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An Incentive-Based and Community Health Worker Package Intervention to Improve Early Utilization of Antenatal Care: Evidence from a Pilot Randomised Controlled Trial

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Abstract
Objectives One of the factors linked to South Africa's relatively high maternal mortality ratio is late utilization of antenatal care (ANC). Early utilization is especially important in South Africa due to the high HIV prevalence amongst pregnant women. This study examined the impact of a package intervention, consisting of an incentive called the Thula Baba Box (TBB) and a community health worker (CHW) programme, on early utilization of ANC. *Methods* A pilot randomised controlled trial consisting of 72 women aged 18 and older was conducted in an urban area in South Africa to evaluate the impact of the package intervention. Women were recruited and randomised into either intervention (n = 39) or control group (n = 33). The intervention group received both the TBB and monthly CHW visits, while the control group followed standard clinical practice. Both groups were interviewed at recruitment and once again after giving birth. The outcomes measured are the timing of first ANC visit and whether they attended more than four times. It is anticipated that the box will also have a beneficial impact on infant health outcomes, but these fall out of the scope of this study. *Results* Women in the intervention groups sought care on average 1.35 months earlier than the control group. They were also significantly more likely to attend at least four antenatal clinic visits. *Conclusions for practice* Given the South African context and the importance of early care-seeking behaviour to improve health outcomes of HIV-positive pregnant women, the intervention can help to improve maternal and neonatal health outcomes. Further research is needed to investigate the impact of the two interventions separately, and to see if these findings hold in other communities.

Keywords Maternal health · Maternal mortality · Antenatal care · Incentives · Community health worker · South Africa

Significance

What is already known on this subject? Late and infrequent antenatal care visits, combined with high HIV rates, are linked to South Africa's relatively high maternal and neonatal mortality ratios. *What does this study add?* This research provides preliminary evidence of an intervention which successfully changed health-seeking behaviour of pregnant women.

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Introduction

The reduction of global maternal mortality to below 70 deaths per 100,000 live births by 2030 was identified as one of the United Nation's Sustainable Development Goals (SDG) (United Nations 2015). Despite some progress, South Africa's maternal mortality ratio (MMR) remains above that of middle-income peer countries with comparable per capita levels of public health spending which have MMR around 60 deaths per 100,000 live births, while South Africa's ratio was estimated at 197 deaths per 100,000 in 2011 (Dorrington et al. 2014).

A high HIV prevalence among pregnant women is a major contributor to the comparably high MMR. HIV

prevalence among pregnant women in South Africa is approximately 30% (Shisana et al. 2012), and the leading cause of maternal mortality (non-pregnancy related infections) consisted almost entirely of women who were HIV positive (Moodley 2014).

This intervention focuses on improving MMR via increasing early utilization of antenatal care (ANC). It has been demonstrated that early utilization of ANC is strongly linked with MMR. Pattinson (2012) reports that in almost a quarter of maternal deaths, women either did not attend or did not attend antenatal clinics frequently enough. The medical benefits of ANC include detecting, monitoring and treating treatable conditions which may otherwise lead to morbidity or mortality of mother or infant (Liu et al. 2015). Early utilization of ANC is particularly vital for maternal health in South Africa with its high HIV prevalence. Early initiation of antiretroviral treatment is necessary to prevent vertical transmission and to promote the health of both the mother and the infant (World Health Organization 1999; Moodley et al. 2016).

The South African Department of Health suggests that pregnant women should utilize ANC before 20 weeks of gestation to minimise the risk of vertical transmission. Earlier utilization at 14 weeks is recommended by the World Health Organization to minimise the risk even further (Schnippel et al. 2015). Despite healthcare to pregnant women in South Africa being free of charge (Cooper et al. 2004), according to the 2012 District Health Information System (DHIS) 59.9% of women sought ANC at a gestational age of 20 weeks/5 months or later (National Department of Health 2012). Consequently, the Department of Health prioritised improving early utilization of care.

