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The impact of an educational text message intervention on young urban women's knowledge of oral contraception

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Abstract

Background—Oral contraceptive (OC) knowledge deficits may contribute to OC discontinuation. We examined the effect of an innovative educational intervention on young women's OC knowledge.

Study Design—As part of a randomized trial evaluating the impact of text message reminders on OC continuation, we assessed OC knowledge in 659 women ages 13-25 years. Women received routine care or routine care plus six months of daily educational text messages. We administered a comprehensive 41-item OC knowledge survey at baseline and six months.

Results—Mean OC knowledge scores improved over time for all women (baseline 22.8, 56% correct versus 24.7, 60% at six months), including knowledge of OC's mechanisms of action ($p=0.004$), effectiveness ($p<0.001$), side effects ($p=0.03$), and benefits ($p<0.001$). Mean six-month scores were greater in the intervention (25.5) than the control group (23.7)($p<0.001$). In multivariable linear regression models, the text message intervention most strongly predicted OC knowledge ($\beta=1.6$, 95% CI 0.9, 2.2).

Conclusion—Daily educational text messages can modestly improve knowledge of OCs, which may promote successful contraceptive outcomes.

Keywords

oral contraception; contraceptive knowledge; educational intervention; text message

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1. Introduction

Nearly half of the 3.1 million annual unintended pregnancies among women in the United States are attributed to misuse and discontinuation of effective and popular contraceptive methods [1]. Of the 45 million U.S. women who have ever used oral contraceptives (OC), over 30% have discontinued them [2]. More than 50% of all unintended pregnancies are estimated to result from OC discontinuation alone [3].

Cognitive, behavioral and social factors influence OC use and help explain why young women misuse and discontinue OCs [1-11]. A woman's understanding of information related to OCs may play a critical role, either directly or indirectly, in facilitating or inhibiting successful OC use [4]. Unfortunately, comprehensive knowledge of OCs is limited among young women across diverse settings and populations [10-30]. In a recent review of studies measuring OC knowledge, nine of the 15 studies reported overall poor knowledge [31].

Studies testing strategies to address poor OC knowledge, including educational counseling interventions, have shown some improvements in knowledge but results have been inconsistent [21,23-26]. Interventions have relied upon information sources such as written handouts [21,23,26], audio tapes [26], health provider counseling [25], and provider question/answer sessions [21]. Few studies have capitalized on technological advances such as text messaging [32,33], which can deliver sensitive, educational preventive health information, like reproductive and contraceptive information, in an efficient, cost-effective and youth-centered way [34,35].

Limited measures and designs in OC knowledge research may have contributed to inconsistent findings and the lack of clarity on relationships between OC knowledge and behavior [31,36]. Previous studies have failed to capture the multidimensional nature of OC knowledge [36]. Most research, both descriptive and interventional, has focused on evaluating and improving knowledge of OC risks, side effects and, less commonly, use [31,36]. Strategies to address all dimensions of OC including efficacy, benefits, and mechanism of action are needed to fill knowledge gaps and ultimately improve behavior [36].

As part of a larger randomized controlled trial to evaluate the impact of daily educational text message reminders on OC continuation rates among young urban women, we also investigated whether comprehensive educational text messages could improve young women's knowledge of OC.

2. Methods

Results and methods of the larger study of OC continuation have been described elsewhere [37]. In the main study, we found that the use of daily educational text messages improves OC continuation at 6 months over routine care alone [37]. Here we report on the impact of the text message intervention on OC knowledge at 6 months. The Institutional Review Board of Columbia University Medical Center and Planned Parenthood Federation of American Research Department approved the study.

Participants were recruited from a family planning health center in New York City. Women eligible for inclusion were: 1) aged 25 years or younger, 2) currently sexually active, 3) owners of a cell phone with text messaging capabilities, and 4) requesting OCs. Research assistants screened participants, obtained written consent, conducted a baseline interview and documented contact information for a six-month exit interview. Of the 962 participants randomized to either the text message intervention or the routine clinical care control group

at baseline, we obtained follow-up information on 659 young women at six months including OC knowledge assessment. These participants provided the data analyzed here.

