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INCREASED EXCLUSIVE BREASTFEEDING IN SOUTH AFRICA FROM 2010 TO 2013: IMPACT OF NATIONAL POLICY CHANGE?

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3 **INCREASED EXCLUSIVE BREASTFEEDING IN SOUTH AFRICA FROM 2010 TO**
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5 **2013: IMPACT OF NATIONAL POLICY CHANGE?**
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ABSTRACT

Objective

Between 1998 and 2009 reported exclusive breastfeeding (EBF) rates in South African infants, age 0-6 months, ranged from 4% to 25.7%. In 2011, the National Minister of Health made a policy shift to promote 'exclusive' breastfeeding for all women in South Africa irrespective of HIV status (Tshwane Declaration of Support for Breastfeeding). This analysis examines early EBF prior to and through implementation of the Declaration.

Setting

Data from the three South Africa national, cross-sectional, facility-based surveys, conducted in 2010, 2011-12 and 2012-13, were analysed. Primary Health facilities (n=580) were randomly selected after a two-stage probability proportional-to-size sampling to provide valid national and provincial estimates.

Participants

A national sample of all infants attending their six-weeks vaccination at selected facilities, regardless of HIV status. Caregiver-infant pairs were enrolled in 2010, 2011-12, and 2012-13 with 10,182, 10,106 and 9,120 pairs enrolled, respectively.

Primary Outcome Measure

Infant feeding as measured using structured 24-hour recall and World Health Organisation definitions, with a specific focus on exclusive breastfeeding.

Results

The adjusted odds ratio comparing EBF prevalence of EBF in 2011-12 and 2012-13 to 2010 were 2.08 and 5.51, respectively. These increases were seen across all provinces and subgroups, suggesting a population-wide effect, rather than an increase in certain subgroups or locations. Mothers with higher socioeconomic status, HIV-positive, post-caesarean delivery, resided in certain provinces, and women who did not receive breastfeeding counselling had significantly lower odds of EBF.

Conclusion

With what seemed to be an intransigently low EBF rate since 1998, South Africa saw a remarkable increase in early EBF for infants 4-8 weeks old from 2010 to 2013, coinciding with a major national infant feeding policy change. While these increases in EBF were significant, the

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3 59.1% prevalence is still below desired levels of early EBF suggesting further improvements in
4 infant feeding are needed.
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8 **Trial Registry:** Not applicable
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11 **Article Summary: Strengths and Limitations of this Study**
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14 • The data were from a nationally representative survey of infants presenting at primary
15 facilities presenting for immunization services which provides robust national estimates.
16 However, infants who did not come for immunization or had already died by 6 weeks of
17 age or attended private hospital/clinic for care were not included in the sample suggesting
18 a possible selection bias.
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22 • The study used structured validated questionnaires and WHO recommended infant
23 feeding definitions. However, caregivers may have not accurately reported infant feeding
24 practices due to recall bias.
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Introduction

South Africa is reported to have one of the lowest Exclusive Breastfeeding (EBF) rates in Africa. National and regional studies conducted between 1998 and 2009 reported EBF rates in South African infants, age 0-6 months ranging from 4% to 25.7% (Table 1).¹⁻⁷ Although questions, settings, and methods varied across these studies, all found that the EBF rate in South Africa remained consistently low in the 1990s through 2010.

Reasons for these low EBF rates have been examined across various settings. The South African HIV epidemic has no doubt been a contributing factor for avoiding breastfeeding or early breastfeeding cessation; however, low EBF rates pre-date the increased focus since 2000 on HIV. The use of formula by health service providers to treat malnutrition and for babies of mothers living with HIV, has been cited as providing mixed messages to communities about the benefits of breastfeeding compared with formula milk, and about EBF. Cultural norms for early mixed feeding, urbanization, stigma in HIV-positive mothers, and mothers returning to work have all been cited as challenges to EBF.⁸⁻¹⁰ Consequently, EBF messaging was not consistently supported by front line health workers, programme managers or policy makers at the height of the HIV epidemic, between 2001 and 2011.

In 2011, the National Minister of Health held a consultation on breastfeeding, which led to a clear shift in national policy to promote 'exclusive' breastfeeding for all women in South Africa irrespective of HIV status, through the release of the Tshwane Declaration of Support for Breastfeeding (Tshwane Declaration).^{11,12} By September 2012, free formula milk for mothers living with HIV was withdrawn from the Prevention of Mother-to-Child Transmission (PMTCT) programme and EBF messaging for front line workers was emphasized as a policy priority.

This analysis uses data from the three South Africa National PMTCT surveys conducted to measure early PMTCT effectiveness¹³⁻¹⁵ and aims to examine early EBF rates at six-weeks postpartum, in 2010 prior to the Tshwane Declaration, in 2011-12 during the policy transition period, and 2012-13 after complete implementation of the Tshwane Declaration.

Methods

Data from three national, cross-sectional, facility-based surveys, South African PMTCT Evaluations (SAPMTCTEs), conducted in 2010, 2011-12 and 2012-13¹³⁻¹⁵ were analysed. These surveys aimed to capture a national sample of all infants attending their six-weeks vaccination, regardless of HIV status. Known and unknown HIV-exposed and HIV-unexposed infants, as well as PMTCT participants and non-participants were included in these three surveys, such that the sample used for this infant feeding analysis represents a nationally representative sample of HIV exposed and unexposed infants. There was no patient or public involvement in the design of this study.

These surveys were conducted in public primary health care (PHC) and community health centres (CHC) offering immunisation services in all nine provinces. This methodology was chosen as uptake of six-week immunisation in South Africa was >99%, according to the 2007 District Health Information System (DHIS). Stratified multi-stage probability sampling proportional to size, followed by random sampling of facilities and consecutive or systematic sampling of participants (caregivers with infants aged 4-8 weeks receiving their 1st DTP immunization) was conducted. The methods for the 2011-12 and 2012-2013 surveys were the same as described in 2010.¹³⁻¹⁵ The sampling frame and selected facilities were identical between 2011-12 and 2012-13, except for four clinic replacements due to shifting of services or clinic closure for maintenance.

Immunisation data from the 2007 DHIS were used to quantify the number of children that could be expected within Primary Health Care/Community Health Centres (PHC/CHC) facilities over a period of time. These were then stratified by size. Sample size was calculated so that valid national and provincial level estimates of MTCT could be ascertained. This resulted in 34-79 facilities per province, 580 in total. Facilities were randomly selected within 3 strata with probability proportional to size sampling. Caregiver/infant pairs were consecutively or randomly selected from facilities (depending on facility size). The desired sample size was 12,200 infants aged 4-8 weeks, per survey to produce national and provincial estimates. Hospitals and mobile clinics, very sick infants or infants aged <4 weeks or >8 weeks were excluded.

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3 Maternal/caregiver interviews were conducted and infant dried blood spot (iDBS) were drawn
4 after receiving consent from caregivers for study participation. Data were collected using low
5 cost cellular telephones and interview data were uploaded into a web-based database console, in
6 real-time. Interviews gathered data on maternal socio-demographics, ante- and postnatal care,
7 mothers reported HIV status and PMTCT services. Infant feeding information was collected
8 using structured recall documenting whether the infants received a particular food or fluid during
9 the past 24 hours or during the 7 days prior to the past 24 hours (separately). Foods or fluids
10 were grouped according to World Health Organisation definitions¹⁶ into breastmilk, formula
11 milk, nutritive liquids, non-nutritive liquids, solids, prescribed medication and non-prescribed
12 medication. Yes/No responses were used for each food group.
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22 This analysis includes all infants for which there was consent and a valid questionnaire, with or
23 without an iDBS and regardless of HIV exposure or HIV infection status. Analysis was weighted
24 for sample realisation and at provincial level proportional to the live birth distribution of South
25 Africa. For this analysis, feeding patterns were generated during data analysis using WHO
26 definitions (Box 1).¹⁶ The main outcome variable of interest gathered from the three surveys was
27 the proportion of infants exclusively breastfed at six-weeks postpartum. We conducted logistic
28 regression to examine if these factors were associated with EBF: maternal - age, education,
29 marital status, parity, employment and HIV status; household - type, water source, fuel for
30 cooking, and toilet; food insecurity; planned pregnancy, antenatal care - initiation (trimester) and
31 attendance (4+ visits); delivery mode and receipt of breastfeeding counselling; child - sex and
32 age in weeks.
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43 The analytic dataset included three years (2010-2013) of data from the three consecutive cross-
44 sectional nationally-representative SAPMTCTEs. We used survey statistics in STATA SE, v15
45 as simple random sampling was not employed and this method ensures that the standard errors of
46 the estimates are calculated correctly, accounting for 23 strata, weighting, and identifying the
47 primary sampling unit (n = 615).
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53 Survey statistics were used to report 2-way table descriptive statistics, which included
54 proportions and 95% confidence intervals (CI). Univariate logistic regressions (survey) were run
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3 on the binary EBF outcome at 6 weeks controlling for year. The first multiple logistic regression
4 model included 19 possible categorical predictors (including year) were examined based on
5 known predictors of EBF from the literature. Predictors were retained if at least one category was
6 significant at 5% level; leaving a final multiple regression model with 15 categorical predictors.
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8 Interaction effects between year and other predictor variables were also examined; from this only
9 the interaction effect of breastfeeding counseling receipt and year was retained in the final
10 model. All results were reported as odds ratios with 95% CI's and p-values (significance at 5%
11 level).
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19 Results

20 The number of caregiver-infant pairs enrolled in 2010, 2011-12, and 2012-13 were 10,182,
21 10,106 and 9,120, respectively. National EBF rates at 4-8 weeks of age were 22.9% (95%
22 confidence interval (CI) 21.5-24.3) in 2010, 35.7% (95% CI 33.9-37.6) in 2011-12, and 59.1%
23 (95% CI 57.4-60.7) in 2012-13, $p < 0.001$. All nine provinces showed similar statistically
24 significant increasing EBF trends between 2010 and 2012-13. (Table 2)
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30 Examining non-EBF categories, consistent with the increase in EBF, both Exclusive Formula
31 Feeding (EFF) and Mixed Breastfeeding (MBF) had significant ($p < 0.001$) reductions in 2010
32 compared with 2012-2013 (24.7% to 16.5% and 19.0% to 15.1%, respectively). There were
33 significant reductions in the introduction of solids before 4-8 weeks in both EFF and MBF
34 groups in 2010 compared to 2012-2013 (3.5% to 0.5% and 25.1% to 7.0%, respectively).
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41 The crude OR for EBF comparing 2011-12 and 2012-13 to 2010 was 1.88 (95% CI 1.70 – 2.07)
42 and 4.87 (95% CI 4.40 – 5.38), respectively (Table 3). In univariate analysis (Table 3) and the
43 full logistic model excluding counseling by year interaction term (data not shown) the EBF by
44 year estimates did not change by more than 10% suggesting that these increases were seen across
45 all regions and population sub-groups. However, in the final logistic model including the
46 interaction term (Table 4) the annual EBF differences did change by just over 10% (to 2.08 in
47 2011-2012 and 5.51 in 2012-2013) suggesting a potential confounding effect. In both 2011-2012
48 and 2012-2013, compared to 2010, the odds for EBF for mothers who received breastfeeding
49 counseling increased significantly.
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5 In the full multivariable model (Table 4), mothers with higher socioeconomic status, employed
6 mothers, mothers who are HIV-positive, had a caesarean delivery, and who did not receive
7 breastfeeding counselling had lower odds of EBF. Women with older infants (8 weeks of age)
8 were also less likely to EBF.
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13 **Discussion**