This research addresses the patient-related factors related to late and infrequent ANC utilization. We report the results from a pilot, randomised-controlled trial where we tested a demand-side package intervention to improve timing and frequency of ANC utilization. The package comprised two jointly implemented interventions. The first was an incentive, the Thula Baba Box (TBB), which was a reward for early and frequent clinic attendance. In healthcare, incentives are often promoted as once-off nudges aimed at transforming social norms and individual expectations to promote long-term, prudent health behaviour. It works by *"triggering a virtuous circle of 'good' habits"* (Ranganathan and Lagarde 2012). If used, the content of the box will also likely have a positive impact on infant health outcomes, but this does not fall within this study's scope.

In the second intervention, we supported the women with advice, guidance and health information delivered by experienced local community health workers (CHWs). Similar programmes have successfully been used in developed countries to promote earlier and frequent attendance at antenatal clinics (Julnes et al. 1994; Rogers et al. 1996; Daaleman 1997; Mbuagbaw et al. 2015; Edmond et al. 2018).

The intervention was tested in two low-income areas in Cape Town, South Africa during 2015. This study was approved by the Stellenbosch University Humaniora Research Ethics Committee (HS 1020/2014). Participation was voluntary, and all participants signed an informed consent form.

Methods

This study was a pilot, randomised-controlled trial. One hundred women were recruited and randomly assigned to either an intervention (50) or control group (50). The intervention group received the package of interventions (the incentive and CHW support). The health-seeking behaviour of the two groups was compared.

Due to budgetary limitations, a sample of 100 women (50 control, and 50 intervention) was obtained for this pilot study. It is therefore viewed as a pilot study for implementing a larger scale intervention. This sample size was achieved by visiting all households in the implementation area and recruiting any participant who met the criteria. After attrition (discussed in the "Results section"), a total sample of 72 participants remained.

Synopsis of Interventions

Intervention 1: The Thula Baba Box Incentive

The TBB is a starter kit for new mothers, based on the Finnish baby boxes which were used to curb infant mortality in Finland in the 1930s and are still given to all pregnant women in Finland (Kela 2015). Research was conducted and interviews done with women who recently gave birth, healthcare workers and policy makers to adjust the box to a South African setting.

The box was valued at R440 ($27.8 on 29 February 2016) and contains baby clothing, a blanket, wash products (face cloth, hand soap, aqueous cream, baby jelly and wipes), maternity pads, condoms, a kangaroo mother-care wrap, plastic balls, health information brochures and some nursery rhymes. The box was made of clear plastic and can be used for storage or as a baby bath.

Similarly to the Finnish box (Gissler et al. 1998), the TBB was used as an incentive to promote earlier and frequent ANC attendance. It was given conditionally to the women using ANC at least four times with the first visit occurring within 4 weeks after her first interaction with the CHW. The content of the TBB was predominantly aimed at the baby in line with evidence indicating this approach was more likely

to motivate women (Smith et al. 1990). While infant health outcomes were not the focus of the study, we anticipated this as an additional benefit of the box.

Intervention 2: CHW Support

The second intervention entailed providing pregnant women with monthly visits by a local, trained CHW. Through an established and reputable CHW non-governmental organization, Philani Health and Nutrition, we recruited women with CHW experience from within the intervention communities. In preparation for this study they received further specialist training in ANC and nutrition from Philani Health and Nutrition. The scope of the Philani programme's impact is reported elsewhere (Le Roux et al. 2013, 2014; Rotheram-Borus et al. 2015; Tomlinson et al. 2015).

The service that these CHWs provide is considered supplemental to the standard clinical practice, and is focused on providing health information and psycho-social support. CHWs visited their identified participants at least once a month, with visits ranging from 30 to 90 min each. The content of these visits included promoting early and frequent ANC visits, discussing pregnancy and infant-danger signs, the dangers of drinking and smoking during pregnancy, the importance of HIV and TB testing, maternal nutrition and general health, infant-feeding options, the importance of bonding, and providing general emotional support. Once the CHW had established a rapport with the pregnant women, she spoke about the importance of knowing and disclosing one's HIV status. Each CHW was responsible for covering a specific geographical area within the intervention area, visiting each household and identifying possible participants.

