Evaluation report

Impact Evaluation of MomConnect

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1. Background

Maternal and Child Health remains a key public health priority in South Africa, with persistently high levels of morbidity and mortality despite some progress. To achieve the Sustainable Development Goal (SDG) target 3.1 of reducing the maternal mortality ratio from 138/100,000 in 2015 to below 70 deaths per 100,000 live births by 2030, intensified efforts will be required to increase the demand for, and supply of high- quality services (United Nations SDG 3, 2015).

MomConnect is a national initiative to strengthen maternal and child health outcomes. Launched in 2014, the MomConnect vision was to empower pregnant women who use public sector antenatal care and to receive their feedback on the quality of care they received (Barron 2018). MomConnect offers pregnant women the opportunity to use mobile phone technology to receive gestational age-appropriate messaging as well as to send pregnancy and parenting questions and concerns to the MomConnect Helpdesk. As a flagship programme of the South African National Department of Health, implemented with a strong team of partners, MomConnect has been successful in registering women at 95% of clinics to receive mobile phone messaging and promote linkages to services, reaching a coverage of over 60% of women nationally (Barron 2018). Through government commitment and external donor funding, MomConnect is integrated into the public health system as a national mobile health(m-health) programme and has the benefit of providing a large data collection tool on user patterns of pregnant women (Benjamin 2017).

Several studies have been conducted to evaluate the MomConnect programme to date. Skinner et al(2018) implemented a qualitative study in five provinces to assess the perceived value and experience by women who used the service. The findings confirmed that women found the messaging empowering and expressed strong support for the programme to continue. Similarly, Maliwichi et al (2021) investigated the scale up of mHealth initiatives in low- and middle- income countries. The findings revealed access to mobile phones was a barrier to the scale-up of the initiatives such as MomConnect. Some women, particularly those in rural areas were found to be without reliable access to mobile phones, while those with access to phones changed their cell phone numbers and network providers without informing the initiative administrators. Moreover, cultural and religious beliefs were found to be contributing to the underutilisation of the MomConnect messaging initiative, as some women preferred not to discuss their pregnancy with non-family members. In Johannesburg, a retrospective cohort study, conducted to compare maternal health services utilisation between those registered and not registered with MomConnect, found no difference between the groups. Methodological weaknesses such as the retrospective nature, lack of randomisation and small sample size were cited and possible reasons for not showing

an effect (Coleman 2017). In a separate review of the programme, facility staff experiences of the programme were explored, and staff described MomConnect as an added burden, requiring completion of a new and time-consuming task within an already time-pressured patient interaction without directly assisting other clinical and administrative work (Fisher 2019, Wolff-Piggott 2017).

While previous studies have generated valuable information, their designs have not enabled an assessment of the impact of the programme. To promote sustainability of the programme, impact evidence is required to justify allocating ongoing resources by both government and external donors. Evidence of the value of MomConnect will contribute to an investment case for mHealth services for pregnant women, and more broadly. To this end, Research and Training for Health and Development and Wits School of Public Health were contracted by Praekelt to conduct a Cluster Randomised Trial of the MomConnect Programme in 2019. The evaluation is funded by Grand Challenges Canada.

2 Evaluation aims and objectives

The evaluation aims and objectives were developed in consultation and discussion with Praekelt and the National Department of Health. The study aims to evaluate the effectiveness of the MomConnect programme to increase family planning use and breastfeeding among post-partum women attending primary health care services in two provinces in South Africa.

Specific objectives were:

1. To assess whether exposure to MomConnect increases uptake of family planning services 8-10 weeks post-partum compared to the control
2. To assess whether exposure to the MomConnect messages leads to higher levels of breastfeeding in the intervention compared to an unexposed control group
3. To assess whether exposure to MomConnect increases knowledge and self-efficacy to seek family planning and to breastfeed postpartum

3.Methods

Trial design and participants

A cluster randomised controlled trial (CRT) where clusters were defined as government Primary Health Care (PHC) clinics was used to evaluate MomConnect. Clinics were randomised to receive the intervention (new and existing messaging from MomConnect) or control (no messaging from MomConnect) groups. A total of 40 clinics with between 20 and 25 women recruited at each clinic were included.

Recruitment of participants at the clinics took place in the antenatal queue. All pregnant women waiting in the queue were informed about the study and women who indicated their interest were then screened for eligibility. To be eligible, women needed to be in their last trimester of the pregnancy (33 weeks or more), have a cell phone or daily access to a cell phone, age of 18 years or over and not be registered to receive MomConnect messages. Participants who were eligible then completed an informed consent process and the interview was scheduled.

Sample size

The sample size calculation was based on achieving 80% power to detect a 10-14% change in the primary study outcome -uptake of contraceptive services by eight to ten weeks postpartum- based on a projected increase from 50%-64%, while adjusting for the intra-cluster correlation coefficient (ICC) of 0,2(Marlow et al, 2015, Cherish, 2017). On this basis we estimated that a minimum number of 40 clinics (20 per each arm) with 25 women recruited at each PHC clinic will be required. A total of 500 women per arm and 1000 in total were recruited and followed up at about eight-ten weeks postpartum

Study sites

The study sites were three districts in two provinces, namely:

- West Rand District-Gauteng Province: urban and peri-urban setting 16 clinics
- Sedibeng District-Gauteng Province: urban, and peri-urban setting 14 clinics
- Bojanala district, North West Province: urban, peri-urban and rural setting 10 clinics

The districts were selected purposively as they represented urban, peri-urban and rural areas. Clinics were selected based on having both high utilisation rates and low levels of MomConnect registration as determined by Department of Health records .

Intervention

The intervention included both existing MomConnect messages on breastfeeding and new post-partum family planning messaging that were developed specifically for the impact evaluation. Existing breastfeeding messaging contained breastfeeding information and encouraged new mothers to exclusively breastfeed for six months postpartum. New messages contained post-partum family planning information and the value of using family planning six weeks postpartum. The messages sought to increase knowledge and self-efficacy to use family planning. Participants who were receiving antenatal care at a clinic that was randomly allocated to the intervention group were registered remotely on MomConnect by Praekelt to receive messages via SMS or WhatsApp depending on the type of phone they owned or had regular access to. For those receiving SMS messages, a standard set of SMSs relevant to the gestational stage of their pregnancy and to the post-partum period were received. For those receiving WhatsApp messages, participants received a message aligned to their next clinic appointment reminder and then had to respond with the word "yes" to receive more detailed messages. For both SMS and WhatsApp message recipients, the content of the messages included all standard MomConnect messages e.g., on the importance of breastfeeding, as well as nine additional messages on family planning which were developed and added for the purposes of the evaluation. Only study participants allocated to the intervention group were meant to receive these family planning messages. Women who received antenatal care at a clinic that was randomised to the control group, received the standard antenatal and postnatal care at the clinic and MomConnect registration was offered to them after the endline data had been collected at between 8 and 10 weeks postpartum. As per the Praekelt standard, SMS messages were in English, isiZulu and Tswana, while WhatsApp messages were in English only.

