Evaluation of a Mobile Phone Program to Improve Knowledge, Communication, and Attitudes about Reproductive Health: A Randomized Field Experiment*

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Abstract

Use of mobile phone technology has been suggested as a tool for improving health in developing countries. We use a randomized experiment to test whether a mobile phone intervention can improve knowledge, communication, and attitudes about reproductive health among a population of adolescent girls in Accra, Ghana. Sending information passively via text message increases knowledge by 34%, while engaging participants in a reward-incentivized text-messaging quiz game increases knowledge by 75%. The mobile phone quiz game also increased communication by 28% and there is some indication that the program improved some attitudes. These results show that the design of a mobile health program is critical to its effectiveness. Policy makers should consider incorporating the use of mobile phones into sex education programs in developing country settings.

Keywords: reproductive health, family planning, adolescent health, mobile health

JEL codes: I10, I18, J13

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1 Introduction

Most countries in sub-Saharan Africa continue to struggle with high fertility and high maternal mortality rates (Bongaarts and Casterline 2012; Hogan et al. 2010). The adoption of contraception has been exceptionally slow in Africa compared to other developing regions, with attitudinal resistance and access being the biggest barriers (Cleland et al. 2010).

A great body of evidence shows that there are numerous social and economic benefits to improving reproductive health. First, improved access to family planning has been shown to reduce unwanted fertility and increase birth spacing, leading to lower maternal mortality and infant mortality rates, as well as improved childhood health through increased birth weight and reduced infections (Singh et al. 2009). Use of contraception also reduces the number of high-risk pregnancies that would have resulted in death or unsafe abortion (Cleland et al. 2012). Second, reduced fertility in developing countries benefits the economy at both the macro- and microeconomic levels. Access to family planning increases women’s earnings, assets, and body-mass indexes, and children’s schooling and body mass indexes (Canning and Schultz 2012). Decreased fertility rates result in economic growth by reducing youth dependency ratios and increasing the number of women in the labor market (Bloom et al. 2009). Third, improved reproductive health can improve women’s social and political positions, by enabling women to delay childbearing and increase their education (Singh et al. 2009; Duflo 2012). In the United States, a direct effect of the diffusion of the birth control pill was to decrease the cost to women of remaining unmarried, allowing women to increase their investments in formal schooling, major in career-oriented subjects, and continue to professional and graduate schools in greater numbers (Goldin and Katz 2002). In Columbia, family planning access led to delayed first births which resulted in increased education and substantial socio-economic gains for women (Miller 2005).

The role of adolescence has been emphasized as a foundation of adult health and social development, especially in the context of reproductive health (Sawyer et al. 2012). Targeting adolescents in reproductive health interventions has many benefits. First, averting teenage pregnancy can prevent school dropout and expulsion as well as social stigmatization (Hindin and Fatusi 2009). Since educated girls are more likely to invest in the health and education of their children, reducing teenage pregnancy is a potential way of breaking the chain of intergenerational poverty and poor health (Population Council 2010). Second, adolescents are particularly vulnerable to poor reproductive health investments. In sub-Saharan Africa, 25% of
unsafe abortions are undertaken by girls aged 15-19 and adolescents make up 41% of all new HIV infections in those older than 15 years (Sawyer et al. 2012). Consequently, targeting adolescents could lead to significant gains in reproductive health targets. Finally, interventions for adolescents can make use of the newest technologies and communications for social change, including mobile health (or mHealth) technologies such as text messaging (known as Short Message Services or SMS), since young people are its most prominent users (Sawyer et al. 2012, Pew Research 2014). Social marketing and information technology can be exploited in a positive way to gain a wide social audience and diffuse information in order to change health-related attitudes and behaviors.

While mHealth technologies are increasingly used in developing countries, evidence of their effectiveness in a developing country setting is relatively scarce (Tomlinson et al. 2013). Most mHealth behavior change communication (BCC) interventions are implemented in the United States or other developed countries (Gurman et al. 2012). A 2012 systematic review of mobile health BCC interventions in developing countries found only 5 peer reviewed articles, of which 2 were randomized trials, both evaluating reminder messages (Gurman et al. 2012). A more recent study in Uganda found that a self-directed, passive mHealth sexual information program was ineffective in changing knowledge, behavior, or norms among adults (Jamison et al. 2013). The ineffectiveness was attributed to heterogeneous treatment levels leading to a the lack of a clear learning objective, technology failures that discouraged people from using the service, and the inability of adult women to change their partner’s behavior even though they learned information themselves due to firmly established sexual norms.

More generally, the design of a mobile health BCC program is critical to its success. One of the most salient findings in the most recent literature is the importance of actively engaging participants in two way communication and providing incentive to interact (Gurman et al. 2012, Tomlinson et al. 2013). Studies on learning and education have found that retrieving information during a test or quiz facilitates later memory, and that testing promotes the application of the knowledge to new situations (Carpenter 2012, Roediger and Karpicke 2006). A study in China found that messages sent to caregivers improved students’ physical health and academic performance but only if the weekly messages came with quiz questions that encouraged recipient response (Mo et al. 2013). Feedback enhances the benefits of testing such as long-term retention (Roediger and Butler 2011). Rewarding correct answers increases attention to the text messages and provides motivation to learn which can make the messages more effective (Sarter et al...
Finally, mHealth interventions can be group-level rather than solitary to take advantage of diffusion effects of information; peer effects have been found to increase program participation, learning, and technology adoption (Dahl et al. 2012, Li et al. 2014, Oster and Thornton 2012).

In this context, engaging adolescent girls in an interactive text messaging program may reduce unwanted pregnancy and sexually transmitted infections (STIs) through the delivery of information at a time before sexual norms have been established via a technology that adolescents feel comfortable with and use readily. We use data from a randomized field experiment involving 716 adolescent girls from 34 secondary schools in Accra, Ghana to evaluate the effectiveness of a text-messaging program on improvement in knowledge, communication, and attitudes about reproductive health. The 12-week program randomized schools to one of two treatment arms or a control. In the first treatment arm (“Interactive arm”), adolescent girls passively received messages about reproductive health for 12 weeks. In the second treatment arm (“Basic arm”), adolescent girls were sent quiz questions and were financially incentivized via mobile airtime credit rewards to interact with the system by sending in responses each week. We hypothesized that both treatments would increase knowledge and communication, as well as improve attitudes about reproductive health compared to the control. We also hypothesized that the Interactive treatment arm would be more effective than the Basic treatment arm due to the design elements.

This paper makes several contributions to the literature. To the best of our knowledge, it is the first paper evaluating the effectiveness of an mHealth communication program on outcomes among adolescents in a developing country. We find that while both treatment arms are effective in increasing knowledge of reproductive health among adolescents, the Interactive arm is twice as effective as the Basic arm. In addition, the Interactive treatment arm is equally effective for those with low or high baseline knowledge scores, while the Basic arm is most effective for those with high baseline scores. Both of these findings indicate that design elements of a mobile health program dramatically impact the results, and that the elements of testing, feedback, and financial incentive engage all participants, regardless of initial interest or knowledge of the subject.