Study Site and Participants

The study was implemented in Lwandle–Nomzamo, in the Metro region of the Western Cape between January and November 2015. These are low-income areas with high levels of unemployment and informal housing. They fall within the Eastern Health Sub-district, where approximately 43% of women attend ANC after 20 weeks of gestation (National Department of Health 2012). We selected these sites as they had few competing interventions, relatively low rates of early utilization of ANC, but good general health system performance. The latter was important because in a setting with overburdened, ineffective primary care facilities, one would not be able to observe the impact of a patient-targeting, demand-side intervention.

The study targeted women who were pregnant but had not yet been to an ANC facility. The CHWs went door-to-door in the sampling area, identifying and recruiting pregnant women for the study. Women of reproductive age who were sexually active were also offered a pregnancy test, and recruited into the study if pregnant. The sample comprised female residents of Lwandle–Nomzamo who either knew they were pregnant but had not yet been to the antenatal clinic, or women who did not know they were pregnant but found out via a pregnancy test offered by the CHW. Only women aged 18 and older were considered for the study, as women under the age of 18 are considered minors and would require parental consent to participate. Given the sensitive nature of the topic, parent consent may introduce bias in care seeking behaviour.

During the 36 days of recruitment, CHWs visited every house in the two communities by working through both communities twice. Women were screened based on their age (18–50) and their sexual activity. In 2011, 80,346 individuals resided in Lwandle–Nomzamo, (covering an area of 33,401 per km^2) (Statistics South Africa 2011). Gaining access to households did not prove difficult, since the CHWs were familiar to people in the community. Since the CHWs were from the community, they were able to communicate with neighbours if someone was not home when they visited and able to identify whether there were any eligible women in those households. The sample is therefore representative of the two communities.

In order to address the multiple constraints related to poor healthcare-seeking behaviour in pregnancy, we administered the TBB and the CHW support interventions jointly as a package intervention. Upon enrolment, women were randomised into either the intervention or control arm using an on-site lottery. Allocation was discreetly decided by the off-site project manager. CHWs asked all eligible women to provide them with their cell phone number. The CHW would then text the number to the project manager, who allocated the woman to the intervention or control group based on the third last digit of her number. This was done to ensure that the CHWs did not favour any of the respondents and place them into intervention group.

Women randomised to receiving the package intervention were told that they would receive monthly visits from the CHW and, if they went to the antenatal clinic within the next 30 days and made all four visits, they would receive the TBB after giving birth. The women were also told that if they did not comply fully with these conditions, they would only receive a partial version of the box. Women in the control group were subject to standard clinical practice and received neither box nor CHW visit. At the time of the intervention, there were no public programmes to promote earlier utilization of ANC. Women in the control group would only receive guidance on the frequency and timing of ANC visits after completing their first ANC booking visit. Although urine pregnancy tests (UPTs) are supposedly provided free of charge at primary health clinics, there are widespread reports of poor staff attitudes, long waiting times and the

rejection of request for UPTs, which act as supply-side barriers to women getting tested.

The flow of participants from recruitment to analysis is shown in Fig. 1. A sample of 100 women (50 control and 50 intervention) were enrolled and it is therefore viewed as a pilot study for implementing a larger-scale intervention. Twenty-eight women left the study during implementation due to a range of reasons described in Fig. 1. After attrition, 72 participants remained.

Data-Collection and Sampling Methods

Data were collected by the CHWs in the participant's home using a baseline questionnaire (conducted following recruitment) and an endline questionnaire (conducted 1 week after birth). Women in the intervention group received their TBB after giving birth, when the endline questionnaire was conducted.

The control group received food vouchers worth R30 ($1.9 on 29 February 2016) as compensation for the time spent completing the questionnaire. The questionnaires were conducted by the CHWs with quality monitoring by the team supervisor and project manager.

