Sexual and Reproductive Health Literacy, Misoprostol Knowledge and Use of Medication Abortion in Lagos State, Nigeria: A Mixed Methods Study

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REPORT

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Little is known about the link between health literacy and women's ability to safely and successfully use misoprostol to self-induce an abortion. While abortion is only allowed to save a woman's life in Nigeria, misoprostol is widely available from drug sellers. We interviewed 394 women in 2018 in Lagos State, Nigeria, who induced abortion using misoprostol obtained from a drug seller to determine their sexual and reproductive health literacy (SRHL) and misoprostol knowledge levels; and how these were associated with ending the pregnancy successfully or seeking care for (perceived) complications. Our results show that women's misoprostol knowledge (measured both quantitatively and qualitatively) was low, but that almost all women were nevertheless able to use the drug effectively and safely. Higher SRHL was associated with being more likely to end the pregnancy successfully and also seeking postabortion health care. Our study is the first to examine this association and adds to the scarce literature examining the relationship between health literacy and self-use of misoprostol to induce abortions in restrictive settings.

INTRODUCTION

Health literacy is defined as the ability to "gain access to, understand and use information in ways which promote and maintain good health" (World Health Organisation [WHO] 1998, 10). Health literacy skills are formed by individual and societal level factors (Sørensen et al. 2012; Squiers et al. 2012). Demographic characteristics, socioeconomic position such as education and occupation, and prior knowledge about health, influence health literacy (Squiers

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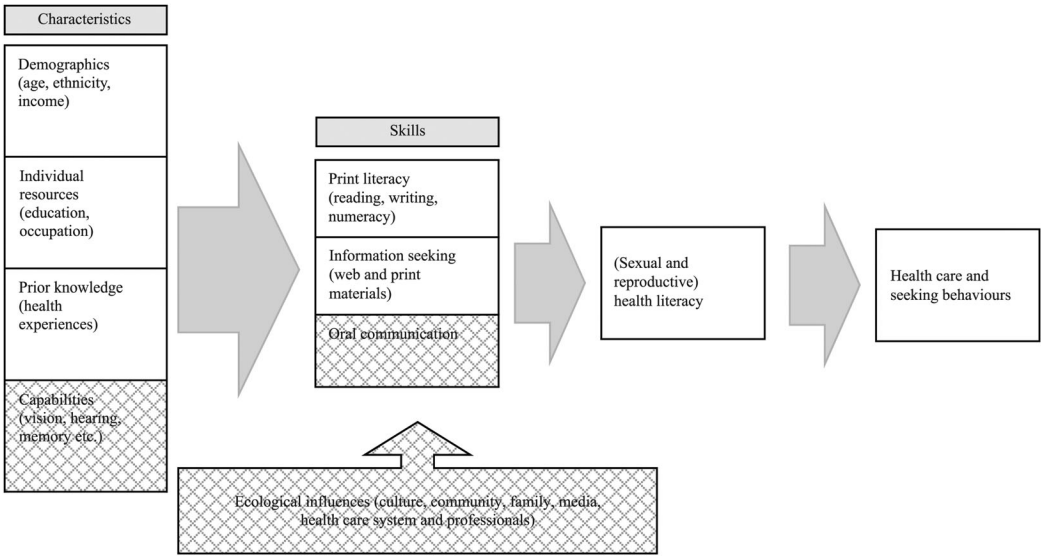
et al. 2012). Health literacy is linked to literacy and numeracy. Both skills facilitate the ability to gather information, understand health messages from the media, communicate with health care professionals, implement treatment regimens, understand and apply health information, and make health decisions (Sørensen et al. 2012; Glewwe 1999; Smith-Greenaway 2013; 2015). However, health literacy is more than just a combination of numeracy, literacy, and word recognition (Mancuso 2009). Health literacy skills range from "functional" (e.g., knowledge about the health system and health risks) to more advanced "interactive" (e.g., confidence to act independently on knowledge) and "critical" health literacy skills (e.g., ability to effectively act for the benefit of the individual and their community) (Nutbeam 2000). Similar to general health literacy, sexual and reproductive health literacy (SRHL) is positively associated with age, educational attainment, and having received sexuality education (Naigaga et al. 2015; Vongxay et al. 2019). According to the WHO (2016), health literacy, including SRHL, is a key mechanism through which health-related sustainable development goals can be obtained.

Health literacy is of particular importance in contexts where health care information and services may be hard to access because of distance, insufficient medical providers, cost or language barriers, or because the health care an individual is seeking is illegal where they live. In such circumstances, the ability to explore options and make appropriate health-related decisions, with no or limited guidance from qualified health care professionals, is influenced by health literacy, potentially reducing mortality and morbidity, for example, due to unsafe abortion.

Misoprostol, used in combination with mifepristone or alone, is recommended by the WHO (2018) for pregnancy termination, with the combination medication having greater efficacy. Self-administered abortion using these medications is recommended up to 12 weeks gestation. Access to misoprostol has been embraced as a harm reduction approach making clandestine abortions safer and more effective, greatly reducing the risk of morbidity and mortality (Hyman et al. 2013; Harvey 2015; Erdman et al. 2018). WHO's inclusion of misoprostol on the model list of essential medicines for the management of postpartum hemorrhage and other obstetric-gynecologic conditions has made the drug available even where abortion is highly restricted (Fernandez et al. 2009; Millard et al. 2015). Many women in these settings are able to access misoprostol for self-induced abortion (Sherris et al. 2005; Footman et al. 2018; Stillman et al. 2020), which can increase women's reproductive autonomy. By deciding to end a pregnancy, they challenge norms around femininity and maternity (Kumar et al. 2009).

Women may not be able to receive adequate professional guidance where abortion is legally restricted and have to rely on their health literacy to use misoprostol effectively. Health literacy relates to an individual's capacity to process and understand health information including how to seek information about the drug. Leaflets available in misoprostol packets in restrictive settings generally do not carry information about how to use the drug as an abortifacient (Reiss et al. 2017; Footman et al. 2018), and some women may not even receive the original packet with the leaflet inside when purchasing the drug. Inadequate knowledge about dosage and route of administration is a major challenge in the use of misoprostol for abortion globally (Footman et al. 2018). However, the increasing number of internet information sites and safe abortion information hotlines around the world have increased access to such information (Dzuba et al. 2013; Drovetta 2015).

