

RESEARCH ARTICLE

Factors associated with reporting good maternal health-related knowledge among rural mothers of Yemen

Dalia Hyzam^{1a} , Mingyang Zou^{1a}, Michael Boah² , Huda Basaleem³, Xiaoli Liu⁴ and Li-Jie Wu^{1*} 

¹Department of Children's and Adolescent Health, and Maternal Health Care, Public Health College, Harbin Medical University, Harbin, China, ²Department of Epidemiology, Biostatistics, and Disease Control, School of Public, University for Development Studies, Tamale, Ghana, ³Community Medicine and Public Health, Faculty of Medicine and Health Sciences, University of Aden, Yemen and ⁴Harbin Maternity Hospital, Harbin Medical University, Harbin, China

*Corresponding author. Email: wulijiehyd@126.com

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Abstract

Increasing women's knowledge about maternal health is an important step towards empowering them and making them aware of their rights and health status, allowing them to seek appropriate health care. In Yemen, the ongoing conflict has hampered the delivery of health information to women in public health facilities. This study examined rural women's knowledge of, and attitude towards, maternal and child health in Yemen and identified the factors associated with good maternal health knowledge. The study was conducted between August and November 2018. A sample of 400 women aged 15–49 years who had delivered in the 6 months prior to the survey were systematically selected from selected public health facilities in Abyan and Lahj. Women were interviewed using a structured questionnaire to gather data on their demographic and economic characteristics, obstetric history and responses to health knowledge and attitude questions. Women's knowledge level was assessed as poor or good using the mean score as a cut-off. Chi-squared test and multiple logistic regression analysis were used to identify statistically significant factors associated with good maternal health knowledge. The percentage of women who had good knowledge was 44.8% (95% CI: 39.8–49.8). Women's attitude towards maternal health was negative in the areas of early ANC attendance, managing dietary regime and weight during pregnancy, facility delivery, PNC visits, cord care and mother and child health management. Women with primary education, whose husbands had received no formal education, who had their first ANC visit from the second trimester of pregnancy and who had fewer than four ANC visits were more likely to have poor health knowledge. Conversely, those with higher household income and only one child were more likely to have good maternal health knowledge. Overall, women's knowledge on maternal and child health care in rural areas of Yemen was low. Strategies are needed to increase rural women's knowledge on maternal and child health in this conflict-affected setting.

Keywords: Maternal health knowledge; Predictors; Yemen

Introduction

Maternal mortality is the second largest cause of death among women of childbearing age. Annually, about 295,000 maternal deaths occur across the globe (WHO, 2019). The use of maternal health services is a catalyst for reducing the risk of maternal morbidity and mortality, but only a minority of women in Yemen access antenatal care (ANC) and deliver their babies with skilled assistance. The ongoing conflict in Yemen has resulted in a marked deterioration in the functions

^aAuthors contributed equally to this work.

of its already weakened public health system as a result of direct and indirect attacks, including the destruction of health infrastructure, erratic funding support from the government, worsening access to preventive and curative services (especially by rural dwellers), widespread shortages of essential medicines and equipment across the country and service delivery that has become increasingly challenging in the context of a funding crisis (Qirbi & Ismail, 2017; El Bcheraoui *et al.*, 2018; Hyzam *et al.*, 2020). The deteriorating health system and structural vulnerabilities in Yemen have negatively impacted the health of women and children. Vaccine coverage decreased for all antigens between 2013 and 2016 among children aged 12–23 months, child and maternal mortality increased and life expectancy at birth decreased in Yemen (Qirbi & Ismail, 2017; El Bcheraoui *et al.*, 2018). In fact, Yemen is among the fifteen countries included as ‘very high alert’ according to the 2017 Fragile State Index (WHO, 2019). Poor maternal and newborn health status and services contribute significantly to the burden of maternal and neonatal ill health in conflict-affected countries in Asia and the Middle East (Gopalan *et al.*, 2017).

Health knowledge is an important factor that enables women to be aware of their rights and health status in order to seek appropriate health care services. Therefore, interventions and strategies have been adopted in most low- and middle-income countries (LMICs) geared at promoting the use of essential health services. One such intervention is the use of multimedia channels to deliver health information to increase awareness on the availability and use of important health services, including family planning (Naugle & Hornik, 2014; Zamawe *et al.*, 2016; Habibov & Zainiddinov, 2017). Emerging evidence shows that women’s knowledge and health-seeking behaviour are influenced by their exposure to information on health. A study among rural women in Malawi found that the likelihood of using contraception, PNC services and sleeping under insecticide-treated bed nets was significantly increased by women’s exposure to community-driven mass media (Zamawe *et al.*, 2016). Also, in post-Soviet Central Asia, exposure to messages on family planning on television was shown to increase the odds of using modern contraception among women in both Kyrgyzstan and Tajikistan (Habibov & Zainiddinov, 2017).

Undoubtedly, people’s information need relates to the specific problems they face and the decision they have to make. In addition, it is associated with age, occupation and level of education (Mtega, 2012). Notwithstanding, rural women have a high need for health information. However, they lack adequate access to reliable information sources and literacy to fulfill their health needs. Qualitative evidence from south-western Nigeria has revealed that rural women tend to rely on traditional sources, including friends and family, for health information, practise self-medication, guided by their previous diagnoses, and only use health facilities when their sicknesses gets out of hand (Nwagwu & Ajama, 2011). Limited access to information is caused by a number of factors, including inadequate basic infrastructure, lack of suitable information services and lack of competent professionals (Mtega, 2012; Hyzam *et al.*, 2020).

