2]

[1]*Division of Health Systems and Public Health, Department of Global Health, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa;* [2]*Infection Control Africa Network—ICAN, Cape Town, South Africa;* [3]*Paediatric Infectious Diseases, Department of Paediatrics and Child Health, Stellenbosch University, Cape Town, South Africa*

*Corresponding author. E-mail: andybulabula@gmail.com

Received 18 April 2019; returned 11 June 2019; revised 9 September 2019; accepted 13 September 2019

Objectives: To establish the knowledge, attitudes and practices (KAP) regarding antibiotic use and self-medication among pregnant women.

Methods: We conducted a KAP survey of 301 pregnant women hospitalized at a tertiary hospital obstetric service in Cape Town, South Africa in November and December 2017, using an interviewer-administered 12 item questionnaire. We stratified analysis of attitudes and practices by participants' mean knowledge score (K-score) group (<6 versus ≥6 out of 7 questions). Multivariate models were built to identify independent predictors of antibiotic self-medication and K-score.

Results: The mean age of pregnant women was 29 (SD 6.1) years, 44/247 (17.8%) were nulliparous, 69/247 (27.9%) were HIV-infected, 228/247 (92.3%) had completed secondary school and 78/247 (31.6%) reported a monthly household income in the lowest category of ≤50–100 US dollars (USD). The mean K-score was 6.1 (SD 1.02) out of 7 questions. Sixteen percent of the cohort reported antibiotic self-medication, with higher rates among pregnant women with K-score <6 [18/48 (37.5%) versus 32/253 (12.6%); $P<0.001$]. The monthly household income category of >500 USD (the highest category) was the only predictor of antibiotic self-medication behaviour [adjusted OR=6.4 (95% CI 1.2–35.2), $P=0.03$].

Conclusions: Higher antibiotic knowledge scores are associated with lower rates of antibiotic self-medication, whereas higher household income is correlated with increasing self-medication behaviours. Education of pregnant women regarding the potential dangers of antibiotic self-medication and stricter enforcement of existing South African antibiotic prescribing and dispensing regulations are needed.

Introduction

The use of antibiotics during pregnancy is prevalent worldwide, raising concerns about increasing antenatal antibiotic exposure and antimicrobial resistance (AMR) in this population group.[1–5] The threat of AMR is of global concern and is increasingly reported from both hospital and community settings.[6–10] In these settings, the transmission of MDR Gram-negative bacteria (MDR-GNB) is a major cause of morbidity and mortality, especially in countries with sub-optimal health systems and inadequate management of water, sanitation and hygiene (WASH).[11,12] Transmission of MDR-GNB occurs in every human population group, including pregnant women. In a systematic review and meta-analysis, the prevalence of maternal (pregnant and post-partum women) colonization with ESBL-producing Enterobacteriaceae (ESBL-E) in Africa was 17.6%.[13]

Despite the concerns of pregnant women regarding the potential teratogenic effects of medications used during pregnancy,[14–16] there is less awareness of the potential harm associated with antibiotic self-medication.[1,17] Self-medication is defined as the acquisition, and use of, one or more medicines without a physician's opinion or diagnosis, as well as without prescription or therapeutic monitoring, including the use of herbal medicines.[18,19] In South Africa, the Medicines and Related Substances Act [Act 101, 1965,[20] section 22A (4)(b)] and the Regulations Relating to the Practice of Pharmacy made in terms of the Pharmacy Act,[21] 1974, stipulate that a medical prescription must be presented before a medicine can be dispensed to an individual patient. Studies from Africa have reported the practice of self-medication in adult populations, including pregnant women.[15,22–26] The prevalence of self-medication among pregnant women varies between countries; for example, a Nigerian study reported a 63.8% prevalence (of which 9.6% self-medicated with antibiotics)[25] and 46.2% has been reported in Tanzania (1.9%

with antibiotics).[27] In South Africa, Abrahams *et al.*[15] studied self-medication among pregnant women and reported that self-medication with non-prescribed drugs, such as herbs and Dutch remedies was common practice amongst Afrikaans-speaking women for both themselves and their babies. The authors also reported that Xhosa-speaking women followed indigenous healing practices for both themselves and their babies because of the need to 'strengthen' their womb against sorcery, to prevent childhood illnesses and to treat symptoms they perceived biomedical services would not be able to treat.[15]

Five elements are considered as pillars of safe motherhood: choice of contraception, antenatal care (ANC), clean and safe delivery, essential obstetric care and choice on termination of pregnancy.[28] It is well recognized that ANC visits represent an important opportunity to identify risk factors and perform early diagnosis of pregnancy complications and appropriate management, as well as provide health education. In South Africa, the basic antenatal care (BANC) approach is applied and during the first ANC visit pregnant women receive advice (including advice to avoid self-medicating) and health education about pregnancy danger signs (bleeding and reduced fetal movements).[29] However, there is little or no evidence of efforts to provide education on antibiotic use or antibiotic self-medication during pregnancy at ANC visits.[29] Noncungu,[30] in his work in Cape Town, found that the health education needs of pregnant women might be addressed through the individualized tailoring of the health information provided based on the pregnant woman's demographics.

There are limited data on the effect of pregnant women's antibiotic knowledge on their attitudes and practices regarding antibiotic use. Understanding potential misconceptions and knowledge gaps regarding antibiotic use in pregnancy and associated attitudes and practices will inform the development of appropriate interventions to encourage prudent use of antibiotics in pregnancy.