FIGURE 1 Conceptual Framework (adapted from Squiers et al. 2012)



NOTE: Patterned fill means we were not able to measure these aspects in our study.

The conceptual framework for this study (Figure 1) was adapted from the Health Literacy Skills Framework by Squiers and colleagues (2012). Demographic characteristics, resources such as education, prior knowledge about health, and capabilities to retain such information influence health literacy skills. Skills such as literacy, information seeking, and oral communication tend to improve health literacy. Literacy and numeracy facilitate the ability to gather information, understand health messages, and implement treatment regimens (Glewwe 1999; Smith-Greenaway 2013; 2015). Oral communication skills help communication with health care professionals (Mancuso 2008; Squiers et al. 2012). Ecological influences are also important for health literacy (Figure 1; Sørensen et al. 2012; Squiers et al. 2012).

Health literacy is in turn associated with the ability to take care of one's health. Some studies have examined a link between health literacy and seeking care. For example, among cancer patients, poor health literacy has been linked with both unnecessary interventions and undertreatment (Koay et al. 2012). Among women in the perinatal period, better mental health literacy was associated with a higher likelihood of seeking help for depressive symptoms (Fonseca et al. 2015). Thus, the link between health literacy and health-seeking behaviors is complex, and the direction of the effect is difficult to predict. No studies have examined the link between health literacy and health-seeking behaviors in the context of misoprostol use in a restrictive setting.

The aim and context of the study

This paper examines women's use of misoprostol for abortion in Lagos State, Nigeria to understand the role of SRHL and knowledge about misoprostol on their ability to safely and effectively self-induce an abortion. We focused on these domains of health literacy, as we presumed knowledge about the reproductive system generally and misoprostol specifically were likely to be the most important domains for our study. To the best of our knowledge, this

is the first study to examine this topic using a sample from a general population of women purchasing misoprostol rather than linked to a specific clinic or a hotline. Thus, our study population did not necessarily receive any formal consultation on how to use the drug making health literacy a potential key factor in using the drug safely and successfully.

We conducted our study in Nigeria for several reasons. It has the largest population in sub-Saharan Africa—200 million in 2019 (United Nations Population Division [UNPD] 2019) including over 250 ethnic groups (The World Factbook 2021). Our research setting of Lagos State in southwest Nigeria includes Lagos, the most populous city in Nigeria and Africa (population of over 13 million in 2018 (UNPD 2018)). The country's abortion law permits abortion only if a pregnancy threatens a woman's life (Center for Reproductive Rights 2019), and abortion is highly stigmatized. In 2012, it was estimated that 14 percent of all pregnancies and over 56 percent of unintended pregnancies end in abortions in Nigeria (Bankole et al. 2015). In 2017, using a different methodology, Nigeria's abortion rate was estimated as 46/1000 women of reproductive age (Bell et al. 2020). Unsafe abortion contributes to Nigeria's high maternal mortality ratio (917 deaths per 100,000 live births in 2017) (WHO 2019). In 2013, around one-fifth of maternal deaths in Western Africa were attributable to unsafe abortion (Kassebaum et al. 2014).

Nigeria was the first country in the world to register misoprostol for managing postpartum hemorrhage in 2006 (Jadesimi and Okonofua 2006; Campbell and Holden 2006). The awareness of misoprostol as an abortifacient has increased among Nigerian women over time (Okonofua et al. 2014; Oyeniran et al. 2019). Misoprostol is widely available at pharmacies and other drug stores over-the-counter (Bello et al. 2018). In Nigeria, informal drug sellers are often used as the first point of health care, including for abortion, although their knowledge of correct use of misoprostol for abortion is often poor (Beyeler et al. 2015; Footman et al. 2018; Reiss et al. 2017; Stillman et al. 2020).

There are very few studies on health literacy in Nigeria. One study showed low levels of general health literacy (Adekoya-Cole et al. 2015). Few studies have considered specific domains of health literacy. One study found low levels of mental health literacy among young people in a university (Aluh et al. 2019), and another low levels of health literacy concerning cancer (Adedimeji et al. 2017). Neither study linked these health literacy levels to health behaviors.

Our primary research questions were (1) What are the levels of SRHL and misoprostol knowledge of women using misoprostol to induce abortion? (2) To what extent are SRHL and misoprostol knowledge associated with women's ability to complete their abortions? And (3) is SRHL associated with whether women will seek care after their abortion? Overall, this study fills an important research gap in examining how SRHL is related to successfully and safely using misoprostol to terminate a pregnancy in a low-resource and restrictive abortion setting.

METHODS

Data Collection

Data for this study were collected in six purposively selected urban and rural local government areas (LGAs) in Lagos State. We selected the LGAs based on their geographical location

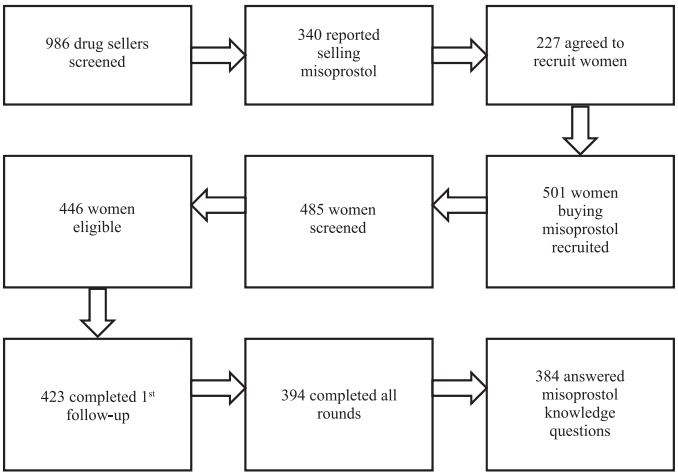
and included many that were close to universities to increase our chances of capturing drug sellers operating in areas with young populations, who might be more likely to seek pregnancy termination. Mapping was conducted to identify the universe of drug sellers (we jointly refer to pharmacies and proprietary and patent medicine vendors (PPMVs) as "drug sellers" in this paper) in the selected LGAs. Drug sellers who reported selling misoprostol were requested over a period of two months to attempt to recruit everyone who purchased the medicine into the study. Those recruited received a "burner" cell phone from the drug seller (supplied by the study team) on which all communication for the study took place.