This paper also elucidates a mechanism for the increased knowledge via communication with peers. We find that the Interactive arm increased communication among friends and classmates, potentially by de-stigmatizing the topic of sexual health among teenage girls. The
quiz questions may have served as exogenous catalysts for reproductive health topics that previously were difficult to discuss due to the taboo behaviors talking about such topics imply.

Finally, this paper evaluates whether change in knowledge and communication can impact attitudes about reproductive. It is not obvious that providing adolescents information via text message could change their beliefs surrounding sexual health, as beliefs and attitudes are often influenced by familial and social norms and are difficult to change, particularly in a highly religious context such as Ghana. We find evidence that the program positively impacted some attitudes, including benefits of using condoms, susceptibility to sexually transmitted infections (STIs), and social support for using contraception among peers.

The remainder of the paper is organized as follows. Section 2 describes the Ghanaian context and the experimental design. Section 3 presents the data and evaluation strategy. Section 4 presents the results, and Section 5 discusses the results.

2 Ghana Background and Experimental Design

2.1 Study context and participants

2.1.1 Reproductive Health

In Ghana, knowledge of reproductive health among adolescent girls is low; according to the Guttmacher Institute’s 2004 National Survey of Adolescents, only 44% know a girl can get pregnant if she washes herself after sex, 38% know a girl can get pregnant if she has sex standing up, and 49% have heard of any other STI apart from HIV/AIDS (Awusabo-Asare et al. 2006). Only 28% of sexually experienced female adolescents use a condom the first time they had sex (Awusabo-Asare et al. 2006, Karim et al. 2003). Sexual initiation most often happens during adolescence: by age 15 only 8% of girls have had sex, by age 18 about 43%, and by age 20, about 71% have had sex (Hessburg et al. 2007). The adolescent birth rate is about 66 births per 100 girls aged 15-19 (ICF Macro 2010).

Previous research has shown that misconceptions about how contraceptive methods work and the likely side effects impede Ghanaian women from using contraception (Adanu et al. 2012, Hindin et al. 2013). Four major barriers underlie the lack of uptake of modern contraception by sexually active adolescents. First, there appears to be a lack of basic biological knowledge about sex and pregnancy. Misconceptions about sexual health appear common, such as whether
actions like washing after sex or standing up during sex can prevent pregnancy (Awusabo-Asare K et al. 2006). This confusion leads to uncertainty about whether contraception is necessary. Second, Ghanaian adolescent girls appear to have very limited knowledge about how to use contraception and how contraception functions in the body, leading to lack of self-efficacy surrounding contraceptive use. Third, there appear to exist many misconceptions about the future fertility risks of contraception. Many are worried about being unable to have a future child. Finally, there is an apparent lack of communication about reproductive health among adolescents with their friends, parents, health workers or teachers, and partners, leading to little to no social support in the use of contraception. Communication about HIV/AIDS between students and parents or other family members increases the odds of using a condom at last sexual intercourse (Adu-Mireku 2003; Hindin). Self-reported ability to communicate with peers is related to more positive condom attitudes, which in turn is associated with greater condom commitment and use (Halpern 2004). Communication with partners is also associated with increased contraceptive use (Awusabo-Asare K et al. 2006).

In 1994, the government of Ghana revised the National Population Policy and followed it with an Adolescent Reproductive Health Policy in 1996. One of the strategies in both policy documents was to teach family life education in pre-tertiary educational institutions. As a result, by 2004, 61% of males and 70% of females aged 15-19 years reported that sex education was offered in their schools (Awusabo-Asare K et al. 2006). Ninety-three percent of female and male adolescents were introduced to sex education before they had their first sexual experience (median age at first intercourse is 18.4 years for women and 20.0 years for men) (Awusabo-Asare K et al. 2006, GSS 2008). However, in practice actual learning has generally been superficial; for example, less than half of students report ever seeing a condom demonstration (Awusabo-Asare K et al. 2006). Thus there remain substantial gaps in knowledge.

2.1.2 Mobile Phones

In 2013, the number of active mobile phone lines in Ghana stood at 25.3 million, which is greater than Ghana’s population (Dowuona 2013). Preliminary research by the authors found that in urban settings like Accra, most adolescents have their own personal phone. A cheap mobile phone costs about 30GhC (less than 10USD) and a text message can be sent at about .04GhC (less than .02USD). Urban and rural areas vary in mobile phone ownership, though the gap is closing (Overa 2006).
2.2 Procedures

2.2.1 Sample Selection and Randomization

The sampling frame was drawn from the 2012-2013 Ghana Education Service Register of Secondary Schools. The list contained 79 boarding or day secondary schools, which we reduced to 38 functioning public and private day secondary schools that were eligible for randomization. The inclusion criteria were girls aged 14-23 in day schools of Greater Accra who gave consent for involvement. Participants gave written consent, with those under 18 obtaining parental consent, and were free to stop participating at any time. Participants used their own mobile phones; phones and network airtime credit were not provided.

The study was a cluster randomized, controlled trial. We randomized 38 schools to basic treatment, interactive treatment, and control in a ratio of 1:1:1.2. We generated the randomization numbers with a random number generating program and randomization was stratified by school category (a measure of school quality) and whether the school had a home economics class (a class with mostly girls). After randomization, 4 schools refused to participate. The final sample included 34 schools with 12 schools assigned basic treatment, 10 schools assigned interactive treatment, and 12 schools assigned to control (Appendix Figure A1). Participants in all treatment groups were told they would receive “health messages”, including such topics as reproductive health or malaria, in order to prevent unequal take-up of the program, with the interactive intervention schools receiving a brief training on how to respond to the quiz questions. Study participants and data collection staff could not be masked because the intervention required overt participation as well as the brief training conducted by staff.

2.2.2. Intervention Protocol

The study compares two intervention arms to a control arm. The first intervention arm was designated the “Basic” intervention: participants were sent one reproductive health fact each week for 12 weeks. The messages contained information on topics of reproductive health anatomy, sex and pregnancy, STIs, and contraception including male condoms, female condoms, birth control pills, and emergency contraception. Topics and wording of the messages were

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3 Day schools were required because boarding school students are not allowed to have their phones at any time during the semester, while day school students return home to their phones each night.
4 Categories B, C, D, and Private with B being the better schools. Private schools are usually either very high (A) or very low (D) level as they are either for students of great ability whose parents want to pay for a better education, or they serve to take students who did not pass their middle school examinations and failed to enter any public high school.
generated after extensive focus groups and interviews with adolescent girls in the months prior to the launch of the study, as well as guidance from the Ghana Health Service Health Promotion Unit. Details on content of the messages are provided in Appendix Table A1. The second intervention was designated the “Interactive” intervention; participants were sent one multiple-choice quiz question each week to which they were incentivized to respond for free. Every two correct answers resulted in an airtime credit reward of 1GhC (0.45USD). Both the Basic and Interactive interventions also received 4 extra messages about a free hotline number they could call for reproductive health information, the effectiveness of condoms, and encouragements to talk with their friends and boyfriend about reproductive health. The control arm participants were sent placebo messages about malaria with no extra tips.