14 **Exclusive Breastfeeding Rates**

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17 This study suggests that exclusive breastfeeding in South Africa at national level and across all
18 nine provinces increased significantly between 2010 and 2012-13. Similar increases in EBF
19 have been recorded in local studies in KwaZulu-Natal¹⁷ and Gauteng.¹⁸ However, the South
20 African National Health and Nutrition Examination Survey (SANHANES)¹⁹ data do not suggest
21 an increase. The SANHANES rate reported for 2012 was 12.7% for infants less than two months
22 of age, this is relatively similar to the 2003 South African Demographic and Health survey
23 (SADHS) of 11.2%.³ Possible differences between our study and the SANHANES is in the way
24 data were collected. We used 24-hour feeding recall in this study, consistent with most other
25 reported studies; however, SANHANES had no specified time period for the collection of their
26 feeding information (mix of 'from birth' and 'current' questions). However, the most recent
27 South African Demographic and Health Survey (SADHS) also showed an increase in EBF to
28 32% for infants less than six months, with EBF at 44% at 0-1 month and 28.2% at 2-3 months
29 (similar time frames as this study).²⁰ The SADHS used a similar method to determine infant
30 feeding (24-hour recall) and used the same definition of EBF and other feeding categories as
31 used in the SAPMTCTE. While the SAPMTCE EBF rates are higher than the SADHS, the
32 relative increase in EBF across years, and rapidly decreasing EBF by age in the first few months
33 of the infant's life are similar to our data.
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48 **Changes in National and Provincial Programmes after Tshwane Declaration**

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50 Our data are different from other studies as we measured EBF immediately before, during, and
51 immediately after a major national infant feeding policy shift. Our results suggest that this
52 policy shift may be responsible in part for the rapid increases seen in exclusive breastfeeding that
53 we found, which are also confirmed by the latest SADHS.
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5 While our time series is an ecologic comparison, measured in the context of a national policy
6 change in 2011, the policy did lead to major rapid changes in many aspects of infant feeding
7 guidance and programmes across South Africa. For example, after adoption of the Tshwane
8 Declaration of Support for Breastfeeding, which committed to and declared “South Africa as a
9 country that actively promotes, protects, and supports exclusive breastfeeding as a public health
10 intervention to optimize child survival, regardless of the mother's HIV status.” guidelines on
11 Infant and Young Child Feeding (IYCF) were revised and the issuing of free infant formula was
12 stopped in a phased out process from 1 April 2012 with full withdrawal by September 2012.
13 From April 2012 no new mothers with newborns were to be issued with free infant formula.
14 South Africa enforced into law the Code of Marketing of Breastmilk Substitutes. Letters were
15 sent to provincial Heads of Health requesting that the documents "The Tshwane Declaration of
16 Support for Breastfeeding in South Africa"¹¹ and the "Policy Directive for the Implementation of
17 the Declaration on Support of Exclusive Breastfeeding and Revised Guidelines on Infant and
18 Young Child Feeding for Women with HIV"¹² be brought to the attention of all health facilities
19 for implementation.
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32 Following this national guidance, all provinces developed revised infant and young child feeding
33 policies and implementation plans for 2012-2013. A review of these policies found the
34 following common components: IYCF policy consistent with the national policy (e.g. promotion
35 of EBF for all children under 6 months of age), withdrawal of free-formula from the PMTCT
36 programme (e.g. no new formula as of 1 April 2012 with all free formula withdrawn by end of
37 2012), training programmes for health workers and facility managers, implementation and
38 strengthening of the Mother Baby Friendly Hospital Initiative (MFFHI), implementation of
39 Kangaroo Mother Care, implementation of mother's milk banks, and a variety of communication
40 strategies, such as outdoor advertising (e.g. billboards), radio programming, print advertising,
41 IEC materials, community outreach activities and training of community health workers in
42 breastfeeding promotion and support.
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53 In addition to formal national and provincial communication plans, and in particular due to the
54 withdrawal of free formula from the PTMCT programme, the Tshwane Declaration saw national
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3 and local media attention to the new policy and the evidence to support exclusive breastfeeding
4 in South Africa through reports in most major newspapers, radio and television news and on-line
5 health news sites. The media coverage likely served to increase awareness about the benefits of
6 EBF. Other extended effects include the resurgence in the MBFHI and the number of MBHFI
7 accredited hospitals increased from 178 in 2005 to 382 in 2014-2015.
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13 The variety of implementation strategies included in the provincial plans are consistent with
14 recent meta-analyses of health system strategies to increase exclusive breastfeeding. A 2015
15 meta-analysis²¹ found the following interventions to significantly increase exclusive
16 breastfeeding: baby friendly (health facility) support, counselling in health facilities, training of
17 health workers, counselling and support in communities (individual or in groups), and integrated
18 mass media and counselling. Another meta-analysis reported in 2016²² concurred with the
19 2015²¹ findings and also found that using a combination of approaches showed even higher
20 impact on EBF. These findings suggest that the implementation of IYCF in South Africa post
21 Tshwane Declaration, which used many of these proven strategies primarily as a combination of
22 approaches, further strengthens our argument that changes in national policy which were then
23 implemented at all levels is a plausible explanation for the rapid increase in EBF found between
24 2010 and 2012-2013.
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36 Our results show that the similar increases in breastfeeding were found across all subgroups of
37 mothers (Table 3), however results do indicate some groups were still at risk for lower EBF rates
38 (Table 4). Our data suggest that generally higher socio-economic status and employed mothers
39 were less likely to exclusively breastfeed. This inverse relationship between socioeconomic
40 status and EBF is commonly seen in lower- and middle-income countries (LMICs).²³ However
41 this finding was not consistent across all proxy measures for socio-economic status as those
42 mothers without electricity and piped water were less likely to EBF, which is a concern as lack
43 of electricity and piped water have been found to be substantial risk factors for mortality when
44 the infant is formula feeding.²⁴
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3 We also found younger mothers to have lower EBF. Findings on young maternal age and
4 association with breastfeeding in Africa have seen mixed results.²⁵⁻²⁷ Targeting interventions to
5 these at-risk groups might help to further increase EBF.
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10 Particularly encouraging is that the strongest predictor of higher EBF was breastfeeding
11 counselling both individually and in interaction across years, which is consistent with recent
12 systematic reviews,^{21,22} suggesting that programme managers should assure on-going
13 breastfeeding counselling across all facilities and communities.
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18 **Limitations**

19 Limitations of the source cross-sectional survey must be recognized. The data were primary
20 facility-based using infants presenting for immunization services. Infants who did not come for
21 immunization or had already died by 6 weeks of age or attended private hospital/clinic for care
22 were not included in the sample suggesting a possible selection bias. Mothers may have not
23 accurately reported infant feeding practices due to recall bias.
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30 **Public Health Implications**

31 With what seemed to be an intransigently low EBF rate since 1998, South Africa saw a
32 remarkable increase in early EBF (4-8 weeks, mean = six-weeks postpartum) from 2010 to 2013
33 coinciding with major national infant feeding policy change. These increases were seen across all
34 provinces and subgroups, suggesting a population wide effect, not just an increase in certain
35 subgroups or locations.
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42 While these increases in EBF were significant, and a huge step towards changing the tide of poor
43 infant feeding in South Africa, the 59.1% prevalence is still below desired levels of early EBF
44 suggesting that much remains to be done to further improve infant feeding practices. The results
45 of this study suggest several predictors of EBF which could guide future programmatic
46 interventions to further improve EBF rates, such as assuring breastfeeding counselling with a
47 combination of approaches as suggested in recent meta-analyses.^{21,22}
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Authors Contributions

DJ and AE were principal investigators for the three national surveys used for this analysis. SS and CL analysed the data. TD and SB were co-investigators and members of the steering committee for the three national surveys used in this analysis. DJ wrote the first draft of the manuscript and is corresponding author. All authors had access to study data, contributed to writing and editing the manuscript and approved the final manuscript.

Conflict of Interest

None to declare

Human Participant Protection Statement

The protocol was approved by the institutional review board of the South African Medical Research Council and was reviewed by the Centers for Disease Control and Prevention according to the human research protection procedures. All mothers/caregivers signed informed consent prior to study participation. Laboratory results were returned to mothers through routine services. At all visits, mother and infants not in routine care were referred to routine services. No personal identifiers were included in the interview and laboratory study databases.

Data Sharing

Requests for data sharing can be addressed to Principal Investigators: Ameena Goga (Ameena.goga@mrc.ac.za) and Debra Jackson (debrajackson58@gmail.com).

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7 **"Exclusive Breastfeeding"** is defined as giving the infant no other food or drink, not even water,
8 except breast milk (including milk expressed or from a wet nurse) for 6 months of life, but allows the
9 infant to receive ORS, drops and syrups (vitamins, minerals and medicines).

10 **"Exclusive Formula Feeding"** is defined as giving the infant commercial formula without any
11 breastmilk or solids.