A screening interview was conducted over the phone one to two days after the purchase of any misoprostol-containing drug, to explain the study, obtain the woman's consent to participate in the study, screen her for eligibility, and test her literacy skills. All women aged 18–49 who obtained misoprostol to terminate a pregnancy were eligible for participation. Our study design included two follow-up telephone interviews. The first follow-up interview took place 5–7 days after screening to learn about women's experiences in purchasing and using the drug. The second follow-up interview was conducted three weeks later to obtain their demographic characteristics; assess misoprostol knowledge, SRHL, and numeracy; their sources of information about the drug; whether they sought further health care after taking misoprostol; and women's assessment of the completion of their abortions. Consent for follow-up interviews was obtained at the end of the screener and at the time of each interview. Women's identities were confirmed over the three waves using a unique identification number, age, and nicknames provided by the women.

Data were collected between April and September 2018 by fieldworkers trained by the study team in sensitive interviewing techniques, using the mobile data collection application SurveyCTO version 2.40 (Cambridge, MA and Washington, DC) on password-protected and encrypted Android tablets. Data were stored on a secure server accessible only to the research team. All data collection took place in English or Yoruba (the native language in southwest Nigeria). The English research instrument was translated into Yoruba and then backtranslated into English by university-based linguistic experts. This study was a collaboration between the Guttmacher Institute, the University of Southampton, and a consortium of two Nigerian research organizations, the Academy for Health Development (AHEAD) and the Centre for Research, Evaluation Resources and Development (CRERD). The National Health Research Ethics Committee Nigeria, the institutional review board of Guttmacher Institute, and the ethics board at the University of Southampton approved the study. The study conducted in Nigeria was part of a larger study conducted also in Colombia and Indonesia investigating misoprostol access and use in the informal sector.

The participant recruitment strategy in our study has been detailed by Stillman et al. (2020). In brief, we approached all 340 drug sellers who reported selling misoprostol within our study LGAs; 227 of them agreed to recruit participants for our study. Overall, 501 women were recruited into the study. 485 women were successfully screened, 446 were eligible to participate. 423 women completed the first follow-up interview and 394 women (88 percent of all eligible women) completed all rounds of the survey. Ten women did not answer any of the misoprostol knowledge questions and were excluded from this study. Hence, our analytic sample includes the 384 women who answered at least one misoprostol knowledge question (see Figure 2).

FIGURE 2 Data collection and analytic sample selection flowchart



SOURCE: Nigeria misoprostol study 2018.

Variables

Our outcome variables include *ending the pregnancy successfully* and *seeking health care after the abortion.* The first variable is based on the question, "Now I would like to ask you about your experience confirming that you are no longer pregnant or that your period has returned. Do you think you are still pregnant?" (yes/no)[1]. The second is based on the question, "Did you go to seek care at a health facility or with a medical provider for any reason after taking the medicine?" (yes/no) followed by an open-ended question about the main reason for seeking care.

We assessed women's knowledge of the fertile period during the menstrual cycle via two questions, adopted from the Nigeria Demographic and Health Survey 2013 as a proxy for *SRHL*. No standardized validated tool for measuring SRHL exists, and there are many dimensions to SRHL, but given the cognitive load of the interviews, we chose knowledge of the fertile period as the most feasible and relevant point to assess. During the second follow-up interview, we asked if the participants thought that there were certain days, from one menstrual period to the next, when a woman is more likely to become pregnant. If they responded "yes," they were asked if these days are just before her period begins, during her period, right after her period has ended, or halfway between two periods. Those who answered "yes" to the first question and "halfway between two periods" to the second, were considered to have high SRHL (see Table 1).

1 We asked women how they knew they were no longer pregnant allowing them to report more than one method. Out of the 367 women who were no longer pregnant, 53% ($n = 195$) used a pregnancy test to confirm; 67% ($n = 245$) knew based on their period having returned, having passed products of conception or pregnancy symptoms having ended; 2% ($n = 7$) had an evacuation at a facility; and 1% ($n = 3$) reported "other" reason. Almost 40% of these women ($n = 145$) used more than one method to ensure they were no longer pregnant. The method of confirming that the pregnancy ended was not associated with SRHL or misoprostol knowledge. We did not analyze these data further, as previous studies have shown that women's self-reports of their pregnancy status are reliable (Strote and Chen 2006), and thus we made the assumption that the binary question about whether they thought they are still pregnant provided reliable information about the completeness of their abortion.