Randomisation

A stratified randomised matching approach was used applying block randomisation within each district, which formed a stratum. Field workers, clinic managers and participants were blinded to the allocation status of the clinic for the duration of the study. Within each of the three districts, the clinics were randomised 1:1 into either intervention or control groups. In total, 20 clinics were assigned to each arm. This was done by a senior researcher using a random number generator in Excel. Each clinic was numbered between 1 and 16 for west rand, between 1 and 14 for Sedibeng and between 1 and 10 for Bojanala. Eight, 7 and 5 random numbers in the respective ranges were generated and the clinics that were numbered with the random numbers were then allocated to the intervention. Women who attended the intervention clinics were registered with MomConnect after the baseline interview, while those in the control clinics were registered after their endline interview.

Data collection

Baseline interviews were conducted at the clinic and took about 30-45 minutes. Interviews were completed using a structured questionnaire on Samsung tablets. Study data were collected and managed using REDCap electronic data capture tools hosted at the University of the Witwatersrand(Harris et al, 2019). REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture. Data were collected offline and then uploaded to the server on the same day as data capture. The endline questionnaires were conducted telephonically 8-10 weeks post the expected date of delivery. Efforts were made to reach the participant using the cell phone number provided at the baseline. If the participant was not reachable on their number, the two other next-of-kin provided at baseline data collection were contacted to reach the participant. After three attempts to reach the participant on different days and at different times, the participant was classified as unreachable and hence lost to follow-up. After completion of the questionnaire field workers uploaded the data. Questionnaires were checked centrally for quality including completeness. The data were imported into STATA 17 for analysis.

Consultations and health service engagements

District Health engagement meetings were held with each of the District Health Departments prior to commencement of baseline data collection. The aims of the study and data collection procedures were presented, as well as the list of proposed clinics to be included within each district. In Sedibeng, the district team proposed some alternative clinics, where they anticipated lower rates of MomConnect registration due to late bookings. Prior to recruitment at each clinic, the field work supervisor or team leader contacted the clinic manager to inform them that the fieldwork was about to commence at the clinic. At the first visit the facility manager introduced the fieldwork team to key staff at the clinic including the professional nurse in charge of antenatal care, the mentor mother (a layperson responsible for registering pregnant women on MomConnect) or other staff who could facilitate the research. In the majority of clinics, data collection occurred outdoors in an area where auditory privacy could be assured. A few clinics had a venue indoors where the field worker could be accommodated for the interview.

Field worker training

A one-week fieldworker training was conducted prior to the start of the baseline data collection and was followed by several refresher trainings. The training covered the study design, recruitment criteria, screening form, obtaining informed consent, REDCap (the software used to collect data), the different sections of the questionnaire and administering the questionnaire. Standard Operating Procedures (SOP) were developed and shared with the field work team to guide the standardised

implementation of all study procedures. This included a COVID-19 SOP which covered the use of personal prevention equipment (PPE) and completion of a daily symptom questionnaire and temperature check by fieldworkers. It also included regular hand and surface sanitisation and maintaining a 1,5 metre distance from participants. Prior to the endline data collection, fieldworkers were trained in the endline questionnaire and conducting the follow-up telephonic interviews.

Measures

The primary outcome measures were initiation of modern contraception uptake (if method included any of the highly effective methods including long -acting contraceptives) and breastfeeding at 8-10 weeks postpartum. Secondary outcomes were knowledge and self-efficacy related to both breastfeeding and family planning, as well as support seeking behaviour . Composite scores for knowledge and self-efficacy were developed as per Table 1. The internal consistency for the scales was acceptable (α=0.71) to very good (α=0.85).

Table 1: Statements included in composite scores for family planning and breastfeeding knowledge and self-efficacy

Secondary outcomes	Statements (response options: definitely true, probably true, probably false, definitely false)
Knowledge of family planning (Cronbach's alpha=0.82)	● A woman cannot get pregnant if she is feeding her baby ● Contraceptives are safe while breastfeeding your baby ● There are long lasting contraceptives, like and IUD(loop) which can be kept for several years ● Having a space between children of at least 2 years is good for the health of the child and the mother ● The injection stops your body from producing an egg ● Using the pill or implant won't stop you from having a baby in the future
Knowledge of breastfeeding (Cronbach's alpha=0.75)	● A woman cannot get pregnant if she is both breastfeeding and feeding her baby formula ● Your baby needs only breastmilk and nothing else for the first six months ● You should not give your baby porridge or juice until they are 6 months old ● Breastmilk helps fight disease ● If you breastfeed too much your body will stop making milk ● If you breastfeed your bleeding may be less after birth
Family planning self-efficacy (Cronbach's alpha=0.85)	● I feel confident that I can get information about different types of family planning methods ● I am confident that I will be able to get family planning even if I have to wait in long queues ● I am confident that I can discuss how many children I want with my partner ● I am confident to discuss family planning methods with my friends
Breastfeeding self-efficacy Cronbach's alpha=0.71)	● I am confident that if I set a goal of breastfeeding for six months that I will be able to achieve it ● I am confident that even if I experience challenges and difficulties breastfeeding that I will be able to overcome them

Data analysis

Baseline and endline datasets were merged using study identification number and facility record number, and data analyses were performed in Stata 17.

Intention to treat analysis

Intention to treat analysis was conducted where participants were analysed by the trial arms to which they were allocated regardless of their exposure to MomConnect. The effect of loss to follow-up was assessed by comparing socio-demographic characteristics amongst those who were retained and those who were lost.

The main study outcomes were measured by comparing proportions between intervention and control groups and applying a chi-squared and Fisher Exact (for small numbers) tests of statistical significance. In addition, sub-analyses by age (18-24 years compared to 25 and older) and previous pregnancy history (first pregnancy compared to multiple pregnancies) were conducted to assess differences between those in the intervention and control groups within these categories.

For knowledge and self-efficacy some responses were reverse coded as necessary and then summed to create a score. The normality of the distribution of scores were assessed. Mean knowledge and self efficacy scores were compared between the intervention and control groups at endline using a two-sample t-test 5 % probability to reject the null.