We conducted a knowledge, attitudes and practices (KAP) study among pregnant women at a tertiary obstetric service in Cape Town, South Africa to establish their KAP regarding antibiotics and self-medication practices.

Methods

Study setting

This study was conducted at the Tygerberg Hospital (TBH) Department of Obstetrics in Cape Town, South Africa. This public-sector tertiary, referral obstetric centre manages women with complicated pregnancies, with 144 inpatient beds in six wards and an antenatal outpatient clinic.

Study population

Three hundred and one hospitalized pregnant women were interviewed between 28 and 40 weeks of gestation after obtaining their written consent. The study was conducted between November and December 2017.

Study design

We conducted a study to explore the KAP of pregnant women regarding antibiotic use during pregnancy. Convenience sampling was used to select available and eligible participants. We approached all available pregnant women (to improve the representativeness of the sample) in each obstetric ward and clinic room to obtain their consent prior to their inclusion in the study. The study sample was solely made of consenting pregnant women from the available groups in the Department of Obstetrics at TBH. No prior power or sample size estimations were made. Two trained research nurses (B.Z. and S.E.) who are fluent in three locally spoken languages conducted the patient interviews and data collection during the early morning and at lunch time, to avoid disrupting clinical activities.

The KAP study used an interviewer-administered 12-item questionnaire including seven knowledge questions (true/false questions, each correct response scored 1). For the knowledge score (K-score, defined as the number of correct answers out of 7 questions), we considered as satisfactory a K-score of equal to or above the mean K-score. For analysis purposes, we further subdivided the participants into two groups based on K-score, using the mean K-score as the cut-off value (<mean K-score and ≥mean K-score).

The questionnaire also included three attitude questions with responses graded on a Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree) and there were two practice questions, with either 'yes' or 'no' answers. We worked out the attitude score (A-score) for attitudes (each desired response was scored 1, maximum A-score was 3) and practice score (P-score) for practices (each desired response was also scored 1, maximum P-score was 2). Participants were verbally informed that the questions would cover antibiotic use during the current pregnancy.

Questionnaire development

The literature search did not identify any validated questionnaire measuring KAP regarding antibiotic use among pregnant women. The study team designed a questionnaire to assess KAP regarding antibiotic use in pregnant women attending a tertiary hospital obstetric service in Cape Town, South Africa. The setting included a multicultural patient population, with high levels of socioeconomic deprivation and mixed educational backgrounds. Given these challenges and uncertainty regarding the mean educational level of the participants, the research team designed a short questionnaire with brief, uncomplicated statements regarding concepts of antibiotic use. The questionnaire was provided in English and, where needed, was verbally translated by the research nurse into the patient's language of preference. The internal consistency (the degree of the inter-relatedness among the items/questions in a multi-item questionnaire measure) of items for each section (i.e. knowledge, attitudes and practices) was assessed by computing the Cronbach's alpha value. Each section was evaluated separately: the knowledge section had a reliability of 0.64; attitudes, 0.45; and practices, 0.21. No pilot study was conducted but the questionnaire was assessed for content and face validity by two senior professionals (A.D. and S.M.) in the field.

Data analysis and result reporting

Data analysis of the KAP study included descriptive and analytic components. For descriptive analysis we calculated frequencies, proportions, mean and SD for the K-score after checking for its normal distribution. For the section on attitudes, we combined 'strongly agree' and 'agree' answers to define 'agree'; we also performed the same combination for 'strongly disagree' and 'disagree' to define 'disagree'. We reported proportions of correct answers in the knowledge section and desired answers in the attitude and practice sections.

The analytic component compared proportions of baseline characteristics, desired attitudes and practices, between K-score <6 and K-score ≥6 by using the chi-squared test; proportions of desired attitude and practice between K-score <6 and K-score ≥6 levels were compared. In addition, we built univariate and multivariate logistic regression models (K-score and attitudes) to identify predictors of antibiotic self-medication (practice). Moreover, we performed univariate and multivariate linear regression analyses to assess the correlation between K-score and the following baseline characteristics variables: age, education, monthly household income (MHI),

residential area (rural and urban), number of previous pregnancies, HIV status and A-score.

In addition, we performed the *t*-test to compare means and the Wilcoxon rank sum test to compare medians, where appropriate.

A *P* value <0.05 was considered statistically significant. Stata software version 13.1 (Stata, College Station, TX, USA) was used for all statistical analyses.

Ethics approval

Ethics approval was obtained from the Health Research Ethics Committee of Stellenbosch University (HREC Reference #: S17/10/200).

Results

Baseline characteristics of participants

Of 301 participants, 247 (82.1%) provided demographics and clinical data (HIV status and parity). The mean (SD) age of pregnant women in this study was 29 (6.1) years, 44/247 (17.8%) were nulliparous, the median (IQR) number of previous pregnancies for the multiparous women was 2 (1–3) and 69/247 (27.9%) women were HIV infected. The MHI groups were as follows: 78/247 (31.6%) earned ≤50–99 US dollars (USD), 42/247 (17%) 100–249 USD, 93/247 (37.7%) 250–500 USD and 34/247 (13.8%) >500 USD. Of 247 participants with demographic data, 14 (5.7%) had a primary school education, 228 (92.3%) had completed secondary school and 5 (2%) had a university-level educational qualification. One hundred and thirty-eight (55.9%) participants described their place of residence as a rural setting.

