

Effect of Daily Text Messages on Oral Contraceptive Continuation

A Randomized Controlled Trial

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OBJECTIVE: To estimate whether daily educational text messages affect oral contraceptive pill (OCP) continuation at 6 months.

METHODS: We randomized young women electing OCPs at an urban family planning health center to either routine care or routine care plus 180 days of daily educational text messages. Investigators masked to treatment allocation randomized participants who were not masked to treatment. The primary outcome measure was self-reported OCP continuation through a telephone call at 6 months (contacts between 5 and 8 months).

RESULTS: We enrolled 962 participants (480 intervention and 482 routine care) and obtained continuation data on 683 (346 and 337, respectively). At the follow-up, 64% of participants randomized to the intervention were still OCP users compared with 54% of the routine care group ($P=.005$). Continuation was highest in the intervention group if the interview took place while the intervention

was ongoing (75% compared with 54%, $P=.003$); the effect of the intervention on continuation was less after the intervention ended (60% compared with 54%, $P=.16$). Participants receiving the intervention were more likely to continue oral contraception than control participants at 6 months (odds ratio 1.44, 95% confidence interval 1.03–2.00) in analyses adjusted for age, race or ethnicity, age at coitarche, pregnancy history, and OCP experience.

CONCLUSION: The use of daily educational text messages improves OCP continuation at 6 months over routine care alone. Ten women would need to receive this simple intervention to improve continuation in one. This effect is strongest in the women whose follow-up took place while the text intervention was ongoing.

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Fifty percent of patients worldwide take medications improperly, and this poor adherence to medications can result in adverse outcomes.¹ Young women are most likely to choose oral contraceptive pills (OCPs) for pregnancy prevention,² but improper use and discontinuation are common. Six-month OCP continuation rates in young women range from 12% to 58%.^{3–5} Oral contraceptive pill misuse, failure, and discontinuation lead to 1 million unintended pregnancies each year in the United States.⁶ Failure to establish a routine of taking the pill is a common reason for OCP discontinuation.⁷

Text messaging has been investigated as an adjunct to routine health care, including the management of chronic medical conditions and medication regimen adherence. Studies have evaluated text messages as behavior modifiers,^{8,9} laboratory result ser-



vices,¹⁰ and medication reminders.^{11,12} Only one trial has evaluated the use of daily text messages on OCP adherence and yielded null results. In that study of 82 women, both the control and the intervention groups used an electronic device that tracked pill-taking behavior for 3 months. Use of the device did not resemble ordinary OCP use; thus, it is difficult to interpret the results. That study did confirm the prevalence of missed OCPs with all participants missing nearly five pills per cycle.¹³

Young women lead the way in cell phone use.¹⁴ Monthly cell phone bills reveal that women under age 18 years send and receive 4,050 text messages monthly followed by young adult women up to age 24 years who send and receive 1,630 text messages monthly.¹⁵ Our study estimates whether a daily educational text message, in addition to routine clinical care, affects 6-month OCP continuation rates in young women.

MATERIALS AND METHODS

We recruited women younger than age 25 years at a Planned Parenthood family planning health center in downtown Brooklyn, New York. Clients were eligible for participation if they were sexually active, owned a cell phone with text messaging functionality, and had no medical contraindications to oral contraceptive use. The Columbia University Medical Center institutional review board and the Research Department at Planned Parenthood Federation of America approved the study. Bilingual study staff screened all participants, who provided written informed consent, completed a baseline questionnaire, and agreed to be contacted by phone after 6 months for an exit questionnaire. At enrollment, we provided participants with \$10 compensation, the average cost of 180 additional text messages.

We randomized participants to receive routine care or routine care plus a daily text message for 6 months using 1:1 fixed allocation randomization with blocks of four. Staff members who had no contact with the enrollment site or study participants used a random-number table to generate the sequence and placed assignments into sequentially numbered, sealed opaque envelopes. We kept the sequence in a password-protected database. Randomization envelopes were opened by recruiters at the enrollment site after all enrollment procedures were completed. Study participants could not be masked.