Women’s poor knowledge about maternal and child health is a precursor to poor health-seeking behaviour and adverse health outcomes. Titilayo *et al.* (2015), in their study in Nigeria, found low overall use of ANC and institutional delivery services among women, and the odds of good health-seeking behaviour was lower among women who had poor knowledge about the causes of maternal deaths than in those with good knowledge. Kifle *et al.* (2017) reported that knowledge of pregnancy complications was significantly associated with the use of ANC, health facility delivery and PNC services in Ethiopia. In Yemen, inappropriate health-seeking behaviour is a common phenomenon that is influenced by many factors, including poor maternal and child health knowledge (Basaleem, 2012; Webair & Bin-Gouth, 2013, 2014; Masood & Alsonini, 2017; Seham *et al.*, 2017). Moreover, women’s level of knowledge on health topics has been found to vary widely by place of residence. According to national statistics, women in urban areas of Yemen are more likely to report blood transfusion and sexual contact with an infected husband as means of HIV transmission (84% and 85%, respectively) than their counterparts in rural areas (55% and 56%, respectively) (Ministry of Public Health and Population, 2015).

Overall, only 28% of Yemeni women know that the risk of getting HIV can be reduced by using condoms every time during sexual intercourse.

Nevertheless, literature on maternal health knowledge levels of Yemen is scarce. The present study sought to bridge this gap by examining the knowledge levels and attitudes of rural Yemeni women on maternal and child health care and identify the factors associated with good maternal and child health knowledge.

Methods

Setting

There are 22 governorates in Yemen: Sana'a, Amanat Al Asimah, Shabwah, Al-Baidha, Aldhalae, Al-Hodeida, Al-Jawf, Al-Mahrah, Al-Mahwit, Amran, Dhamar, Hadramout, Hajjah, Ibb, Lahj, Mareb, Reimah, Sadah, Socotra, Taiz, Abyan and Aden. Each has its own local health department, which reports to the central Ministry of Public Health and Population (MoPHP). National data for Yemen show that 70% of the population live in rural areas (Ministry of Public Health and Population, 2015). In this study, Abyan and Lahj governorates were selected for two main reasons. First, these are among the few governorates with comparatively low coverage of maternal and child health indicators. Second, due to the ongoing war in Yemen, Abyan and Lahj were comparatively safe for research. The study took place at Ibn-Khaldoun hospital (the only public hospital providing Comprehensive Emergency Obstetric and Newborn Care services (CEmONC) in Lahj governorate); the Maternity and Childhood Health Centre, which is one of five health centres providing Basic Emergency Obstetric and Newborn Care services (BEmONC) in Lahj governorate; Al-Razi hospital (one of two public hospitals cover CEmONC in Abyan governorate); and the Maternity and Childhood Health Centre (one of nine health centres providing BEmONC). The majority of rural mothers in Abyan and Lahj governorates visit these health facilities to receive health care services and access health information.

Study design and sampling

A cross-sectional study was conducted between August and November 2018 among women aged 15–49 years who had delivered in the 6 months preceding the current survey. The sample size (N) needed for the study was calculated using the formula $N = Z^2 P(1-P)/d^2$ with the assumption that the proportion of women with maternal and neonatal knowledge (P) was 50% and a 5% margin of error (d); Z at 95% confidence interval (CI) was equal to 1.96 (Lwanga *et al.*, 1991).

A simple systematic sampling strategy was employed to select participants. The first respondent was selected randomly. Subsequently, the 5th woman who met the inclusion criteria and agreed to participate was selected and this continued until the final sample size was reached. In the event that a selected woman refused to take part, the woman immediately after her was selected. A total of 400 women (200 from each city) were included in the study with an adjustment for non-response. Information was collected by seven trained research assistants in face-to-face interviews in the appropriate local language.

Data collection tool

The questionnaire was developed in English and reviewed by maternal health experts before being implemented. For the purpose of the interview, the questionnaire was translated into Arabic. A one-day training session was provided for seven data collectors by the first and third researchers to equip them with interviewing skills and ensure consistency in the data collection. The questionnaire collected information on women's socio-demographic characteristics, obstetric history and knowledge about ANC, PNC and neonatal care, as well as their attitude towards maternal health. Overall, there were 20 questions on knowledge regarding maternal health. A score of 1

point was given for each correct answer, and no mark was given for wrong answers. The maximum attainable points were 57. The attitude of mothers towards maternal health was measured using 19 positive statements with 5-point Likert scale agreement options. Responses for 'strongly agree' and 'agree' were reported as 'agree', and 'strongly disagree' and 'disagree' responses were similarly reported as 'disagree'. Answers were scored as '1' for strongly disagree/disagree responses, '2' for neutral and '3' for strongly agree/agree.

Validity and reliability of the data collected

To ensure internal consistency, validity and reliability, the questionnaire was assessed and modified by experts in the Department of Children's and Adolescent Health and Maternal Health Care, Harbin Medical University. The questionnaire was piloted among 30 respondents, who were similar in characteristics to the participants in the final study. Ambiguous questions were revised. A reliability test for the knowledge and attitude scale was performed giving Cronbach's alpha values of 0.66 and 0.89, respectively. Data from the pre-test were excluded in the main analysis.