Description of Outcome Variables

The key intermediary outcome measured in this study is the timing of first ANC visit, but we also consider the frequency of subsequent ANC visits. The timing of first ANC visit was measured using both binary and continuous measures. Firstly, a binary indicator equal to one was used as the outcome measure if the participant went to the ANC on or before 5 months of gestation. In a second step, in order to quantify the size of the effect, age of gestation at first ANC visit is used as the measure of outcome. Participants who never attended ANC were considered to have gone to the clinic at 9 months of gestation.

For frequency of visits, we use a binary indicator to indicate whether they visited the clinic at least four times. Number of visits is affected to some extent by the presence of complications. At the time of the intervention, a minimum of four visits was recommended by the WHO and the

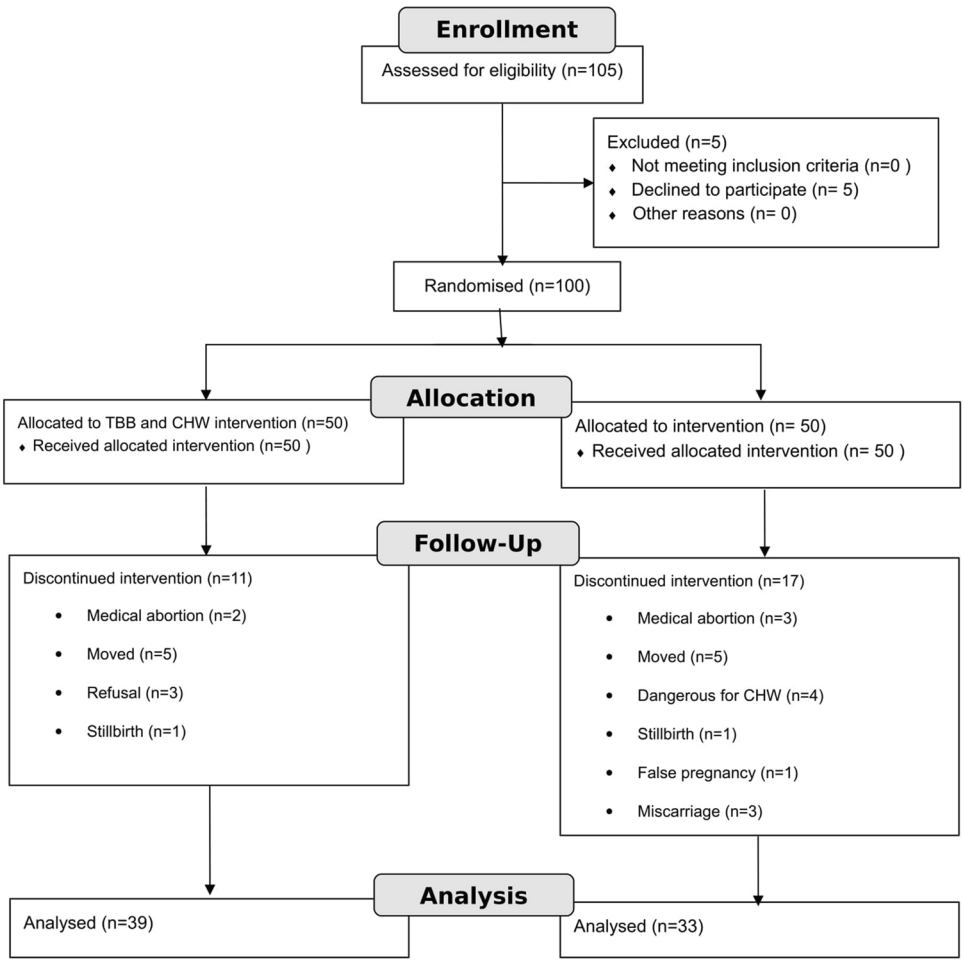

Fig. 1 CONSORT diagram: flow of participant recruitment and retention

National Department of Health. This has since been updated to eight visits (World Health Organization 2016). All health-outcome measures are based on information provided in the questionnaires.