All participants received routine care following health center protocols, including contraceptive counseling by staff and an educational information handout detailing use, effectiveness, benefits, and risks. The in-

tervention group also received 180 daily text messages that included an introductory message, three reminders of how to change contact information or message time, 47 individual educational messages that were repeated up to four times, 12 two-way messages for quality control, and a final message (available in the Appendix online at <http://links.lww.com/AOG/A272>). The educational messages were adapted from information in the handout, were both positive and negative in content, and included: "The pill improves anemia" and "Women who use the pill have a slightly greater risk of developing blood clots in their legs." The educational messages incorporated six domains of OCP knowledge: risks, benefits, side effects, use, effectiveness, and mechanisms of action.¹⁶ The two-way messages asked for participant feedback and included: "We want 2 know if ur receiving this message at the time u requested. Please reply 1 for Yes or 2 for No." We maintained a total message length under 160 characters. To maintain confidentiality, the messages did not refer to the participant by name or specify that they were reminders to take OCPs. We prepared Spanish research documents and text messages, but all participants chose to complete documents and receive messages in English.

The notification company began to send out text messages using a secure web-based platform on a start date specified by the participant at enrollment. The start date depended on the participant's OCP use status (new start compared with ongoing user) and, for ongoing users only, date of next pack start. Participants chose the time they wanted messages to be sent and could change the time by logging onto the study's web portal. Participants could also change their contact information or discontinue receiving messages at any time. We informed participants that all medical questions should be directed to their health care providers.

We collected participant contact information, including two alternate contacts, at enrollment. We planned for participants to undergo a single telephone interview 6 months after enrollment to assess our primary outcome, OCP continuation. Contact attempts began at 5 months and, for difficult-to-reach participants, continued until 8 months. To achieve desired follow-up rates, we added compensation for completing the 6-month interview. We asked participants if they had taken a pill within the last 7 days, which we defined as continuation. Because some interviews took place 6–8 months after enrollment, and thus up to 2 months after the intervention had ended, we also asked the participant if she had been taking the pill on the date 6 months after her enroll-



ment. We further assessed continuation by asking about missed pills, interruptions in OCP use of greater than 7 days, and use of the OCP at last sexual intercourse. We created a variable for cell phone service interruptions during the study; participants were assigned to this variable if they reported either a new cell phone number or service provider or service suspensions in the past month. To have 80% power ($P=.05$, two-sided) to detect a 10% change in OCP continuation between the two groups, with an assumed 6-month continuation rate of 40% in the routine care group and a 15% loss to follow-up, we required 480 women in each group (960 total).

Using an intent-to-treat approach, we tested the hypothesis that educational daily text messages would affect oral contraceptive continuation. We used Student's t test to compare continuous variables and Pearson's χ^2 test to compare categorical variables when describing the population and assessing characteristics associated with 6-month OCP continuation. We conducted multivariable analyses with logistic regression using variables associated with continuation in univariable analyses. We evaluated for fit using likelihood ratio tests. We also evaluated outcomes in subgroups using both univariable and multivariable analyses. We used SPSS 18 software to compute all statistics.

RESULTS

We screened women from March 2008 through July 2009; 78% were ineligible, 4,163 (80%) of these

electing a non-OCP method of birth control (Fig. 1). Only 212 (4%) clients screened had no cell phone. We randomized 968 participants. Participants randomized to the text message intervention began receiving messages a median of 4 days (range 0–84 days) after enrollment. Four participants randomized to the intervention never received texts because they provided blocked or nonworking phone numbers. Forty-two participants randomized to the intervention discontinued text messages during the study after receiving a median of 71 messages (range 1–170).

Participants were aged 13 to 25 years with 35% younger than age 20 years. Eighty-four percent were born in the United States and 60% were students. Only 11% had delivered a child, but 88% percent planned future childbearing (Table 1). Most were in a sexual relationship and satisfied with that relationship, but few were cohabiting.