Statistical analysis

Statistical analyses were carried out in SPSS version 20. Pearson chi-squared (χ^2) and Fisher's exact tests were used where appropriate to determine differences among groups on maternal health knowledge. The total score for each woman was obtained by summing up all the individual points obtained in each of the questions. The dependent variable 'maternal health knowledge' was dichotomized into 'poor knowledge' and 'good knowledge' using the mean score as a cut-off point. Similarly, the mean score was used as the cut-off point to identify mothers with a 'negative attitude' from mothers with a 'positive attitude' towards maternal health. A multivariable analysis was applied using Logistic regression with maternal health knowledge as the dependent variable to identify the factors associated with good maternal health knowledge. All the independent variables were fitted simultaneously in the final model. The odds ratios with their corresponding confidence intervals were estimated. All analyses were two-tailed. A *p*-value of less than 0.05 was considered statistically significant.

Results

Characteristics of respondents

The socio-demographic characteristics of the 400 female participants are shown in Table 1. A larger percentage of the respondent women were married (97.3%), unemployed (87.8%) and exposed to maternal health information (90.0%). Quite a high percentage of the women (42.5%) had not received any formal education. Among the women who were married or in a union ($n=389$), a significant number ($n=177$; 45.5%) reported that their partner received less than secondary level of education. Nevertheless, the majority (76.9%) reported that their partner was employed. Regarding ANC utilization during the most recent pregnancy, the majority of women (74.0%) reported receiving ANC services at least once before delivery. However, only about 23% had least four ANC follow-up visits before delivery. Lastly, about 41.2% reported booking their first ANC visit in the first 3 months of pregnancy, whereas 46.6% and 11.1% had their first ANC visit in the second and the third trimesters of pregnancy, respectively. Among the 104 women who did not receive any ANC services during their most recent pregnancy, the reasons mentioned, in order of frequency, were: couldn't pay for ANC services, nearest facility too far, husband's decision, poor quality of ANC services, busy at work and didn't know ANC was important during pregnancy. Regarding health information received during pregnancy, the most frequently mentioned were related to the necessity of ANC and PNC check-ups (Table 1).

Table 1. Demographic, economic and obstetric characteristics of study women, $N=400$ (unless stated)

Variable	<i>n</i>	%
Age (years)		
Mean age (Mean±SD)	27.9±6.5	
15–19	37	9.3
20–24	82	20.5
25–29	118	29.5
30–34	93	23.3
35–39	48	12.0
40>	22	5.5
Marital status		
Married	389	97.3
Divorced/widowed	11	2.8
Number of children		
1	110	27.5
2	74	18.5
3	76	19.0
4 or more	140	35.0
Mother's education		
No education	170	42.5
Primary	70	17.5
Secondary	107	26.8
Tertiary and above	53	13.3
Husband's education ($N=389$)		
No education	89	22.9
Primary	88	22.6
Secondary	122	31.4
Tertiary and above	90	23.1
Mother's employment		
Unemployed	351	87.8
Employed	49	12.3
Husband's employment ($N=389$)		
Unemployed	90	23.1
Employed	299	76.9
Household monthly income (US\$) ($N=316$) ^b		
40–59	84	26.6
60–79	97	30.7
80–99	107	33.9
100–300	28	8.9

(Continued)

Table 1. (Continued)

Variable	<i>n</i>	%
ANC in most recent pregnancy		
No	104	26.0
Yes	296	74.0
Number of ANC visits before delivery (<i>N</i> =296)		
<4	228	77.0
4	68	23.0
Gestation at first ANC (<i>N</i> =296)		
First trimester	122	41.2
Second trimester	138	46.6
Third trimester	33	11.1
Don't remember	3	1.0
Reasons for not attending ANC ^a (<i>N</i> =104)		
Didn't know that ANC was important during pregnancy	7	6.7
Couldn't pay for ANC services	88	84.6
Nearest health facility too far away	52	50.0
Poor quality of ANC services	19	18.3
Husband's decision	26	25.0
Busy at work	11	10.6
Exposure to information		
No	40	10.0
Yes	360	90.0
Source of information on maternal health care ^a (<i>N</i> =360)		
Maternity and childhood health centre	225	62.5
Community health volunteers	44	12.2
Mass media (radio, TV, posters and newspapers)	50	13.9
Health campaigns	23	6.4
Mothers, friends, neighbours	203	56.4
Health information received ^a (<i>N</i> =360)		
ANC and PNC check-up	121	33.6
Danger signs of pregnancy	53	14.7
Pregnancy physical examination	15	4.2
Dietary regimen, vitamin supplements and pregnancy exercises	14	3.5
Family planning	81	22.5
Breastfeeding	72	20.0
Keeping baby safe during pregnancy and after childbirth	49	13.6
Vaccination	68	18.9

^aMultiple responses were allowed.

^bGross Domestic Product (GDP) *per capita* of Yemen estimated to be Yemen (GDP) USD\$ was (1343 in 2013). 1US\$=490 RY in 2018.