Knowledge regarding antibiotic use and AMR among pregnant women

A total of 301 KAP survey questionnaires were completed between November and December 2017. Pregnant women had an overall mean correct score of 6.1/7 (SD 1.02) for the knowledge questions, which assessed the participants' understanding of the role of antibiotics in pregnancy, AMR, medical prescriptions and access to antibiotics (Table 1). Ninety-two per cent (278/301) of participants defined AMR as the resistance of 'germs' to antibiotics. A similar number, 277/301 (92.0%), knew that AMR is a serious problem to health. Over half of the participants, 163/301 (54.2%) knew that antibiotics are ineffective for the treatment of influenza. The univariate linear regression analysis did not find a significant association between the K-score and the number of previous pregnancies; however, a trend of positive correlation was found between the two variables (Pearson's $r=0.011$, $P=0.76$). No association was found between K-score and age, education level, MHI, residential area (rural and urban), number of previous pregnancies or HIV status. (Table 2) However, a significant difference in proportions of antibiotic self-medication was found between K-score categories: pregnant women with a lower K-score were more likely to self-medicate; 18/48 (37.5%) among pregnant women with K-score <6 and 32/253 (12.6%) for the K-score ≥6 group, $P<0.001$.

Attitudes to antibiotic use in pregnant women

Ninety-five per cent (286/301) of participants agreed that 'pregnant and lactating women need to see a doctor before taking antibiotics'. Approximately 52.8% (159/301) agreed that infections with resistant 'germs' may be life-threatening (Table 1).

Table 1. Overall KAP of pregnant women regarding antibiotic use and AMR (*N*=301)

Question	Correct/desired responses, *n* (%)
Knowledge (correct response)	
An antibiotic kills germs (true)	291 (96.7)
Antibiotics may be used to treat infections like urinary tract infections (UTIs) (true)	296 (98.3)
'Antimicrobial resistance' is the failure of an antibiotic to kill germs (true)	278 (92.4)
Resistance to antibiotics is a serious health issue (true)	277 (92.0)
Misuse of antibiotics is the major cause of resistance (true)	276 (91.7)
Is it important to have a medical prescription before you buy an antibiotic? (yes)	284 (94.4)
One can use an antibiotic to cure flu (no)	163 (54.2)
Attitudes (desired responses)	
Pregnant and lactating women need to see a doctor before taking antibiotics (agree)	286 (95.0)
Infection with resistant germs during pregnancy can be life-threatening (agree)	159 (52.8)
Pregnant women should not buy antibiotics over the counter (agree)	132 (43.4)
Practices (desired responses)	
Do you buy antibiotics over the counter/ without a medical prescription/ self-medicate? (no)	251 (83.4)
Do you take antibiotics to treat influenza ('flu')? (no)	191 (63.5)

Practices regarding antibiotic use among pregnant women

Seventeen per cent (50/301) of pregnant women reported that they had purchased antibiotics over the counter or without medical prescription during pregnancy and approximately 36% (110/301) used antibiotics to treat 'flu' (Table 1).

Table 2. Baseline characteristics, attitudes to and practices of antibiotic use among pregnant women analysed by mean K-score level

	K-score <6, *n* (%)	K-score ≥6, *n* (%)	*P*
Baseline characteristics, *N*=247	*n*=21	*n*=226	
age, years, mean±SD	29.6±7.1	29.9±5.9	0.5
education level			
primary school	3 (14.3)	11 (4.9)	0.2
secondary school	18 (85.7)	210 (92.9)	0.2
university	0 (0.0)	5 (2.2)	0.2
MHI			
≤250 USD	12 (57.1)	108 (47.8)	0.4
>250 USD	9 (42.9)	118 (52.2)	0.4
residential area			
rural	12 (57.1)	126 (55.8)	0.9
urban	9 (42.9)	100 (44.2)	0.9
number of previous pregnancies, median (IQR)	2 (1–3)	2 (1–2)	0.6
HIV positive	3 (14.3)	66 (29.2)	0.1
Antibiotic self-medication	*n*=48	*n*=253	
	18 (37.5)	32 (12.6)	<0.001
Attitudes (desired responses), *N*=301	*n*=48	*n*=253	
Pregnant and lactating women need to see a doctor before taking antibiotics (agree)	43 (89.6)	243 (96.0)	0.1
Infection with resistant germs during pregnancy can be life-threatening (agree)	17 (35.4)	142 (56.1)	0.01
Pregnant women should not buy antibiotics over the counter (agree)	17 (35.4)	115 (45.5)	0.09
Practices (desired responses), *N*=301	*n*=48	*n*=253	
Do you take antibiotics to treat flu? (no)	30 (62.5)	161 (63.6)	0.9
Do you buy antibiotics over the counter/without a medical prescription/self-medicate? (no)	30 (62.5)	221 (87.4)	<0.001

K-score <6 and K-score ≥6 correct answers out of 7 knowledge questions; mean K-score=6.

Correlation of attitudes and practices with K-scores regarding antibiotic use (K-score <6 and K-score ≥6)

There was a statistically significant difference in proportions of participants providing desired responses with regards to one attitude question ('Infection with resistant germs during pregnancy can be life-threatening') between the K-score <6 and K-score ≥6 groups: 17/48 (35.4%) agreeing for K-score <6 versus 142/253 (56.1%) for K-score ≥6, *P*=0.01.