Twenty percent of participants were OCP users at enrollment (ie, took a pill within the last 7 days) and 75% ever used OCPs. Of ever OCP users, 22% discontinued past OCP use because they could not remember to take their medication. Almost all participants (98%) planned to use the pill for at least 6 months.

Seventeen percent of participants took concomitant medications, most commonly for asthma (50%), a psychiatric condition (13%), or seasonal allergies (11%). Forty percent reported forgetting and 33% worrying about forgetting to take these medications on time.

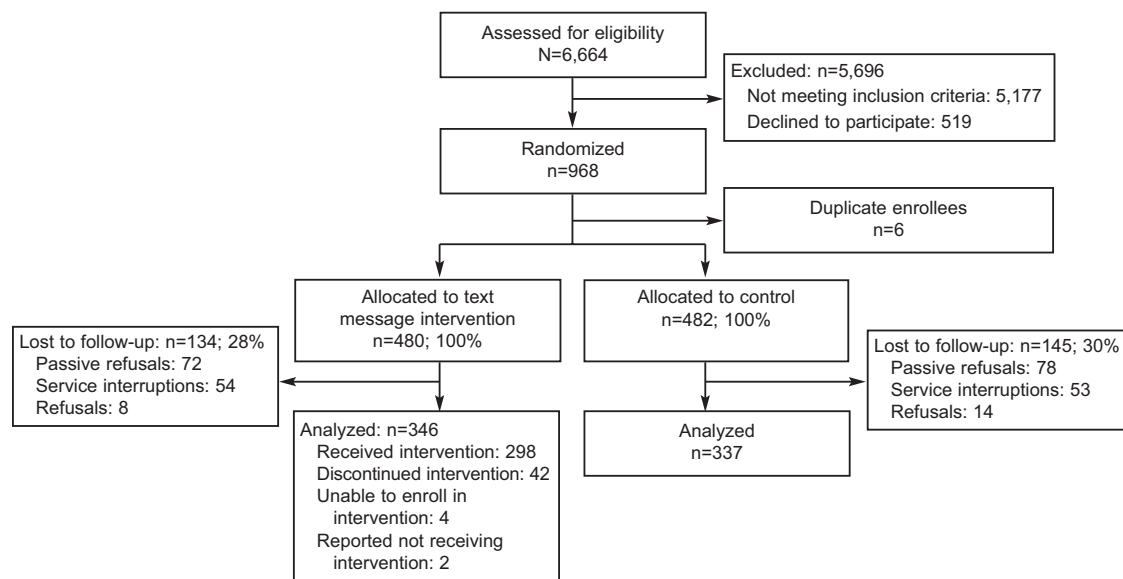


Fig. 1. Flow of participants through the trial. Passive refusals: never responded to up to 30 contact attempts. Service interruptions: all contact numbers did not work.

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Table 1. Baseline Characteristics by Randomization Groups

Characteristic	Text Group (n=480)	Control Group (n=482)
Demographic		
Age (y)*	20.8±2.5	20.4±2.7
Race or ethnicity		
African American	188 (39)	216 (45)
Hispanic	138 (29)	122 (25)
White	131 (27)	125 (26)
Asian	23 (5)	19 (4)
Years of school completed	13±2.0	13±2.2
Employed	272 (57)	255 (53)
Sexual history		
Age at coitarche (y)	16.3±2.1	16.2±2.0
Never been pregnant	256 (53)	266 (55)
Parous	53 (11)	54 (11)
History of abortion	204 (43)	205 (43)
Relationship history		
Has main sexual partner now	415 (87)	428 (89)
Satisfied with relationship	396 (83)	414 (86)
Cohabiting	84 (18)	78 (16)
Partner knowledge of plan to use OCP	357 (74)	366 (76)
Partner wants pregnancy in 6 mo	30 (6)	39 (8)
When partner wants pregnancy		
2 y or more	269 (56)	297 (62)
Within next 2 y	70 (15)	75 (16)
Never	39 (8)	34 (7)
Likelihood of pregnancy in next 6 mo		
Likely	21 (4)	28 (6)
Unlikely	458 (95)	453 (94)
Feelings if pregnancy in next 6 mo		
Happy	112 (23)	97 (20)
Upset	358 (75)	383 (79)
Contraceptive history		
Current user of OCP	91 (19)	97 (20)
Has used an OCP [†]	380 (79)	343 (71)
Forgot to take pills before*	295 (61)	259 (54)
Once per mo	131 (27)	121 (25)
2 or more times per mo [‡]	164 (34)	135 (28)
Satisfied with OCP use in past	341 (71)	313 (65)
Considered other methods at baseline	122 (25)	100 (21)
Other		
Smoke cigarettes	66 (14)	60 (12)
Take medications for other conditions	80 (17)	79 (16)
Cell phone use		
Cell phone with them 24 h/d	433 (90)	429 (89)
Unlimited text messaging plan	388 (80)	379 (78)