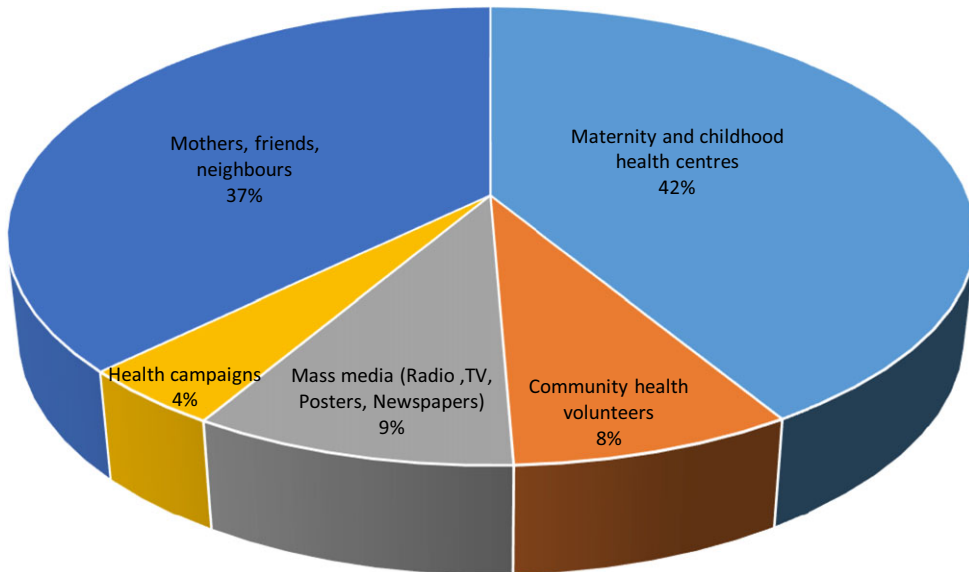


Figure 1. Health information sources on maternal health care among rural mothers in Yemen ($N=360$).

Of the total mothers, 360 received health information on maternal health care from various sources. These included, in order of frequency: maternity and childhood health centres; mothers, friends and neighbours; mass media; community health volunteers; and health campaigns (Figure 1).

Knowledge on maternal health

Table 2 shows the women's responses to the question on knowledge regarding maternal health, including ANC, nutrition during pregnancy, danger signs during pregnancy, PNC, neonatal health, breastfeeding and vaccination. The respondents' scores ranged between 1 and 51, with a mean of 24.4 (standard deviation, $SD=9.4$) and a median of 22 (Interquartile Range, $IQR=13$). More broadly, further analysis of the women's responses to the questions showed that a significant number had little knowledge about the maternal health as the proportion of women with correct answers in most of the areas was less than 50%. Using the mean score as a cut-off point, the results showed that the percentage of respondents with good knowledge (i.e. with a score equal to or above the mean score) was 44.8% (95% CI: 39.8–49.8).

Knowledge on maternal health by respondents' characteristics

Table 3 shows women's level of maternal health knowledge by their demographic, economic, and obstetric characteristics. Women's level of maternal health knowledge differed significantly by their level of education, their husband's level of education, household income, whether they had ANC during most recent pregnancy, number of ANC visits, gestation at first ANC visit and exposure to maternal health information. Good maternal health knowledge was noted among women with tertiary education, those in the highest income group (100–300 US\$), those who had ANC visits during pregnancy, those who attended their first ANC visit in the first trimester of pregnancy, those who had at least four ANC follow-up visits before delivery and those who were exposed to maternal health information. In addition, good knowledge was significantly more likely among women whose husbands had tertiary level education.

Table 2. Percentages of study women with correct maternal health knowledge, *N*=400

Question and correct answer	Women giving correct answer <i>n</i> (%)
Antenatal health care	
1. Do all pregnant women need to attend ANC?	
Yes	340 (85.0)
2. How many times should pregnant woman visit ANC?	
More than 4 times	66 (16.5)
3. At what gestational age should pregnant woman start ANC?	
First trimester	157 (39.3)
4. What are the important food nutrients for pregnant mothers?	
Protein	309 (77.3)
Fat	98 (24.5)
Carbohydrate	125 (31.3)
Vitamins	303 (75.8)
Minerals	140 (35.0)
5. At which stage of pregnancy is fetal deformity most likely to happen?	
First trimester	242 (60.5)
6. Which food supplement plays a key role in the fetus's brain growth?	
Folic acid	99 (24.8)
7. Which of these physical examinations are important during pregnancy?	
Weight and blood pressure examination	259 (64.8)
Blood test	280 (70.0)
Urine test	248 (62.0)
Ultrasound screening	111 (27.8)
8. How often should the pregnant women have physical examinations?	
Regularly	33 (8.3)
9. Which of these symptoms are danger signs in pregnancy?	
Vaginal bleeding	368 (92.0)
Excessive dizziness and vomiting	123 (30.8)
Swelling of face or feet	182 (45.5)
Abdominal pain	97 (24.3)
Intermittent headache	86 (21.5)
Fever	128 (32.0)
Hypertension	196 (49.0)
Contraction of the uterus	251 (62.8)
Blurred vision	101 (25.3)
Dysuria	114 (28.5)

(Continued)

Table 2. (Continued)