With regards to the correlation of practices and K-score levels, a higher proportion of participants with a K-score ≥6 reportedly did not buy over-the-counter (OTC) antibiotics or get antibiotics without a medical prescription: 221/253 (87.4%) versus 30/48 (62.5%) for K-score <6, *P*<0.001 (Table 2).

Predictors of antibiotic OTC/self-medication in pregnant women

From the univariate model, the following factors showed statistically significant ORs: two factors for reduced likelihood of self-medication behaviour, K-score ≥6 [OR=0.24 (95% CI 0.12–0.48, *P*<0.001)] and increasing A-score [OR=0.7 (95% CI 0.4–0.9, *P*=0.03)], each increase of A-score by one mark was associated with a 30% decrease in the odds of antibiotic OTC/self medication; and one factor for increased likelihood of self-medication, the MHI category of >500 USD [OR=6.6 (95% CI 1.2–35.7, *P*=0.03)]. Higher K- and A-scores were both protective factors against self-medication with antibiotics, associated with a decrease of 76% and 30% in the odds of self-medication, respectively. The MHI category of >500 USD was associated with 7-fold higher odds of self-medication with antibiotics than the category of ≤50–99 USD. The three significant variables (the MHI of >500 USD, K-score ≥6 and increasing A-score) from the univariate logistic regression model were then included in a multivariate logistic regression model; only one factor remained independently significant, the MHI category of >500 USD, adjusted OR=6.4 (95% CI 1.2–35.2, *P*=0.03). Participants with an MHI >500 USD had about 6-fold higher odds of self-medicating than participants with MHI ≤50–99 USD (Table 3).

Predictors of knowledge regarding antibiotic use in pregnant women

In a univariate linear regression model, two variables were significantly correlated with the K-score: MHI category of 100–249 USD [*r*=−0.14 (95% CI −0.24 to −0.04, *P*=0.009)] and the A-score [*r*=0.08 (95% CI 0.03–0.13, *P*=0.002)]. The two variables were

Table 3. Univariate and multivariate logistic regression of predictors for antibiotic self-medication/OTC among pregnant women

			Univariate		Multivariate	
Variable	Total, *N*	Self-medication, *n* (%)	crude OR (95% CI)	*P*	adjusted OR (95% CI)	*P*
Overall	301	50 (16.6)				
Baseline characteristics						
K-score out of 7, mean 6 (SD 1.02)						
<6			1			
≥6			0.24 (0.12–0.48)	<0.001[a]	0.8 (0.2–3.6)	0.7
age			0.98 (0.91–1.1)	0.7		
education level						
primary school			1			
secondary school			1.25 (0.15–10.1)	0.8		
university			1	—		
MHI			1.6 (1.03–2.55)	0.04[a]	**1.6 (1.02–2.55)**	**0.04**
≤50–99 USD			1			
100–249 USD			5.1 (0.9–27.7)	0.06	5.4 (0.9–29.9)	0.053
250–500 USD			4.1 (0.9–19.4)	0.08	4.1 (0.8–19.4)	0.080
>500 USD			6.6 (1.2–35.7)	0.03[a]	**6.4 (1.2–35.2)**	**0.032**
residential area						
rural			1			
urban			0.6 (0.2–1.6)	0.3		
number of previous pregnancies			0.9 (0.6–1.2)	0.4		
HIV status (reference group=negative)			0.6 (0.2–1.8)	0.3		
Attitudes, A-score out of 3			0.7 (0.4–0.9)	0.03[a]	1.3 (0.7–2.4)	0.4
Overall	301	50 (16.6)				
K-score out of 7, mean 6 (SD 1.02)						
K-score<mean K-score, *n* (%)	48 (15.9)	18 (37.5)	1.00			
K-score ≥ mean K-score, *n* (%)	253 (84.4)	32 (12.6)	0.2 (0.1–0.5)	<0.001[a]	0.3 (0.1–0.5)	<0.001
Attitudes						
Pregnant and lactating women need to see a doctor before taking antibiotics						
disagree	8 (2.7)	2 (25)	1.00			
agree	286 (95.0)	43 (15)	0.5 (0.1–2.6)	0.4	—	—
neutral	7 (2.3)	5 (71.4)	7.5 (0.8–74)	0.09[a]	10.6 (1.8–59)	0.009
Infection with resistant germs during pregnancy can be life-threatening						
disagree	14 (4.7)	4 (28.6)	1.00			
agree	159 (52.8)	19 (11.9)	0.3 (0.09–1.1)	0.08[a]	0.6 (0.3–1.2)	0.1
neutral	128 (42.5)	27 (21.1)	0.7 (0.2–2.3)	0.5	—	—
Pregnant women should not buy antibiotics over the counter						
disagree	94 (31.2)	8 (18)	1.00			
agree	132 (43.9)	23 (17.4)	0.4 (0.2–1.01)	0.05[a]	1.3 (0.7–2.6)	0.4
neutral	75 (24.9)	19 (25.3)	1.7 (0.8–3.3)	0.15	—	—

Statistically significant adjusted ORs are shown in bold.
[a]Variables with *P* value <0.1.

included in a multivariate linear regression model; only the MHI category of 100–249 USD remained independently and negatively correlated with K-score, $r=-0.13$ (95% CI −0.22 to 0.034, $P=0.008$), i.e. K-score was lower in the group with MHI of 100–249 USD as compared with ≤50–99 USD (Table 4).