The baseline interview collected information on demographic characteristics and sexual, contraceptive and reproductive histories. We also administered a 41-item OC knowledge questionnaire we designed for this study to measure six major dimensions of OC knowledge including mechanism of action (4 items), effectiveness (2), use (9), side effects (4), risks (9) and benefits (13). Knowledge questions were developed from information within comprehensive standardized handouts from the clinical site. The questionnaire employed multiple question formats including true-false (10 items), multiple choice (15 items) and alternate choice (16 items). Examples of questions included, “The pill works partly by thickening the cervical mucus so sperm cannot get into the womb, true or false” (mechanism of action); “Please select whether you think the pill makes menstrual cramps better, worse, or has no effect” (benefits); “Select whether you think the pill increases, decreases or has no effect on the risk of getting ovarian cancer” (benefits); “For the health problem of leg pain or swelling, please select whether you would continue or stop taking the pill, and whether you would call your doctor immediately or discuss at the next visit” (risks, use). Questions were coded “1” for a correct response and “0” for an incorrect response, with possible scores ranging from 0 to 41 points. The questionnaire, which was pilot tested, was available in both English and Spanish and had a Flesch-Kincaid readability score [38] of 4.6 (corresponding to a 4^{th} to 5^{th} grade reading level).

Following baseline assessment, participants were randomly assigned in a 1:1 fixed allocation ratio to the intervention (routine care with six months of daily text messages) or control (routine clinical care only) groups. The random assignments were generated by blinded study staff using a random number table and placed into sequentially numbered, sealed, opaque envelopes, which were later opened by study recruiting staff at the enrollment site. Routine care following clinical protocols included contraceptive counseling by staff and provision of the standard written educational handout. The intervention group received this care in addition to 180 daily text messages, including 47 individual messages (which were repeated up to four times over the study). The educational text messages and OC knowledge questionnaire were developed in tandem using educational content from the handout; 32 questions (78%) had direct overlap in wording with the text messages and the remaining 9 questions indirectly reflected text content. We tested both 41-item and 32-item questionnaires and knowledge results were similar for the two versions; thus, we present results from the 41-item questionnaire.

The text messages also addressed the six major dimensions of OC knowledge noted above: mechanism of action (4 messages), effectiveness (6), use (17), side effects (5), risks (13), benefits (14). Examples of text messages included: “The pill may work by keeping the ovaries from releasing eggs” (mechanism of action) and “U should not use the pill if u have uncontrolled hi blood pressure” (risks, use). All participants elected to receive the messages in English and message length was less than 160 characters for all texts.

Six months after enrollment, participants underwent a telephone interview to assess OC use. We also re-administered the OC knowledge questionnaire orally during this interview.

We used descriptive statistics and bivariate tests (Student’s independent t-tests and ANOVA, where appropriate) to describe our sample and compare OC knowledge scores across sociodemographic groups. We present mean scores as well as mean percentage of items scored correctly (score divided by 41 points). Paired t-tests were used to compare baseline and six-month OC knowledge scores (overall and for all groups) and Student’s t-tests further compared OC knowledge scores (baseline, six-month, and change in scores)

between participants in the intervention versus control groups. Finally, we conducted multivariable linear regression to further examine relationships between sociodemographic factors, the text message intervention and OC knowledge. Our primary outcome variable was continuous, six-month OC knowledge scores, but we also examined baseline knowledge scores and percentage point change in scores. We examined models for all women as well as stratified models by education level (≤ high school education versus > high school). Potential covariates were considered for inclusion in regression models if they were associated with OC knowledge scores in bivariate analyses. Variables retained in final models were those associated with knowledge ($p<0.05$). We present linear regression model results as beta coefficients with standard errors and confidence intervals and interpret estimates as the relative adjusted change in OC knowledge score (going from control group to text message intervention group) while keeping all other variables constant.