Question and correct answer	Women giving correct answer n (%)
Rupture of membranes	153 (38.3)
10. Which of these symptoms require a visit to the health centre?	
Vaginal bleeding	358 (89.5)
Excessive dizziness and vomiting	96 (24.2)
Swelling of face or feet	150 (37.8)
Abdominal pain	150 (37.8)
Intermittent headache	89 (22.4)
Fever	146 (36.8)
Hypertension	180 (45.3)
Contraction of the uterus	258 (64.5)
Blurred vision	105 (26.4)
Dysuria	123 (30.8)
Rupture of membranes	148 (37.0)
11. Is it important to examine fetal movement every day in the last stage of pregnancy?	
Yes	8 (2.0)
Postnatal health care	
12. How many times should mothers visit the health care centre after a normal delivery?	
On day 3, between (7–14 days) and in sixth week (after 42 days)	35 (8.8)
13. How should the mother care for the neonate's umbilical cord stump?	
Clean it with ethanol and leave to dry	149 (37.2)
14. How should mothers keep their babies warm?	
Skin-to-skin contact (Kangaroo method)	5 (1.3)
Warm clothes and keeping the baby close to mother	224 (56.0)
Warm clothes or keeping the baby close to mother	170 (42.5)
15. What is the appropriate interval between the first and the second pregnancy?	
At least 2 years	264 (66.0)
According to method of first delivery and postpartum condition of mother (depending on doctor's suggestion)	35 (8.8)
Neonatal health care	
16. What should mothers feed their newborns in the first 6 months?	
Only breast milk	128 (32.1)
17. When should be the first breastfeed of the baby?	
First hour of delivery	354 (88.7)
18. What is the main reason for vaccination?	
To prevent diseases	258 (64.5)
19. Name at least 4 vaccines for children or pregnant women ^c	

(Continued)

Table 2. (Continued)

Question and correct answer	Women giving correct answer <i>n</i> (%)
Tdap	40 (10.0)
Hepatitis A or B	65 (16.3)
MMR	43 (10.8)
BCG	23 (5.8)
OPV	40 (10.0)
20. When should a mother take her baby to hospital?	
Baby not able to drink or breastfeed	354 (88.5)
Baby develops a fever	339 (84.8)
Baby has fast breathing	168 (42.0)
Baby has diarrhoea	174 (43.5)
Baby has icterus (jaundice)	142 (35.5)
Umbilical redness and swelling	86 (21.5)

^cBCG: Bacillus Calmette-Guerin; MMR: Measles, Mumps and Rubella; OPV: Oral Poliovirus Vaccines; Tdap: Tetanus, diphtheria and pertussis.

Attitude of respondents towards maternal health

Table 4 shows women's attitudes towards maternal health care. The maximum attitude score was 57. Women's average attitude score was 45.6 ± 7.73 (range 21–57, median 46), indicating that the majority agreed with most of the questionnaire statements. The exceptions were those related to early ANC attendance, managing dietary regime and weight during pregnancy, delivery at a health facility, that delivering at health facilities minimizes delivery complications, PNC visits, cord care and children's and self-health management. For example, 265 mothers (66.3%) agreed that ANC visits during pregnancy are essential for all pregnant women. Likewise, 283 (70.8%) and 300 (75%) of mothers, respectively, agreed that all pregnant women needed to know about danger signs during pregnancy and that early breastfeeding enhances infant immunity. However, only 39.8% of mothers agreed that they would keep their baby's umbilical cord stump clean and dry, and only 18.3% agreed that mothers needed to have a PNC visit after birth, even if they didn't experience any complications after birth. The interesting finding here is that although 164 women (41%) agreed that delivering at health facilities minimizes delivery complications, only 32.5% agreed they would deliver their next child at a health facility; 25.5% were neutral, and 42% disagreed. Using the average score as a cut-off point, the findings showed that 61.8% of the women (CI: 57.3–66.5) had a positive attitude towards maternal health.

Independent factors associated with good knowledge on maternal health

A multivariable logistic regression analysis was applied to identify the independent factors associated with good knowledge on maternal health among the women (Table 5). The following groups had lower odds of good knowledge on maternal health: women with primary level education (aOR=0.149, 95% CI: 0.035–0.625), women whose husbands received no formal education (aOR=0.211, 95% CI: 0.054–0.821), women who made their first ANC visit in the second and the third trimester of pregnancy (aOR=0.107, 95% CI: 0.045–0.254 and aOR=0.272, 95% CI: 0.078–0.952, respectively) and women who made less than 4 ANC visits (aOR=0.259, 95% CI: 0.100–0.671). However, women in the income group 80–100 US\$ were more likely to have good knowledge compared with those in the income group 40–59 US\$ (aOR=3.653, 95% CI:

Table 3. Women's maternal health knowledge by demographic, economic and obstetric characteristics (*N*=400 unless stated)