12 **"Mixed Breastfeeding"** is defined as giving the infant breastmilk and other fluids or solids.
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14 **Text Box 1: WHO Infant Feeding Definitions¹⁶**
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Table 1: South African Exclusive Breastfeeding (EBF) Rates (%) 1998-2009

Study	Time Period	Location	Recall Period	1998	2003	2007	2008	2009
HSRC ¹	0-6 months	National	Unknown				25.7	
DHS ²	0-6 months	National	24 hour	7	8.3			
DHS ³	0-3 months	National	24 hour	10.4	11.2*			
Good Start 1 ^{4,5}	7 weeks	KZN, EC, WC	24 hour		HIV+: 18 HIV-: 11			
PROMISE- EBF ⁶	3 months	KZN; WC	24 hour			6		
Good Start 2 ⁷	3 months	KZN - Durban	24 hour					14.9

Footnote: HIV+ = HIV positive; HIV- = HIV negative; HSRC=Human Sciences Research Council; DHS = Demographic Health Survey KZN = Kwa Zulu Natal province EC = Eastern Cape province WC = Western Cape province *Data for infants <2 months

Table 2: South African and Provincial EBF Rates at Six (4-8) Weeks Postpartum 2010, 2011-2012 and 2012-2013

	2010	2011-12	2012-13
	% [95% Confidence Intervals (CI)]	% [95% Confidence Intervals (CI)]	% [95% Confidence Intervals (CI)]
Eastern Cape	15.5 [12.0,19.8]	24.8 [21.0,29.1]	53.8 [49.0,58.5]
Free State	16.1 [14.1,18.2]	33.3 [30.5,36.3]	53.3 [48.7,57.9]
Gauteng	23.2 [20.2,26.5]	36.4 [31.6,41.6]	65 [61.2,68.6]
KwaZulu Natal	33.7 [30.2,37.4]	46.6 [43.0,50.2]	60.4 [55.9,64.6]
Limpopo	19.5 [16.1,23.4]	21.3 [18.0,24.9]	47.9 [43.0,52.8]
Mpumalanga	15.9 [13.1,19.2]	47.3 [41.2,53.5]	65 [61.7,68.2]
Northern Cape	22.1 [18.8,25.8]	30.9 [26.6,35.4]	61.7 [57.4,65.9]
Northwest	24.3 [20.7,28.2]	30.4 [26.8,34.2]	65.4 [60.6,69.8]
Western Cape	17.9 [15.3,20.8]	36 [31.2,41.1]	54.9 [49.8,59.8]
South Africa*	22.9 [21.5,24.3]	35.7 [33.9,37.6]	59.1 [57.4,60.7]

* Trends for year, adjusting for province significant, $p < 0.0001$

Table 3: Co-Variates Influence on EBF Increase 2010 compared to 2011-2012 and 2012-2013 (univariate analysis)

Variable	2011-2012 OR (compared to 2010)	2012-13 OR (compared to 2010)
EBF (crude)	1.88 [95% CI 1.70,2.07]	4.87 [95% CI 4.40,5.38]
<i>EBF OR adjusted for:</i>		
HIV Status	1.87	4.93
Maternal Age	1.88	4.86
Maternal Education	1.89	4.92
Maternal Marital Status	1.88	4.87
House Type	1.88	4.90
Water Source	1.88	4.87
Toilet Type	1.87	4.86
Fuel source	1.88	4.87
Mother Employment	1.88	4.92
Food Insecurity	1.85	4.87
Planned Pregnancy	1.90	4.98
Infant Gender	1.88	4.87
Infant Age	1.85	4.77
Parity	1.90	4.97
ANC 4+ Visits	1.91	5.04
Trimester Initiate ANC	1.98	4.99
Delivery Method	1.96	4.98
Breastfeeding Counseling	1.94	4.80

Table 4: Full Adjusted Model for Predictors of EBF at 4-8 Weeks postpartum, 2010-2013.

Variable	Adjusted Odds Ratio	95% Conf. Interval	
Year (Ref: 2010)			
2011	2.08	1.87	2.32
2012	5.51	4.94	6.15
Province (Ref: EC)			
FS	1.22	0.99	1.50
GP	1.70	1.38	2.09
KZN	2.15	1.76	2.64
LP	0.97	0.77	1.22
MP	1.63	1.31	2.03
NC	1.33	1.07	1.66
NW	1.49	1.21	1.84
WC	1.30	1.03	1.64
Mother Age (Ref: <20)			
20-34y	1.07	0.99	1.61
35-50y	1.12	1.01	1.25
Mother Education (Ref: No education)			
Grade 1-7	1.00	0.83	1.21
Grade 8-12	0.86	0.72	1.03
Tertiary	0.62	0.50	0.77
Parity (Ref: Primipara)			
Multipara	1.16	1.09	1.23
Mother Employment (Ref: Employed)			
Other Income	1.53	1.42	1.65
No Income	1.53	1.02	2.31
HIV Status (Ref: Negative)			
Positive	0.66	0.61	0.71
Don't Know	0.74	0.56	0.99

House Type (Ref: Brick)			
Informal/Wood	1.09	1.00	1.19
Traditional/Mud	1.20	1.01	1.42
Water Source (Ref: piped in house/yard)			
Not piped in house/yard	0.84	0.75	0.93
Toilet (Ref: Indoor Flush)			
Pit Latrine	1.19	1.07	1.32
Portable	0.89	0.59	1.33
Other	1.55	0.80	3.02
None	1.03	0.82	1.29
Fuel for cooking (Ref: Electricity)			
Wood/Coal	0.85	0.74	0.98
Other	0.96	0.57	1.62
Food Insecurity (Ref: Yes)			
No	1.13	1.04	1.23
Don't Know	1.65	1.20	2.25
Planned Pregnancy (Ref: Yes)			
No	0.93	0.88	0.99
Delivery Mode (Ref: Vaginal)			
Cesarean	0.84	0.78	0.90
Infant Age Weeks (Ref: 4 weeks)			
5 weeks	0.82	0.66	1.02
6 weeks	0.92	0.75	1.24
7 weeks	0.86	0.71	1.05
8 weeks	0.69	0.55	0.86
Breastfeeding counseling (Ref: Yes)			
No	0.74	0.63	0.88
Breastfeeding Counseling by Year (Ref: Yes in 2010)			
No counselling in 2011-12	0.62	0.49	0.80

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No counselling in 2012-2013	0.66	0.52	0.84
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CHANGES IN RATES OF EARLY EXCLUSIVE BREASTFEEDING IN SOUTH AFRICA FROM 2010 TO 2013: BEFORE AND DURING IMPLEMENTATION OF A CHANGE IN NATIONAL BREASTFEEDING POLICY

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Manuscripts

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7 **CHANGE IN NATIONAL BREASTFEEDING POLICY**
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ABSTRACT

Objective

Between 1998 and 2009 reported exclusive breastfeeding (EBF) rates in South African infants, age 0-6 months, ranged from 6.2% to 25.7%. In 2011, the National Minister of Health shifted policy to promote 'exclusive' breastfeeding for all women in South Africa irrespective of HIV status (Tshwane Declaration of Support for Breastfeeding in South Africa). This analysis examines early EBF prior to and through implementation of the Declaration.

Setting

Data from the three South Africa national, cross-sectional, facility-based surveys, conducted in 2010, 2011-12 and 2012-13, were analysed. Primary Health facilities (n=580) were randomly selected after a stratified multi-stage probability proportional-to-size sampling to provide valid national and provincial estimates.

Participants

A national sample of all infants attending their six-weeks vaccination at selected facilities. The number of caregiver-infant pairs enrolled were 10,182, 10,106 and 9,120 in 2010, 2011-12, and 2012-13, respectively.

Primary Outcome Measure

Exclusive breastfeeding as measured using structured 24-hour recall plus prior 7 days (8 days inclusive prior to day interview) and World Health Organisation definition.

Results

The adjusted odds ratio comparing EBF prevalence in 2011-12 and 2012-13 to 2010 were 2.08 and 5.51, respectively. Mothers with generally higher socioeconomic status, HIV-positive, unplanned pregnancy, primipara, post-caesarean delivery, resided in certain provinces, and women who did not receive breastfeeding counselling had significantly lower odds of EBF.

Conclusion

With what seemed to be an intransigently low EBF rate since 1998, South Africa saw an increase in early EBF for infants 4-8 weeks old from 2010 to 2013, coinciding with a major national breastfeeding policy change. These increases were seen across all provinces and subgroups, suggesting a population-wide effect, rather than an increase in certain subgroups or locations.

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3 While these increases in EBF were significant, the 59.1% prevalence is still below desired levels
4 of early EBF. Further improvements in EBF programmes are needed.
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8 **Trial Registry:** Not applicable
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11 **Article Summary: Strengths and Limitations of this Study**
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- 14 • The data were from a nationally representative survey of infants presenting at primary
15 facilities for immunization services which provides robust national estimates.
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 - 17 • Infants who did not come for immunization or had already died by 4-8 weeks of age or
18 attended a private hospital/clinic for care were not included in the sample suggesting a
19 possible selection bias.
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 - 21 • The study used structured validated questionnaires and WHO recommended infant
22 feeding definitions.
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 - 24 • Caregivers may have not accurately reported infant feeding practices due to recall bias.
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 - 26 • The comparison to the Tshwane Declaration of Support for Breastfeeding in South Africa
27 policy change is ecologic, therefore no causal inference can be confirmed.
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Introduction

South Africa is reported to have one of the lowest exclusive breastfeeding (EBF) rates in Africa. National and regional studies conducted between 1998 and 2009 reported EBF rates in South African infants, age 0-6 months ranging from 6.2% to 25.7% (Table 1).¹⁻⁷ Although questions, settings, and methods varied across these studies, all found that the EBF rate in South Africa remained consistently low in the 1990s through 2009.

Reasons for these low EBF rates have been examined across various settings. The South African HIV epidemic has no doubt been a contributing factor for avoiding breastfeeding or early breastfeeding cessation; however, low EBF rates pre-date the increased focus on HIV since 2000.² The use of formula by health service providers to treat malnutrition and for babies of mothers living with HIV, has been cited as providing mixed messages to communities about the benefits of breastfeeding compared with formula milk, and about EBF.⁸ Cultural norms for early mixed feeding, urbanization, stigma in HIV-positive mothers, and mothers returning to work have all been cited as challenges to EBF.⁹⁻¹¹ Consequently, EBF messaging was not consistently supported by front line health workers, programme managers or policy makers at the height of the HIV epidemic, between 2001 and 2011.

In 2011, the National Minister of Health held a consultation on breastfeeding, which led to a clear shift in national policy to promote EBF for all women in South Africa irrespective of HIV status, through the release of the Tshwane Declaration of Support for Breastfeeding in South Africa (Tshwane Declaration).^{12,13} By September 2012, free formula milk for mothers living with HIV was withdrawn from the Prevention of Mother-to-Child Transmission (PMTCT) programme and EBF messaging for front line workers was emphasized as a policy priority.¹³

This analysis uses data from the three national South Africa National PMTCT surveys conducted to measure early PMTCT effectiveness¹⁴⁻¹⁶ and aims to examine early EBF rates at 4-8 weeks postpartum, in 2010 prior to the Tshwane Declaration, in 2011-12 during the policy transition period, and 2012-13 after complete implementation of the Tshwane Declaration.

Methods

Data from three national, cross-sectional, facility-based surveys, South African PMTCT Evaluations (SAPMTCTEs), conducted in 2010, 2011-12 and 2012-13¹⁴⁻¹⁶ were analysed. These surveys aimed to capture a national sample of all infants attending their six-weeks vaccination, regardless of HIV status. Known and unknown HIV-exposed and HIV-unexposed infants, as well as PMTCT participants and non-participants were included in these three surveys, such that the sample used for this infant feeding analysis represents a nationally representative sample of HIV exposed and unexposed infants.

These surveys were conducted in public primary health care (PHC) and community health centres (CHC) offering immunisation services in all nine provinces. This methodology was chosen as uptake of six-week immunisation in South Africa was >99%, according to the 2007 District Health Information System (DHIS). Stratified multi-stage probability sampling proportional to size, followed by random sampling of facilities and consecutive or systematic sampling of participants (caregivers with infants aged 4-8 weeks receiving their 1st DTP immunization) was conducted. The methods for the 2011-12 and 2012-2013 surveys were the same as described in 2010.¹⁴⁻¹⁶ The sampling frame and selected facilities were identical between 2011-12 and 2012-13, except for four clinic replacements due to shifting of services or clinic closure for maintenance.