The text messages were in English, the language of secondary school instruction in Ghana. If a message did not give indication of delivery, it was resent. The Basic and Control groups received their messages on Tuesdays and Thursdays of each week, respectively, with extra tips for the Basic group on four Saturdays at the end of weeks 3, 5, 6, and 8 (Appendix Table 1). The interactive group received their initial text messages on Mondays of each week. If they responded they were sent a confirmatory message stating whether they were correct or incorrect and more information (with the content being identical to the fact sent to the Basic group). If they did not respond by Wednesday of each week, they were sent a reminder message that day, and again on Friday, reminding them and encouraging them to respond. They were also sent the additional tips on the same four Saturdays as the Basic group. Airtime credit rewards were sent on Sunday of each week, along with a message informing them of how many answers they had correctly answered so far and encouraging them to keep participating. A flowchart of an example week is show in Appendix Figure A2.

To assess the interventions, we conducted two questionnaires, one at baseline between January 15th and February 28th, 2014 and one at follow-up, between June 2nd and June 27th. The questionnaires were self-administered to the entire classroom of students at the same time. Intervention delivery ran from March 3rd to May 25th.

2.2.3 Ethical Approval

The study design and statistical analysis plan was registered on clinicaltrials.gov and AEArepository.org. Approval was granted by Harvard University [Internal Review Board (IRB) #FWA00004837] as well as the local IRB at the Ghana Health Service (GHS-ERC: 05/09/13).
Written informed consent was taken from both the participants as well as their parents if participants were under the age of 18.

3 Data and Evaluation Strategy

3.1 Data

The primary outcome measure was the score received on a reproductive health knowledge index, which was assessed via the percentage of correct responses of 24 true/false/don’t know questions. A “don’t know” answer was marked as incorrect as was a missing answer. Items on the knowledge quiz are in Appendix Table A2 and include questions on basic anatomy, pregnancy, STIs, use of condoms and female condoms, use of the birth control Pill, and use of emergency contraception.

The secondary outcomes measures were communication and attitudes. Communication was assessed via 4 questions following the structure, “In the last 3 months, how often have you spoken to [X] about sex or reproductive health issues?” where [X] includes “your close friends”, “your parents”, “a teacher, nurse, or any professional”, and “your boyfriend”. The responses provided by the participant were on a 5-point scale from “Every day or almost every day” to “Never”.

We also assessed communication via 5 questions following the structure, “Think about the last message you received. Did you talk about the last message with [X]” with [X] being the same 4 groups as above with an additional group of “your class”. Possible answers were “yes” or “no”. This question was only asked of those who self-reported receiving at least one message. We asked about the last message to avoid forcing respondents to average their communication about the messages over 12 weeks of messages.

Attitudes were evaluated via 18 items on an attitudes index (Appendix Table A3). Items for all attitude questions were ranked on a 5-point Likert-type scale (from “Strongly agree” to “Strongly disagree”), with higher scores indicating attitudes consistent with increased protection against sexual risk-taking behaviors.

3.2 Evaluation Strategy

3.2.1 Knowledge

For the primary outcome, we analyzed linear intent-to-treat models, regardless of whether participants actually received text messages. We evaluated three models: a minimal model only
adjusted for those variables on which we stratified our randomization; a model adjusted for all
other baseline individual and school-level characteristics, including age, ethnicity, religion,
mother’s education, father’s education, school size, and baseline knowledge; and an interaction
model between baseline score and treatment. For all analyses, standard errors were clustered at
the school level. We tested whether the two interventions were equivalent with a generalized
linear hypothesis test of the difference between the two coefficients.

The Knowledge score is the fraction correct of 24 items on the follow up questionnaire. The
index is composed of questions that are marked as “True”, “False”, or “Don’t know”. A “Don’t
know” answer is marked as incorrect. Items on the knowledge quiz are in Appendix A1 and
include questions on basic anatomy, pregnancy, STIs, use of condoms, use of the birth control
Pill, and use of emergency contraception.

The Ordinary Least Squares (OLS) minimal model is specified in Eq 1.

\[
\text{KnowledgeScore}_{is} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + X'_s\delta_1 + \varepsilon_{is}
\]

for student \(i\) in school \(s\). \(X_s\) is the vector of blocking variables during the randomization process
which include school category and whether or not the school has a Home Economics department.
Since we have randomly assigned treatment to the schools, conditional on the blocking variables,
we expect \(E(\varepsilon_{is}|\text{BasicTrt}, \text{InteractiveTrt}, X_s) = 0\). The treatment effects are captured by \(\beta_1\) and \(\beta_2\),
which is the causal effect of being in a basic treatment school versus the control and in an
interactive treatment school versus the control, respectively.

This adjusted model is shown in Eq 2.

\[
\text{KnowledgeScore}_{is} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + \gamma \text{BaseKnow}_{is} + X'_s\delta_1 + Z'_s\delta_2 + \varepsilon_{is}
\]

where \(\text{BaseKnow}_{is}\) is the baseline knowledge score, \(X_s\) is the same vector of blocking variables
as before, \(Z_{is}\) is a vector of individual and school-level covariates including age, ethnicity,
religion, mother’s education, father’s education, and school size.

The third specification interacts baseline knowledge with treatment, in order to assess
whether there was a differential effect for those with higher baseline knowledge. The variable
HighBaseline is an indicator of whether the individual’s baseline score was above or below the
overall average. We include the same individual and school-level covariates as in specification 2. The specification is shown in Eq 3.

\[ \text{KnowledgeScore}_{is} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + \beta_3 \text{HighBaseline}_{is} + \beta_4 \text{BasicTrt}_{is} \times \text{HighBaseline}_{is} + \beta_5 \text{InteractiveTrt}_{is} \times \text{HighBaseline}_{is} + X'_{is} \delta_1 + Z'_{is} \delta_2 + \varepsilon_{is} \]

The interactive terms result in parameter estimates for \( \beta_4 \) and \( \beta_5 \). We assess if there was a differential impact of baseline score on the final score by comparing these estimates to the null.

3.2.2. Communication

For the secondary outcome of communication, we generated an indicator variable for talking at least once a week about reproductive health with each contact (friends, parents, professional, and boyfriend)\(^5\) and conducted linear probability models\(^6\). The analysis adjusts for the same covariates as in the previous section. Additionally, for those who received messages, we conducted similar models on an indicator of discussing the last message with each contact (friends, family, professional, boyfriend, class). We calculate population effects, in that those who claimed to not have friends or a boyfriend were counted as not having spoken about reproductive health. For each contact \( k \) for \( k=\{ \text{friends, parents, professional, boyfriend} \} \):

\[ \text{Comm1perweek}_{ik} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + X'_{is} \delta_1 + \varepsilon_{is} \]
\[ \text{Comm1perweek}_{ik} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + \gamma \text{BaseComm}_{is} + X'_{is} \delta_1 + Z'_{is} \delta_2 + \varepsilon_{is} \]

Where Comm1perweek indicates that at follow-up the individual reported talking about reproductive health at least once a week and BaseComm is the same indicator but for baseline.