Characteristic	<i>n</i>	Poor knowledge <i>n</i> (%)	Good knowledge <i>n</i> (%)	<i>p</i> -value
Age (years)				0.377
15–19	37	19 (51.4)	18 (48.6)	
20–24	82	44 (53.7)	38 (46.3)	
25–29	118	73 (61.9)	45 (38.1)	
30–34	93	53 (57.0)	40 (43.0)	
35–39	48	21 (43.8)	27 (56.2)	
40>	22	11 (50.0)	11 (50.0)	
Marital status				0.962
Married	389	215 (55.3)	174 (44.7)	
Divorced/widowed	11	6 (54.5)	5 (45.5)	
Number of children				0.234
1	110	55 (50.0)	55 (50.0)	
2	74	37 (50.0)	37 (50.0)	
3	76	43 (56.6)	33 (43.4)	
4 or more	140	86 (61.4)	54 (38.6)	
Mother's education				<0.001
No education	170	102 (60.0)	68 (40.0)	
Primary	70	47 (67.1)	23 (32.9)	
Secondary	107	57 (53.3)	50 (46.7)	
Tertiary and above	53	15 (28.3)	38 (71.7)	
Husband's education (<i>N</i> =389)				<0.001
No education	89	66 (74.2)	23 (25.8)	
Primary	88	50 (56.8)	38 (43.2)	
Secondary	122	66 (54.1)	56 (45.9)	
Tertiary and above	90	33 (36.7)	57 (63.3)	
Mother's employment				0.346
Unemployed	351	197 (56.1)	154 (43.9)	
Employed	49	24 (49.0)	25 (51.0)	
Husband's employment (<i>N</i> =389)				0.365
Unemployed	90	46 (51.1)	44 (48.9)	
Employed	299	169 (56.5)	130 (43.5)	
Household monthly income (US\$) (<i>N</i> =316)				0.003
40–59	84	57 (67.9)	27 (32.1)	
60–79	97	63 (64.9)	34 (35.1)	
80–99	107	53 (49.5)	54 (50.5)	

(Continued)

Table 3. (Continued)

Characteristic	<i>n</i>	Poor knowledge <i>n</i> (%)	Good knowledge <i>n</i> (%)	<i>p</i> -value
100–300	28	10 (35.7)	18 (64.3)	
ANC in most recent pregnancy				0.029
No	104	67 (64.4)	37 (35.6)	
Yes	296	154 (52.0)	142 (48.0)	
Number of ANC visits (<i>N</i> =296)				<0.001
<4	228	134 (58.8)	94 (41.2)	
4	68	20 (29.4)	48 (70.6)	
Gestation at first ANC (<i>N</i> =293)				<0.001
First trimester	122	30 (24.6)	92 (75.4)	
Second trimester	138	100 (72.5)	38 (27.5)	
Third trimester	33	23 (69.7)	10 (30.3)	
Exposed to information				0.048
No	40	28 (70.0)	12 (30.0)	
Yes	360	193 (53.6)	167 (46.4)	

1.470–9.079), as were women who had one child compared with women who had four or more children (aOR=3.921, 95% CI: 1.049–14.653). Furthermore, women who reported being exposed to information had a higher likelihood of having good knowledge compared with those who were not exposed to information, but this relationship was not statistically significant.

Discussion

Rural Yemeni women's level of knowledge on maternal health varies widely. Only 45% of the study women had good maternal health knowledge, and the women's overall knowledge was lower than reported in other low- and middle-income countries. For instance, a study conducted among women in Sierra Leone reported mean and median knowledge scores of 61.6% and 63.3%, respectively (Kanu *et al.*, 2014). The present study also showed that rural Yemeni women's knowledge was generally low on several health parameters, including danger signs during pregnancy and newborn care. This finding broadly corroborates those of a previous study conducted in three governorates of Yemen (Sana'a, Taiz and Ibb), which showed that knowledge of young adults on reproductive health, including family planning, was low to moderate (Masood & Alsonini, 2017). More specifically, a study in Sana'a city found that 60% of participants were unaware of any of the danger signs during pregnancy (Seham *et al.*, 2017).

A vast literature shows that health workers are a good source of health information on maternal health during ANC and PNC (Senarath *et al.*, 2007; Jemberia *et al.*, 2018). The antenatal and postnatal period, therefore, serve as good entry points to providing women with information on maternal health, including danger signs during pregnancy, the importance of ANC and delivery by a skilled attendant, breastfeeding and care of the newborn. Unfortunately, in some LMICs, health information is not provided to pregnant women during ANC and during PNC after delivery. A study of PNC mothers in sub-Saharan Africa found that information on neonatal danger signs was not provided by health providers to nearly 47% during their ANC visits (Jemberia *et al.*, 2018). Also, a previous study in rural Yemen found that health education and promotion activities in public health facilities were *ad hoc* and coverage was poor, mainly due to inadequate human

Table 4. Attitude of women towards maternal health care (N=400)

Question	Disagree n (%)	Neutral n (%)	Agree n (%)
ANC during pregnancy is essential for all pregnant women	31 (7.8)	104 (26.0)	265 (66.3)
Early ANC attendance reduces women's pregnancy complications during delivery	30 (7.5)	190 (47.5)	180 (45.0)
Pregnant women need vitamin supplements	20 (5.0)	72 (18.0)	308 (77.0)
Iron and folic acid protect pregnant women from anaemia	23 (5.8)	107 (26.8)	270 (67.5)
Pregnant women need to consult a doctor before taking any medicine	26 (6.5)	82 (20.5)	292 (73.0)
Managing dietary regime and weight during pregnancy are important for the mother's and fetus's health	165 (41.3)	90 (22.5)	145 (36.3)
Pregnant women need to know about danger signs during pregnancy	20 (5.0)	97 (24.3)	283 (70.8)
Regular physical examination protects the mother and fetus from unexpected health problems	38 (9.5)	138 (34.5)	224 (56.0)
I will go to see a doctor if there is change in my fetal kick history	27 (6.8)	84 (21.0)	289 (72.3)
I will deliver my next child at a health facility	168 (42.0)	102 (25.5)	130 (32.5)
Delivering at health facilities minimizes delivery complications	133 (33.3)	103 (25.8)	164 (41.0)
I will follow up on my baby's vaccination, and I will monitor my baby's body temperature after vaccination	24 (6.0)	77 (19.3)	299 (74.8)
I will keep my baby's umbilical cord stump clean and dry	89 (22.3)	152 (38.0)	159 (39.8)
I will recommend birth spacing to others to recover pregnancy energy and replenish the mother's body resources	33 (8.3)	123 (30.8)	244 (61.0)
Mothers need to attend PNC after birth, even if they don't experience any complications	215 (53.8)	112 (28.0)	73 (18.3)
Breast milk is rich in nutrients	72 (18.0)	79 (19.8)	249 (62.3)
Early breastfeeding enhances infant immunity	33 (8.3)	67 (16.8)	300 (75.0)
Exposure to health information like mass media, health campaigns, increase mothers' health knowledge	6 (1.5)	91 (22.8)	303 (75.8)
I am ready to protect myself and my neonate from complications and diseases	150 (37.5)	63 (15.8)	187 (46.8)