TABLE 1 Variables measuring literacy, numeracy, SRHL, and misoprostol knowledge

Measure	Questions	Scoring
SRHL	Q1. Are there days, from one menstrual period to the next, when a woman is more likely to become pregnant? Yes/No Q2. [If 'yes'] Are these days just before the period begins, during the period, right after the period has ended, or halfway between two periods?	Coded: 1 if the respondent has 'high SRHL', 0 otherwise. Respondents classified as having 'high SRHL' if answered 'yes' to Q1 and 'halfway between two periods' to Q2.
Quantitative Misoprostol knowledge	Q1. How long after conception can misoprostol be used to end a pregnancy?	One point given, if answer between 9 and 28 weeks of gestation
	Q2. How many times a year it is possible to use this medicine?	One point given, if answer at or above 3 times a year.
	Q3. How soon after using the drug a woman's period returns?	One point given, if answer between 3 and 6 weeks after using the medicine.
	Q4. How soon can one become pregnant again after using the drug?	One point given, if answered 'immediately' or 'when ovulation returns'.
	Total:	Overall misoprostol knowledge score range 0 to 4.
Qualitative Misoprostol knowledge	Please tell me what you think is [physiologically] the process that happens inside your body to make this medicine end a pregnancy. I am not talking about symptoms or side effects you may experience, but want to know about the drug's mechanisms.	No scoring as such, answers analyzed using qualitative thematic analysis.
Literacy	Q1. Which of the following sentences correctly describes what is happening in [Online Appendix Figure 1]? (1) The woman is working in the field. (2) The men are farming. (3) The women are walking to the market. (4) The woman is washing her clothes. (5) The woman is selling groundnuts in the market. Q2. Please read out loud the sentence you picked [if no sentence chosen, please read out loud the first sentence].	The correct answer to Q1 is the first sentence. Women were classified as having a good literacy level if they picked the right sentence in Q1 and were able to read all the words in Q2; otherwise, they were classified as not having a good literacy level.
Numeracy	Q1. Imagine you were going to buy a raffle ticket and you had three different raffles to choose from. In the first raffle, 1 out of every 100 people wins. In the second raffle, 1 out of every 1000 people wins. In the third raffle, 1 out of every 10 people wins. In which raffle would you have the best chance of winning?	One point given if answered 'the raffle where 1 out of 10 people wins'.
	Q2. Imagine that 10 men and 20 women put their names on little pieces of paper and put them in a hat. If the papers were all mixed up, and you picked a name out of the hat without looking, do you think it would more likely to be the name of a woman or a man?	One point given if answered 'the name of a woman'.
	Q3. Imagine that you play a raffle where 5 out of 10 people win a prize (50% chance of winning). Do you think it is more likely that you'll win than you'll lose, less likely you'll win than you'll lose, or equally likely to win or lose this raffle?	One point given if answered 'equally likely to win or lose this raffle'.
	Q4. Ayomide is hoping to win a lottery. The chance of winning is 15 out of 100. If 1000 people play the lottery, about how many would be expected to win?	One point given if answered '150 would be expected to win'.
	Total:	Numeracy score range 0 to 4.

SOURCE: Nigeria Misoprostol study 2018.

Misoprostol knowledge was measured using four questions[2] developed by the study team (see Table 1). The correct answers were determined based on the literature on misoprostol.

2 We do not know of any sets of misoprostol knowledge questions that have been validated, and so we were identifying questions we believe are relevant to the woman's correct use of misoprostol. The rationale and intended behind each question is as follows:Q1. How long after conception can misoprostol be used to end a pregnancy?: We wanted to examine what women thought was the safe gestational period in which they could take this drug to end a pregnancy. It is important that women know the safe period in which they can induce an abortion using misoprostol.Q2. How many times a year is it possible to use this medicine?: The purpose of this question is to gauge whether women know that they can use this medicine as often as they need to end a pregnancy, as women who think they cannot use this medicine as often as they need to, might turn to other less safe methods to end a pregnancy after having used misoprostol to end an earlier pregnancy.Q3. How soon after using the drug a woman's period returns?: This question measures women's understanding of how misoprostol works in the body. We wanted to know, whether women know that the bleeding induced by misoprostol is not the same thing as having a period. This is particularly interesting in a context, where "bringing back the period" is a commonly used euphemism

The correct answer to question 1 was classified as 9–28 weeks of gestation based on WHO's (2018) recommendations about misoprostol use. There are no known clinical reasons to limit the number of times a woman can use misoprostol each year for this purpose, so we classified answers at or above three times a year to question 2 as correct. It typically takes 3–6 weeks for a woman's menstrual period to return after a medication abortion (see, e.g., British Pregnancy Advisory Service 2020), which is the correct answer to question 3. Since some women can ovulate only a few days after taking this medication (Schreiber et al. 2011), we classified 'immediately' or 'as soon as ovulation returns' as correct answers to question 4. Each correct answer contributed one point to the misoprostol knowledge score; each incorrect or missing answer did not contribute any points.

We also asked an open-ended question about how women think misoprostol works in their body to end the pregnancy to assess how they conceptualize the process (see Table 1). Giving space for women to explain their understanding of misoprostol provides enhanced ethnophysiological (i.e., lay representations of reproductive physiology) (Poth 2018) explanation of their misoprostol knowledge. Women's answers to the question were written verbatim by the fieldworkers and for those who spoke in Yoruba, the interviewers simultaneously translated their answers into English.

Our *literacy* measurement tool was adapted from Smith-Greenaway (2015), who developed this tool for a Malawian context designed to assess elementary-level reading and comprehension. It assessed two dimensions: (1) How well women could select the right description of a pictorial scene based on a sentence describing the scene; and (2) how well women could read a written sentence. To measure the first dimension, when women were recruited to the study by the drug seller, they were given a piece of paper with a picture of a woman working in a field on one side and five sentences in Yoruba and English written on the other side (see Online Appendix Figure 1 and Table 1). The first sentence described the scene correctly (i.e., "The woman is working in the field"), and the four other sentences did not. Women were first asked to pick the sentence that accurately represented what was happening in the picture, and then they were asked to read that sentence aloud. The interviewers recorded whether the women could read every word or only some/none of the words. Women who did not respond to the first question, or said they did not know, were still asked to read the first sentence. This measure was used rather than educational attainment or self-report of literacy skills, as the former does not often reliably measure literacy skills in many low and middle-income countries and the latter tends to result in overreporting of literacy skills (Smith-Greenaway 2015).

Our *numeracy* tool was based on measures used by the Umoyo wa Thanzi (UTHA), Health for Life research project (https://u.osu.edu/utha/). The study team developed the tool based on numeracy tests used and validated in the United States (e.g., Weller et al. 2013) adapting it to the Malawian context (see Norris et al. 2017). It consisted of four multiple-choice questions assessing the ability to interpret numbers, probabilities, and risk. The questions and the correct answers are listed in Table 1.

for abortion.Q4. How soon can one become pregnant again after using the drug?: The purpose of this question was to test whether women know that they can become pregnant again very soon after taking this drug so that they may avoid unwanted pregnancies with whatever means they have in their disposal after using the drug.