Additionally, we evaluated the effect of the treatments on the probability of talking about the last message via the following models:

\[ \text{CommLastMessage}_{ik} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + X'_{is} \delta_1 + \varepsilon_{is} \]
\[ \text{CommLastMessage}_{ik} \sim \alpha + \beta_1 \text{BasicTrt}_{is} + \beta_2 \text{InteractiveTrt}_{is} + X'_{is} \delta_1 + Z'_{is} \delta_2 + \varepsilon_{is} \]

\(^5\) A 1 indicated a response of “Every day or almost every day” or “At least once a week”, while a 0 indicated a response of “At least once a month”, “Less than once a month”, or “Never.”

\(^6\) A specification using hierarchical logistic regression models with school random effects was robust to the results.
3.2.3 Attitudes

Attitudes were broken into 6 families for family testing: perceived self-efficacy in STI and pregnancy prevention, barriers to use, benefits of use, partner communication, susceptibility of STIs, and social support. Items for all attitude questions are ranked on a 5-point Likert-type scale, with higher scores indicating attitudes consistent with increased protection against sexual risk-taking behaviors. Appendix Table 5 shows the question and corresponding family for the attitudes outcomes.

The attitude score for each family was the average of the items in that family. Thus for family j,

(8) \[ \text{AttitudeScore}_j \sim \alpha + \beta_1 \text{BasicTrt}_is + \beta_2 \text{InteractiveTrt}_is + X's_1 + \epsilon_{is} \]

(9) \[ \text{AttitudeScore}_j \sim \alpha + \beta_1 \text{BasicTrt}_is + \beta_2 \text{InteractiveTrt}_is + \gamma \text{BaseAttitude}_is + X's_1 + Z's_2 + \epsilon_{is} \]

4 Results

4.1 Descriptive Statistics and Balance

Descriptive characteristics of the participants by treatment arm are shown in Table 1. Average age of the participants was about 17.6-17.8 years. Across treatment arms, most identified as pertaining to a spiritual religion and the Akan ethnicity. Most had lived in their communities for at least 10 years. The vast majority owned their own phone (84.3-86.3%).

Baseline knowledge was about 26-31% (not statistically significant across treatment arms). None of the f-statistics yielded a p-value of less than 0.10; thus, balance of the randomization was achieved.

Participation among those in the interactive arm was high. Figure 1 shows the response rates for each of the 12 weeks of intervention, and (among those who responded) the fraction who responded correctly.
Table 1: Sample demographic characteristics at baseline by treatment arm

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Basic</th>
<th>Interactive</th>
<th>F-test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of clusters [n]</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of participants [n]</td>
<td>286</td>
<td>238</td>
<td>192</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median per cluster (range)</td>
<td>22.5 (6-47)</td>
<td>20.5 (2-42)</td>
<td>19.5 (1-39)</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Age [mean (SD)] (years)</td>
<td>18.1 (1.3)</td>
<td>17.9 (1.4)</td>
<td>18.0 (1.46)</td>
<td>0.33</td>
<td></td>
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<tr>
<td>Baseline knowledge score [mean (SD)]</td>
<td>0.26 (0.17)</td>
<td>0.31 (0.17)</td>
<td>0.31 (0.17)</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Religion:</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Muslim [n (%)]</td>
<td>49 (17.1%)</td>
<td>31 (13%)</td>
<td>22 (11.5%)</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Catholic [n (%)]</td>
<td>20 (7%)</td>
<td>17 (7.1%)</td>
<td>18 (9.4%)</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>Spiritual [n (%)]</td>
<td>125 (43.7%)</td>
<td>114 (47.9%)</td>
<td>85 (44.3%)</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Protestant [n (%)]</td>
<td>61 (21.3%)</td>
<td>57 (23.9%)</td>
<td>53 (27.3%)</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Other [n (%)]</td>
<td>26 (9.1%)</td>
<td>14 (5.9%)</td>
<td>10 (5.2%)</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>Mother’s Education:</td>
<td></td>
<td></td>
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<tr>
<td>Don’t know [n (%)]</td>
<td>71 (24.8%)</td>
<td>52 (21.8%)</td>
<td>44 (22.9%)</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Less than Secondary [n (%)]</td>
<td>44 (15.4%)</td>
<td>45 (18.9%)</td>
<td>20 (10.4%)</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>At least Secondary [n (%)]</td>
<td>167 (58.4%)</td>
<td>139 (58.4%)</td>
<td>127 (66.1%)</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Father’s Education:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know [n (%)]</td>
<td>63 (22%)</td>
<td>40 (16.8%)</td>
<td>40 (20.8%)</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Less than Secondary [n (%)]</td>
<td>116 (40.6%)</td>
<td>97 (40.8%)</td>
<td>69 (35.9%)</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>At least Secondary [n (%)]</td>
<td>103 (36%)</td>
<td>100 (42%)</td>
<td>82 (42.7%)</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>Ethnicity:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akan [n (%)]</td>
<td>110 (38.5%)</td>
<td>108 (45.4%)</td>
<td>68 (35.4%)</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Ga [n (%)]</td>
<td>84 (29.4%)</td>
<td>53 (22.3%)</td>
<td>63 (32.8%)</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Ewe [n (%)]</td>
<td>41 (14.3%)</td>
<td>48 (20.2%)</td>
<td>34 (17.7%)</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>Other [n (%)]</td>
<td>39 (13.6%)</td>
<td>18 (7.6%)</td>
<td>24 (12.5%)</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Own phone:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes [n (%)]</td>
<td>242 (84.6%)</td>
<td>202 (84.9%)</td>
<td>167 (87%)</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>No, but have access [n (%)]</td>
<td>36 (12.6%)</td>
<td>27 (11.3%)</td>
<td>21 (10.9%)</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>No, no access [n (%)]</td>
<td>2 (0.7%)</td>
<td>4 (1.7%)</td>
<td>3 (1.6%)</td>
<td>0.48</td>
<td></td>
</tr>
</tbody>
</table>

Notes: F-test comes from a Wald test, with variance-covariance matrix adjusted for clustering
4.2 Regression Results

Figure 2 shows the distribution of knowledge scores at baseline and at follow-up for all participants. Distributions for all treatment groups are highly overlapping at baseline, centered around 0.30. At follow-up, the distributions look quite different, with a clear movement to higher scores for both basic and interactive groups.
Figure 3 shows boxplots for knowledge score at baseline and follow-up for each school. At baseline, no school had a median knowledge score of greater than 50%. At follow up, while that was still true for the control group, 3 of 12 schools were above a median of 50% in the basic and 8 of 10 had a median above 50% in the interactive group.