OCP, oral contraceptive pill.

Data are mean±standard deviation or n (%).

* $P=.02$.† $P=.004$.‡ $P=.04$.

Participants reported having the same cell phone number for almost 3 years, but 13% reported at least one service suspension in the past 6 months lasting an average of 12 days. Only 2% of participants shared a phone. Participants reported sending and receiving 171 text messages per day and only 9% ever worried about the cost of text messaging. Randomization yielded similar groups, except that intervention group participants were more likely to have ever used OCPs (79% compared with 71%), more likely to have forgotten to take pills before (61% compared with 54%), and more likely to have missed two or more pills per month (34% compared with 28%) than control group participants.

We obtained follow-up information from 683 (71%) participants at a 6-month telephone interview. We made up to 31 attempts (median, four) to reach participants. The median time to follow-up was 204 days from enrollment. Of those reached, 28% reported cell phone service interruptions or changes during the study period; this did not differ by group assignment. Thirty-eight percent of loss to follow-up was the result of service interruptions of all contact numbers provided at enrollment. Compared with participants reached, those lost to follow-up were younger, had completed fewer years of school, were less likely to identify as Hispanic, more likely to have been pregnant or given birth, and less likely to be current users of OCPs (all $P<.03$).

Most participants were satisfied with the number (91%), content (91%), and length (90%) of the messages received. Eighty-five percent reported the messages helped them remember to take the OCP with 81% taking a pill within 1 hour of receiving a text. Nearly half (49%) wanted to continue receiving the messages.

The intervention group ($n=346$) consistently had higher OCP continuation rates than the routine care group ($n=337$) regardless of how we defined continuation (Table 2). For every 10 women we enrolled in this 6-month daily text message intervention, we noted improved OCP continuation in one of them. Exploratory analyses revealed that OCP continuation was greatest in the intervention group compared with the control group (75% compared with 54%, $P=.003$) if the follow-up interview occurred while the intervention was ongoing (ie, within 187 days of enrollment). Intervention group participants reached after 187 days remained somewhat more likely to continue OCPs (60% compared with 54%, $P=.16$). Oral contraceptive pill continuation remained stable (52–55%) in the control group whether follow-up occurred at 5, 6, 7, or 8 or more months after enrollment. However,



Table 2. Six-Month Continuation, Intent-to-Treat Analyses

Continuation Variable	Subgroup (n)	Text Group (n=346)	Control Group (n=337)	Difference (%)	P
OCP user at follow-up		223 (64)	182 (54)	10	.005
Follow-up 187 d or less	200	76 (75)	53 (54)	21	.003
Follow-up 188 d or more	483	147 (60)	129 (54)	6	.16
No OCP use interruptions*		203 (59)	162 (48)	11	.006
Missed no pills during the past month		136 (39)	92 (27)	12	.04
OCP use at last intercourse		238 (69)	202 (60)	9	.03

OCP, oral contraceptive pill.

Data are n (%) unless otherwise specified.

* More than 7 days without OCPs.

the improved continuation in the intervention group gradually decreased over time from 82% to 54% such that by 8 months, the effect of the intervention was extinguished.