In addition, we measured a range of other sociodemographic factors including age, marital status, place of residence (city, suburb/outskirts, or town/village), educational level, previous abortions, and the number of children. We also asked women how many sources of information they used to find out information about misoprostol (and what these sources were) thus using the number of sources used as an indicator of information-seeking behaviors.

Analytic Strategy

We first describe the levels of misoprostol knowledge and SRHL in our sample by showing how many respondents knew the right answers. We also examine whether SRHL and misoprostol knowledge are associated with being able to use misoprostol successfully and the likelihood of seeking care after the abortion. We study this both with descriptive statistics and in multivariate binary logistic regression models which follow our conceptual framework (Figure 1) and thus control for *demographics* (marital status, and place of residence); *resources* (education); *prior sexual and reproductive health experiences* (previous abortions and births); and *other skills* (seeking information about misoprostol, literacy, and numeracy). We retain variables in the model if their p-value is smaller than 0.10, which we interpret as suggesting there might be a meaningful association between the variables even though our p-values cannot be interpreted as signifying an association in the population due to the purposive sampling design. We retain the SRHL/misoprostol literacy variables in the models regardless of their statistical significance, as well as women's age, as age is one of the key variables controlled for in most demographic analyses because of its correlation with many other unmeasured factors.

The open-ended questions about how misoprostol works in the body were analyzed using thematic analysis by one of the co-authors (AMM) in Excel. The analysis consisted of reading through all of the responses and identifying whether these described symptoms, mechanisms, both, or the respondent answered that she did not know how misoprostol worked. (A small number of responses were unintelligible.) Then all of the responses describing symptoms were further analyzed to identify common symptoms named by the respondents, with some responses capturing more than one symptom.

Results

Characteristics of the Sample

Ninety-six percent of women reported they successfully ended the pregnancy, and 6 percent sought postabortion care from a health facility. On the SRHL question, half of the women (52 percent) correctly knew the most fertile time of the month. Women's knowledge of misoprostol was relatively low. Almost 22 percent of women did not answer any of the questions correctly. Around half of the women answered one question correctly, and 29 percent answered two to three correctly. One woman got all four questions right. The most well-known aspect of misoprostol knowledge was how soon a woman's period returns after using the drug (65 percent). The other three questions were answered correctly by 12–20 percent of respondents. Most women (77 percent) sought information about misoprostol from one source only

TABLE 2 The sociodemographic characteristics of women in the sample and their misoprostol knowledge, percentage, *n*, total *N* = 384

	Percentage	*N*	*N* missing
Abortion outcomes			
Pregnancy has ended	95.6	367	5
Sought care from a health facility	6.0	23	0
SRH literacy			
Did not know the most fertile time	47.9	162	46
Knew the most fertile time	52.1	176	
Misoprostol knowledge, correct answers[a]			
Gestational period misoprostol can be used (9-28 weeks)	20.1	77	N/A
Times misoprostol can be used per year (3 or more)	12.5	48	N/A
How soon period returns (3-6 weeks)	65.1	250	N/A
How soon can become pregnant again (immediately)	16.4	63	N/A
Misoprostol knowledge score[a]			
0 correct	21.9	84	N/A
1 correct	48.2	185	N/A
2 correct	24.2	93	N/A
3 correct	5.5	21	N/A
4 correct	0.3	1	N/A
Number of sources sought information from			
No sources used	9.6	37	0
One source used	77.3	297	
2 or more sources used	13.0	50	
Literacy			
Read no or some words	26.5	90	45
Read every word	73.5	250	
Numeracy			
Got 0–2 right	29.8	90	82
Got 3–4 right	70.2	212	
Age			
18–24 years	22.9	88	0
25–29 years	32.0	123	
30–34 years	22.9	88	
35 or older	22.1	85	
Marital status			
Not married or cohabiting	49.5	190	0
Married or cohabiting	50.5	194	
Place of residence			
City	56.8	218	0
Suburb/outskirts	25.5	98	
Town/village	17.7	68	
Education			
Up to lower secondary	8.4	32	2
Secondary	54.2	207	
Some tertiary	20.4	78	
Completed tertiary	17.0	65	
Previous abortion(s)			
Yes	15.9	61	0
No	84.1	323	
Parity			
No children	19.5	75	160
1 child	10.4	40	
2 children	11.5	44	
3 children	9.9	38	
4 or more children	7.0	27	

NOTES: [a]Answer counted as incorrect, if the woman skipped the question, but answered (some of) the other misoprostol knowledge questions.N/A = not applicable.
SOURCE: Nigeria Misoprostol study 2018.

(Table 2), the most common source being the drug seller (not shown). The respondents had relatively high literacy and numeracy levels, with over 70 percent of them being able to read the example sentence correctly and answering at least three out of four numeracy questions right (Table 2).

In terms of socio-demographic characteristics, most of the sample was under the age of 30 (54.9 percent) and lived in a city (56.8 percent), half were married or cohabiting

(50.5 percent), and less than a tenth (8.4 percent) did not complete secondary education. Sixteen percent of the sample reported having experienced at least one abortion before the index abortion for which they were purchasing misoprostol. Around 40 percent of the women had at least one child, but due to a data collection error, this information was missing for 42 percent of the sample (Table 2).

Characteristics Associated with Abortion Completion and Seeking Care for Complications

Misoprostol knowledge was not associated with being able to terminate the pregnancy successfully or seeking help from a health care facility, whereas high SRHL was associated with a lower percentage of women still pregnant after using the drug and a higher percentage of women seeking care after the abortion (Table 3). None of the sociodemographic characteristics, numeracy, literacy, or information-seeking behavior were associated with the two outcomes.