![Figure 3: Distributions of knowledge score at baseline and follow-up, by school and treatment.](image)

Note: Boxplots show median in black line. The upper whisker extends from the hinge to the highest value that is within 1.5 * IQR of the hinge, where IQR is the inter-quartile range, or distance between the first and third quartiles. The lower whisker extends from the hinge to the lowest value within 1.5 * IQR of the hinge. School 14 had only one participant who was not lost to follow-up.

Table 2 shows the regression results for the minimal model and the adjusted model for knowledge score. Being in the basic group increased knowledge by 13.9 percentage points in the minimal model and 11.0 percentage points in the adjusted model (an increase of 34%). Being in the interactive group increased knowledge by 27.3 percentage points in the minimal model and
by 23.8 percentage points in the adjusted model (an increase of 75%). The p-value for the
difference between basic and treatment arms was highly significant for both models.

We further investigate the differential impact of the treatment on knowledge by baseline
knowledge. We interact treatment with an indicator for a baseline score greater than overall
average. We find that for the interactive program, there is no statistical difference in effect (at the
0.05 level) between those who scored high on the baseline compared to low on the baseline, that
is, everyone in the interactive group had an average increase of about 28.2 percentage points.
The interactive treatment was very effective even for those who had a low baseline score.
However, the results for the basic group are different. For those with low baseline scores, the
basic treatment increased knowledge scores by only about 6.4 percentage points, while for those
with high baseline scores, basic treatment increased knowledge scores by an additional 8.8
percentage points (a total of 15.2 percentage points). The basic treatment was much more
effective for those with a higher baseline knowledge of reproductive health.

Next, we assessed the effect of the treatment on communication via two response
questions. Panel A evaluates the effect of treatment on the probability of talking about
reproductive health at least once a week in the past 3 months. Panel B evaluates the effect of
treatment on the probability of having talked about the last text message (only asked of those
who reported to have received at least one message).

In Panel A, we found that those in the interactive group increased probability of talking
about reproductive health with friends by 9.6 percentage points (an increase of 28%). None of
the other coefficients were significant for the interactive group and none were significant for the
basic group. We also find that among those that received messages, those in the interactive group
had an increased probability of talking about the messages with their friends (16.6 percentage
points) and with their classmates (23.9 percentage points). On the other hand, being in the basic
group decreased probability of talking about the text messages with family by 17.0 percentage
points.

Finally, we assessed the effect of the treatment on attitudes about reproductive health.
Table 4 shows the results of the treatment on the 6 families that we pre-specified in our analysis,
with an additional (non-pre-specified) analysis of the social support family with the item about
parental support removed. Panel A shows the minimal models and Panel B shows the adjusted
model for each family. The full list of questionnaire items included in each family is shown in
Appendix Table A4. Results were not consistent, although there is some indication that the
treatments improved attitudes about the benefits of contraception and marginally improved attitudes about susceptibility to STIs and social support from friends.

Table 2: Effect of Treatment on Knowledge

<table>
<thead>
<tr>
<th></th>
<th>Minimal model</th>
<th>Adjusted model</th>
<th>Interaction model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Treatment</td>
<td>0.139 (0.034)***</td>
<td>0.109 (0.021)***</td>
<td>0.064 (0.025)**</td>
</tr>
<tr>
<td>Interactive Treatment</td>
<td>0.273 (0.031)***</td>
<td>0.237 (0.023)***</td>
<td>0.282 (0.036)***</td>
</tr>
<tr>
<td>High Baseline</td>
<td>0.173 (0.019)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic*High Baseline</td>
<td></td>
<td>0.088 (0.029)***</td>
<td></td>
</tr>
<tr>
<td>Interactive*High Baseline</td>
<td>-0.051 (0.030)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stratifying variables</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Baseline Knowledge</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Demographic covariates</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Mean Dep Var (Ctl)</td>
<td>0.32</td>
<td>0.32</td>
<td>0.24</td>
</tr>
<tr>
<td>Basic v Interactive p-value</td>
<td>0.001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>F-Statistic</td>
<td>22.23</td>
<td>1130</td>
<td>136</td>
</tr>
<tr>
<td>N</td>
<td>716</td>
<td>716</td>
<td>716</td>
</tr>
</tbody>
</table>

Notes: Standard errors clustered at school level. P-values: '****' 0.01 '***' 0.05 '**' 0.1
Demographic covariates: age, religion, ethnicity, mother’s education, father’s education, school size; Stratifying variables: school category and presence of home economics class
High Baseline defined as greater than the overall baseline average (0.29); Mean Dep Var for column 3 is control follow-up knowledge score for those with low baseline.
### Table 3: Effect of treatment on communication

<table>
<thead>
<tr>
<th></th>
<th>Friends</th>
<th>Professional</th>
<th>Parents/Family</th>
<th>Boyfriend</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Adj</td>
<td>Min</td>
<td>Adj</td>
<td>Min</td>
</tr>
<tr>
<td>Basic</td>
<td>-0.010</td>
<td>-0.019</td>
<td>-0.046</td>
<td>-0.063</td>
<td>-0.030</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td>(0.054)</td>
<td>(0.030)</td>
<td>(0.036)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>Interactive</td>
<td><strong>0.135</strong></td>
<td><strong>0.096</strong></td>
<td>0.011</td>
<td>-0.022</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>(0.066)*</td>
<td>(0.043)*</td>
<td>(0.056)</td>
<td>(0.053)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>Dep Var (Ctl)</td>
<td>0.36</td>
<td>0.36</td>
<td>0.16</td>
<td>0.16</td>
<td>0.17</td>
</tr>
<tr>
<td>N</td>
<td>716</td>
<td>716</td>
<td>716</td>
<td>716</td>
<td>716</td>
</tr>
</tbody>
</table>

Panel A: Probability of talking about reproductive health at least once a week with:

| Basic                    | 0.013  | 0.016        | -0.021         | -0.026    | **-0.177** | **-0.17** | -0.009 | -0.006 | 0.079  | 0.068 |
|                          | (0.058)| (0.055)      | (0.033)        | (0.033)   | (0.037)*** | (0.033)***| (0.036) | (0.029) | (0.073) | (0.072)|
| Interactive              | **0.168** | **0.166**    | 0.062          | 0.046     | -0.051    | -0.048   | 0.013  | 0.008  | **0.267** | **0.239**|
|                          | (0.077)*| (0.066)*     | (0.035)        | (0.036)   | (0.077)   | (0.066)  | (0.042) | (0.038) | (0.061)***| (0.060)***|
| Dep Var (Ctl)            | 0.54   | 0.54         | 0.12           | 0.12      | 0.33     | 0.33    | 0.21   | 0.21   | 0.53    | 0.53 |
| N                        | 592    | 592          | 592            | 592       | 592     | 592    | 592    | 592    | 592     | 592 |

Stratifying: ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
Baseline: ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
Comm: ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
Demographic: ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |

Stratifying, Baseline, and Comm variables are adjusted for demographic covariates (age, religion, ethnicity, mother’s education, father’s education, school size) and baseline communication. All models adjusted for stratifying variables (school category and presence of home economics class).
### Table 4: Effect of treatment on attitudes