The comparison of means of K-score between pregnant women who reported self-medicating with antibiotics [mean K-score 5.5 (SD 1.4)] and those who reportedly did not [mean K-score 6.2 (SD 0.9)], showed a statistically significant difference, $P<0.001$, suggesting that self-medication occurred in the lower mean K-score group.

Discussion

Overall mean K-score on antibiotic use and AMR awareness was satisfactory based on the questionnaire used (mean K-score was 6 correct answers out of 7 knowledge questions) in a South African cohort of pregnant women; about 80% had a K-score equal to or above the mean K-score, in contrast to KAP studies of the general population on antibiotic use conducted in other African countries or the Middle East, where the knowledge of the participants was reported as poor.[17,31–35] Despite the fact that the majority of participants had completed secondary school as their highest

Table 4. Univariate and multiple linear regression of predictors of knowledge regarding use of antibiotics in pregnant women

			Univariate		Multivariate	
Variable	Total, *N*	Self-medication, *n* (%)	crude coefficient (95% CI)	*P*	adjusted coefficient (95% CI)	*P*
Overall	301	50 (16.6)				
Baseline characteristics						
age			−0.002 (−0.02 to 0.015)	0.8		
education level						
primary school			0			
secondary school			0.25 (−0.18 to 0.68)	0.3		
university			0.52 (−0.28 to 1.34)	0.2		
MHI						
≤50–99 USD			0			
100–249 USD			−0.14 (−0.24 to −0.034)	0.009[a]	**−0.13 (−0.22 to −0.034)**	**0.008**
250–500 USD			−0.045 (−0.13 to 0.038)	0.28		
>500 USD			0.05 (−0.06 to 0.16)	0.34		
residential area						
rural			0			
urban			0.15 (−0.05 to 0.35)	0.14		
number of previous pregnancies			0.01 (−0.06 to 0.08)	0.8		
HIV status (reference group=HIV negative)			0.07 (−0.2 to 0.29)	0.5		
Attitudes, A-score out of 3			0.16 (0.008 to 0.3)	0.04[a]	−0.04 (−0.18 to 0.09)	0.54

Statistically significant adjusted ORs are shown in bold.
[a]Variables with *P* value <0.1.

education level at the time of this study, participants had an overall satisfactory mean K-score, suggesting that there are means through which they acquire information on antibiotic use, which may include the media or health bodies.[36] In South Africa, one of the objectives of the South African Antibiotic Stewardship Program (SAASP) is to promote rational use of antibiotics and antibiotic education for healthcare workers and the public.[36] In addition, the Antimicrobial Resistance National Framework from the Department of Health in South Africa encourages communication with the public to create antibiotic awareness and patient education on the dangers associated with inappropriate use of antibiotics, including self-medication.[37]

Accessing antibiotics without prescription, mainly identified as self-medication, is common in many parts of the world, including Africa and the Middle East.[17,27,38–41]A recent systematic review and meta-analysis has studied the prevalence of self-medication among pregnant women; it reported a pooled prevalence of 32% (13 studies, from 5 countries: Tanzania, Nigeria, Ethiopia, Iran and China) and about 20% of self-medication with an antibiotic.[1] In our study, 50/301 (16.6%) participants reported self-medicating with antibiotics [a higher proportion was in the group with a K-score <6, 18/48 (37.5%) versus 32/253 (12.7%) in the group with K-score ≥6] despite the fact that they know it is not recommended, especially in pregnancy. In South Africa, Abrahams *et al.*[15] reported self-medication with non-prescribed drugs and herbs among Afrikaans-speaking pregnant women, and indigenous healing practices among Xhosa-speaking women; no details on the nature of the non-prescribed drugs were provided.

It is reported in the literature that factors associated with antibiotic self-medication may be grouped into three categories: sociocultural factors (past successful use, the idea of self-care, good knowledge of antibiotics, advice or influence of a relative or friend and health-seeking behaviour); health system-related factors (long delays at clinics/hospitals, lack of trust in the health facilities and workers, non-compliance with prescribing and dispensing regulations and easy access to antibiotics); and economic factors (individual and family income, time and money saving).[22,42–45] In our study, education level, knowledge (K-score) and attitudes (A-score) regarding antibiotic use during pregnancy, HIV status, residential area (rural and urban), number of previous pregnancies and age were not independently associated with antibiotic self-medication practices. We found only one factor that independently predicted self-medication with antibiotics among pregnant women, which was an MHI of >500 USD. In addition, we found a statistically significant negative correlation between MHI and K-score; on the other hand, pregnant women who self-medicated with antibiotics had a lower mean K-score compared with those who did not self-medicate.

Although K-score was not an independent predictor of self-medication with antibiotics in our cohort of pregnant women, our findings suggest that pregnant women with lower K-scores and power of purchase (higher MHI) do self-medicate with antibiotics. There is additional evidence that income predicts self-medication practices in low- and middle-income countries. Studies conducted in Guatemala, Nigeria, Ethiopia and Eritrea have documented an association between self-medication (including with antibiotics) and monthly income; the authors of these studies explained this association by the role of medication-purchasing power of the participants.[46–49] Knowledge regarding antibiotics may affect a pregnant woman's decision to self-medicate. In Lebanon, Jamhour *et al.*[50] reported that self-medication with antibiotics

was highly correlated with both knowledge of antibiotics and lower educational level; people with lower antibiotic knowledge scores were more likely to exhibit bad practices, such as stopping a course of antibiotics prematurely.