We conducted regression models testing the associations between misoprostol knowledge and (a) ending the current pregnancy successfully and (b) seeking postabortion care from a health facility but found no associations (Online Appendix Table 1). While the odds ratios suggest there might be a negative relationship between better misoprostol knowledge and being able to end the pregnancy successfully and a positive relationship with seeking care after the abortion, there is a lot of uncertainty in the estimates as demonstrated by the large standard errors (SEs). The 95 percent confidence intervals around these two odds ratios ($OR_{\text{pregnancy ended}}$=0.64, CI (0.17–2.39); $OR_{\text{sought care}}$=1.40 CI (0.52–3.75), not shown) demonstrate the association could be negative, positive, or nonexistent and thus will not be discussed further.

However, high SRHL was associated with almost seven times the odds of ending the pregnancy successfully compared to low SRHL, and 2.5 times the odds of seeking care for abortion complications (Table 4), when controlling for age (in both models, not significant in either) and for a number of information sources used (model a, Table 4) or for a place of residence (model b, Table 4). Yet, absolute differences between groups were quite small, as illustrated by predicted probabilities by SRHL (keeping other variables as observed): women with low SRHL had a 93.8 percent probability of ending the pregnancy successfully, compared to 99.0 percent among those with high SRHL. Those with low SRHL had a 3.1 percent probability of seeking care after the abortion, whereas those with high SRHL had a 7.5 percent probability (not shown). No associations between the other explanatory variables and either outcome were found.

In order to better understand women's motivations to seek care after the abortion, we analyzed an open-ended question "What was the main reason you decided to seek care?" for the 23 women who sought care. We grouped the responses into four categories: potential complications (women reporting excessive bleeding or pain, or fear of dying, $N = 6$); a checkup (women reporting wanting to know "everything was okay," wanting to make sure the pregnancy had ended, or going for "a general checkup," $N = 12$); to complete the abortion (women mentioning an evacuation, $N = 4$); and other (one woman reporting going for an "antigen injection"). The numbers are too small to make any definitive conclusions, but among those

TABLE 3 Associations between misoprostol knowledge, SRHL, and abortion outcomes, percentage (*N*), total *N* = 384

	Pregnancy terminated, %	*N*	Sought care, %	*N*
Misoprostol knowledge (*p*-value)	($p = 0.803$)		($p = 0.602$)	
0-1 correct	97.0	257	5.6	15
2-3 correct	96.5	110	7.0	8
SRH literacy (*p*-value)	($p = 0.019$)		($p = 0.079$)	
Did not know the most fertile time	94.3	148	3.1	5
Knew the most fertile time	98.9	174	7.4	13
Literacy (*p*-value)	($p = 0.222$)		($p = 0.277$)	
Read no or some words	94.4	84	3.3	3
Read every word	97.2	241	6.4	16
Numeracy (*p*-value)	($p = 0.764$)		($p = 0.847$)	
Got 0–2 right	96.5	83	5.6	5
Got 3–4 right	97.2	206	6.1	13
Number of sources sought information from (*p*-value)	($p = 0.307$)		($p = 0.384$)	
No sources used	94.4	34	10.8	4
One source used	96.6	283	5.7	17
2 or more sources used	100.0	50	4.0	2
Age (*p*-value)	($p = 0.643$)		($p = 0.265$)	
18–24 years	95.3	85	6.8	6
25–29 years	98.4	123	8.9	11
30–34 years	96.5	86	3.4	3
35 or older	96.5	85	3.5	3
Marital status (*p*-value)	($p = 0.978$)		($p = 0.553$)	
Not married or cohabiting	96.8	188	5.3	10
Married or cohabiting	96.9	191	6.7	13
Place of residence (*p*-value)	($p = 0.620$)		($p = 0.125$)	
City	96.7	215	4.6	10
Suburb/outskirts	95.8	96	10.2	10
Town/village	98.5	68	4.4	3
Education (*p*-value)	($p = 0.231$)		($p = 0.197$)	
Up to lower secondary	100.0	31	6.3	2
Secondary	95.6	194	3.9	8
Some tertiary	96.2	75	7.7	6
Completed tertiary	100.0	65	10.8	7
Previous abortion(s) (*p*-value)	($p = 0.956$)		($p = 0.331$)	
Yes	96.7	59	6.5	21
No	96.9	308	3.3	2
Parity (*p*-value)	($p = 0.286$)		($p = 0.217$)	
No children	93.2	68	4.0	3
1 child	100.0	38	7.5	3
2 children	97.7	43	6.8	3
3 children	94.7	36	0.0	0
4 or more children	100.0	26	0.0	0
Missing	97.5	156	8.8	14

SOURCE: Nigeria Misoprostol study 2018.

with good SRHL 61.5 percent ($N = 8$) went for a checkup, 15.4 percent ($N = 2$) had a potential complication or went to complete the abortion each; and one woman was in the 'other' category. Among those with low SRHL, 20 percent ($N = 1$) went for a checkup, 40 percent ($N = 2$) had a potential complication or went to complete the abortion each. For five women, information on their SRHL was missing. Thus, women with better SRHL in our sample were more likely to seek health care for a checkup, but less likely to do so due to a potential complication or not having ended the pregnancy successfully. There were few differences between women with better or worse misoprostol knowledge.

Women's Descriptions of How Misoprostol Works in Their Bodies

We employed ethnophysiology to gain greater insight into women's understanding of misoprostol. Of 394 responses to the question about what misoprostol does in the body, a quarter

TABLE 4 The association between SRHL and (a) ending the pregnancy successfully and (b) seeking care after abortion

	Odds ratio	SE	*p*-Value
(a) Ending pregnancy successfully			
SRH literacy			
Knew the most fertile time	6.87	5.77	0.022
Did not know the most fertile time (ref)	1.00		
Number of sources of information			
No sources used (ref.)	1.00		
One or more sources used	4.54	4.06	0.091
(b) Seeking health care after abortion			
SRH literacy			
Knew the most fertile time	2.55	1.38	0.082
Did not know the most fertile time (ref)	1.00		
Place of residence			
City (ref.)	1.00		
Suburban area/city outskirts	2.78	1.49	0.056
Town/village	1.16	0.82	0.830

NOTES: Controlling for age (not significant). Other variables tested but not significant in the model: misoprostol knowledge, numeracy, literacy, marital status, education, previous abortion(s), and parity.
SOURCE: Nigeria Misoprostol study 2018.