<table>
<thead>
<tr>
<th></th>
<th>Social Support</th>
<th>Self-Efficacy</th>
<th>Barriers</th>
<th>Benefits</th>
<th>Partner Communication</th>
<th>Susceptibility</th>
<th>Social Support - Friends</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Minimal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>0.084 (0.085)</td>
<td>0.089 (0.108)</td>
<td>-0.101 (0.102)</td>
<td>0.202 (0.176)</td>
<td>-0.001 (0.102)</td>
<td><strong>0.306</strong> (0.159)*</td>
<td><strong>0.157</strong> (0.083)*</td>
</tr>
<tr>
<td>Interactive</td>
<td>0.192 (0.124)</td>
<td>0.133 (0.145)</td>
<td>-0.127 (0.088)</td>
<td><strong>0.403</strong> (0.140)**</td>
<td>-0.074 (0.076)</td>
<td>0.259 (0.162)</td>
<td><strong>0.280</strong> (0.133)**</td>
</tr>
<tr>
<td>Stratifying</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline att</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel B: Adjusted</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>0.031 (0.073)</td>
<td>0.038 (0.086)</td>
<td>-0.108 (0.092)</td>
<td>0.094 (0.152)</td>
<td>-0.043 (0.10)</td>
<td><strong>0.225</strong> (0.127)*</td>
<td>0.094 (0.075)</td>
</tr>
<tr>
<td>Interactive</td>
<td>0.096 (0.088)</td>
<td>0.094 (0.093)</td>
<td>-0.100 (0.079)</td>
<td><strong>0.267</strong> (0.105)**</td>
<td>-0.112 (0.084)</td>
<td>0.224 (0.139)</td>
<td><strong>0.181</strong> (0.093)**</td>
</tr>
<tr>
<td>Stratifying</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline att</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>716</td>
<td>716</td>
<td>716</td>
<td>716</td>
<td>716</td>
<td>716</td>
<td>716</td>
</tr>
</tbody>
</table>

Standard errors clustered at school level. P-values: ‘***’ 0.01 ‘**’ 0.05 ‘*’ 0.1 The “Adjusted” models are adjusted for demographic covariates (age, religion, ethnicity, mother’s education, father’s education, school size) and baseline attitude score. All models adjusted for stratifying variables (school category and presence of home economics class). Social support – friends is the average for the social support family but with the parental item removed.
5 Discussion

Our findings show that mobile phone messaging can be an effective tool for improving knowledge of reproductive health among adolescent girls, as well for increasing communication about reproductive health with their friends and classmates. There is some evidence that the program positively impacted some attitudes, including benefits to using condoms, susceptibility to STIs, and social support for using contraception among peers. Overall, participants were very responsive to the program and the messages were well accepted.

Importantly, we found that the Interactive intervention, a program design that used theories of engagement (via testing and feedback) and financial incentives, was much more effective than the Basic intervention, which was a passive messaging program. Participants in the Interactive group gained significantly more knowledge than participants in the Basic group. Through incentivized, active learning, girls retained knowledge longer than just by receiving information passively. Furthermore, all participants in the Interactive group experienced equal gains in knowledge, regardless of their baseline knowledge score, while most of the benefit for participants in the Basic group came for those with already high baseline scores. This could indicate that for girls with high ability or interest in the subject, a passive way of learning is adequate. On the other hand, the interactive design engages all girls regardless of ability or initial interest, and improves their retention of the material through active processing and increased communication.

Participants in the Interactive group were more likely to communicate with their close friends about reproductive health than those in the Control group or the Basic group, giving indication of peer effects for the Interactive intervention. It is possible that the quiz question messages served as catalysts for discussions of reproductive health among girls by reducing the stigma of bringing up such taboo topics on their own in an interesting way. In Ghana, condom use among adolescents is predicted by feeling of self-efficacy as well as social normative factors such as the behavior of peers (Karim et al. 2003). Self-reported ability to communicate with peers is related to more positive condom attitudes, which in turn is associated with greater condom commitment and use (Adih and Alexander 1999, Halpern 2004). We found consistent results in that participants in the Interactive arm had more positive attitudes toward benefits to condoms than those in the Control. We also found evidence that those in the Interactive group felt more social support from their friends than those in the Control, although this analysis was not pre-specified in the Analysis Plan.
This is, to our knowledge, the first randomized trial evaluating the effectiveness of mobile health communication to an audience of adolescents in a developing country. In emerging economies including Ghana, young people aged 18-29 are significantly more likely to own a cell phone or a smartphone, use social networking, and access the internet than those aged 30 and over; overall, texting is still the most common activity use for a cell phone (Pew Research 2014). The mobile “revolution” is still at the start of its growth curve in the developing world, with devices continuously becoming cheaper and more powerful (World Bank 2012). Understanding the technological habits of the intended audience for mobile health innovations is key to designing a program that is effective.

This study has some limitations. First, we included only adolescent girls in secondary school in Accra. We do not know if this setting is generalizable to girls who did not go to secondary school as well as those in a more rural setting. However, the low level of knowledge about reproductive health even among those in secondary school gives indication that the Interactive intervention may be effective even among those with lower education. Additionally, mobile phones are consistently becoming cheaper and the rural to urban disparity in phone ownership is closing (Overa 2006). We also do not know the effectiveness of this program on adolescent boys and is an area where further research would be very interesting. Evaluating the program in other developing countries is also an area of further study. Finally, due to the nature of informed consent, the study staff could not be masked to treatment. However, staff were trained to provide the same description of the messages (aside from the short, additional training for the Interactive group) to all treatment groups to prevent differential uptake. Similarity of baseline characteristics across treatment groups indicates that the participants were comparable.

On the basis of these results, the SMART program should be considered as an addition to secondary school curriculum on reproductive health. The intervention is low-cost and is likely to be highly cost effective if it prevents STIs and unwanted pregnancy. Evidence from 83 evaluated sex education programs found that that curriculum-based programs can have positive effects on risky sexual behaviors in young people, with the most effective programs using teaching methods that actively involved youth participants and targeted psychosocial risk and protective factors affecting sexual behaviors including knowledge, perceived risk, attitudes, perceived norms, and self-efficacy (Bearinger et al. 2007). Our results show that mobile technology can be effectively incorporated into sex education programs in a developing country setting.
References


Awusabo-Asare K et al., Adolescent Sexual and Reproductive Health in Ghana: Results from the 2004 National Survey of Adolescents, Occasional Report, New York: Guttmacher Institute, 2006, No. 22.


Appendix

Figure A1: Trial Profile
Figure A2: Flow of interactive group messages each week as compared to the Basic group messages

Interactive

Response from user: "SMT2"

Confirmation Reply: "SMART answer: Correct! The menstrual cycle is usually 28 days. If day 1 is the first day of your menses, then days 8-19 are the most likely time that you can get pregnant. The egg is released from the ovaries between days 8-19. If sperms are present, then the egg may be fertilized, causing pregnancy."