A recent KAP study of patients on antibiotic use at a regional hospital in KwaZulu-Natal, South Africa, reported that patients with higher knowledge scores were six times more likely to report desirable antibiotic practices.[51] Similar findings have been reported in a Palestinian study on the relationship between knowledge score and attitudes and practices.[52] Theoretical models conceptualize that greater knowledge predictably leads to an enhanced attitude–practice consistency.[53] Thus educational interventions targeting pregnant women might have a positive impact on their attitudes and practices regarding antibiotic use.

There have been attempts to educate the public on appropriate antibiotic use; clinical trials at community level have been conducted in high-income countries, mostly in the USA, and have indicated moderate benefits of patient education on antibiotic use.[54–58] Public awareness on appropriate antibiotic use has also been achieved through public campaigns.[54]

On one hand the fact that pregnant women self-medicate with antibiotics may also suggest that pharmacies fail to comply with the current regulations for dispensing of antimicrobial agents in South Africa.[20,21] On the other hand, increasing knowledge regarding antibiotics has the potential to lead to improved antibiotic-use practices in pregnant women. Our data have the potential to inform the development of tailored interventions such as educational programmes for both pregnant women (during ANC visits) and health professionals (antibiotic prescribers and dispensers) on antibiotic use during pregnancy (as currently these are not included in health education information packages).[28–30] The educational programmes may focus on the danger of antibiotic self-medication for the foetus and the mother and the importance of medical prescription and its legal value in South Africa. In addition, stricter enforcement of the existing regulations on prescribing and dispensing of medicines in South Africa is needed to curb the practice of antibiotic self-medication. The educational programmes need to take into account the demographics of the individual pregnant woman and antibiotic prescribers/dispensers need to have more impact.[30]

The strengths of this study were the assessment of KAP regarding antibiotic use in a particular study population (pregnant women) and the multivariate analysis of KAP, clinical and demographic data giving a clearer picture of the risk factors involved in self-medication with antibiotics.

The limitations were, firstly, that this was a single-centre study based at a tertiary referral hospital receiving only women with pregnancy-related complications, thus interpretation of the findings needs some caution and may not be generalizable to all pregnant women in the country. Secondly, the use of convenience sampling included only pregnant women who were available and willing to take part in the study. Thirdly, recall bias regarding antibiotic use is possible as all the responses are based on memory of past events, thus the accuracy and volume of information might have been influenced by past events. Lastly, the small sample size in a few variables included in the subanalysis may result in non-generalizable findings.

Conclusions

In pregnant women, higher MHI predicted antibiotic self-medication and lower mean K-scores were found in women who self-medicated with antibiotics. These findings may serve as the basis for the development of tailored interventions addressing the danger of antibiotic self-medication during pregnancy both to mother and child, the role of antibiotics and the legal framework around antibiotic prescribing and dispensing in South Africa, all by taking into account the demographics of participants. The ANC visits may be a good opportunity to implement the educational programmes on antibiotic use among pregnant women.

Acknowledgements

Our thanks go to Sisters Bojana Zoleka and Eveline Swanepoel for the data collection and Mrs Fiki Peter for data capturing. We thank all the study participants for giving their consent, their time and the information presented in this work.

Funding

This study was supported by the Infection Control Africa Network (ICAN). A.B. received grant-holder linked support from the South African Medical Research Council towards his expenses as a PhD student and attendance to FIDSSA (Federation of Infectious Diseases Societies of Southern Africa) congress.

Transparency declarations

None to declare.

References

1 Mohseni M, Azami-Aghdash S, Gareh Sheyklo S *et al*. Prevalence and reasons of self-medication in pregnant women: a systematic review and meta-analysis. *Int J Community Based Nurs Midwifery* 2018; **6**: 272–84.

2 Mensah KB, Opoku-Agyeman K, Ansah C. Antibiotic use during pregnancy: a retrospective study of prescription patterns and birth outcomes at an antenatal clinic in rural Ghana. *J Pharm Policy Pract* 2017; **10**: 1–7.

3 Vidal AC, Murphy SK, Murtha AP *et al*. Associations between antibiotic exposure during pregnancy, birth weight and aberrant methylation at imprinted genes among offspring. *Int J Obes* 2013; **37**: 907–13.

4 Raheel H, Alsakran S, Alghamdi A *et al*. Antibiotics and over the counter medication use and its correlates among Arab pregnant women visiting a tertiary care hospital in Riyadh, Saudi Arabia. *Pakistan J Med Sci* 2017; **33**: 452–6.

5 Zaki NM, Albarraq AA. Use, attitudes and knowledge of medications among pregnant women: a Saudi study. *Saudi Pharm J* 2014; **22**: 419–28.

6 WHO. Antimicrobial Resistance: Global Report on Surveillance. 2014. https://apps.who.int/iris/bitstream/handle/10665/112642/9789241564748_eng.pdf? sequence=1.

7 O'Neill J. Antimicrobial Resistance: Tackling a Crisis for the Health and Wealth of Nations. 2014. https://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf.

8 O'Neill J. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations. 2016. https://amr-review.org/sites/default/files/160518_Final paper_with cover.pdf.

9 Holmes AH, Moore LSP, Sundsfjord A *et al*. Understanding the mechanisms and drivers of antimicrobial resistance. *Lancet* 2016; **387**: 176–87.