Per protocol analysis

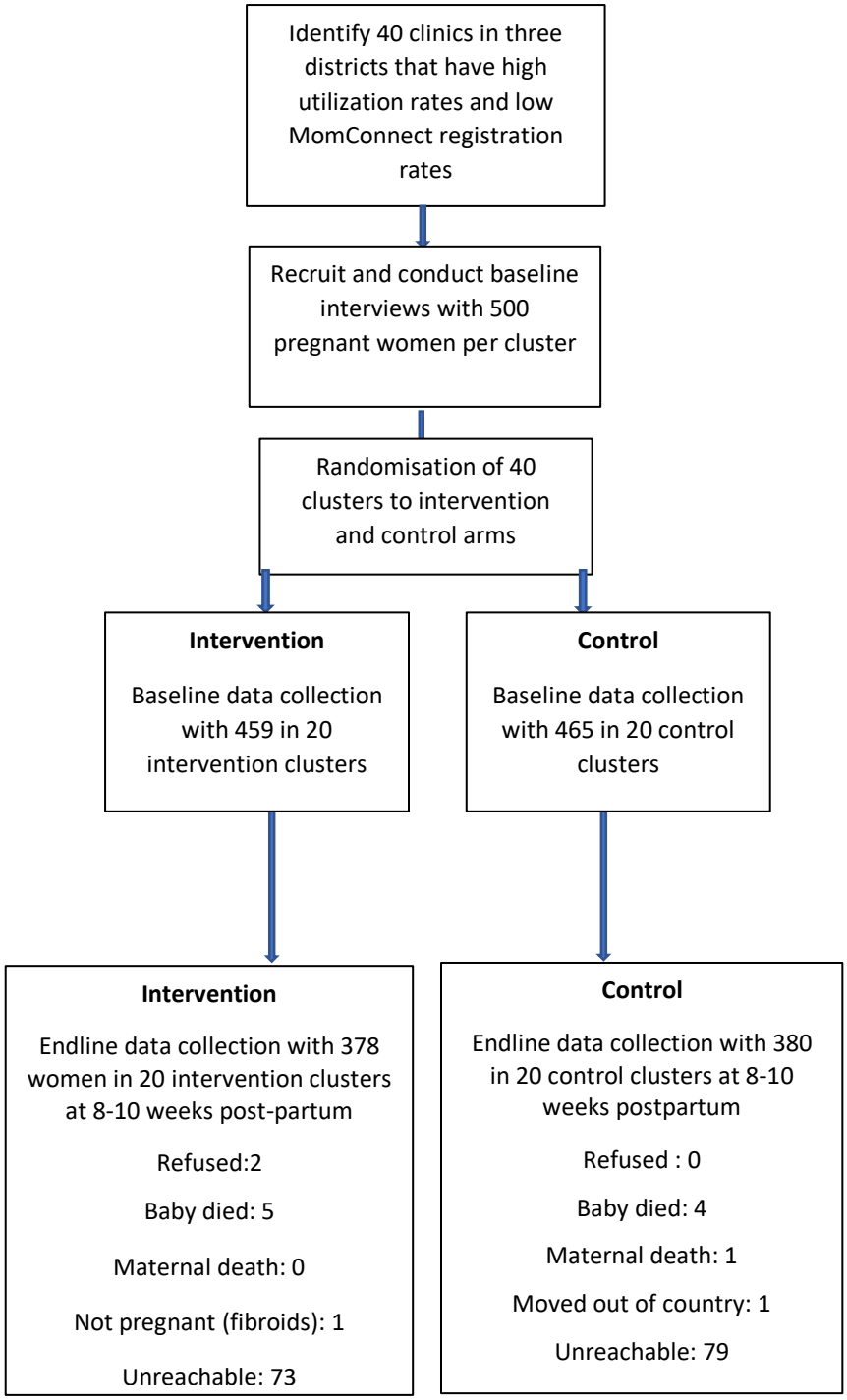
Since MomConnect is a national programme it was possible that pregnant women who were in the control group (attending clinics randomly allocated to not receiving MomConnect messages) may have been exposed to MomConnect either during a previous pregnancy and/or sought registration onto the platform through the routine clinic registration system. In addition, some intervention participants may not have received MomConnect messages because they did not have data, changed their cell phone numbers, or delays in registration. To account for these possible misclassifications of exposure, the data were analysed by exposure group which was determined from the Praekelt records on the total number of messages sent to user cellphone numbers. Participants were assigned exposed and non-exposed status and a regression analysis was conducted controlling for potential confounders: education, relationship status, district, age and time since baby's date of birth to the exposure outcome. The potential confounders were identified by comparing socio-demographic characteristics among those categorised as exposed and unexposed to the MomConnect intervention.

Ethical approval

Ethical approval was granted by the Wits Health Sciences Ethics committee, number: M1911160. Written informed consent was obtained prior to administering the baseline questionnaire. Data were collected electronically in REDCap and uploaded daily to a secure server located at Wits University. In addition, approval was received from the North West province Health Department and the Sedibeng and West Rand districts in Gauteng province.

4. Results

At baseline 924 pregnant women were recruited into the trial across the 40 clinics—459 in the intervention, and 465 in the control. Of these, 758 were followed up at 8-10 weeks post- partum for the endline interview, 378 (82.3%) and 380 (81.7%) from the intervention and control groups respectively, giving a follow-up rate of 82%. (Figure 1)



A further 123 participants were excluded from the per protocol analysis most likely since their telephone numbers were no longer valid with an alternative number not located and hence they were not registered on the MomConnect platform.

Equivalence between arms and loss to follow-up

At baseline, women allocated to the intervention and control groups were similar in terms of age, employment, education and number of previous children. However differences were noted in household income and relationship status (Table 2).

Those that were lost to follow-up were more likely to be younger (aged 18-24 years), have a household income of <R1000 per month and not completed high school. There were no significant differences in district, employment or home language between those that were retained at endline and those that were not (Table 3).

Equivalence was also assessed for time from the baby's date of birth to the endline interview date to ascertain if there were differences in the time to make desired changes between the intervention and control groups. No significant differences were measured for baby date of birth to follow-up -a mean of 98 days (SD 47.3) in the intervention group and 100 days (SD44.0) in the control group (p=0.56).

Table 2: Comparison of socio-demographic characteristics between intervention and control groups of participants at baseline

Variable	Range	Baseline results	Baseline		p-value
			Control	Intervention	
		Number (%)	*Number(%)*	*Number(%)*	
Age groups (years)	18-24	308(33.51	168(36.29)	140(30.70)	Fisher's exact 0.399
	25-29	236(25.68)	103(23.54)	127(27.85)	
	30-34	228(24.81)	112(24.19)	116(25.44)	
	35-39	130(14.15)	66(14.25)	64(14.04)	
	40 years or older	17(1.85)	8(1.73)	9(1.97)	
	Total	**919(100)**	**463(100)**	**456(100)**	
Household Income in last month	R1-R1000	109(12.22)	65(14.77)	44(9.73)	0.039
	R1001-R2000	182(20.40)	96(21.82)	86(19.03)	
	R2001-R5000	362(40.58)	177(40.23)	185(40.93)	
	R5001-R10000	187(20.96)	78(17.73)	109(24.12	
	R10000 or more	52(5.83)	24(5.45)	28(6.19)	
	Total	**892(100)**	**440(100)**	**452(100)**	
Employment-worked for money in past 12 months	Each month	194(21.20)	98(21.49)	96(20.92)	0.283
	Most months	72(7.87)	33(7.24)	39(8.59)	
	Never worked	570(62.30)	293(64.25)	277(60.35)	
	Once in a while	79(8.63)	32(7.02)	47(10.24)	
	Total	**915(100)**	**456(100)**	**459(100)**	
Education	No schooling	6(0.66)	1(0.22)	5(1.09)	Fisher's exact 0.109
	Primary	26(2.84)	13(2.86)	13(2.83)	
	Some high school	448(49.02)	240(52.86)	208(45.22)	
	Completed high school	389(42.56)	180(39.65)	209(45.43)	
	Completed Tertiary	45(4.92)	20(4.41)	25(5.43)	
	Total	**914(100)**	**454(100)**	**460(100)**	
Districts	Sedibeng	303(32.76)	143(30.82)	160(34.71)	0.275
	West Rand	401(43.35)	201(43,32)	200(43,38	
	Bojanala	221(23.89)	120(25.86)	101(21.91)	
	Total	**925(100)**	**464(100)**	**461(100)**	
Relationship status	Currently married, living together	213(23.28)	107(23.46)	106(23.09)	0.042
	Currently married, not living together	15(1.64)	10(2.19)	5(1.09)	
	Living together, not married	277(30.27)	152(33.33)	125(27.23)	
	No current relationship	19(2.08)	12(2.63)	7(1.53)	
	Not living together	391(42.73)	175(38.38)	216(47.06)	
	Total	**915(100)**	**456(100)**	**459(100)**	
Number of pregnancies	1	316(48.99)	146(46.06)	170(51.83)	0.341
	2	202(31.32)	105(33.12)	97(29.57)	
	3 or more	127(19.69)	66(20.82)	61(18.60)	
	Total	**645(100)**	**317(100)**	**328(100)**	