3. Results

The average age of the 659 participants was 21 years. The majority were born in the U.S. (84%). African American was the most commonly identified race/ethnicity (41%), followed by Caucasian (29%), Hispanic (25%), and Asian and other (5%). The average participant had completed 14 years of education, with 63% having at least some college education. Many reported a student status (60%), while just over half were employed (55%). The majority of participants were uninsured (34%) or had Medicaid (41%). Three-quarters had used OCs in the past and 20% were OC users at the time of enrollment. Sexual activity within the past six months was nearly universal (96%) and half reported recent sexual activity in the last week. The average age at coitarche 17 years, with 46% having experienced a pregnancy and 39% an abortion. Of those who had a primary sexual partner (80%), the majority of partners were aware of participants' plans for OC use (95%).

Baseline and six-month mean OC knowledge scores were 22.8 and 24.7 (56% and 60% correct), respectively ($p<0.001$). Scores varied by nearly all sociodemographic characteristics (Table 1). Younger, less educated, racial/ethnic minority and unemployed women had lower OC knowledge scores than their counterparts at baseline and six months (all $p <0.001$). Participants with histories of OC use and pregnancy (but not abortion) had higher knowledge scores at baseline and six months than their counterparts (all $p<0.001$). Improvements in knowledge were similar across all sociodemographic and reproductive characteristics.

Mean baseline scores were similar between the text message intervention and routine care control groups (22.8 and 22.7, respectively, $p=0.75$), while mean six-month scores were higher in the intervention than control group (25.5 versus 23.7, $p<0.001$); this corresponds to a 7% versus 3% increase for the intervention versus control group ($p<0.001$).

In multivariable linear regression models, factors positively associated with six-month OC knowledge scores included Caucasian race/ethnicity (versus non-Caucasian) (ß=1.4), increasing years of education (ß=0.2), history of OC use (ß=0.7) and baseline OC knowledge (ß=0.5) (Table 2). Pregnancy history was negatively associated with six-month scores (ß= −0.7). These same factors were associated with baseline OC knowledge scores.

Receipt of the text message intervention was the strongest predictor of mean six-month knowledge scores in regression models. Participants who received the text message intervention scored on average 1.6 points higher than those in the control group (ß=1.6, CI 0.9-2.2). This positive intervention effect was stable when modeling the percentage point change in knowledge score outcome (ß=1.7, CI 1.0-2.3) (data not shown). Results were also stable when stratified by education level (Table 2).

We further examined scores by OC knowledge dimension and by question format (Table 3). Mean scores for specific knowledge dimensions improved over time for both the intervention and control groups (data not shown, all $p<0.05$), except for knowledge of OC risks (for the intervention group) and OC use (for either group). The intervention group had higher mean six-month scores on knowledge of OC mechanisms of action ($p=0.004$), effectiveness ($p<0.001$), side effects ($p=0.03$), and benefits ($p<0.001$) than the control group. When comparing the percentage point change in mean baseline and six-month scores, the intervention group experienced a higher increase in knowledge of OC benefits ($p<0.001$), with trends also noted towards greater improvements in mechanism of action ($p=0.07$) and effectiveness ($p=0.05$).

OC knowledge also varied by question format (Table 3). At baseline, participants from both the intervention and control groups scored similarly high on true-false questions (mean 76-77%) and low on multiple choice questions (mean 34-35%). At six months, the text message intervention group scored higher on true-false and multiple choice questions than did the control group ($p<0.001$), with a mean 10% versus 6% improvement in true-false scores ($p=0.002$), and mean 12% versus 2% improvement in multiple choice scores ($p<0.001$) for the intervention and control groups, respectively.