Immunisation data from the 2007 DHIS were used to quantify the number of children that could be expected within Primary Health Care/Community Health Centres (PHC/CHC) facilities over a period of time. These were then stratified by size. Sample size was calculated so that valid national and provincial level estimates of MTCT could be ascertained. In the first stage, facilities (Primary sampling units - PSUs) were randomly sampled proportional to size (PPS) within each stratum. This resulted in 34-79 facilities per province, 580 in total. In the second-stage, caregiver/infant pairs were consecutively or randomly selected from facilities (depending on facility size). The desired sample size was 12,200 infants aged 4-8 weeks, per survey to produce national and provincial estimates. Hospitals and mobile clinics, very sick infants or infants aged <4 weeks or >8 weeks were excluded.

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3 Maternal/caregiver interviews were conducted and infant dried blood spots (iDBS) were drawn
4 after receiving consent from caregivers for study participation. Data were collected using low
5 cost cellular telephones and interview data were uploaded into a web-based database console, in
6 real-time. Interviews gathered data on maternal socio-demographics, ante- and postnatal care,
7 mother's reported HIV status and PMTCT services. Infant feeding information was collected
8 using structured recall documenting whether the infants received a particular food or fluid during
9 the past 24 hours and the 7 days prior (8 days inclusive prior to day of interview). Exclusive
10 breastfeeding was defined as giving the infant no other food or drink (not even water) except
11 breast milk (including milk expressed or from a wet nurse), but allowed the infant to receive
12 prescribed medicines.¹⁷
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22 This analysis includes all infants for which there was consent and a valid questionnaire, with or
23 without an iDBS and regardless of HIV exposure or HIV infection status. Analysis was weighted
24 for sample realisation and at provincial level proportional to the live birth distribution of South
25 Africa. The main outcome variable of interest gathered from the three surveys was the proportion
26 of infants exclusively breastfed at 4-8 weeks postpartum. We conducted logistic regression to
27 examine if these factors were associated with EBF: maternal - age, education, marital status,
28 parity, employment and HIV status; household - type, water source, fuel for cooking, and toilet;
29 food insecurity; planned pregnancy, antenatal care - initiation (trimester) and attendance (4+
30 visits); delivery mode and receipt of breastfeeding counselling: (asked as "During pregnancy did
31 you ever discuss with anyone at the clinic what the best way for you to feed your baby"); child -
32 sex and age in weeks.
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43 The analytic dataset included three years (2010-2013) of data from the three consecutive cross-
44 sectional nationally representative SAPMTCTEs. We used survey statistics in STATA SE, v15
45 for the calculation of the standard errors of the survey estimates to account for the stratification,
46 sample weights, and the multi-stage design.
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51 Survey statistics were used to report 2-way table descriptive statistics, which included
52 proportions and 95% confidence intervals (CI). Univariate logistic regressions (survey) were run
53 on the binary EBF outcome at 4-8 weeks controlling for year. The first multiple logistic
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3 regression model which included 19 possible categorical predictors (including year) were
4 examined based on known predictors of EBF from the literature. Predictors were retained if at
5 least one category was significant at 5% level; which resulted in a final multiple regression
6 model with 15 categorical predictors. Interaction effects between year and other predictor
7 variables were also examined; from this only the interaction effect of antenatal breastfeeding
8 counselling receipt and year was retained in the final model. All results were reported as odds
9 ratios with 95% CI's (significance at 5% level).
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16 17 **Patient and Public Involvement**

18 There was no patient or public involvement in the design of this study.
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22 **Funding**

23 This manuscript has been supported by the President's Emergency Plan for AIDS Relief
24 (PEPFAR) through the Centers for Disease Control and Prevention (CDC), UNICEF, and the
25 South African National Research Foundation.
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31 **Results**

32 The number of caregiver-infant pairs enrolled in 2010, 2011-12, and 2012-13 were 10,182,
33 10,106 and 9,120, respectively. National EBF rates at 4-8 weeks of age were 22.9% (95%
34 confidence interval (CI) 21.5-24.3) in 2010, 35.7% (95% CI 33.9-37.6) in 2011-12, and 59.1%
35 (95% CI 57.4-60.7) in 2012-13, $p < 0.001$. All nine provinces showed similar statistically
36 significant increasing EBF trends between 2010 and 2012-13. (Table 2)
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43 The crude OR for EBF comparing 2011-12 and 2012-13 to 2010 was 1.88 (95% CI 1.70 – 2.07)
44 and 4.87 (95% CI 4.40 – 5.38), respectively (Table 3). The OR comparing EBF in 2010 to the
45 subsequent time period (2011-12 or 2012-2013) is adjusted just for the individual variable listed,
46 such as maternal marital status (all categories, details of variable categories can be found in
47 Table 4)). In this univariate analysis (Table 3) the EBF by year odds ratios did not change by
48 more than 10% for any of the examined variables, suggesting that these increases were seen
49 across all regions and population sub-groups.
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3 In the full logistic model including all variables (data not shown) the EBF by year estimates did
4 not change by more than 10% suggesting again no confounding due to examined co-variates.
5 However, in the final logistic model, including an interaction term for year and counseling,
6 (Table 4) the annual EBF differences did change by just over 10% (to 2.08 in 2011-2012 and
7 5.51 in 2012-2013) suggesting a potential confounding effect.
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13 In the full multivariable model (Table 4), mothers with younger age, mothers who were HIV-
14 positive, had an unplanned pregnancy, primipara, had a caesarean delivery, and who did not
15 receive breastfeeding counselling had lower odds of EBF. Socioeconomic status influence
16 showed mixed results with mothers with tertiary education, formal brick housing, indoor flush
17 toilet, employed mothers having lower odds of EBF, while piped water in the house or yard and
18 electricity as fuel source had higher odds. Exclusive breastfeeding showed significant decline by
19 the 8th week of age (Table 4, Figure 1)
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27 Discussion

28 Exclusive Breastfeeding Rates

29 This study suggests that exclusive breastfeeding in South Africa at national level and across all
30 nine provinces increased significantly between 2010 and 2012-13. Similar increases in EBF
31 have been recorded in local studies in KwaZulu-Natal¹⁸ and Gauteng.¹⁹ While, the KwaZulu-
32 Natal study was in the context of an improved EBF counselling programme, it is consistent with
33 improved programme efforts post-Tshwane.
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41 The South African National Health and Nutrition Examination Survey (SANHANES)²⁰ data do
42 not suggest an increase. The SANHANES rate reported for 2012 was 12.7% for infants less than
43 two months of age, this is relatively similar to the 2003 South African Demographic and Health
44 survey (SADHS) of 11.2%.² Possible differences between our study and the SANHANES is in
45 the way data were collected. We used an 8 day feeding recall in this study; however,
46 SANHANES had no specified time period for the collection of their feeding information (mix of
47 ‘from birth’ and ‘current’ questions).
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3 The most recent South African Demographic and Health Survey (SADHS) in 2016 also showed
4 an increase in EBF to 32% for infants less than six months, with EBF at 44% at 0-1 month and
5 28.2% at 2-3 months (similar time frames as this study).²¹ The SADHS used a 24-hour recall and
6 used the same definition of EBF as used in the SAPMTCTE. It should be noted that a major
7 difference in the SADHS and our survey is that one is a household survey and one facility based.
8 Additionally SADHS included only 115 infants < 1 month. This is a very small sample size, and
9 results from SADHS should be interpreted with caution. Our use of 8 day recall and large sample
10 sizes suggest potentially robust estimates,^{22,23} nevertheless many studies use longer periods of
11 measurement such as 0-6 months, such that our estimates of early EBF at 4-8 weeks would be
12 expected to be higher. However, while the SAPMTCE EBF rates are higher than the SADHS, the
13 relative increase in EBF across years (1998, 2003 to 2016), and rapidly decreasing EBF by age in
14 the first few months of the infant's life are similar to our data,
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25 **Changes in National and Provincial Programmes after Tshwane Declaration**

26 Our data are different from other studies as we measured EBF immediately before, during, and
27 immediately after a major national infant feeding policy shift. Our results suggest that this
28 policy shift may be responsible in part for the rapid increases seen in exclusive breastfeeding that
29 we found, which are also confirmed by the latest SADHS.
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36 Our time series is an ecologic comparison, measured in the context of a national policy change in
37 2011, thus causal inference cannot be established. However, the policy did lead to major rapid
38 changes in many aspects of infant feeding guidance and programmes across South Africa. For
39 example, after adoption of the Tshwane Declaration of Support for Breastfeeding in South
40 Africa, which committed to and declared "South Africa as a country that actively promotes,
41 protects, and supports exclusive breastfeeding as a public health intervention to optimize child
42 survival, regardless of the mother's HIV status."¹² guidelines on Infant and Young Child Feeding
43 (IYCF) were revised and the issuing of free infant formula was stopped in a phased out process
44 from 1 April 2012 with full withdrawal by September 2012. From April 2012 no new mothers
45 with newborns were to be issued with free infant formula.¹³ South Africa enforced into law the
46 Code of Marketing of Breastmilk Substitutes.²⁴ Letters were sent to provincial Heads of Health
47 requesting that the documents "The Tshwane Declaration of Support for Breastfeeding in South
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3 Africa"¹² and the "Policy Directive for the Implementation of the Declaration on Support of
4 Exclusive Breastfeeding and Revised Guidelines on Infant and Young Child Feeding for Women
5 with HIV"¹³ be brought to the attention of all health facilities for implementation.
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10 Following this national guidance, all provinces developed revised infant and young child feeding
11 policies and implementation plans for 2012-2013. A review of these policies found the
12 following common components: IYCF policy consistent with the national policy (e.g. promotion
13 of EBF for all children under 6 months of age), withdrawal of free formula from the PMTCT
14 programme (e.g. no new formula as of 1 April 2012 with all free formula withdrawn by end of
15 2012), training programmes for health workers and facility managers, implementation and
16 strengthening of the Mother Baby Friendly Hospital Initiative (MBFHI), implementation of
17 Kangaroo Mother Care, implementation of mother's milk banks, and a variety of communication
18 strategies, such as outdoor advertising (e.g. billboards), radio programming, print advertising,
19 IEC materials, community outreach activities and training of community health workers in
20 breastfeeding promotion and support.
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31 In addition to formal national and provincial communication plans, and in particular due to the
32 withdrawal of free formula from the PTMCT programme, the Tshwane Declaration saw national
33 and local media attention to the new policy and the evidence to support exclusive breastfeeding
34 in South Africa through reports in most major newspapers, radio and television news and on-line
35 health news sites. The media coverage likely served to increase awareness about the benefits of
36 EBF. Other extended effects include the resurgence in the MBFHI and the number of MBHFI
37 accredited hospitals increased from 178 in 2005 to 382 in 2014-2015.
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45 The variety of implementation strategies included in the provincial plans are consistent with
46 recent meta-analyses of health system strategies to increase exclusive breastfeeding. A 2015
47 meta-analysis²⁵ found the following interventions to significantly increase exclusive
48 breastfeeding: baby friendly (health facility) support, counselling in health facilities, training of
49 health workers, counselling and support in communities (individual or in groups), and integrated
50 mass media and counselling. Another meta-analysis reported in 2016²⁶ concurred with the
51 2015²⁵ findings and also found that using a combination of approaches showed an even higher
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3 impact on EBF. These findings suggest that the implementation of IYCF in South Africa post the
4 Tshwane Declaration, which used many of these proven strategies primarily as a combination of
5 approaches, further strengthens our argument that changes in national policy which were then
6 implemented at all levels is one plausible contributor for the rapid increase in EBF found
7 between 2010 and 2012-2013.
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17 **Groups at Risk for Lower EBF**