Table 3: Comparison of socio-demographic characteristics of those retained and those lost-to follow up

Variable	Range	LTFU at Endline		p-value
		followed up	Lost	
		Freq(frq%)	*Freq(freq%)*	
Age groups (years)	18-24	238(31.86)	70(40.70)	Fisher's exact 0.014
	25-29	194(25.97)	42(24.42)	
	30-34	196(26.24)	32(18.60)	
	35-39	109(14.59)	21(12.21)	
	40 years or older	10(1.34)	7(4.07)	
	Total	**747(100)**	**172(100)**	
Household Income in last month	R1-R1000	82(11.28)	27(16.36)	Fisher's exact 0.046
	R1001-R2000	143(19.67)	39(23.64)	
	R2001-R5000	293(40.30)	69(41.82)	
	R5001-R10000	163(22.42)	24(14.55)	
	>R10000	46(6.33)	6(3.64)	
	Total	**727(100)**	**165(18.50)**	
Employment-worked for money in past 12 months	Each month	162(21.80)	32(18.60)	0.810
	Most months	57(7.67)	15(8.72)	
	Never worked	460(61.91)	110(63.95)	
	Once in a while	64(8.61)	15(8.72)	
	Total	**743(100)**	**172(100)**	
Education	No schooling	4(0.54)	2(1.17)	Fisher's exact <0.001
	Primary	18(2.42)	8(4.68)	
	Some high school	340(45.76)	108(63.16)	
	Completed high school	341(45.90)	48(28.07)	
	Completed Tertiary	40(5.38)	5(2.92)	
	Total	**743(100)**	**171(100)**	
Districts	West Rand	331(43.78)	70(41.42)	0.115
	Sedibeng	237(31.35)	66(39.05)	
	Bojanala	188(24.87)	33(19.53)	
	Total	**756(100)**	**169(100)**	
Relationship status	Currently married, living together	174(23.42)	39(22.67)	Fisher's exact 0.137
	Currently married, not living together	14(1.88)	1(0.58)	
	Living together, not married	232(31.22)	45(26.16)	
	No current relationship	12(1.62)	7(4.07)	
	Not living together	311(41.86)	80(46.51)	
	Total	**743(100)**	**172(100)**	
Home language	Sesotho	213(28.63)	55(31.98)	0.341
	Setswana	195(26.21)	35(20.35)	
	isiXhosa	116(15.59)	22(12.79)	
	isiZulu	69(9.27)	18(10.47)	
	Other languages	151(20.30)	42(24.42)	
	Total	**744(81.22)**	**172(18.78)**	
Number of children	1	259(49,71)	57(45.97)	0,754
	2	161(30.90)	41(33.06)	
	3 or more	101(19.39)	26(20.97)	
	Total	**521(100)**	**124((19.22)**	

Socio-demographic characteristics and obstetric history

Overall the age range of participants was 18-46 years and 69.4% (n=517) had had a previous pregnancy. Socio-demographic results of the study sample indicate differences across the three districts with Sedibeng having a higher proportion of young women compared to the other districts. Both Bojanala and Sedibeng had a significantly higher proportion of women who had never worked compared to the West Rand district. In Bojanala, a lower proportion of women had a monthly household income of >R5000 and a greater proportion received a child support grant in the previous 4 weeks suggesting a lower socio-economic status as anticipated from a more rural setting. (Table 4).

Table 4: Comparison of Socio-demographic characteristics among districts for enrolled pregnant women .

Variable	Range	Districts			p-value
		West Rand	**Sedibeng**	**Bojanala**	
		Freq(frq%)	***Freq(freq%)***	***Freq(freq%)***	
Age groups (years)	18-24	127(31.99)	115(38.08)	64(29.77)	0.031
	25-29	93(23.43)	83(27.48)	60(27.91)	
	30-34	111(27.96)	63(20.86)	54(25.12)	
	35-39	58(14.61)	41(13.58)	30(13.95)	
	40 years or older	8(2.02)	0(0.00)	7(3.26)	
	Total	**397(100)**	**302(100)**	**215(100)**	
Household Income in last month	R1-R1000	49(12.89)	35(11.59)	23(11.22)	0.053
	R1001-R2000	66(17.37)	67(22.19)	48(23.41)	
	R2001-R5000	146(38.42)	125(41.39)	89(43.41)	
	R5001-R10000	92(24.21)	65(21.52)	30(14.63)	
	R10000 or more	27(7.11)	10(3.31)	15(7.32)	
	Total	**380(100)**	**302(100)**	**205(100)**	
Child support grant in last 4 weeks	No	203(51.65)	170(56.86)	97(44.50)	0.021
	Yes	190(48.35)	129(43.14)	121(55.50)	
	Total	**393(100)**	**299(100)**	**218(100)**	
Employment-worked for money in past 12 months	Each month	94(24.10)	51(16.89)	48(22.02)	<0.05
	Most months	48(12.31)	16(5.30)	8(3.67)	
	Never worked	205(52.56)	209(69.21)	152(69.72)	
	Once in a while	43(11.03)	26(8.61)	10(4.59)	
	Total	**390(100)**	**302(100)**	**218(100)**	
Education	No schooling	1(0.26)	2(0.66)	3(1.38)	<0.05
	Primary	3(0.77)	8(2.65)	14(6.45)	
	Some high school	202(51.79)	129(42.72)	115(53.00)	
	Completed high school	160(41.03)	149(49.34)	78(35.94)	
	Completed Tertiary	24(6.15)	14(4.46)	7(3.23)	
	Total	**390(100)**	**302(100)**	**217(100)**	
Number of children	1	140(49.30)	103(52.55)	71(43.83)	0.224
	2	86(30.28)	64(32.65)	52(32.10)	
	3 or more	58(20.42)	29(14.80)	39(24.07)	
	Total	**284(100)**	**196(100)**	**162(100)**	

Mobile phone use and m-health exposure

At baseline, 80% of participants said they had access to a smartphone while 74% reported having WhatsApp on their phones. Only 15.7% said they had received m-health messages during their previous pregnancy. Regular access to a smart phone did not differ significantly between intervention participants (81.6%) and control participants (79.4%) at endline.