10 WHO. Global Action Plan on Antimicrobial Resistance. 2015. https://apps.who.int/iris/handle/10665/193736.

11 Laxminarayan R, Duse A, Wattal C *et al*. Antibiotic resistance—the need for global solutions. *Lancet Infect Dis* 2013; **13**: 1057–98.

12 Kariuki S, Dougan G. Antibacterial resistance in sub-Saharan Africa: an underestimated emergency. *Ann NY Acad Sci* 2014; **1323**: 43–55.

13 Bulabula ANH, Dramowski A, Mehtar S. Maternal colonization or infection with extended-spectrum β-lactamase-producing Enterobacteriaceae in Africa: a systematic review and meta-analysis. *Int J Infect Dis* 2017; **64**: 58–66.

14 Nordeng H, Ystrøm E, Einarson A. Perception of risk regarding the use of medications and other exposures during pregnancy. *Eur J Clin Pharmacol* 2010; **66**: 207–14.

15 Abrahams N, Jewkes R, Mvo Z. Indigenous healing practices and self-medication amongst pregnant women in Cape Town, South Africa. *Afr J Reprod Health* 2002; **6**: 79–86.

16 Liao S, Luo B, Feng X *et al*. Substance use and self-medication during pregnancy and associations with socio-demographic data: a cross-sectional survey. *Int J Nurs Sci* 2015; **2**: 28–33.

17 Abasiubong F, Bassey EA, Udobang JA *et al*. Self-medication: potential risks and hazards among pregnant women in Uyo, Nigeria. *Pan Afr Med J* 2012; **13**: 15.

18 WHO. The Role of the Pharmacist in Self-Care and Self-Medication. 2014. http://apps.who.int/medicinedocs/en/d/Jwhozip32e/3.html.

19 Gul H, Omurtag G, Clark PM *et al*. Nonprescription medication purchases and the role of pharmacists as healthcare workers in self-medication in Istanbul. *Med Sci Monit* 2007; **13**: 9–14.

20 Republic of South Africa. Medicines and Related Substances Act 101 of 1965. https://www.hpcsa.co.za/Uploads/editor/UserFiles/downloads/legislations/acts/medicines_and_related_sub_act_101_of_1965.pdf.

21 South African Government. Pharmacy Act (53 of 1974). https://www.gov.za/sites/default/files/gcis_document/201505/act-53-1974.pdf.

22 Afolabi A. Factors influencing the pattern of self-medication in an adult Nigerian population. *Ann Afr Med* 2008; **7**: 120–7.

23 Afolabi A, Akinmoladun V, Adebose I *et al*. Self-medication profile of dental patients in Ondo state, Nigeria. *Niger J Med* 2010; **19**: 96–103.

24 Sapkota AR, Coker ME, Rosenberg Goldstein RE *et al*. Self-medication with antibiotics for the treatment of menstrual symptoms in southwest Nigeria: a cross-sectional study. *BMC Public Health* 2010; **10**: 610.

25 Yusuff KB, Omarusehe LD. Determinants of self medication practices among pregnant women in Ibadan, Nigeria. *Int J Clin Pharm* 2011; **33**: 868–75.

26 Abeje G, Admasie C, Wasie B. Factors associated with self medication practice among pregnant mothers attending antenatal care at governmental health centers in Bahir Dar city administration, Northwest Ethiopia, a cross sectional study. *Pan Afr Med J* 2015; **20**: 276.

27 Marwa KJ, Njalika A, Ruganuza D *et al*. Self-medication among pregnant women attending antenatal clinic at Makongoro health centre in Mwanza, Tanzania: a challenge to health systems. *BMC Pregnancy Childbirth* 2018; **18**: 16.

28 National Department of Health South Africa. Guidelines for maternity care in South Africa. *Gazette* 2015; 174. https://www.knowledgehub.org.za/content/guidelines-maternity-care-south-africa.

29 Department of Health. Improving Antenatal Care in South Africa. HealthGovZa. 2017. http://www.health.gov.za/index.php/gf-tb-program/347-improving-antenatal-care-in-south-africa.

30 Noncungu TM. Investigating health education needs of pregnant women in their first antenatal visit at primary health care facilities in Khayelitsha. Masters Thesis. University of the Western Cape Faculty of Community Health Science. 2017. https://etd.uwc.ac.za/xmlui/bitstream/handle/11394/5777/Noncungu_MCur_2017.pdf? sequence=1&isAllowed=y.

31 El Sherbiny NA, Ibrahim EH, Masoud M. Assessment of knowledge, attitude and behavior towards antibiotic use in primary health care patients in Fayoum Governorate, Egypt. *Alexandria J Med* 2018; **54**: 535–40.

32 Abdel Gawad Elmasry A, Samir Mohamed Bakr A, Alaaeldin Abdou Abdelaziz Kolkailah D *et al*. Pattern of antibiotic abuse – a population based study in Cairo. *Egypt J Chest Dis Tuberc* 2013; **62**: 189–95.

33 Al-Shibani N, Hamed A, Labban N *et al*. Knowledge, attitude and practice of antibiotic use and misuse among adults in Riyadh, Saudi Arabia. *SMJ* 2017; **38**: 1038–44.

34 Shehadeh M, Suaifan G, Darwish RM *et al*. Knowledge, attitudes and behavior regarding antibiotics use and misuse among adults in the community of Jordan. A pilot study. *Saudi Pharm J* 2012; **20**: 125–33.