Data Analysis

All analyses were run using Stata Version 13 (Statacorp, 2014). The impact of the intervention on the outcomes is measured using a binary predictor equal to one if the participant is in the intervention group. In all analyses, we also control for a range of baseline characteristics, including age, employment, education, marital status, self-reported race, asset wealth (a composite measure of the household's durable assets created using multiple correspondence analysis), nationality, household size and whether this is a first pregnancy. Since women were recruited at different gestational ages and received interventions of differing intensity, we controlled for the duration of exposure to our interventions in the regression analyses.

When analysing the impact of the intervention on the binary outcomes ('Went to ANC clinic more than four times' and 'went to ANC clinic before 5 months' gestation'), a logit estimator was applied, and odds ratios calculated and presented. In the second step, where the impact of the intervention on the continuous 'months of gestation at first ANC visit' measure is used, an ordinary least-squares estimator was applied.

Results

Baseline Characteristics of Participants

One hundred women were recruited at baseline and randomised. Twenty-eight were lost due to attrition. However, this did not affect the quality of randomisation, as there were still no significant differences in the baseline characteristics in the intervention and control groups (see Table 1).

We observed high demand for pregnancy tests in the sampling area. Over a 36-day period, 314 tests were distributed of which 54 were positive, leading to a pregnancy-detection rate of 17%. Although pregnancy-test distribution was not randomised, these women were found in both the control and intervention groups. The average age was 27 years, 60% being unemployed, and most had not finished Grade 12. A large proportion reported being unmarried. The largest subgroup of participants was Black African (86%), and most participants had poor wealth status (as measured by the asset index). Almost half were foreign nationals (43%), and almost one in three participants were experiencing their first pregnancy (29%). There were on average four household members in participants' households.

Main Findings

The effect of exposure to the package intervention on utilisation of specific maternal care services is shown in Table 2. The table reports the crude and adjusted odds ratios on the intervention variable from a logit estimator. The table shows that the interventions had a significant impact on the frequency of ANC sought before controlling for confounding factors ($p = 0.022$) and on getting women to an antenatal clinic earlier ($p = 0.005$ and $p = 0.009$). For this part of the analysis, we will only consider women recruited into our sample on or before 5 months of gestation, since the ability of the intervention to influence the frequency and timing of women's utilization of ANC after this period would have been significantly reduced. This reduced the sample from 72 to 61.

The table shows that the likelihood of going to the antenatal clinic more than four times (OR = 5.69; 95% CI 1.28–25.38) and going to the antenatal clinic for the first time before 5 months of gestation (OR = 8.78; 95% CI 1.95–39.47) were significantly higher for participants exposed to the intervention.

Table 1 Descriptive statistics on study participants, by intervention status

Parameter	Overall (n = 72)	Intervention (n = 39)	Control (n = 33)	p Value
Age [Mean (SD)]	27.54 (5.82)	27.23 (5.13)	27.91 (6.60)	0.63
Unemployment (%)	67%	62%	73%	0.32
Grade 12 attained (%)	17%	21%	12%	0.35
Married (%)	24%	26%	21%	0.66
Black African population group (%)	89%	90%	88%	0.81
Assets index [Mean (SD)]	1.81 (0.94)	1.83 (0.94)	1.78 (0.95)	0.83
Foreign nationals (%)	44%	41%	48%	0.53
Household size [Mean (SD)]	3.69 (2.40)	3.90 (2.72)	3.45 (1.95)	0.44
First pregnancy (%)	26%	21%	33%	0.22
Identified using pregnancy test	47%	44%	52%	0.51

Table 2 The impact of the intervention on main health facility attendance outcome variables

Variables	Crude OR (95% CI)	p Value	Multivariable adjusted OR (95% CI)	p Value
Went to the ANC more than four times				
Control group	Referent		Referent	
Intervention group	**5.69 (1.28–25.38)**	**0.022**	4.85 (0.84–27.88)	0.077
Went to ANC before 5 months' gestation				
Control group	Referent		Referent	
Intervention group	**8.78 (1.95–39.47)**	**0.005**	**10.51 (1.80–61.83)**	**0.009**