resources and related workload, as well as poor government funding for health promotion activities (Hyzam *et al.*, 2020). The poor delivery of health information by public health facilities in Yemen may have played an important role in the low knowledge of women on maternal health topics found in this study.

Regarding the attitude of respondents towards maternal health, the study found that the majority of participants agreed with most of the questionnaire statements, except for areas relating to

Table 5. Independent factors associated with women's good knowledge on maternal health

Characteristic	aOR	95% CI	<i>p</i> -value
Age (years)			
15–19 (Ref.)			
20–24	0.916	0.274–3.058	0.886
25–29	0.544	0.142–2.082	0.374
30–34	0.240	0.053–1.083	0.063
35–39	2.332	0.282–19.296	0.432
40>	3.116	0.352–27.592	0.307
Number of children			
1	3.921	1.049–14.653	0.042
2	2.643	0.753–9.270	0.129
3	2.191	0.701–6.854	0.178
4 or more (Ref.)			
Mother's education			
No education	0.292	0.079–1.078	0.065
Primary	0.149	0.035–0.625	0.009
Secondary	0.331	0.100–1.090	0.069
Tertiary and above (Ref.)			
Husband's education			
No education	0.211	0.054–0.821	0.025
Primary	0.663	0.223–1.975	0.460
Secondary	0.532	0.281–2.971	0.219
Tertiary and above (Ref.)			
Mother's employment			
Unemployed (Ref.)			
Employed	0.914	0.281–2.971	0.881
Husband's employment			
Unemployed (Ref.)			
Employed	0.787	0.261–2.374	0.671
Household monthly income (US\$)			
40–59 (Ref.)			
60–79	1.005	0.402–2.513	0.991
80–99	3.653	1.470–9.079	0.005
100–300	3.161	0.787–12.696	0.105
Number of ANC visits			
<4	0.259	0.100–0.671	0.005
4 (Ref.)			

(Continued)

Table 5. (Continued)

Characteristic	aOR	95% CI	p-value
Gestation at first ANC			
First trimester (Ref.)			
Second trimester	0.107	0.045–0.254	<0.001
Third trimester	0.272	0.078–0.952	0.042
Exposed to information			
No (Ref.)			
Yes	2.430	0.580–10.177	0.224

early ANC attendance, managing dietary regime and weight during pregnancy, delivery at a health facility, delivering at health facilities minimize delivery complications, PNC visits, cord care and children's and self-health management. In fact, the interesting finding was that although about 41% of women agreed that delivery in health facilities contributes to averting complications that may arise during labour and delivery, only 32.5% of women agreed that their next child would be delivered at a health facility. A significant 25.5% were undecided whether they would deliver their next child at a health facility or not. This finding may suggest that enhanced knowledge on health may not always lead to positive health behaviour. Nonetheless, the underlying mechanisms associating knowledge with attitude or behaviour are not well understood. Moreover, current perspectives on knowledge–attitude sometimes fail to specify which conditions can be expected to serve as catalysts for greater or lesser roles of knowledge in attitude (Fabrigar *et al.*, 2006). In the case of Yemen, this study hypothesized that perceived poor quality and high cost of health services, lack of female providers and distance to a health facility may be contributing substantially to the phenomenon (Grainger *et al.*, 2017; Hyzam *et al.*, 2020).

The study identified important factors associated with women's knowledge on maternal health. The educational levels of women and their partners were found to be associated with women's knowledge on maternal health, which is consistent with previous reports (Essa *et al.*, 2010; Kanu *et al.*, 2014; Masood & Alsonini, 2017; Jemberia *et al.*, 2018). In addition, compared with women who attained tertiary level educational status, those with primary level education had lower maternal health knowledge. It has also been established that women's years of formal education are associated with health knowledge (Greenaway *et al.*, 2012). Health knowledge has been discussed in the vast literature as the potential mechanism through which education influences the use of maternal health services by women (Titaley *et al.*, 2010; Doku *et al.*, 2012; Sahoo *et al.*, 2015; Aliyu & Dahiru, 2017; Kifle *et al.*, 2017). Previous studies have conceptualized that formal education increases health knowledge through direct exposure to the germ theory and disease categorization or the literacy skills acquired in school (Nayga, 2001; LeVine *et al.*, 2004; LeVine & Rowe, 2009). Bloom *et al.* (2000) documented that men with more years of school were about two times more likely to know two or more maternal morbidity signs compared with less-educated men after controlling for other factors in the model. Also, a study among husbands in Myanmar identified that husband's exposure to maternal health education and their knowledge of maternal health were strong predictors of their involvement in reproductive health issues (Wai *et al.*, 2015). Thus, husbands are more involved in maternal health issues if they have higher maternal health knowledge. Finally, Mullany *et al.* (2009) reported that when women were educated on health topics together with their partners, they learnt and retained the most information, and in addition increased their knowledge score relative when women were educating women. Therefore, it can be postulated that women's knowledge on health issues could be enhanced through their interaction and communication with their educated husbands/partners – a process