Intention to treat analysis

Primary outcomes

Family planning uptake post-partum

Figure 2 below presents the primary outcomes of family planning uptake at baseline and endline by control and intervention groups. Family planning uptake increased in both groups between baseline and 8-10 weeks post-partum, and this increase was higher amongst those in the intervention group- n=274/377 or 72,7% to 334/373 or 89,5% (17 % increase) compared to those in the controls (n=277/365 to 318/358) (10 % increase). However, the differences between the two groups did not reach statistical significance (p=0.19).

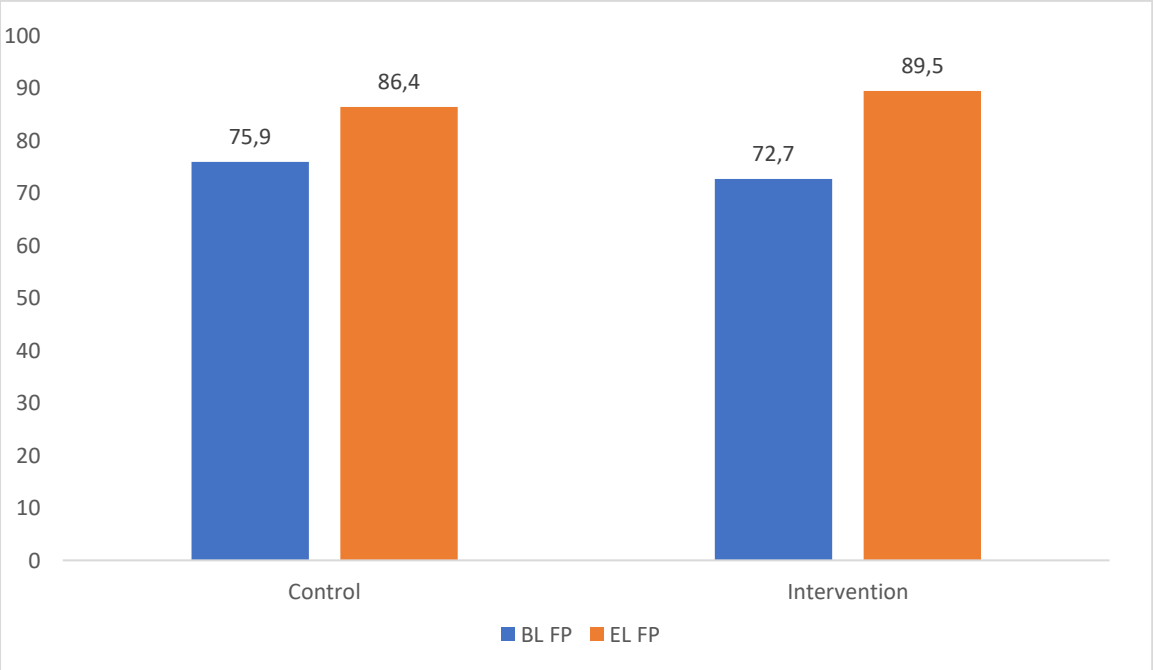
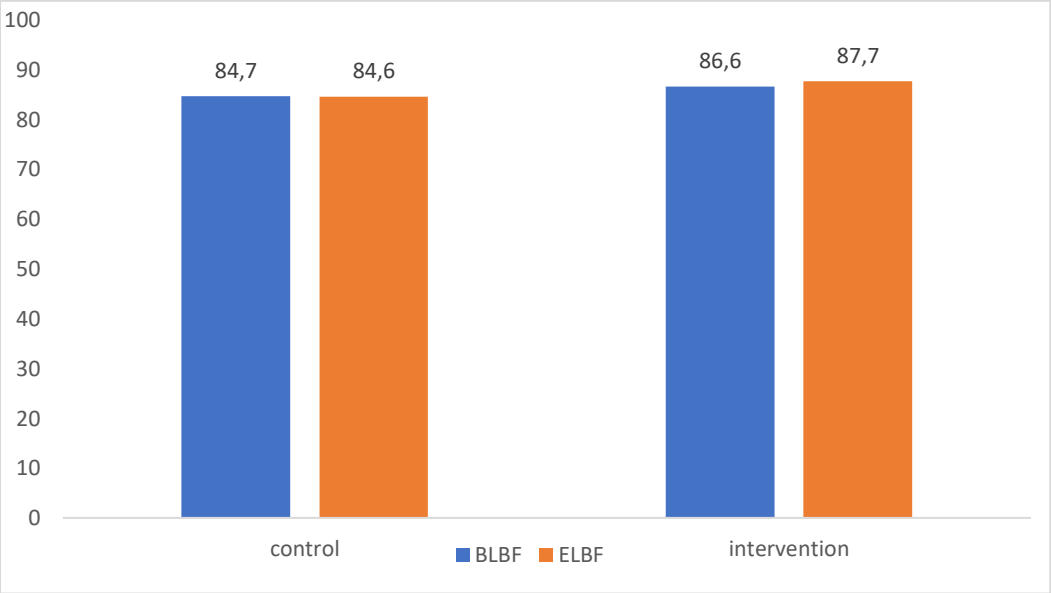


Figure 2: Baseline and endline family planning by intervention & control groups

Breastfeeding post-partum

For women who had a previous pregnancy(N=498), a high proportion overall had ever breastfed at baseline (85.7%) with minimal increase at endline: 86.2%(n=221/255) to 87.7%(n=328/374) in the intervention group and no change the control group(n=206/243 to n=314/371) (figure 3). The change at end-line was not significant between the groups(p=0.2)



N (endline)=745

Figure 3: Baseline and endline breastfeeding by intervention and control

Sub-group analysis: breastfeeding and contraceptive uptake

The intention to treat analysis was further explored in key sub-groups—namely women aged 18-24 years, and women who had first time versus previous pregnancies.

Breastfeeding for first-time mothers and younger women

Women exposed to MomConnect messaging and who were pregnant for the first time were more likely to breastfeed than those not exposed and this association was statistically significant (p=0.013) (see figure 4 below).

For younger women (18-24 years), a greater proportion of those in the intervention group compared to control group breastfed at endline (n=98/112, 87.5% versus n= 96/122, 78.6%) and this association almost reached statistical significance (p=0.074). While exclusive breastfeeding (no solids or formula) in young women was more common in those that were exposed to MomConnect (78.7% vs 73.6%), this finding was not statistically significant (p=0.4)

These findings are represented in figure 4.