Significant results ($p < 0.05$) are given in bold

OR odds ratios

Both crude and multivariable adjusted odds ratios estimates control for the difference in time that participants were exposed to the study

Other confounding variables controlled for in the adjusted coefficient estimates are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test

After controlling for possible confounding factors (as described in Table 1), the effects remain significant for timing (AOR = 10.51; 95% CI 1.80–61.83) of the visit of women in the intervention group but loses significance for frequency (AOR = 4.85; 95% CI 0.84–27.88). Both effects are slightly less precisely measured ($p = 0.077$; $p = 0.009$).

The large and significant impact of the intervention on the timing of first ANC visit required further investigation. As a result, we explored the impact of the intervention on months of gestation at the time of using ANC services to quantify the impact of the intervention. For this purpose, we regress the months of gestation at the time of using ANC onto the binary variable equal to one if a participant is in the intervention group. This provides us with a more quantifiably relatable measure of the impact of the intervention. The results are shown in Table 3.

Participants were likely to use the antenatal clinic on average 1.2 months earlier if they were in the intervention group (significant at 1% level). After controlling for confounding factors, the effect becomes slightly bigger at 1.35 months.

Discussion

The package intervention significantly improved the frequency and timing of ANC visits. Specifically, the intervention led to an increase in the probability that a woman would make at least four ANC visits and significantly advanced the timing of the first visit by a month. Although this is a small pilot, the result is viewed as encouraging because of the policy focus on early utilization of care and the potential social and health impact in a country where 30% of pregnant women have HIV.

There are, however, concerns about whether the intervention would yield the same results in other settings. A programme designed to affect behaviour should take into account both the "monetary and psychological" (Kane et al. 2004) costs. Although the monetary costs faced by our sample may be replicable to other low-income, urban settings, the psychological costs and cultural barriers may differ. It is therefore recommended that this intervention should be tested in other communities to examine whether these findings hold in other settings. Also, further research is needed to investigate the impact of the two interventions separately.

The study has various limitations, most notably its scope and size as a feasibility study. Other than contextual

Table 3 The impact of the intervention on months of gestation at which participants accessed care

Variables	Crude month's estimate (95% CI)	p Value	Multivariable adjusted month's estimate (95% CI)	p Value
Intervention	**−1.17 (−2.00 to −0.34)**	**0.007**	**−1.35 (−2.21 to −0.48)**	**0.003**

Significant results ($p < 0.05$) are given in bold

OR odds ratios

Both crude and multivariable adjusted odds ratios estimates control for the difference in time that participants were exposed to the study

Other confounding variables controlled for in the adjusted coefficient estimates are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test

applicability, other factors which should be considered before scaling up is the cost and feasibility of expanding this programme. We did not encounter any negative externalities, but a follow-up study should verify this finding.

Conclusion

A package intervention consisting of a baby starter-kit incentive and CHW support was effective at encouraging pregnant women to utilize ANC early in a low-income, urban setting in Cape Town, South Africa. Early utilization of ANC has been prioritised as a key maternal health target by the United Nation's Sustainable Development Goals and local South African policy.

South African maternal mortality rates are relatively high given the country's level of economic development. A large number of these deaths can be attributed to the prevalence of HIV amongst pregnant women. Given the South African context and the importance of early care-seeking behaviour in improving the health outcomes of HIV-positive pregnant women, the intervention could potentially be a successful tool to improve maternal health outcomes. Further research is needed to examine the impact of the intervention on a broader selection of communities and provinces.

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Author Contributions LR, RPB and RB all contributed to the study design. Implementation, fieldwork, project management and statistical analysis were performed by LR. Manuscript drafting was performed by LR, RB and RPB. All the authors read and approved the final manuscript.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no competing interests.

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