often referred to as the ‘information transfer hypothesis’ (Baker *et al.*, 2011). Also, this could in part explain the lower odds of maternal knowledge among women whose husbands had no formal education in this study. Nevertheless, the findings on the positive relationship between higher maternal education and higher maternal health knowledge contradict findings from Sri Lanka by Senarath *et al.* (2007), who found that Sri Lankan women of lower educational level demonstrated poor knowledge on newborn care, although the relationship was not statistically significant.

The present study also demonstrated that gestational age at first ANC registration and number of ANC follow-up visits made before delivery were associated with maternal health knowledge. Late ANC registration, i.e. booking the first visit in the second instead of the first trimester, was associated with poor maternal health knowledge. Health providers are the major source of maternal health information in many rural settings, especially where other information sources are minimal or non-existent. Jemberia *et al.* (2018), in their study in Africa, reported that 53% of mothers had obtained information about neonatal danger signs from health care providers. Similarly, ANC has been identified as the main source of information during the prenatal period. Senarath *et al.* (2007) reported that almost 90% of women in their Sri Lankan study received information on breastfeeding and nutrition during ANC visits. Studies in rural Paraguay reported significant gains in maternal health knowledge among women after their participation in a community-based ANC programme, and that health care personnel contributed significantly to women’s gains in maternal health knowledge (Ohnishi *et al.*, 2005; Kawasaki *et al.*, 2014). These studies’ findings also showed that women who made at least four ANC visits during pregnancy had higher maternal health knowledge, which may be explained by the repeated health education messages during ANC visits. Significant improvement in maternal knowledge was observed among rural women who received ANC at least three times during their pregnancy (Kawasaki *et al.*, 2014).

Although this study found a positive relationship between early ANC booking, making at least four ANC visits and higher maternal knowledge, it is worth noting that in rural Yemen do recognize the need for ANC in the first trimester of pregnancy. However, registering for ANC in the first trimester was associated with perceived need, as indicated by the presence of complications (Hyzam *et al.*, 2020). Also, an association was found between number of children and maternal health knowledge. Further analysis showed that mothers who had one child had more ANC visits during pregnancy than those with two and more children. This could be explained by women who have ANC visits during pregnancy having better knowledge than those who don’t (Kawasaki *et al.*, 2014).

The study found that low household income was related to poor knowledge, which has been supported by a study in Egypt (Essa *et al.*, 2010). Although the actual mechanism through which household income influences maternal health knowledge is not crystal clear, there are several plausible explanations. First, low household income is correlated with low educational level (Blanden & Gregg, 2004; West, 2007; Turčínková & Stávková, 2012). This study found a strong relationship between low maternal education and poor maternal health knowledge. Moreover, a significant number of women did not receive formal education, were unemployed and belonged to a lower household income group. Poor women usually have poor access to education, including health education, due to challenges such as lack of financial resources. Second, the ongoing war in Yemen has affected health promotion through mass media, especially in rural areas (Basaleem, 2012). Therefore, public health facilities appear to be the best option for providing information on maternal health. Unfortunately, these are rarely used by pregnant women for ANC due to the high cost of services, as well as perceived poor quality of service and inadequate critical staff (Hyzam *et al.*, 2020). These factors may have contributed directly or indirectly to rural Yemeni women’s negative attitude towards early ANC attendance, institutional delivery and PNC.

The study had its limitations. First, women’s knowledge on maternal health issues can be influenced by a host of factors working independently or interacting with each other, including those related to the women themselves, their immediate social network, their community of residence

and the health system quality of care. However, not all these factors were included in the study. Furthermore, the study was cross-sectional so causal conclusions could not be drawn. Moreover, the study only included women from two rural cities of Yemen, which were safer for the research due to the ongoing war in Yemen, so the findings may not be applicable to women in urban areas. Nevertheless, the findings provide vital information that can inform decision-making on maternal and child health in conflict-affected countries such as Yemen.

In conclusion, this study found that rural women in a selected area of Yemen have low knowledge on maternal health. However, these women had a positive attitude towards maternal health care, with the exception of early ANC attendance, managing dietary regime and weight during pregnancy, facility delivery, PNC visits, cord care and children's and self-health management. Several important factors were found to be associated with women's good knowledge on maternal health care. Women with less than secondary level education, whose partners received no formal education, who booked their first ANC visit late and women who made fewer than four ANC visits before delivery were more likely to have poor maternal health knowledge. Conversely, women in the higher income group (80–100 US\$) were more likely to have good knowledge compared with women in the lower (40–59 US\$) income group, as were women who had one child compared with women who had four or more children. Health promotion interventions are needed to increase rural women's knowledge on maternal and child health in conflict-affected settings, such as Yemen. In addition, factors such as low maternal education, late booking at ANC and low socioeconomic status have to be addressed in the study setting.

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