18 Our results show that the similar increases in EBF were found across all subgroups of mothers
19 (Table 3), however results do indicate some groups were still at risk for lower odds of EBF rates
20 (Table 4). Our data suggest that generally higher socio-economic status and employed mothers
21 were less likely to exclusively breastfeed. This inverse relationship between socioeconomic
22 status and EBF is commonly seen in lower- and middle-income countries (LMICs).²⁷ However
23 this finding was not consistent across all proxy measures for socio-economic status as those
24 mothers without electricity and piped water were less likely to EBF, which is a concern as lack
25 of electricity and piped water have been found to be substantial risk factors for mortality when
26 the infant is formula feeding.⁸
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36 We also found younger mothers to have lower EBF. Findings on young maternal age and
37 association with EBF in Africa have seen mixed results.²⁸⁻³⁰ Primiparas were also seen to have
38 lower EBF, which is consistent with the finding on younger mothers. However, again results in
39 the literature were mixed. A study in Tanzania³⁰ found no difference in EBF across parity
40 groups, while studies in Nigeria²⁹ and Ethiopia²⁸ found an opposite result of higher EBF in lower
41 parity mothers. These mixed results across age and parity may reflect local social and cultural
42 norms across countries. For South Africa targeting interventions to younger first time mothers
43 might help to further increase EBF. Unintended pregnancy also was associated with lower EBF.
44 The literature is sparse on this potential association, one study in Ghana³¹ describes shorter
45 breastfeeding duration for mothers with unintended pregnancy and in a qualitative study in
46 Kenya³² respondents cited unintended pregnancy as a factor which influenced their infant
47 feeding. Further study is needed on the relation between unintended pregnancy and EBF.
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5 Consistent with the literature we also saw a drop in EBF in the older infant age group at 8 weeks
6 across all years of the study.^{21,30} This is consistent with the literature and other South African
7 Studies. This drop of in EBF prior to age six months remains an ongoing concern.
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11 Particularly encouraging is that the strongest predictor of higher EBF was antenatal breastfeeding
12 counselling both individually and in interaction across years, which is consistent with recent
13 meta-analyses,^{25,26} suggesting that programme managers should assure on-going antenatal
14 breastfeeding counselling across all facilities and communities.
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20 **Limitations**

21 Limitations of the source cross-sectional survey must be recognized. The data were primary
22 facility-based using infants presenting for immunization services. Infants who did not come for
23 immunization or had already died by 4-8 weeks of age or attended private hospital/clinic for care
24 were not included in the sample suggesting a possible selection bias. Mothers may have not
25 accurately reported infant feeding practices due to recall bias. Also this analysis only examines
26 early (4-8 weeks) EBF, rates and factors influencing breastfeeding can vary based on the age of
27 the infant. Comparison to the Tshwane policy change is ecologic and therefore no causal
28 inference is implied.
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38 **Public Health Implications**

39 With what seemed to be an intransigently low EBF rate since 1998, South Africa saw a
40 remarkable increase in early EBF (4-8 weeks) from 2010 to 2013 coinciding with a major
41 national infant feeding policy change. These increases were seen across all provinces and
42 subgroups, suggesting a population wide effect, not just an increase in certain subgroups or
43 locations.
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50 While these increases in EBF were significant, and a huge step towards changing the tide of poor
51 infant feeding in South Africa, the 59.1% prevalence is still below desired levels of early EBF
52 suggesting that much remains to be done to further improve infant feeding practices. The results
53 of this study suggest several predictors of EBF which could guide future programmatic
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3 interventions to further improve EBF rates, such as greater attention to vulnerable groups, such
4 as young women and first time mothers, and assuring antenatal breastfeeding counselling with a
5 combination of approaches as suggested in recent meta-analyses.^{25,26}
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Authors Contributions

DJ and AG were principal investigators for the three national surveys used for this analysis. SS and CL analysed the data. TD and SB were co-investigators and members of the steering committee for the three national surveys used in this analysis. DJ wrote the first draft of the manuscript and is corresponding author. All authors had access to study data, contributed to writing and editing the manuscript and approved the final manuscript.

Conflict of Interest

None to declare

Human Participant Protection Statement

The protocol was approved by the institutional review board of the South African Medical Research Council (EC09-002) and was reviewed by the Centers for Disease Control and Prevention (IRB identifier: FWA00002753 Cooperative agreement number: U2G/PS001137-0 1) according to the human research protection procedures. All mothers/caregivers signed informed consent prior to study participation. Laboratory results were returned to mothers through routine services. At all visits, mother and infants not in routine care were referred to routine services. No personal identifiers were included in the interview and laboratory study databases.

Data Sharing

Requests for data sharing can be addressed to Principal Investigators: Ameena Goga (Ameena.goga@mrc.ac.za) and Debra Jackson (debrajackson58@gmail.com).

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Table 1: South African Exclusive Breastfeeding (EBF) Rates (%) 1998-2009

Study	Time Period	Location	Recall Period	1998	2003	2007	2008	2009
DHS ^{1,2}	0-3 months	National	24 hour	10.4 (n=312)	11.2* (n=55)			
DHS ^{1,2}	0-5 months	National	24 hour	7.0 (n=505)	8.3 (n=194)			
Good Start 1 ^{3,4}	7 weeks	KZN, EC, WC	24 hour		HIV+: 13.6 (n=493) HIV-: 12.2 (n=181)			
Good Start 1 ^{3,4}	3 months	KZN, EC, WC	24 hour		HIV+: 7.2 (n=487) HIV-: 2.8 (n=178)			
PROMISE-EBF ⁵	3 months	KZN; WC	24 hour			6.2 (n=485)		
HSRC ⁶	0-6 months	National	Unknown				25.7	

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							(n=508)	
Good Start 2⁷	3 months	KZN - Durban	24 hour					14.9 (n=1693)

Footnote: HIV+ = HIV positive; HIV- = HIV negative; HSRC=Human Sciences Research Council; DHS = Demographic Health Survey KZN = Kwa Zulu Natal province EC = Eastern Cape province WC = Western Cape province *Data for infants <2 months

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Table 2: South African and Provincial EBF Rates at Six (4-8) Weeks Postpartum 2010, 2011-2012 and 2012-2013

	2010 n=10,182	2011-12 n=10,106	2012-13 n=9,120
	% [95% Confidence Intervals (CI)]	% [95% Confidence Intervals (CI)]	% [95% Confidence Intervals (CI)]
Eastern Cape	15.5 [12.0,19.8]	24.8 [21.0,29.1]	53.8 [49.0,58.5]
Free State	16.1 [14.1,18.2]	33.3 [30.5,36.3]	53.3 [48.7,57.9]
Gauteng	23.2 [20.2,26.5]	36.4 [31.6,41.6]	65 [61.2,68.6]
KwaZulu Natal	33.7 [30.2,37.4]	46.6 [43.0,50.2]	60.4 [55.9,64.6]
Limpopo	19.5 [16.1,23.4]	21.3 [18.0,24.9]	47.9 [43.0,52.8]
Mpumalanga	15.9 [13.1,19.2]	47.3 [41.2,53.5]	65 [61.7,68.2]
Northern Cape	22.1 [18.8,25.8]	30.9 [26.6,35.4]	61.7 [57.4,65.9]
Northwest	24.3 [20.7,28.2]	30.4 [26.8,34.2]	65.4 [60.6,69.8]
Western Cape	17.9 [15.3,20.8]	36 [31.2,41.1]	54.9 [49.8,59.8]
South Africa*	22.9 [21.5,24.3]	35.7 [33.9,37.6]	59.1 [57.4,60.7]

* Trends for year, adjusting for province significant, $p < 0.001$

Table 3: Co-Variates Influence on EBF Increase 2010 compared to 2011-2012 and 2012-2013 (univariate logistic regression analysis)*

Variable	2011-2012 OR for EBF (compared to 2010)	2012-13 OR for EBF (compared to 2010)
EBF OR (crude)	1.88 [95% CI 1.70,2.07]	4.87 [95% CI 4.40,5.38]
<i>EBF OR adjusted for each individual variable in univariate analysis:</i>		
Maternal HIV Status	1.87	4.93
Maternal Age	1.88	4.86
Maternal Education	1.89	4.92
Maternal Marital Status	1.88	4.87
House Type	1.88	4.90
Water Source	1.88	4.87
Toilet Type	1.87	4.86
Fuel source	1.88	4.87
Food Insecurity	1.85	4.87
Infant Gender	1.88	4.87
Infant Age	1.85	4.77
Antenatal Breastfeeding Counselling	1.94	4.80

*Notes for reading Table 3: The OR in this table are the OR for EBF adjusted for the individual variable, e.g. Infant Gender or Infant Age as categorized in Table 4. We are not comparing for example OR of EBF by Maternal HIV status (e.g. positive or negative) we are comparing the crude OR for EBF by year to the OR for EBF by year adjusted for maternal HIV status to examine for potential confounding by Maternal HIV Status. This OR is then compared to the crude OR to see if the effect estimate (OR of EBF by year) changes by +/- 10% suggesting potential confounding of OR by year due to the third variable (e.g. variables listed in the first

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3 *column). Note for 2011-2012 compared to 2010 an adjusted OR of <1.69 or >2.07 would reflect*
4 *a greater than 10% difference in OR; while for 2012-2013 an adjusted OR of <4.38 or >5.36*
5 *would reflect a greater than 10% difference in OR. None of the univariate adjusted estimates for*
6 *EBF by year are outside of these ranges suggesting confounding of the OR by year is unlikely*
7 *due to the individual co-variate analysed. Total Observations: 29,981*
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Table 4: Full Adjusted multivariate logistic regression Model for Predictors of EBF at 4-8 Weeks postpartum, 2010-2013.