The first interruption in pill use was 16 days later in the intervention group than the control group ($P=.04$). Control group participants reported missing more pills per month (1.1 compared with 0.7, $P=.01$). Ninety-four percent of participants were sexually active during the study period. At last sexual intercourse, 69% of the intervention group were OCP users compared with 60% of the control group ($P=.03$). We repeated all analyses excluding the 69 women who never started the pill or were not sexually active; results for continuation were nearly identical (data not shown).

We also assessed baseline variables (shown in Table 1) to identify other factors associated with OCP continuation in this study. Table 3 lists those most associated with continuation (ie, $P<.05$). Those who continued OCP use were less likely to have had cell phone service interruptions or changes during the study period (22% compared with 36%, $P<.001$). Exploratory stratified analyses revealed that women with cell phone service interruptions ($n=189$) were much more likely to benefit from the intervention compared with those with no interruptions (25% improvement in continuation compared with 6%, $P<.001$).

We evaluated variables that were associated with continuation in multivariable analyses. We evaluated model fit using the likelihood ratio test and present the model with best fit in Table 4. After adjusting, text intervention group participants remained more likely than control participants to continue the OCPs ($P=.03$). Analyses stratified by age and history of OCP use revealed no difference in the effect of the intervention. Analyses stratified by race and ethnicity showed a slightly stronger effect in African Americans and whites than in Hispanics and Asians; further

analyses showed no evidence of a statistically significant interaction (data not shown).

DISCUSSION

This is a randomized study that evaluates the effect of text message reminders on OCP continuation. The 6-month continuation rate in the control group was

Table 3. Baseline Characteristics Associated With Oral Contraceptive Pill Continuation at 6 Months

Characteristic	Continuers (n=405)	Discontinuers (n=278)	P*
Demographic			
Age (y)	21.3±2.4	19.9±2.6	<.001
Race or ethnicity			
African American	134 (33)	144 (52)	<.001
Hispanic	100 (25)	78 (28)	
White	147 (36)	47 (17)	
Asian	24 (6)	9 (3)	
Years of school completed	13.9±2.0	12.9±2.1	<.001
Employed	245 (61)	130 (47)	<.001
Sexual history			
Age at coitarche (y)	16.7±2.1	15.9±1.8	<.001
Never been pregnant	262 (65)	139 (50)	<.001
History of abortion	137 (34)	131 (47)	<.001
Relationship history			
Cohabiting	78 (19)	33 (12)	.007
Partner knowledge of plan to use OCP	312 (77)	202 (73)	.02
Contraceptive history			
Has used an OCP	336 (83)	188 (68)	<.001
Satisfied with OCP use in past	313 (77)	162 (58)	.03
Considered other methods at baseline	76 (19)	82 (29)	.001

OCP, oral contraceptive pill.

Data are mean±standard deviation or n (%) unless otherwise specified.

* Student's *t* test for comparison of means; Pearson's χ^2 for comparison of proportions.



Table 4. Predictors of Oral Contraceptive Pill Continuation at 6 Months

Baseline Characteristic	Unadjusted Analysis	Adjusted Analysis*
Text intervention (n=683)	1.54 (1.14–2.10)	1.44 (1.03–2.00)
Age (y) (n=683)	1.24 (1.17–1.32)	1.14 (1.05–1.23)
Race or ethnicity (n=683)		
African American (n=278)	Referent	Referent
Hispanic (n=178)	0.84 (0.60–1.19)	1.23 (0.83–1.84)
White (n=194)	2.80 (1.93–4.07)	1.91 (1.19–3.08)
Asian (n=33)	1.88 (0.86–4.12)	1.87 (0.79–4.40)
Age at coitarche (n=670)	1.24 (1.14–1.35)	1.11 (1.01–1.23)
Never been pregnant (n=683)	1.83 (1.34–2.50)	1.49 (1.03–2.15)
Has used an OCP (n=683)	2.33 (1.63–3.34)	1.60 (1.05–2.45)

OCP, oral contraceptive pill.

Data are odds ratio (95% confidence interval).