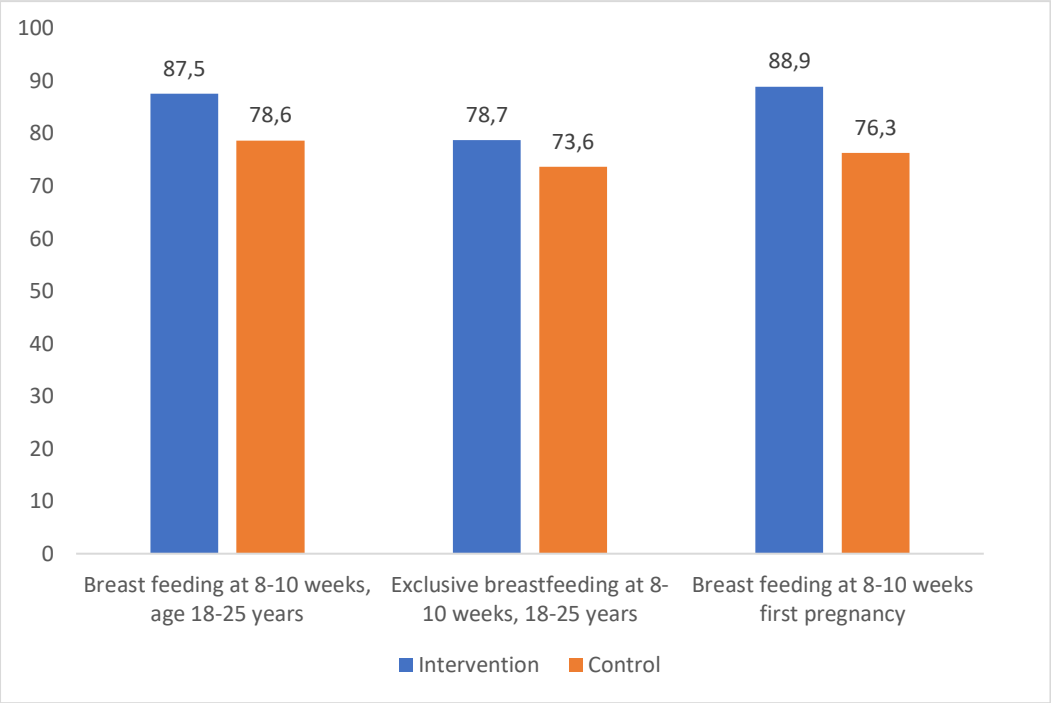


Figure 4: Breastfeeding at age 18-25 years (n=194) and first pregnancies(n=222)

Contraceptive uptake by pregnancy history

Women who had previous pregnancies were more likely to use family planning post-partum if they were in the intervention group, compared to those in the control group (n=239/263, 90.8% versus n=208/243,85.6%) reaching borderline statistical significance (p=0.06).

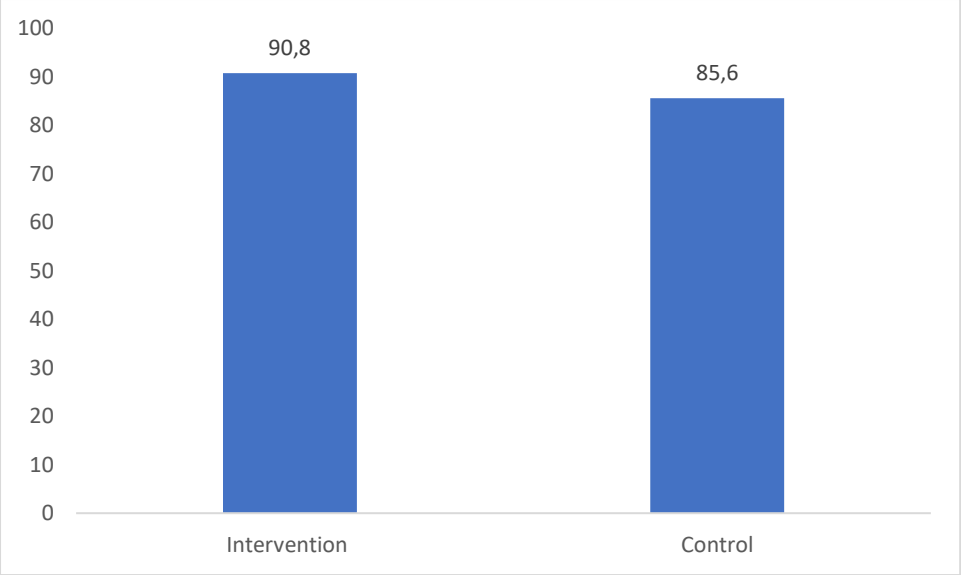


Figure 5: Family planning use post-partum: one/more previous pregnancies (n=506)

Younger women were not more likely to use post-partum family planning if they were exposed to MomConnect(p=0.5).

Secondary outcomes

Table 5 presents the results of the knowledge and self-efficacy scores, comparing intervention and control groups and indicates that there were no significant differences between the groups.

Table 5: Mean knowledge and self-efficacy scores between intervention and control groups in full cohort

	Intervention	Control	p-value
Family Planning knowledge	16.57	16.63	0.72
Breastfeeding knowledge	14.22	14.14	0.51
Family Planning self-efficacy	12.59	12.16	0.16
Breastfeeding self-efficacy	9.35	9.17	0.30

Figure 6 shows that those in the intervention group were more likely than controls to have talked to someone about breastfeeding since their baby was born, and more likely to have asked for help and advice about their own or their baby's health. The association approached statistical significance for talking about breastfeeding (p=0.08) but did not reach significance for asking for advice (p=0.16)

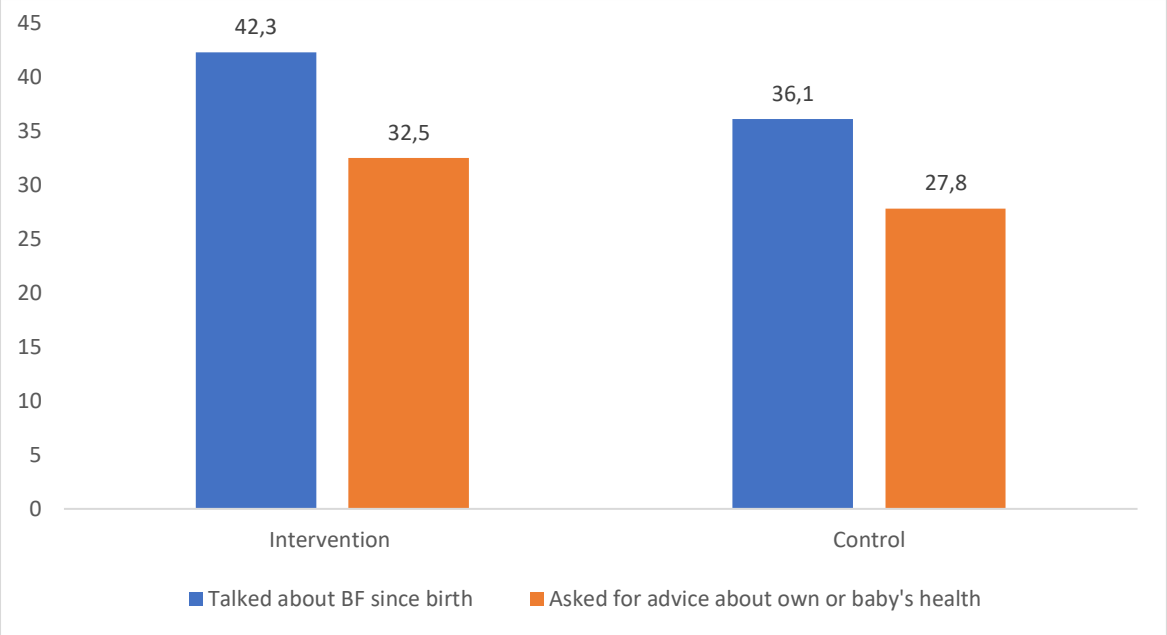


Figure 6: End-line help seeking for breastfeeding in intervention and control groups