Variable	Adjusted Odds Ratio	95% Conf. Interval*	
Year (Ref: 2010)			
2011-12	2.08	1.87	2.32
2012-13	5.51	4.94	6.15
Province (Ref: EC)			
FS	1.22	0.99	1.50
GP	1.70	1.38	2.09
KZN	2.15	1.76	2.64
LP	0.97	0.77	1.22
MP	1.63	1.31	2.03
NC	1.33	1.07	1.66
NW	1.49	1.21	1.84
WC	1.30	1.03	1.64
Mother Age (Ref: <20)			
20-34y	1.07	0.99	1.61
35-50y	1.12	1.01	1.25
Mother Education (Ref: No education)			
Grade 1-7	1.00	0.83	1.21
Grade 8-12	0.86	0.72	1.03
Tertiary	0.62	0.50	0.77
Parity (Ref: Primipara)			
Multipara	1.16	1.09	1.23
Mother Employment (Ref: Employed)			
Other Income	1.53	1.42	1.65
No Income	1.53	1.02	2.31
HIV Status (Ref: Negative)			
Positive	0.66	0.61	0.71

Don't Know	0.74	0.56	0.99
House Type (Ref: Brick)			
Informal/Wood	1.09	1.00	1.19
Traditional/Mud	1.20	1.01	1.42
Water Source (Ref: piped in house/yard)			
Not piped in house/yard	0.84	0.75	0.93
Toilet (Ref: Indoor Flush)			
Pit Latrine	1.19	1.07	1.32
Portable	0.89	0.59	1.33
Other	1.55	0.80	3.02
None	1.03	0.82	1.29
Fuel for cooking (Ref: Electricity)			
Wood/Coal	0.85	0.74	0.98
Other	0.96	0.57	1.62
Food Insecurity (Ref: Yes)			
No	1.13	1.04	1.23
Don't Know	1.65	1.20	2.25
Planned Pregnancy (Ref: Yes)			
No	0.93	0.88	0.99
Delivery Mode (Ref: Vaginal)			
Cesarean	0.84	0.78	0.90
Infant Age Weeks (Ref: 4 weeks)			
5 weeks	0.82	0.66	1.02
6 weeks	0.92	0.75	1.24
7 weeks	0.86	0.71	1.05
8 weeks	0.69	0.55	0.86
Antenatal Breastfeeding counselling (Ref: Yes)			
No	0.74	0.63	0.88
Antenatal Breastfeeding Counselling by Year (Ref: Yes in 2010)			

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No ANC counselling in 2011-12	0.62	0.49	0.80
No ANC counselling in 2012-2013	0.66	0.52	0.84

**Bold indicate 95%CI does not cross null (1.0); Total Observations:29,288*

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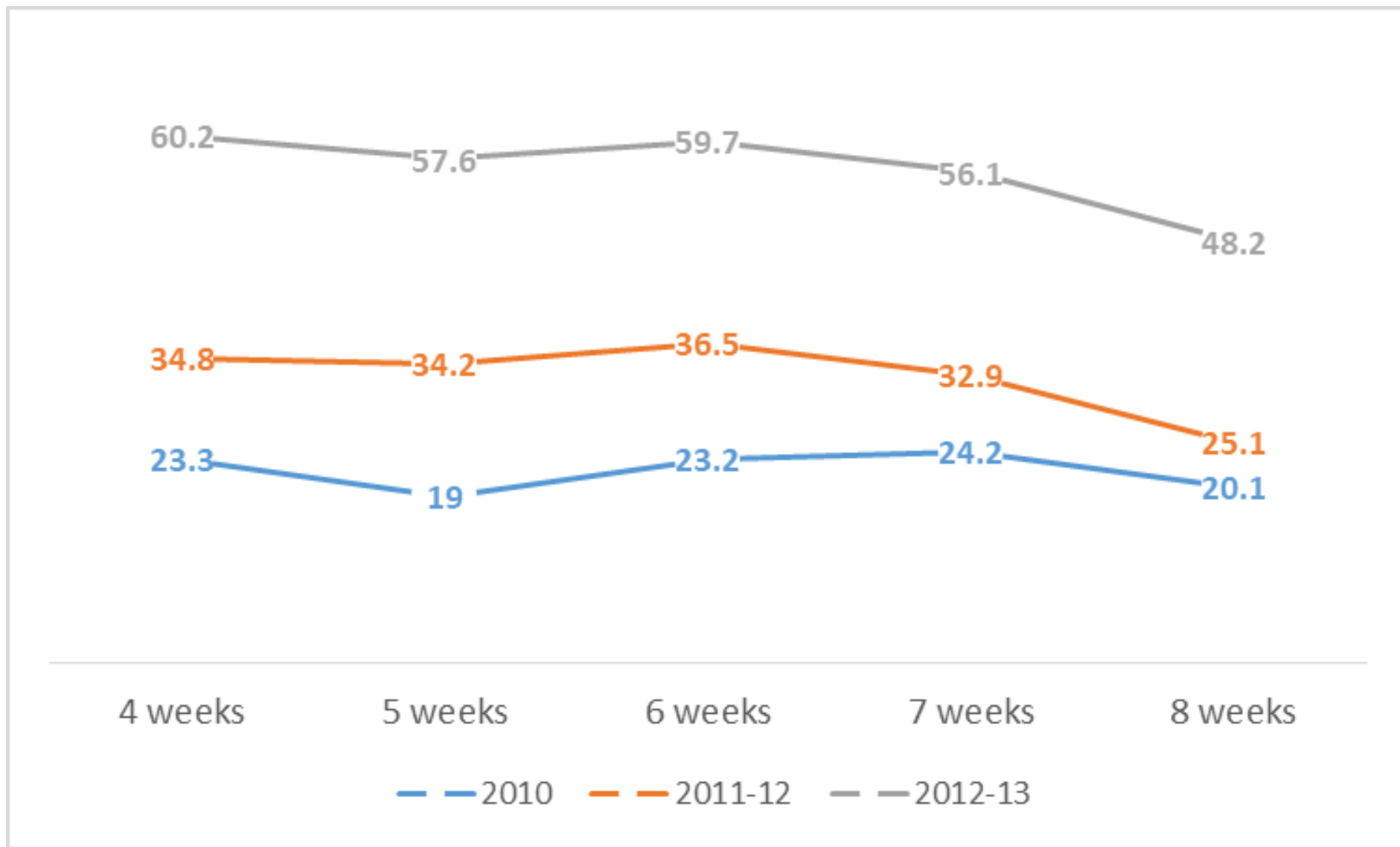


Figure 1: EBF rates by Infant Age in Weeks by Year, 2010-2013

BMJ Open

CHANGES IN RATES OF EARLY EXCLUSIVE BREASTFEEDING IN SOUTH AFRICA FROM 2010 TO 2013: DATA FROM THREE NATIONAL SURVEYS BEFORE AND DURING IMPLEMENTATION OF A CHANGE IN NATIONAL BREASTFEEDING POLICY

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Manuscripts

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3 **CHANGES IN RATES OF EARLY EXCLUSIVE BREASTFEEDING IN SOUTH**
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5 **AFRICA FROM 2010 TO 2013: DATA FROM THREE NATIONAL SURVEYS BEFORE**
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7 **AND DURING IMPLEMENTATION OF A CHANGE IN NATIONAL**
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9 **BREASTFEEDING POLICY**
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ABSTRACT

Objective

Between 1998 and 2009 reported exclusive breastfeeding (EBF) rates in South African infants, age 0-6 months, ranged from 6.2% to 25.7%. In 2011, the National Minister of Health shifted policy to promote 'exclusive' breastfeeding for all women in South Africa irrespective of HIV status (Tshwane Declaration of Support for Breastfeeding in South Africa). This analysis examines early EBF prior to and through implementation of the Declaration.

Setting

Data from the three South Africa national, cross-sectional, facility-based surveys, conducted in 2010, 2011-12 and 2012-13, were analysed. Primary Health facilities (n=580) were randomly selected after a stratified multi-stage probability proportional-to-size sampling to provide valid national and provincial estimates.

Participants

A national sample of all infants attending their six-weeks vaccination at selected facilities. The number of caregiver-infant pairs enrolled were 10,182, 10,106 and 9,120 in 2010, 2011-12, and 2012-13, respectively.

Primary Outcome Measure

Exclusive breastfeeding as measured using structured 24-hour recall plus prior 7 days (8 days inclusive prior to day interview) and World Health Organisation definition.

Results

The adjusted odds ratio comparing EBF prevalence in 2011-12 and 2012-13 to 2010 were 2.08 and 5.51, respectively. Mothers with generally higher socioeconomic status, HIV-positive, unplanned pregnancy, primipara, post-caesarean delivery, resided in certain provinces, and women who did not receive breastfeeding counselling had significantly lower odds of EBF.

Conclusion

With what seemed to be an intransigently low EBF rate since 1998, South Africa saw an increase in early EBF for infants 4-8 weeks old from 2010 to 2013, coinciding with a major national breastfeeding policy change. These increases were seen across all provinces and subgroups, suggesting a population-wide effect, rather than an increase in certain subgroups or locations.

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3 While these increases in EBF were significant, the 59.1% prevalence is still below desired levels
4 of early EBF. Further improvements in EBF programmes are needed.
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8 **Trial Registry:** Not applicable
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11 **Article Summary: Strengths and Limitations of this Study**
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- 14 • The data were from a nationally representative survey of infants presenting at primary
15 facilities for immunization services which provides robust national estimates.
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 - 17 • Infants who did not come for immunization or had already died by 4-8 weeks of age or
18 attended a private hospital/clinic for care were not included in the sample suggesting a
19 possible selection bias.
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 - 21 • The study used structured validated questionnaires and WHO recommended infant
22 feeding definitions.
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 - 24 • Caregivers may have not accurately reported infant feeding practices due to recall bias.
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 - 26 • The comparison to the Tshwane Declaration of Support for Breastfeeding in South Africa
27 policy change is ecologic, therefore no causal inference can be confirmed.
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Introduction

South Africa is reported to have one of the lowest exclusive breastfeeding (EBF) rates in Africa. National and regional studies conducted between 1998 and 2009 reported EBF rates in South African infants, age 0-6 months ranging from 6.2% to 25.7% (Table 1).¹⁻⁷ Although questions, settings, and methods varied across these studies, all found that the EBF rate in South Africa remained consistently low in the 1990s through 2009.

Reasons for these low EBF rates have been examined across various settings. The South African HIV epidemic has no doubt been a contributing factor for avoiding breastfeeding or early breastfeeding cessation; however, low EBF rates pre-date the increased focus on HIV since 2000.² The use of formula by health service providers to treat malnutrition and for babies of mothers living with HIV, has been cited as providing mixed messages to communities about the benefits of breastfeeding compared with formula milk, and about EBF.⁸ Cultural norms for early mixed feeding, urbanization, stigma in HIV-positive mothers, and mothers returning to work have all been cited as challenges to EBF.⁹⁻¹¹ Consequently, EBF messaging was not consistently supported by front line health workers, programme managers or policy makers at the height of the HIV epidemic, between 2001 and 2011.