Encouragement message: "SMART: Great job! You have 1 question right so far. Get 1 more right and we will send you 1GHC. Talk about the answer with your friends so you can be sure of it"

No response from user

Quiz Question: "SMART quiz: When is the most likely time that a girl can get pregnant? Reply SMT1 for days 1-7 of her menses, reply SMT2 for days 8-19, or SMT3 for days 20-28."

Reminder message: "SMART Don't forget! When is the most likely time that a girl can get pregnant? Reply SMT1 for days 1-7 of her menses, SMT2 for days 8-19, or SMT3 for days 20-28."

No response from user

1 more reminder

Fact: "SMART fact: The menstrual cycle is usually 28 days. If day 1 is the first day of your menses, then days 8-19 are the most likely time that you can get pregnant. The egg is released from the ovaries between days 8-19. If sperms are present, then the egg may be fertilized, causing pregnancy."

Basic

Encouragement message: "SMART: Keep trying! If you get 2 questions right, we will send you 1GHC. Next time ask your friends for help so you can be really sure of the answer."

Figure A2: Flow of interactive group messages each week as compared to the Basic group messages
## Table A1: Content of text messages for all Interactive, Basic, and Control arms

<table>
<thead>
<tr>
<th>Week</th>
<th>Interactive Arm</th>
<th>Basic Arm</th>
<th>Control Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SMART quiz:How many ovaries does a woman have? Reply SMT1 for 1 ovary or SMT2 for 2 ovaries. Reply to this number for free. Reply until you receive confirmation</td>
<td>SMART fact: A woman has 2 ovaries. This is where eggs are stored. She has a womb (uterus) where a fertilized egg implants and a pregnancy grows. Two fallopian tubes connect ovaries to the womb. The cervix connects the womb to the vagina. The vagina is a tube of muscle connecting cervix to outside of body.</td>
<td>SMART fact: In 2012, malaria killed over 483000 children under 5 years, or about 1 child every minute. Malaria kills over 45000 adolescents per year in Africa.</td>
</tr>
<tr>
<td>Quiz Question</td>
<td>Correct Answer</td>
<td>Response from SMART</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SMT2</td>
<td>SMART: Right! A woman has 2 ovaries. This is where eggs are stored. She has a womb (uterus) where a fertilized egg implants and a pregnancy grows. Two fallopian tubes connect ovaries to the womb. The cervix connects the womb to the vagina. The vagina is a tube of muscle connecting cervix to outside of body.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SMT2</td>
<td>SMART answer: Correct! The menstrual cycle is usually 28 days. If day 1 is the first day of your menses, then days 8-19 are the most likely time that you can get pregnant. The egg is released from the ovaries between days 8-19. If sperms are present, then the egg may be fertilized, causing pregnancy.</td>
<td>SMART fact: Malaria is caused by Plasmodium falciparum parasites. The only way the parasites are spread to people are thru bites of infected Anopheles mosquitoes.</td>
</tr>
<tr>
<td>3</td>
<td>SMT2</td>
<td>SMART answer: Correct! Standing up during sex does NOT prevent pregnancy. When a man ejaculates (releases sperm), the sperms are deposited deep into the vagina immediately after ejaculation, allowing fertilization to take place. Bathing/washing will NOT prevent pregnancy either.</td>
<td>SMART fact: Getting malaria while pregnant is very serious. About 9% of pregnant women in Ghana die of malaria. It can also result in low birth weight babies.</td>
</tr>
<tr>
<td>Tip 1: End of week 3</td>
<td>SMART tip: If you have any questions about your health, you can call 0302208585 or 080028585 (Toll free- Voda only) to speak to a nurse. It is confidential.</td>
<td>SMART tip: If you have any questions about your health, you can call 0302208585 or 080028585 (Toll free- Voda only) to speak to a nurse. It is confidential.</td>
<td>NA</td>
</tr>
<tr>
<td>4</td>
<td>SMART: Can you be a carrier of a Sexually Transmitted Infection (STI) and NOT be aware that you have it? Reply SMT1 for yes or SMT2 for no.</td>
<td>SMT1</td>
<td>SMART: Right! You can have STI without having any symptoms or knowing you are a carrier. It can take months to see symptoms like sores, itches and problems urinating. A partner may have a STI and it may be impossible for him or you to know that he has it. Condoms or abstinence are effective ways to prevent STI.</td>
</tr>
<tr>
<td>5</td>
<td>SMART quiz: True or False: A woman with an untreated gonorrhea may have severe lower abdominal pains. Reply SMT1 for true or SMT2 for false.</td>
<td>SMT1</td>
<td>SMART: Right! Untreated gonorrhea may lead to severe pains in lower abdomen called pelvic inflammatory disease. It can cause infertility. It also makes it easier to get HIV. It may take months to see signs of gonorrhea in females. In males it takes days. It's important to seek treatment from a health center.</td>
</tr>
<tr>
<td>6</td>
<td>SMART quiz: True or false: A woman can wear the female condom for up to 8 hours before she has sex. Reply SMT1 for true or SMT2 for false.</td>
<td>SMT1</td>
<td>SMART: Right! The female condom is made of a thin transparent and soft plastic that looks like a tube that is closed at one end. It is designed to fit into a woman's vagina. It can be worn up to 8 hours before a woman has sex. It protects against both STIs and pregnancy. It is 95% effective if worn correctly.</td>
</tr>
<tr>
<td>Tip 3: End of week 6</td>
<td>SMART Tip: Great job! Remember, if you don’t want to have sex, it’s ok to say no. Call 0302208585 or 080028585 (Toll free- Vodafone only) to speak to a nurse about strategies for saying no. It is completely confidential. You could also call this number if you have any questions bothering you.</td>
<td>SMART Tip: Great job! Remember, if you don’t want to have sex, it’s ok to say no. Call 0302208585 or 080028585 (Toll free- Vodafone only) to speak to a nurse about strategies for saying no. It is completely confidential. You could also call this number if you have any questions bothering you.</td>
<td>NA</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td>SMART: When putting on a condom, should a man unroll it all the way first before putting it on the penis? Reply SMT1 for yes or SMT2 for no.</td>
<td>SMART: When putting on a condom, do NOT unroll the entire condom first. Open the package, hold the tip of the condom with one hand and roll it down the penis with the other hand. Leave space at the tip to collect semen. If there is no space at the tip the condom will burst open during ejaculation.</td>
<td>SMART: When putting on a condom, a man should NOT unroll the entire condom first. Open the package, hold the tip of the condom with one hand and roll it down the penis with the other hand. Leave space at the tip to collect semen. If there is no space at the tip the condom will burst open during ejaculation.</td>
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<td>8</td>
<td>SMART: When using a condom, when should a man pull out of the vagina after ejaculation? Reply SMT1 for while penis is still stiff or SMT2 for when penis is soft.</td>
<td>SMART answer: Right! When using a condom, it is important for the man to pull his penis out right after ejaculation, while it is still stiff. If the penis gets soft then the condom could fall off inside the woman’s vagina. If this happens then it is possible that the woman will get pregnant.</td>
<td>SMART fact: When using a condom, it is important for the man to pull his penis out right after ejaculation, while it is still stiff. If the penis gets soft then the condom could fall off inside the woman’s vagina. If this happens then it is possible that the woman will get pregnant.</td>
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<td>Tip 4: End of Week 8</td>
<td>SMART Tip: Contraception means a method to prevent pregnancy. Birth control pills and condoms are types of contraception. Condoms are only effective if you use them correctly and use them every time you have sex. Then they are 98% effective against STDs and pregnancy. Condoms do NOT cause infertility in men.</td>
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<td>9</td>
<td>SMART quiz: How often is the Pill taken (the birth control Pill)? Reply SMT1 for only after a woman has sex or reply SMT2 for once a day, everyday.</td>
<td>SMT2</td>
<td>SMART answer: Right! The Pill is taken once a day whether or not a woman has sex. If you choose to use the Pill as your contraceptive method then you must take it everyday or it is NOT effective. You can't just take it whenever you please! It contains low and safe doses of hormones and prevents pregnancy.</td>