($n = 97$) described how misoprostol caused the abortion and of these 20 respondents linked their physical experiences with the mechanism of the abortion (i.e., they described both symptoms and mechanisms). Two-fifths ($n = 157$) described what they experienced when they took the drug. One-third ($n = 122$) said that they do not know how the drug worked; 12 respondents said that they noticed nothing, and six respondents gave incomprehensible answers. Below we summarize the responses women gave according to the most prevalent answers.

Among the quarter of respondents who described how misoprostol caused the abortion, the most common description was the drug destroyed the fetus, pushed out the contents of the uterus, brought about something akin to labor, and induced bleeding. Women who described the drug destroying the fetus explained the drug works by "cutting," "busting," "melting," "killing," "crushing," "dividing," "punching," "evicting," and "dissolving" the fetus:

> *The drug will go straight to the womb and it will find the foetus which is still in [the] form of blood inside my womb and punch it. Then we will pass out the blood. The two pills I inserted in my vagina will go to my ovary or uterus to dissolve the tissued blood.*

Bleeding was described as a "flushing" or "cleaning" of the womb, pushing out the fetus:

> *The drug disconnected the baby and flushed it out.*
>
> *It forced out the baby with blood.*

An incompatibility between the misoprostol and the fetus was also described:

> *I think the drug was there to cut and force out the foetus.*
>
> *The drug was too strong for the foetus; [it] interrupted it and pushed it out.*
>
> *The baby was pushed out by the drug.*
>
> *The foetus couldn't cope with presence of the drug so it pushed the baby out.*

The drug made the baby forming inside my stomach uncomfortable and pushed it out.

Some women described the fetus as blood:

The drug will go directly to the womb and bust the foetus which is still blood.

Women also described the drug as opening their cervix and causing contractions:

The pain felt more like early labour contraction so I feel it pushed out the foetus the same way the baby is expelled from the womb.

It was like childbirth induction; the drugs helped in opening the cervix to expel out the content[s].

Some answers were vague:

The drug goes to work in the womb and removes the foetus.

The drug terminated it.

Other biological processes described by the respondents included: "I think the drug goes to the fallopian tube then to the ovary or the womb where it dissolve[s] into blood," "It works through my breast and down to my private part," "The active ingredient in the misoprostol diluted my enzymes to bring down the fertilized egg," "Something sent the message to the brain," "It goes to all my body system," "I had a headache when I took the drug and I think that was what caused the abortion," "The medicine turned my stomach upside down and this caused the abortion to occur," and "The drug went straight to where it was meant to go to prevent the semen from forming." These descriptions demonstrate less precision in the women's understandings of how misoprostol works in their bodies as well as an incomplete understanding of internal organs and biology.

Among the respondents whose ethnophysiological understanding was restricted to just the physical symptoms, they experienced the most commonly described "tummy sensations," followed by menstrual cramps, pain, and bleeding. Common ways women described "tummy sensations" included: "Painful turning like squeezing my tummy around," "It squeezed my tummy as if something want[ed] to come out," and "Heaviness as if something in the stomach, it's biting and turning my tummy up and down." Many women did not describe the cramps as any worse than a regular period. The pain was described as "stomach pain" or "abdominal pain." Others, however, described a more intense pain: "serious pains," "a sharp pain," and "pain like labor." Bleeding was described without any elaboration, in a few instances clots were mentioned; it was commonly mentioned along with menstrual cramps. A weakening of the body was described as both a symptom and a mechanism of how the drug worked. Less commonly mentioned physical experiences included diarrhea, labor sensations, cervical opening, and feeling warm. A few women (less than five each) described feeling the need to push, vomiting, and feeling cramps in their legs. About half of the women named two different physical symptoms and about half a dozen named three symptoms.

The 20 respondents who described both how misoprostol caused the abortion and physical symptoms, identified pain leading to the expulsion of the fetus, or to a more vague "end

of the pregnancy"; weakness causing the abortion and cramps causing the abortion. The pain was the most common symptom cited among these respondents. The most commonly mentioned symptom-mechanism was bleeding.

> *I felt feverish and weak for days, the bleeding came out with some foetus pieces, the medicine must have cut and push[ed] them out.*

Pushing out the contents of the uterus, experiencing something similar to labor, and inducing bleeding can be treated as explaining various aspects of the way that misoprostol works, meaning that 11 percent ($n = 44$) demonstrated an understanding of how misoprostol brings about an abortion.

DISCUSSION

To the best of our knowledge, this study is the first to examine women's SRHL and misoprostol knowledge among those using misoprostol to induce abortions in a restrictive setting. Our study found that despite the low level of misoprostol knowledge in the domains we evaluated, women were able to use the drug safely and successfully.

High SHRL was positively associated with successfully terminating the pregnancy, which is in line with previous studies showing health literacy's association with positive health outcomes (Schillinger et al. 2002; Paasche-Orlow and Wolf 2007). Higher SRHL was also associated with a higher likelihood of seeking health care after the abortion. This may be because women with high SRHL were more able to recognize potential complications and thus seek health care. However, given that most of these women reported going for a "checkup" it may be that high SRHL can increase women's use of health services not because of a complication, but to ensure they are in good health after a self-induced abortion. More research with larger sample sizes is needed to better understand this potential association and its implications on public health. Even though we achieved a sample size of almost 400 women, the differences in being able to end the pregnancy successfully and safely are relatively small in absolute terms.

Misoprostol knowledge was not associated with either likelihood of ending the pregnancy successfully or seeking health care. It could be that we did not measure the domains of misoprostol knowledge that matter the most. Alternatively, the results can indicate that specific knowledge about the drug used may not be as important for being able to use it successfully as more general SRHL is. Given that misoprostol is a relatively simple drug to use to terminate a pregnancy, the lack of correlation between misoprostol knowledge and successfully completing an abortion should not be interpreted to mean that more complicated conditions/medications can be equally well managed by individuals with low levels of knowledge about the drug without the help of health professionals.