In 2011, the National Minister of Health held a consultation on breastfeeding, which led to a clear shift in national policy to promote EBF for all women in South Africa irrespective of HIV status, through the release of the Tshwane Declaration of Support for Breastfeeding in South Africa (Tshwane Declaration).^{12,13} By September 2012, free formula milk for mothers living with HIV was withdrawn from the Prevention of Mother-to-Child Transmission (PMTCT) programme and EBF messaging for front line workers was emphasized as a policy priority.¹³

This analysis uses data from the three national South Africa National PMTCT surveys conducted to measure early PMTCT effectiveness¹⁴⁻¹⁶ and aims to examine early EBF rates at 4-8 weeks postpartum, in 2010 prior to the Tshwane Declaration, in 2011-12 during the policy transition period, and 2012-13 after complete implementation of the Tshwane Declaration.

Methods

Data from three national, cross-sectional, facility-based surveys, South African PMTCT Evaluations (SAPMTCTEs), conducted in 2010, 2011-12 and 2012-13¹⁴⁻¹⁶ were analysed. These surveys aimed to capture a national sample of all infants attending their six-weeks vaccination, regardless of HIV status. Known and unknown HIV-exposed and HIV-unexposed infants, as well as PMTCT participants and non-participants were included in these three surveys, such that the sample used for this infant feeding analysis represents a nationally representative sample of HIV exposed and unexposed infants.

These surveys were conducted in public primary health care (PHC) and community health centres (CHC) offering immunisation services in all nine provinces. This methodology was chosen as uptake of six-week immunisation in South Africa was >99%, according to the 2007 District Health Information System (DHIS). Stratified multi-stage probability sampling proportional to size, followed by random sampling of facilities and consecutive or systematic sampling of participants (caregivers with infants aged 4-8 weeks receiving their 1st DTP immunization) was conducted. The methods for the 2011-12 and 2012-2013 surveys were the same as described in 2010.¹⁴⁻¹⁶ The sampling frame and selected facilities were identical between 2011-12 and 2012-13, except for four clinic replacements due to shifting of services or clinic closure for maintenance.

Immunisation data from the 2007 DHIS were used to quantify the number of children that could be expected within Primary Health Care/Community Health Centres (PHC/CHC) facilities over a period of time. These were then stratified by size. Sample size was calculated so that valid national and provincial level estimates of MTCT could be ascertained. In the first stage, facilities (Primary sampling units - PSUs) were randomly sampled proportional to size (PPS) within each stratum. This resulted in 34-79 facilities per province, 580 in total. In the second-stage, caregiver/infant pairs were consecutively or randomly selected from facilities (depending on facility size). The desired sample size was 12,200 infants aged 4-8 weeks, per survey to produce national and provincial estimates. Hospitals and mobile clinics, very sick infants or infants aged <4 weeks or >8 weeks were excluded.

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3 Maternal/caregiver interviews were conducted and infant dried blood spots (iDBS) were drawn
4 after receiving consent from caregivers for study participation. Data were collected using low
5 cost cellular telephones and interview data were uploaded into a web-based database console, in
6 real-time. Interviews gathered data on maternal socio-demographics, ante- and postnatal care,
7 mother's reported HIV status and PMTCT services. Infant feeding information was collected
8 using structured recall documenting whether the infants received a particular food or fluid during
9 the past 24 hours and the 7 days prior (8 days inclusive prior to day of interview). Exclusive
10 breastfeeding was defined as giving the infant no other food or drink (not even water) except
11 breast milk (including milk expressed or from a wet nurse), but allowed the infant to receive
12 prescribed medicines.¹⁷
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22 This analysis includes all infants for which there was consent and a valid questionnaire, with or
23 without an iDBS and regardless of HIV exposure or HIV infection status. Analysis was weighted
24 for sample realisation and at provincial level proportional to the live birth distribution of South
25 Africa. The main outcome variable of interest gathered from the three surveys was the proportion
26 of infants exclusively breastfed at 4-8 weeks postpartum. We conducted logistic regression to
27 examine if these factors were associated with EBF: maternal - age, education, marital status,
28 parity, employment and HIV status; household - type, water source, fuel for cooking, and toilet;
29 food insecurity; planned pregnancy, antenatal care - initiation (trimester) and attendance (4+
30 visits); delivery mode and receipt of breastfeeding counselling: (asked as "During pregnancy did
31 you ever discuss with anyone at the clinic what the best way for you to feed your baby"); child -
32 sex and age in weeks.
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43 The analytic dataset included three years (2010-2013) of data from the three consecutive cross-
44 sectional nationally representative SAPMTCTEs. We used survey statistics in STATA SE, v15
45 for the calculation of the standard errors of the survey estimates to account for the stratification,
46 sample weights, and the multi-stage design.
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51 Survey statistics were used to report 2-way table descriptive statistics, which included
52 proportions and 95% confidence intervals (CI). Univariate logistic regressions (survey) were run
53 on the binary EBF outcome at 4-8 weeks controlling for year. The first multiple logistic
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3 regression model which included 19 possible categorical predictors (including year) were
4 examined based on known predictors of EBF from the literature. Predictors were retained if at
5 least one category was significant at 5% level; which resulted in a final multiple regression
6 model with 15 categorical predictors. Interaction effects between year and other predictor
7 variables were also examined; from this only the interaction effect of antenatal breastfeeding
8 counselling receipt and year was retained in the final model. All results were reported as odds
9 ratios with 95% CI's (significance at 5% level).
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16 17 **Patient and Public Involvement**

18 There was no patient or public involvement in the design of this study.
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22 **Funding**

23 This manuscript has been supported by the President's Emergency Plan for AIDS Relief
24 (PEPFAR) through the Centers for Disease Control and Prevention (CDC), UNICEF, and the
25 South African National Research Foundation.
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31 **Results**

32 The number of caregiver-infant pairs enrolled in 2010, 2011-12, and 2012-13 were 10,182,
33 10,106 and 9,120, respectively. National EBF rates at 4-8 weeks of age were 22.9% (95%
34 confidence interval (CI) 21.5-24.3) in 2010, 35.7% (95% CI 33.9-37.6) in 2011-12, and 59.1%
35 (95% CI 57.4-60.7) in 2012-13, $p < 0.001$. All nine provinces showed similar statistically
36 significant increasing EBF trends between 2010 and 2012-13. (Table 2)
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43 The crude OR for EBF comparing 2011-12 and 2012-13 to 2010 was 1.88 (95% CI 1.70 – 2.07)
44 and 4.87 (95% CI 4.40 – 5.38), respectively (Table 3). The OR comparing EBF in 2010 to the
45 subsequent time period (2011-12 or 2012-2013) is adjusted just for the individual variable listed,
46 such as maternal marital status (all categories, details of variable categories can be found in
47 Table 4)). In this univariate analysis (Table 3) the EBF by year odds ratios did not change by
48 more than 10% for any of the examined variables, suggesting that these increases were seen
49 across all regions and population sub-groups.
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3 In the full logistic model including all variables (data not shown) the EBF by year estimates did
4 not change by more than 10% suggesting again no confounding due to examined co-variates.
5 However, in the final logistic model, including an interaction term for year and counseling,
6 (Table 4) the annual EBF differences did change by just over 10% (to 2.08 in 2011-2012 and
7 5.51 in 2012-2013) suggesting a potential confounding effect.
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13 In the full multivariable model (Table 4), mothers with younger age, mothers who were HIV-
14 positive, had an unplanned pregnancy, primipara, had a caesarean delivery, and who did not
15 receive breastfeeding counselling had lower odds of EBF. Socioeconomic status influence
16 showed mixed results with mothers with tertiary education, formal brick housing, indoor flush
17 toilet, and employed mothers having lower odds of EBF, while piped water in the house or yard
18 and electricity as fuel source had higher odds. Exclusive breastfeeding showed significant
19 decline by the 8th week of age (Table 4, Figure 1)
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27 Discussion

28 Exclusive Breastfeeding Rates

29 This study suggests that exclusive breastfeeding in South Africa at national level and across all
30 nine provinces increased significantly between 2010 and 2012-13. Similar increases in EBF
31 have been recorded in local studies in KwaZulu-Natal¹⁸ and Gauteng.¹⁹ While, the KwaZulu-
32 Natal study was in the context of an improved EBF counselling programme, it is consistent with
33 improved programme efforts post-Tshwane.
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41 The South African National Health and Nutrition Examination Survey (SANHANES)²⁰ data do
42 not suggest an increase. The SANHANES rate reported for 2012 was 12.7% for infants less than
43 two months of age, this is relatively similar to the 2003 South African Demographic and Health
44 survey (SADHS) of 11.2%.² Possible differences between our study and the SANHANES is in
45 the way data were collected. We used an 8 day feeding recall in this study; however,
46 SANHANES had no specified time period for the collection of their feeding information (mix of
47 ‘from birth’ and ‘current’ questions).
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3 The most recent South African Demographic and Health Survey (SADHS) in 2016 also showed
4 an increase in EBF to 32% for infants less than six months, with EBF at 44% at 0-1 month and
5 28.2% at 2-3 months (similar time frames as this study).²¹ The SADHS used a 24-hour recall and
6 used the same definition of EBF as used in the SAPMTCTE. It should be noted that a major
7 difference in the SADHS and our survey is that one is a household survey and one facility based.
8 Additionally, SADHS included only 115 infants < 1 month. This is a very small sample size, and
9 results from SADHS should be interpreted with caution. Our use of 8 day recall and large sample
10 sizes suggest potentially robust estimates.^{22,23} Nevertheless many studies use longer periods of
11 measurement such as 0-6 months, such that our estimates of early EBF at 4-8 weeks would be
12 expected to be higher. However, while the SAPMTCE EBF rates are higher than the SADHS, the
13 relative increase in EBF across years (1998, 2003 to 2016), and rapidly decreasing EBF by age in
14 the first few months of the infant's life in the SADHS are similar to the SAPMTCTE data,
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25 **Changes in National and Provincial Programmes after Tshwane Declaration**