Sub-group analysis-secondary outcomes

While the secondary outcomes of knowledge and self-efficacy were not shifted in relation to MomConnect in the full cohort, those that were age 18-24 years had significantly better knowledge scores for breastfeeding, as well as stronger self-efficacy scores related to contraceptive use. (Table 5). Similarly, for those who had their first baby, MomConnect increased self-efficacy to use contraception though had no impact on family planning or breastfeeding knowledge in this subgroup.

Table 6: Mean knowledge and self-efficacy scores between intervention and control groups in key sub-groups

	Intervention	Control	p-value
Family Planning knowledge in age 18-25	16.73	16.37	0.28
Breastfeeding knowledge in age 18-25 years	14.31	13.64	**0.05**
Family Planning self-efficacy in 18-25 years	12.56	11.27	**0.01**
Breastfeeding self-efficacy in age 18-25 years	9.17	9.07	0.74
Family Planning knowledge in first time pregnancies	16.45	16.44	0.99
Breastfeeding knowledge in first time pregnancies	14.17	13.99	0.46
Family Planning self-efficacy in first time pregnancies	12.8	11.73	**0.05**
Breastfeeding knowledge in	14.17	13.99	0.46

first time pregnancies			

Per protocol findings

Tables 7 compares those exposed and unexposed to MomConnect by socio-demographic characteristics. Those exposed to MomConnect were more likely to have higher household income in the preceding month, more likely to have completed high school, less likely to be living with a partner and more likely to have regular access to a smartphone.

After adjusting for confounders, namely district, education level, relationship status, age and time from date of baby's birth to the outcome, the association between exposure and post -natal family planning uptake showed a significant positive association (OR: 1.74 CI: 1.05-2.89)

No statistically significant association (p=0,88) was found between exposure and breastfeeding practices in the overall sample. However, those exposed to the MomConnect were more likely to talk about breastfeeding , after controlling for confounding variables (OR: 1.44 CI: 1.01-2.04).

Sub-sample analyses (age and pregnancy history) were not robust given the small sample sizes and large number of confounding variables in the analysis (age, n=188, first pregnancy n=179) .

Table 7: Socio-demographic characteristics by exposure (per protocol analysis)

Variable		**Total n(%)**	**Unexposed n(%)**	**Exposed n(%)**	**p-value**
Age groups (years)	18-24	203 (32.17)	100 (33.78)	103 (30.75)	Fisher's exact **0.342**
	25-29	162 (25.67)	68 (22.97)	94 (28.06)	
	30-34	166 (26.31)	78 (26.35)	88 (26.27)	
	35-39	92 (14.58)	48 (16.22)	44 (13.13)	
	40 years or older	8 (1.27)	2 (0.68)	6 (1.79)	
	Total	**631 (100)**	**296 (100)**	**335 (100)**	
Household income in last month	R1-R1000	64 (10.46)	40 (14.18)	24 (7.27)	Fisher's exact **0.018**
	R1001-R2000	115 (18.79)	54 (19.15)	61 (18.48)	
	R2001-R5000	249 (40.69)	115 (40.78)	134 (40.61)	
	R5001-R10000	144 (23.53)	61 (21.63)	83 (25.15)	
	R10000 or more	40 (6.54)	12 (4.26)	28 (8.48)	
	Total	**612 (100)**	**282 (100)**	**330 (100)**	
Child support grant in last 4 weeks	No	313 (50.00)	147 (50.17)	166 (49.85)	**0.936**
	Yes	313 (50.00)	146 (49.83)	167 (50.15)	
	Total	**626 (100)**	**293 (100)**	**333 (100)**	
Employment-worked for money in past 12 months	Each month	149 (23.76)	72 (24.57)	77 (23.05)	**0.382**
	Most months	52 (8.29)	20 (6.83)	32 (9.580	
	Never worked	366 (58.37)	177 (60.41)	189 (56.59)	
	Once in a while	60 (9.57)	24 (8.19)	36 (10.78)	
	Total	**627 (100)**	**293 (100)**	**334 (100)**	
Education	No schooling	3 (0.48)	2 (0.68)	1 (0.30)	**0.012**
	Primary	14 (2.23)	8 (2.74)	6 (1.79)	
	Some high school	290 (46.25)	152 (52.05)	138 (41.19)	
	Completed high school	285 (45.45)	120 (41.10)	165 (49.25)	
	Completed Tertiary	35 (5.58)	10 (3.42)	25 (7.460	
	Total	**627 (100)**	**292 (100)**	**335 (100)**	

Districts	West Rand	311 (48.98)	127 (42.76)	184 (54.44)	**0.000**
	Sedibeng	174 (27.40)	79 (26.60)	95 (28.11)	
	Bojanala	150 (23.62)	91 (30.64)	59 (17.46)	
	Total	**635 (100)**	**297 (100)**	**338 (1000**	
Relationship status	Currently married, living together	150 (23.89)	70 (23.89)	80 (23.88)	**Fisher's exact 0.007**
	Currently married, not living together	13 (2.07)	9 (3.07)	4 (1.19)	
	Living together, not married	192 (30.57)	104 (35.49)	88(26.27)	
	No current relationship	11 (1.75)	7 (2.39)	4 (1.19)	
	Not living together	262 (41.72)	103 (35.15)	159 (47.46)	
	Total	**628 (100)**	**293 (100)**	**335 (100)**	
Home language	Sesotho	172 (27.39)	75 (20.60)	97 (28.96)	**0.422**
	Setswana	165 (26.27)	79 (26.96)	86 (25.67)	
	isiXhosa	104 (16.56)	43 (14.68)	61 (18.21)	
	isiZulu	56 (8.92)	27 (9.22)	29 (8.66)	
	Other languages	131 (20.86)	69 (23.55)	62 (18.51)	
	Total	**628 (100)**	**293 (100)**	**335 (100)**	
Number of children	1	214 (48.53)	96 (45.71)	118 (51.080	**0.528**
	2	140 (31.75)	70 (33.33)	70 (30.30)	
	3 or more	87 (19.73)	44 (20.95)	43(18.61)	
	Total	**441 (100)**	**210 (100)**	**231 (100)**	
Own or regular access a smart phone	No	124 (19.59)	68 (22.97)	56 (16.62)	**0.044**
	Yes	509 (80.41)	228 (77.03)	281 (83.38)	
	Total	**633 (100)**	**296 (100)**	**337 (100)**	
WhatsApp on phone	No	37 (7.24)	15 (6.58)	22 (7.77)	**Fisher's exact 0.732**
	Yes	474 (92.76)	213 (93.42)	261 (92.23)	
	Total	**511 (100)**	**228 (100)**	**283 (100)**	

5 Discussion

The cluster randomised trial, conducted amongst users of public health clinics in rural, semi-urban and urban areas, has demonstrated that exposure to MomConnect messages had a statistically significant impact on breastfeeding for first time mothers, and increased breastfeeding knowledge in younger pregnant women. Family planning uptake at 8-10 weeks was also increased amongst those exposed to MomConnect and who were not first-time mothers-and this association almost reached statistical significance. MomConnect messaging also led to increased self-efficacy to use family planning post-partum amongst young women and those who were first time mothers.