4. Discussion

OC knowledge in our young, diverse, inner-city sample was low, with women responding correctly to just over half of the questions on our comprehensive knowledge questionnaire at baseline and at the six-month follow-up. Scores were low even among those who received the educational text message intervention. Our intervention group experienced a higher increase in mean scores compared to women who did not receive the educational text messages, with the largest improvements in knowledge of OCs benefits, mechanism of action and effectiveness. While the 2.7-point mean score increase overall and smaller increases by dimension were statistically significant, they may not be clinically significant.

Other researchers have noted poor OC knowledge and limited effects from educational and counseling interventions [21,23,26,31], though few have tested innovative education strategies for most widely-used reversible contraception [32,33]. In our review of 21 studies assessing OC knowledge [31], three of the four trials that tested knowledge-based interventions found improvements in at least one dimension of OC knowledge; none used modern technologies [21,23,26,31]. Improvements were noted in knowledge of OC use [21,23,26] but less commonly in efficacy [21] and benefits [26]. However, we were unable to draw any conclusions on the extent and clinical relevance of knowledge improvements in any of the reviewed studies, and reliability, validity and comprehensiveness of OC knowledge measures were limited [31].

OC knowledge varied by question type, a finding noted by others reporting on question design in preventive reproductive health surveys [27,28]. For instance, our participants performed well on true-false questions, a format with an inherent 50% chance of a correct response. Merchant *et al.* [28] tested the effect of question wording in a preventive health survey (including three OC questions) of 570 emergency department patients and found that women had higher percentages of correct answers on “agree-disagree” format questions than on multiple choice questions. The authors suggest that “agree-disagree” wording and alternate response question formats may contribute to acquiescence bias [28]. Given that “true” was the correct response for 7 out of 10 true-false items in our survey, the usefulness of these OC knowledge questions is unclear.

Furthermore, the 10-12% improvement in scores for true-false and multiple choice questions among participants receiving the educational text message intervention may reflect properties of both our survey and intervention. While 78% of our survey items were derived directly or indirectly from content in the text messages and although we used rigorous instrument design processes, the influence of text message and question content and wording requires further investigation. Measures that precisely reflect comprehension of OC knowledge are needed.

Beyond the positive but modest effect of our text message intervention, our study highlights important sociodemographic and reproductive factors associated with OC knowledge. Disparities in knowledge exist, with younger, minority and less educated women having the poorest knowledge of OCs. Other researchers have reported similar social differentials, noting lower knowledge among Hispanics compared to non-Hispanics [16], younger college students versus older students [13], and among those with less education [22]. Previous OC use was positively associated with OC knowledge in our study but opposite trends were noted for history of pregnancy, which others have also found [7,22,29]. Both of these associations may reflect an unmet need for contraceptive information. Further evaluation of reproductive history, previous experiences with contraception and broader socioeconomic differentials in reproductive health knowledge is needed to understand the myriad of factors contributing to OC knowledge and ultimately behavior.

5. Conclusion

Daily, comprehensive, educational text messages for six months modestly improved OC knowledge among multi-ethnic, inner-city young women. Our intervention capitalized on a ubiquitous device and information technology to communicate sexual health information and adapt health services delivery to meet reproductive-aged women where they live. Greater understanding of OC knowledge and the benefits of receiving comprehensive information about OCs via text messages is needed. Yet, innovative, patient-friendly, and comprehensive approaches to health information and care delivery may have the most potential to improve family planning outcomes and promote sexual and reproductive health and well-being.

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Table 1

Selected sociodemographic and reproductive characteristics associated with baseline and six-month oral contraceptive knowledge scores