Drawing on their own experiences of menstruation, labor, and childbirth, as well as ethnophysiological understandings of how the pregnancy ended after taking misoprostol, the qualitative results provide insights into how women think misoprostol works. Some of these answers were informed by the physical experiences the women recently had terminating their pregnancies. Many respondents lacked the ability to name the proper part of the body where the abortion was occurring, instead of naming their breasts, stomach, fallopian tubes, ovaries,

and "private part." In addition, they described other physical experiences such as headaches and a weakening of the body being connected to the abortion, which suggest a holistic vision of physiological interconnectedness. We could interpret the almost quarter of the women ($n = 122$) who said that they did not know how misoprostol works to perhaps exhibit the lowest level of misoprostol literacy. In sum, these answers point to ways that language could be used to communicate with women that cohere to their biological knowledge as well as body beliefs to prepare them for the abortion experience.

Apart from SRHL, we found few differences between those who successfully terminated a pregnancy and those who did not; and those who sought care after the abortion and those who did not. The regression model (a) in Table 4 suggests that seeking information about misoprostol from more than one source might be associated with the likelihood of ending the pregnancy successfully ($p = 0.091$). While previous studies have linked characteristics, such as education and occupation, and prior knowledge about health (Squiers et al. 2012) with health literacy; and age and educational attainment (Naigaga et al. 2015; Vongxay et al. 2019) with SRHL, we found few differences in success rates or care-seeking according to women's sociodemographic characteristics or previous reproductive experiences.

Policy Implications

While our results are not generalizable to the population of Lagos State, the associations found within our dataset suggest misoprostol has the potential to be a safe tool for self-induced pregnancy termination even in settings with low knowledge about the drug, as shown by the low proportion of women seeking care after the abortion and by the high rate of successful pregnancy termination. The use of misoprostol could potentially be made even more effective if the information on use were provided drawing on the ethnophysiological concepts women used to describe how misoprostol works to bring about an abortion. Since according to our results high SRHL has the potential to make use even more effective, policies increasing these skills (e.g., sexuality education) could further improve women's ability to self-manage abortions.

Furthermore, if women are unclear as to how misoprostol works and may perceive it to do something violent to the fetus, as indicated in our qualitative findings, it might be associated with more negative feelings or/and fear of using misoprostol than if they understood how misoprostol ended a pregnancy. Thus, accurate knowledge of how the drug works could potentially increase the number of women using this safer method to end a pregnancy as opposed to more dangerous methods. Other studies have also concluded using misoprostol for abortion is a good harm-reduction method in restrictive settings (Hyman et al. 2013; Harvey 2015; Erdman et al. 2018).

Limitations

There were some limitations in our study. Our sample was not randomly selected, and thus the results cannot be generalized. If it had been possible to study a random sample of women obtaining misoprostol for abortion in Lagos State, it is possible that our sample would have been less educated on average (because our sample was drawn from near universities), which could have had implications in overall health literacy levels and the ability to use the drug

safely and successfully. Furthermore, it includes only women who were able to seek out an option to terminate an unwanted pregnancy with misoprostol within a restrictive context. This is a minority of women obtaining abortions in Nigeria: recent estimates show around 30 percent of abortions in Nigeria are conducted using pills—including 6.5 percent using misoprostol-containing drugs, and the rest using unidentified pills unknown proportion of which may contain misoprostol (Bell et al. 2019). They already demonstrate an ability to navigate a complex system to bring about their abortion.

Due to attrition, we may have lost touch with those who were more likely to suffer complications, which makes it difficult to know how many of the 446 eligible women we first reached had to seek care. However, even in the unlikely case that all the women we lost to follow up had to seek care, the vast majority (83 percent) of women would still have not sought care after the abortion. Similarly, even if all these women were not able to end their pregnancy, 84 percent of women in our study would have still used the drug effectively. The high proportion of women being able to end their pregnancies successfully is in line with other studies on the topic (see, e.g., Foster et al. 2017).

A large proportion of the respondents seemed not to understand the open-ended question about how misoprostol works to bring about the abortion as they described their physical symptoms rather than the mechanisms of the drug, and some responses were incomprehensible, which may have affected our interpretation of their misoprostol knowledge levels. However, given that both the qualitative and quantitative data suggest the knowledge was low provides assurance that the knowledge levels were indeed low.

While we did not find associations between overall literacy and numeracy with the outcomes, this could be because our sample population, who was a relatively highly educated group, perhaps found the exercises too easy. Finally, there may be a group of women we did not capture in this sample who imagine misoprostol working in such a way that they do not avail themselves of the use of the drug.

Nevertheless, we believe the results are important because very little is known about the characteristics of the women purchasing and using misoprostol in settings where access to abortion is restricted. Future studies collecting data from a larger sample, exploring more dimensions of health literacy, and using different ways of asking about women's understandings of SRH processes should be conducted.

CONCLUSIONS

This study is an important addition to the literature about the use of misoprostol for abortion in restrictive settings as it is the first to investigate the association between SRHL and abortion experiences in such a context. Taken together, our quantitative and qualitative results show that, although respondents had low misoprostol knowledge and for the most part did not know how the drug works, this was not associated with issues in the successful use of misoprostol for pregnancy termination. While SRHL may help women to end the pregnancy successfully and may be correlated with the likelihood of seeking care from a health facility, the absolute differences were small. These results show that even in settings where knowledge about the drug is low, misoprostol can be effectively used for abortion.

Data Availability Statement

Data are available upon reasonable request (please contact Dr. Onikepe Owolabi oowolabi@guttmacher.org). A member of the study team must be involved in the analysis of the data, and the confidentiality of respondents will be protected at all times.

Conflict of Interest

The authors report no conflicts of interest.

Ethics Approval Statement

The National Health Research Ethics Committee in Nigeria, the Institutional Review Board of Guttmacher Institute, and the University of Southampton Ethics Board approved the study.

Patient Consent Statement

All respondents gave their consent to take part in the study at each round of data collection. See more information in the Methods section.

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