* Simultaneously adjusted for all variables in the table.

similar to other recent reports.^{3–5} Six-month OCP continuation improved by 10% in the intervention group. This is a clinically meaningful difference; we are aware of only one intervention (enhanced pill pack supply) that has achieved such success.⁴ Furthermore, the text message reminders were also associated with OCP use at last sexual intercourse and with fewer missed pills during the trial. After the intervention ended, however, continuation rates gradually decreased to equal those in the control group.

This study included mostly young, minority women, a population with low rates of contraceptive continuation^{3,5} and high rates of unintended pregnancy.¹⁷ From a public health perspective, we need effective strategies to help these most at-risk women reach national family planning goals.¹⁸ Unlike programs that seek to change the behavior of an individual woman to increase OCP continuation (eg, through enhanced counseling), the text messaging intervention used in this study instead adapts the health system to improve outcomes. Such a strategy enables health care providers to enhance the contraceptive success of their patients simply by augmenting their clinical practice.

Limitations of this study include reliance on participant self-report of ongoing OCP use, inadvertent variable time to follow-up, and lack of tailored text message content. We found that women missed an average of one pill per month, whereas Hou, using a pill tracking device, found women missed five pills per month.¹³ Our participants likely underreported

missed pills, as has been noted elsewhere.¹⁹ This may indicate socially desirable reporting, and, of more concern, that women markedly underestimate how often they miss pills and may be unaware of their consequent increased risk of pregnancy. Consistent OCP use is key to avoiding ovulation²⁰ and thus unintended pregnancy. Our exploratory analyses (Table 2) revealed that participants with timely follow-up had higher continuation rates than those who had relatively late follow-up. This may be because the effect of the intervention was limited to women currently receiving the messages. It may also be that participants who were easier to reach may represent better OCP takers because they differ in unmeasured ways from the harder-to-reach subset. This study cannot distinguish which of these possible reasons might explain the difference. Lastly, in this trial, messages were not personalized; all participants received the same messages with identical content. Tailoring message content to the individual's education level, baseline OCP knowledge, or stage of change²¹ may increase the success of text messaging interventions.

Few interventions to improve medication adherence have shown improvements in adherence and treatment outcomes.²² Many interventions have been complex and labor-intensive, limiting their usefulness in clinical settings.²² In contrast, our study of a mobile health intervention used a ubiquitous device, the cell phone, and a technology, text messaging, that is increasingly used by reproductive-aged populations and can be automated to reach large populations. We previously found that most urban patients, even those without commercial insurance, have and use cell phones.²³ An online survey of 2,000 people similarly found that 79% of those with Medicaid regularly use their cell phones for text messaging.²⁴

Based on these results, sending 180 daily text messages to 10 women would improve 6-month OCP continuation for one woman. To set up a similar system, health care providers would pay an upfront fee to establish the service; subsequent per-message costs are low. Furthermore, free-to-end-user systems would eliminate cost concerns for women without unlimited text plans. Clinical facilities can incorporate this technology within electronic medical record systems. Alternately, women may self-select to enroll in online or smart phone reminder systems.

Cell phone service interruptions such as suspensions, lost phones, or changes in cell phone providers were common in this study (28%). Paradoxically, exploratory analyses demonstrated a stronger effect of the intervention in women who reported interrup-



tions. Interruptions may reflect a busier or more disorganized life, which may, in turn, indicate a group at higher risk for OCP discontinuation. Thus, populations likely to have service interruptions may be those who benefit most from the service. Interruptions in cell phone service must be anticipated and managed but need not serve as a deterrent to implementing a similar intervention. More investigation into cell phone variables and their effect on text messaging interventions is needed.

This intervention was successful in increasing OCP continuation at 6 months and continuation was enhanced most while the intervention was ongoing. The Transtheoretical Model contends that a behavior is maintained after 6 months of consistent implementation²¹; however, we found that the improved continuation in the intervention group did not persist after the texts were discontinued at 6 months. Therefore, the ideal time period needed to build lasting pill-taking habits is unclear. Future studies should also evaluate whether message content is pertinent or whether a message notification alone, regardless of content, is enough to improve continuation. This intervention is ready for use in clinical practice but would benefit from large-scale evaluation.

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