Baseline sociodemographic characteristics (n=659)	Baseline knowledge score	(p)	Six-month knowledge score	(p)	Change in score (p)
Age		<0.001		<0.001	0.75
Adolescents ages 13-19 yrs (n=210)	21.0		22.8		
Young adults ages 20-24 yrs (n=449)	23.6		25.6		
Education		<0.001		<0.001	0.49
< High school (n=101)	19.9		21.6		
High school diploma/GED (n=141)	21.3		23.6		
> High school (n=417)	24.0		25.8		
Race/ethnicity		<0.001		<0.001	0.73
African American (n=270)	21.2		23.0		
Hispanic (n=167)	21.8		23.7		
Caucasian (n=189)	25.7		27.6		
Asian or other (n=33)	23.7		26.3		
Employment status		<0.001		<0.001	0.15
Employed (n=366)	23.4		25.4		
Unemployed (n=293)	22.1		23.8		
Past OC use		<0.001		<0.001	0.53
Yes (n=502)	23.4		25.3		
No (n=157)	20.9		22.6		
Past pregnancy		<0.001		<0.001	0.75
Yes (n=270)	23.8		25.7		
No (n=389)	21.3		23.2		

Results are presented as mean oral contraceptive (OC) knowledge scores and mean change in knowledge score points (pts), with p-values (p) from comparisons in scores across groups with independent and paired t-tests or ANOVA, where appropriate.

Table 2

Predictors of oral contraceptive knowledge at six months: results from multivariable linear regression models

	All women			Women with high school education or less			Women with greater than high school education		
	β	SE	95% CI	β	SE	95% CI	β	SE	95% CI
Caucasian race/ethnicity (versus Non-Caucasian)	1.4	0.4	0.7, 2.0	2.3	0.8	0.8, 3.8	1.3	0.4	0.5, 2.0
Education (per additional years)	0.2	0.1	0.1, 0.4	-	-	-	-	-	-
Past pregnancy (yes)	−0.7	0.3	−1.3, −0.1	−0.9	0.5	−1.9, 0.1	−0.7	0.4	−1.4, 0.1
Past OC use (yes)	0.7	0.4	0.1, 1.4	0.4	0.5	−0.6, 1.4	1.3	0.5	0.3, 2.2
Baseline knowledge (score)	0.5	0.1	0.4, 0.6	0.6	0.1	0.5, 0.7	0.5	0.1	0.4, 0.6
Text message Intervention group (versus control)	1.6	0.3	0.9, 2.2	1.4	0.5	0.4, 2.4	1.7	0.3	1.0, 2.3

OC = oral contraceptive. Results are presented as standardized beta coefficients (β) with standard errors (SE) and 95% confidence intervals (CI) from reduced multivariable linear regression models for six-month OC knowledge scores among all women and by education level (≤ high school education versus > high school education).

Table 3

Oral contraceptive knowledge scores among the text message intervention and routine care control groups, by knowledge dimension and question format

OC knowledge scores, by dimension and question format (# questions) [# text messages]	Baseline scores			Six-month scores			Percentage point change in scores		
	Text group	Routine care	P	Text group	Routine care	P	Text group	Routine care	p
Total score (41) [47]	22.8	22.7	0.75	25.5	23.7	<0.001	7	3	<0.001
Mechanism of action (4) [4]	2.6	2.5	0.60	3.2	3.0	0.004	15	11	0.07
Effectiveness (2) [6]	1.7	1.7	0.45	1.9	1.8	<0.001	10	−6	0.05
Use (9) [17]	7.2	7.3	0.94	7.2	7.3	0.28	<1	<1	0.41
Side effects (4) [5]	2.3	2.3	0.71	3.0	2.9	0.03	18	15	0.21
Risks (9) [13]	3.3	3.1	0.27	3.4	3.4	0.87	1	3	0.34
Benefits (13) [14]	5.2	5.4	0.42	6.9	5.5	<0.001	13	9	<0.001
Question format									
True-false (10)	7.7	7.6	0.23	8.7	8.1	<0.001	10	6	0.002
Alternate choice (16)	10.1	10.1	0.37	10.1	10.1	0.86	<1	<1	0.53
Multiple choice (15)	5.0	5.2	0.27	6.7	5.5	<0.001	12	2	<0.001

OC = oral contraceptives. Results are mean baseline and six-month scores (points) and percentage point change in knowledge scores overall, by OC knowledge dimension and by question format for the intervention and control groups. P-values from Student's t-test.