35 Hajjar W, Alnassar S, Al-Khelb S *et al*. Antibiotics use and misuse in upper respiratory tract infection patients: knowledge, attitude and practice analysis in University Hospital, Saudi Arabia. *J Pak Med Assoc* 2017; **67**: 1387–92.

36 Mendelson M, Matsoso MP. The South African Antimicrobial Resistance Strategy Framework. *AMR Control*, 2015; 54–61. http://resistancecontrol.info/wp-content/uploads/2017/07/08_Mendelson-Matsotso.pdf.

37 South Africa National Department of Health. Antimicrobial Resistance National Strategy Framework 2014–2024. https://health-e.org.za/wp-content/uploads/2015/09/Antimicrobial-Resistance-National-Strategy-Framework-2014-2024.pdf.

38 Awad A, Eltayeb I, Matowe L *et al*. Self-medication with antibiotics and antimalarials in the community of Khartoum State, Sudan. *J Pharm Sci* 2005; **8**: 326–31.

39 Sawair FA, Baqain ZH, Abu Karaky A *et al*. Assessment of self-medication of antibiotics in a Jordanian population. *Med Princ Pract* 2009; **18**: 21–5.

40 Grigoryan L, Burgerhof JGM, Degener JE *et al*. Determinants of self-medication with antibiotics in Europe: the impact of beliefs, country wealth and the healthcare system. *J Antimicrob Chemother* 2008; **61**: 1172–9.

41 Skliros E, Merkouris P, Papazafiropoulou A *et al*. Self-medication with antibiotics in rural population in Greece: a cross-sectional multicenter study. *BMC Fam Pract* 2010; **11**: 58.

42 Abasaeed A, Vlcek J, Abuelkhair M *et al*. Self-medication with antibiotics by the community of Abu Dhabi Emirate, United Arab Emirates. *J Infect Dev Ctries* 2009; **3**: 491–7.

43 Torres NF, Chibi B, Middleton LE *et al*. Evidence of factors influencing self-medication with antibiotics in low and middle-income countries: a systematic scoping review. *Public Health* 2019; **168**: 92–101.

44 Ngigi CK, Mwagiru P, Wala J. Self-medication with antibiotics prior to seeking treatment among adult patients attending outpatient department at Gatundu Sub-County Hospital, Kiambu County, Kenya. *Imp J Interdiscip Res* 2016; **2**: 609–16.

45 Grigoryan L, Burgerhof JGM, Degener JE *et al*. Attitudes, beliefs and knowledge concerning antibiotic use and self-medication: a comparative European study. *Pharmacoepidem Drug Safe* 2007; **16**: 1234–43.

46 Ramay B, Córdoba L, Cerón L. Automedicación con antibióticos en cuatro farmacias de Ciudad de Guatemala: características, fuentes de información, efectos percibidos, y motivos. *Rev Cient* 2017; **26**: 18–35.

47 Araia ZZ, Gebregziabher NK, Mesfun AB. Self medication practice and associated factors among students of Asmara College of Health Sciences, Eritrea: a cross sectional study. *J Pharm Policy Pract* 2019; **12**: 3.

48 Osemene KP, Lamikanra A. A study of the prevalence of self-medication practice among university students in southwestern Nigeria. *Trop J Pharm Res* 2012; **11**: 645–50.

49 Gelayee DA. Self-medication pattern among social science university students in Northwest Ethiopia. *J Pharm (Cairo)* 2017; **2017**: 8680714.

50 Jamhour A, El-Kheir A, Salameh P *et al*. Antibiotic knowledge and self-medication practices in a developing country: a cross-sectional study. *Am J Infect Control* 2017; **45**: 384–8.

51 Ramchurren K, Balakrishna Y, Mahomed S. Patients' knowledge, attitudes and practices regarding antibiotic use at a regional hospital in KwaZulu-Natal, South Africa 2017. *South African J Infect Dis* 2018; doi: 10.1080/23120053.2018.1516393.

52 Abu Taha A, Abu-Zaydeh AH, Ardah RA *et al*. Public knowledge and attitudes regarding the use of antibiotics and resistance: findings from a cross-sectional study among Palestinian adults. *Zoonoses Public Health* 2016; **63**: 449–57.

53 Fabrigar LR, Petty RE, Smith SM *et al*. Understanding knowledge effects on attitude-behavior consistency: the role of relevance, complexity, and amount of knowledge. *J Pers Soc Psychol* 2006; **90**: 556–77.

54 Huttner B, Goossens H, Verheij T *et al*. Characteristics and outcomes of public campaigns aimed at improving the use of antibiotics in outpatients in high-income countries. *Lancet Infect Dis* 2010; **10**: 17–31.

55 Perz JF, Craig AS, Coffey CS *et al*. Changes in antibiotic prescribing for children after a community-wide campaign. *JAMA* 2002; **287**: 3103–9.

56 Hennessy TW, Petersen KM, Bruden D *et al*. Changes in antibiotic-prescribing practices and carriage of penicillin-resistant *Streptococcus pneumoniae*: a controlled intervention trial in rural Alaska. *Clin Infect Dis* 2002; **34**: 1543–50.

57 Gonzales R, Corbett KK, Wong S *et al*. 'Get smart Colorado': impact of a mass media campaign to improve community antibiotic use. *Med Care* 2008; **46**: 597–605.

58 Finkelstein JA, Huang SS, Kleinman K *et al*. Impact of a 16-community trial to promote judicious antibiotic use in Massachusetts. *Pediatrics* 2008; **121**: 15–23.