</tr>
<tr>
<td>10</td>
<td>SMART quiz: True or False: Birth control pills are effective even if a woman misses taking them for 2-3 days in a row. Reply SMT1 for true or SMT2 for false.</td>
<td>SMT2</td>
<td>SMART answer: Right! The Pill is NOT effective if a woman misses it for 2 or 3 days in a row. The Pill must be taken everyday and if a woman stops taking it then she may get pregnant after 2-3 days. It does NOT take 6 months to become pregnant after stopping birth control.</td>
</tr>
<tr>
<td>11</td>
<td>SMART: True or False: A woman should take a rest from the Pill every year because the pills build up in the body over time. Reply SMT1 for true or SMT2 for false.</td>
<td>SMT2</td>
<td>SMART answer: Right! The Pill does NOT build up in the body so women do NOT need to take a rest from the Pill. If a woman has side effects like nausea, switching to another type or brand might help. The Pill protects against pregnancy but not STIs. The Pill does not cause infertility later in life.</td>
</tr>
<tr>
<td>12</td>
<td>SMART quiz: True or False. Emergency contraception must be taken within 1 hour of unprotected sex. Reply SMT1 for true, and SMT2 for false.</td>
<td>SMT2</td>
<td>SMART: Right! Emergency contraception (like Postinor-2) is a method to reduce chance of pregnancy after unprotected sex or when a condom breaks. The 2 pills must be taken within 5 DAYS of unprotected sex (that's 120 hours). It should only be used for emergencies, not as a regular method of contraception.</td>
</tr>
</tbody>
</table>
| C1 | Standing up during sex can help prevent pregnancy. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C2 | Condoms cause infertility in men. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C3 | To put on a condom, you should first unroll it all the way and then try to put it on the penis. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C4 | When putting on a condom, it is important to leave space at the tip. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C5 | When using a condom, it is important for the man to pull his penis out right after ejaculation, while it is still stiff. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C6 | Birth control pills (known as The Pill) are taken once every day, whether or not you have sex. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C7 | Birth control pills protect against sexually transmitted infections. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C8 | Birth control pills are effective even if a woman misses taking them for two or three days in a row. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C9 | It is important that women should “take a rest” from the pill every year because the pills build up in a woman’s body over time. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C10 | If a woman is having side effects with one kind of pill, switching to another type or brand might help. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C11 | After a woman stops taking birth control pills, she is unable to get pregnant for at least six months. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C12 | The female condom can be worn up to 8 hours before having sex. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C13 | Emergency contraception must be taken within 1 hour of having unprotected sex. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C14 | Symptoms of gonorrhea in females will appear the day after becoming infected. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C15 | Gonorrhea infection makes it easier to get HIV and other STIs and pass them to sex partners. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C16 | If left untreated, sexually transmitted infections like gonorrhea can cause infertility in both men and women. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C17 | A woman with an untreated gonorrhea may have severe lower abdominal pains. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
<p>| | | |</p>
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</table>
| C18 | If day 1 is the first day of a woman’s period, she has the greatest chance of becoming pregnant during days 8-19. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C19 | You can have a sexually transmitted infection without having any symptoms or knowing you are a carrier. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C20 | Every woman has 1 ovary where her eggs are stored. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C21 | STI symptoms can include sores, itches, and problems urinating. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C22 | Postinor-2 is a type of emergency contraception. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C23 | The female condom protects against both sexually transmitted infections and pregnancy. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
| C24 | Washing/bathing oneself after sex can prevent pregnancy. | 1. ☐ True  
2. ☐ False  
-888. ☐ Don’t know |
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<tr>
<th>ID</th>
<th>Statement</th>
<th>Response Options</th>
</tr>
</thead>
</table>
| D1 | I know about the signs and symptoms of STDs.              | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D2 | I know how to use a condom correctly.                     | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D3 | I know how to use the birth control Pill correctly.       | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D4 | Condoms are effective against sexually transmitted infections. | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D5 | I am confident that I can use a condom every time I have sex. | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D6 | I would be embarrassed to talk about using condoms with my boyfriend/girlfriend (or future boyfriend/girlfriend). | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D7 | I would be worried about getting an STI if I had sex without a condom at this time in my life. | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D8 | My friends think contraception should be used to prevent unwanted pregnancy. | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D9 | It is too much of an inconvenience to use a condom every time you have sex. | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D10| I could insist on using a condom during sex even if my boyfriend/girlfriend (or future boyfriend/girlfriend) does not want to use one. | 1. Strongly agree  
2. Agree a little bit  
3. Neither agree nor disagree  
4. Disagree a little bit  
5. Strongly disagree |
| D11 | My friends think condoms should be used during sex before marriage. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D12 | I feel comfortable talking to my friends about condoms and contraception. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D13 | I would feel embarrassed to buy the birth control pill. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D14 | My friends would approve of me using contraception or condoms to avoid pregnancy. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D15 | I would feel comfortable talking about avoiding or delaying sex with a boyfriend/girlfriend (or future boyfriend/girlfriend). | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D16 | I feel comfortable talking to my parents about condoms and contraception. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D17 | I am confident I could refuse to have sex if my boyfriend/girlfriend (or future boyfriend/girlfriend) does not want to use a condom. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
| D18 | I would be embarrassed to buy condoms. | 1. □ Strongly agree  
2. □ Agree a little bit  
3. □ Neither agree nor disagree  
4. □ Disagree a little bit  
5. □ Strongly disagree |
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<td>I know how to use a condom correctly.</td>
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<tr>
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<td>I would feel embarrassed to buy the birth control pill.</td>
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<tr>
<td><strong>Benefits of Use</strong></td>
<td>Condoms are effective against sexually transmitted diseases.</td>
</tr>
<tr>
<td><strong>Partner Communication</strong></td>
<td>I would feel comfortable talking about avoiding or delaying sex with a boyfriend/girlfriend (or future boyfriend/girlfriend).</td>
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