Talking about breastfeeding and seeking advice on self-care or care of the baby was more common amongst those who received MomConnect messages. Associations approached statistical significance in the sub-group analysis though differences in the full sample were not statistically significant.

The results indicate that there were substantial increases from baseline to endline in family planning uptake for both intervention and control groups, but the increase was greater in the intervention group. This suggests that the clinics encouraged postpartum family planning uptake with MomConnect contributing to this shift. Differences in uptake of breastfeeding after previous

deliveries and with their new infant were minimal in both groups, probably since breastfeeding was widely practiced at baseline which limits the opportunity for changes in this measure.

The intention to treat findings suggest greater value of breastfeeding messaging for young mothers and first-time mothers who may have multiple other influences such as mothers/mothers-in-law regarding infant feeding practices. Given that breast-feeding practices appear to remain constant in mothers later births, this may mean these mothers are also more likely to breastfeed in their future births. Similarly, family planning uptake was higher in the intervention group but was only borderline significant in those with previous pregnancies, possibly signalling a greater readiness to delay or halt reproduction in this sub-group.

For women >25, no differences between intervention and control groups could be detected in knowledge for either family planning or breastfeeding, using a score at endline. Knowledge levels were high at baseline and hence harder to effect a substantial shift through an intervention. While knowledge levels are important to empower pregnant women, these do not necessarily lead to behaviour change since contextual and structural factors such as health service access and/or partner/family attitudes may influence their family planning and breastfeeding decision making. Messaging that encourages choices to promote better health outcomes require greater emphasis than those that simply impart knowledge

For the intention to treat analysis where participants remained in their randomly allocated group, regardless of actual exposure, misclassification of exposure is plausible. In other words, some women in the intervention group may have had very low exposure if they did not have data to receive WhatsApp messages. Also, participants may have changed their phone numbers after the baseline telephonic interview even though women registered on MomConnect can request a telephone number change. Conversely, women allocated to the control group may have received messages if they had registered on MomConnect after enrolment into the study and/or during a previous pregnancy.

The per protocol analysis, where exposure to MomConnect was more accurately quantified was therefore conducted to understand the extent of misclassification while at the same time enabling measurement of the associations between a stronger measure of exposure to MomConnect and desired outcomes. However, the drop in sample size was a limitation of this analysis and differential losses may have influenced the results. The finding that MomConnect impacted post-natal contraception uptake is consistent with the intention to treat analysis for women who had previously been pregnant. It is also consistent with findings from Kenya, where women who received SMS messaging were more likely to use contraception by 16 weeks post-

partum(Unger,2018) . In addition, as per the intention to treat analysis, the per protocol analysis confirmed that momconnect exposure was associated with talking about breastfeeding.

While the retention rate in the study was good and the intervention and control groups were largely equivalent , there were a few statistically significant differences between those followed up and those lost to follow up. Younger women and those with lower education levels were more likely to be lost from follow up and not interviewed at endline. Since young women were shown to be more likely to increase breastfeeding if exposed to MomConnect, the loss of younger women could have decreased the effect size of this association, hence underestimating the true impact of the breastfeeding messaging. The lack of association between MomConnect exposure and breastfeeding in the per protocol analysis could be accounted for by a further differential loss in young women for this analysis. Women with lower levels of education may have greater benefit from an mHealth intervention if they lack access to other sources of relevant communications and hence the greater drop out in this group could also have introduced bias.

In summary, supporting pregnant women through mHealth has substantial potential in the South African context. The CRT, in which the majority of participants were from low-income households, has demonstrated clear impacts for younger women and first-time moms from different areas in South Africa. The per protocol finding of a clear and adjusted association with exposure and post-partum family planning use adds to the evidence of the value of the MomConnect intervention particularly since this was a new message that had not previously been introduced into the message offerings.

References

1. Barron P, Peter J, LeFevre AE, et al. Mobile health messaging service and helpdesk for South African mothers (MomConnect): history, successes and challenges. BMJ Glob Health 2018;3:e000559. doi:10.1136/ bmjgh-2017-000559
2. Benjamin P, LeFevre AE, et al. Taking digital health innovation to scale in South Africa: ten lessons from MomConnect. BMJ Glob Health 2018;3:e000592. doi:10.1136/ bmjgh-2017-000592
3. Cherish M, Wabiri N, Risher K et al. Contraception coverage and methods used among women in South Africa: A national household survey. (2017)S Afr Med J 107(4):307-314
4. Coleman J, Xiong K. Gauging the Impact of MomConnect on Maternal Health Utilisation by women and their infants in South Africa. MEASURE. September 2017
5. Fischer, A. E., Sebidi, J., Barron, P., & Lalla-Edward, S. T. (2019). The MomConnect nurses and midwives support platform (NurseConnect): A qualitative process evaluation. *JMIR mHealth and uHealth*, *7*(2), e11644.
6. Harris PA, Taylor R, Minor BL et al , REDCap Consortium, The REDCap consortium: Building an international community of software partners**,** *J Biomed Inform. 2019 May 9 [doi: 10.1016/j.jbi.2019.103208*
7. Maliwichi P , Chigona W, Sowon K Appropriation of mHealth Interventions for Maternal Health Care in Sub-Saharan Africa: Hermeneutic Review. JMIR MHealth 2021 Oct 6;9(10):e22653. doi: 10.2196/22653
8. Marlow H, Maman S, Moodley D et al HIV status and postpartum contraceptive use in an antenatal population in Durban, South Africa. Contraception; 91, issue 1. January 2015.
9. Skinner D, Delobelle P, Pappin M, et al. User assessments and the use of information from MomConnect, a mobile phone text-based information service, by pregnant women and new mothers in South Africa. BMJ Glob Health 2018;3:e000561. doi:10.1136/ bmjgh-2017-000561
10. Wolff-Piggott B , Coleman J , Rivett U . The clinic-level perspective on mHealth implementation: a South African case study. Information Technology for Development, 2017
11. United Nations. Sustainable Development Goal 3: Good Health and Wellbeing [Internet]. 2015 [cited 2019 Apr 5]. Available from: https://www.un.org/sustainabledevelopment/health/)
12. Unger JA, Ronen K, Perrier T et al Short message service communication improves exclusive breastfeeding and early postpartum contraception in a low- to middle-income country setting: a randomised trial. BJOG. 2018