26 Our data and analytic framework are different from other studies as we measured EBF
27 immediately before, during, and immediately after a major national infant feeding policy shift.
28 Our results suggest that this policy shift may be responsible in part for the rapid increases seen in
29 exclusive breastfeeding that we found, which are also confirmed by the latest SADHS.
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36 Our time series is an ecologic comparison, measured in the context of a national policy change in
37 2011, thus causal inference is difficult to establish. However, the policy did lead to major rapid
38 changes in many aspects of infant feeding guidance and programmes across South Africa. For
39 example, after adoption of the Tshwane Declaration of Support for Breastfeeding in South
40 Africa, which committed to and declared "South Africa as a country that actively promotes,
41 protects, and supports exclusive breastfeeding as a public health intervention to optimize child
42 survival, regardless of the mother's HIV status."¹² guidelines on Infant and Young Child Feeding
43 (IYCF) were revised and the issuing of free infant formula was stopped in a phased out process
44 from 1 April 2012 with full withdrawal by September 2012. From April 2012 no new mothers
45 with newborns were to be issued with free infant formula.¹³ South Africa enforced into law the
46 Code of Marketing of Breastmilk Substitutes.²⁴ Letters were sent to provincial Heads of Health
47 requesting that the "The Tshwane Declaration of Support for Breastfeeding in South Africa"¹²
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3 and the "Policy Directive for the Implementation of the Declaration on Support of Exclusive
4 Breastfeeding and Revised Guidelines on Infant and Young Child Feeding for Women with
5 HIV"¹³ be brought to the attention of all health facilities for implementation.
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10 Following this national guidance, all provinces developed revised infant and young child feeding
11 policies and implementation plans for 2012-2013. A review of these policies conducted by the
12 study team found the following common components: IYCF policy consistent with the national
13 policy (e.g. promotion of EBF for all children under 6 months of age), withdrawal of free
14 formula from the PMTCT programme (e.g. no new formula as of 1 April 2012 with all free
15 formula withdrawn by end of 2012), training programmes for health workers and facility
16 managers, implementation and strengthening of the Mother Baby Friendly Hospital Initiative
17 (MBFHI), implementation of Kangaroo Mother Care, implementation of mother's milk banks,
18 and a variety of communication strategies, such as outdoor advertising (e.g. billboards), radio
19 programming, print advertising, IEC materials, community outreach activities and training of
20 community health workers in breastfeeding promotion and support.
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31 In addition to formal national and provincial communication plans, and in particular due to the
32 withdrawal of free formula from the PTMCT programme, the Tshwane Declaration saw national
33 and local media attention to the new policy and the evidence to support exclusive breastfeeding
34 in South Africa through reports in most major newspapers, radio and television news and on-line
35 health news sites.²⁵ The media coverage may have increased awareness about the benefits of
36 EBF. Other extended effects also found in the policy review include the resurgence in the
37 MBFHI as the number of MBHFI accredited hospitals increased from 178 in 2005 to 382 in
38 2014-2015.
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46 The variety of implementation strategies included in the provincial plans noted above are
47 consistent with recent meta-analyses of health system strategies to increase exclusive
48 breastfeeding. A 2015 meta-analysis²⁶ found the following interventions to significantly increase
49 exclusive breastfeeding: baby friendly (health facility) support, counselling in health facilities,
50 training of health workers, counselling and support in communities (individual or in groups), and
51 integrated mass media and counselling. Another meta-analysis reported in 2016²⁷ concurred with
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3 the 2015²⁶ findings and also found that using a combination of approaches showed an even
4 higher impact on EBF. These findings suggest that the implementation of IYCF in South Africa
5 post the Tshwane Declaration, which used many of these proven strategies primarily as a
6 combination of approaches, further strengthens our argument that changes in national policy
7 which were then implemented at all levels is one plausible contributor for the rapid increase in
8 EBF found between 2010 and 2012-2013.
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15 **Groups at Risk for Lower EBF**

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17 Our results show that the similar increases in EBF were found across all subgroups of mothers
18 (Table 3), however results do indicate some groups were still at risk for lower odds of EBF rates
19 (Table 4). Our data suggest that generally higher socio-economic status and employed mothers
20 were less likely to be exclusively breastfeed. This inverse relationship between socioeconomic
21 status and EBF is commonly seen in lower- and middle-income countries (LMICs).²⁸ However
22 this finding was not consistent across all proxy measures for socio-economic status as those
23 mothers without electricity and piped water were less likely to EBF, which is a concern as lack
24 of electricity and piped water have been found to be substantial risk factors for mortality when
25 the infant is formula feeding.⁸
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34 We also found younger mothers to have lower EBF. Findings on young maternal age and
35 association with EBF in Africa have seen mixed results.²⁹⁻³¹ Primiparas were also seen to have
36 lower EBF, which is consistent with the finding on younger mothers. However, again results in
37 the literature were mixed. A study in Tanzania³¹ found no difference in EBF across parity
38 groups, while studies in Nigeria³⁰ and Ethiopia²⁸ found an opposite result of higher EBF in lower
39 parity mothers. These mixed results across age and parity may reflect local social and cultural
40 norms across countries. For South Africa targeting interventions to younger first-time mothers
41 might help to further increase EBF. Unintended pregnancy also was associated with lower EBF.
42 The literature is sparse on this potential association, one study in Ghana³² describes shorter
43 breastfeeding duration for mothers with unintended pregnancy and in a qualitative study in
44 Kenya³³ respondents cited unintended pregnancy as a factor which influenced their infant
45 feeding. Further study is needed on the relation between unintended pregnancy and EBF.
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3 Consistent with the literature we also saw a drop in EBF in the older infant age group at 8 weeks
4 across all years of the study.^{21,31} This is consistent with the literature and other South African
5 Studies. This drop of in EBF prior to age six months remains an ongoing concern.
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10 Particularly encouraging is that the strongest predictor of higher EBF was antenatal breastfeeding
11 counselling both individually and in interaction across years, which is consistent with recent
12 meta-analyses,^{26,27} suggesting that programme managers should assure on-going antenatal
13 breastfeeding counselling across all facilities and communities.
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18 **Limitations**

19 Limitations of the source cross-sectional survey must be recognized. The data were primary
20 facility-based using infants presenting for immunization services. Infants who did not come for
21 immunization or had already died by 4-8 weeks of age or attended private hospital/clinic for care
22 were not included in the sample suggesting a possible selection bias. Mothers may have not
23 accurately reported infant feeding practices due to recall bias. Also, this analysis only examines
24 early (4-8 weeks) EBF, rates and factors influencing breastfeeding can vary based on the age of
25 the infant. Comparison to the Tshwane policy change is an ecologic analysis, and as such it is
26 difficult to perfectly estimate the average causal effect of this single policy change as other
27 factors may be operational.
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38 **Public Health Implications**

39 With what seemed to be an intransigently low EBF rate since 1998, South Africa saw a
40 remarkable increase in early EBF (4-8 weeks) from 2010 to 2013 coinciding with a major
41 national infant feeding policy change. These increases were seen across all provinces and
42 subgroups, suggesting a population wide effect, not just an increase in certain subgroups or
43 locations.
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50 While these increases in EBF were significant, and a huge step towards changing the tide of poor
51 infant feeding in South Africa, the 59.1% prevalence is still below desired levels of early EBF
52 suggesting that much remains to be done to further improve infant feeding practices. The results
53 of this study suggest several predictors of EBF which could guide future programmatic
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interventions to further improve EBF rates, such as greater attention to vulnerable groups, such as young women and first time mothers, and assuring antenatal breastfeeding counselling with a combination of approaches as suggested in recent meta-analyses.^{26,27}

For peer review only

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Its contents are solely the responsibility of the authors and do not necessarily represent the official views of CDC or UNICEF.

Authors Contributions

DJ and AG were principal investigators for the three national surveys used for this analysis. SS and CL analysed the data. TD and SB were co-investigators and members of the steering committee for the three national surveys used in this analysis. DJ wrote the first draft of the manuscript and is corresponding author. All authors had access to study data, contributed to writing and editing the manuscript and approved the final manuscript.

Conflict of Interest

None to declare

Human Participant Protection Statement

The protocol was approved by the institutional review board of the South African Medical Research Council (EC09-002) and was reviewed by the Centers for Disease Control and Prevention (IRB identifier: FWA00002753 Cooperative agreement number: U2G/PS001137-0 1) according to the human research protection procedures. All mothers/caregivers signed informed consent prior to study participation. Laboratory results were returned to mothers through routine services. At all visits, mother and infants not in routine care were referred to routine services. No personal identifiers were included in the interview and laboratory study databases.

Data Sharing

Requests for data sharing can be addressed to Principal Investigators: Ameena Goga (Ameena.goga@mrc.ac.za) and Debra Jackson (debrajackson58@gmail.com).

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Table 1: South African Exclusive Breastfeeding (EBF) Rates (%) 1998-2009

Study	Time Period	Location	Recall Period	1998	2003	2007	2008	2009
DHS ^{1,2}	0-3 months	National	24 hour	10.4 (n=312)	11.2* (n=55)			
DHS ^{1,2}	0-5 months	National	24 hour	7.0 (n=505)	8.3 (n=194)			
Good Start 1 ^{3,4}	7 weeks	KZN, EC, WC	24 hour		HIV+: 13.6 (n=493) HIV-: 12.2 (n=181)			
Good Start 1 ^{3,4}	3 months	KZN, EC, WC	24 hour		HIV+: 7.2 (n=487) HIV-: 2.8 (n=178)			
PROMISE-EBF ⁵	3 months	KZN; WC	24 hour			6.2 (n=485)		
HSRC ⁶	0-6 months	National	Unknown				25.7	

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							(n=508)	
Good Start 2⁷	3 months	KZN - Durban	24 hour					14.9 (n=1693)

Footnote: HIV+ = HIV positive; HIV- = HIV negative; HSRC=Human Sciences Research Council; DHS = Demographic Health Survey KZN = Kwa Zulu Natal province EC = Eastern Cape province WC = Western Cape province *Data for infants <2 months

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Table 2: South African and Provincial EBF Rates at Six (4-8) Weeks Postpartum 2010, 2011-2012 and 2012-2013

	2010 n=10,182	2011-12 n=10,106	2012-13 n=9,120
	% [95% Confidence Intervals (CI)]	% [95% Confidence Intervals (CI)]	% [95% Confidence Intervals (CI)]
Eastern Cape	15.5 [12.0,19.8]	24.8 [21.0,29.1]	53.8 [49.0,58.5]
Free State	16.1 [14.1,18.2]	33.3 [30.5,36.3]	53.3 [48.7,57.9]
Gauteng	23.2 [20.2,26.5]	36.4 [31.6,41.6]	65 [61.2,68.6]
KwaZulu Natal	33.7 [30.2,37.4]	46.6 [43.0,50.2]	60.4 [55.9,64.6]
Limpopo	19.5 [16.1,23.4]	21.3 [18.0,24.9]	47.9 [43.0,52.8]
Mpumalanga	15.9 [13.1,19.2]	47.3 [41.2,53.5]	65 [61.7,68.2]
Northern Cape	22.1 [18.8,25.8]	30.9 [26.6,35.4]	61.7 [57.4,65.9]
Northwest	24.3 [20.7,28.2]	30.4 [26.8,34.2]	65.4 [60.6,69.8]
Western Cape	17.9 [15.3,20.8]	36 [31.2,41.1]	54.9 [49.8,59.8]
South Africa*	22.9 [21.5,24.3]	35.7 [33.9,37.6]	59.1 [57.4,60.7]

* Trends for year, adjusting for province significant, $p < 0.001$

Table 3: Co-Variates Influence on EBF Increase, 2010 Compared to 2011-2012 and 2012-2013 (Univariate Logistic Regression Analysis)*

Variable	2011-2012 OR for EBF (compared to 2010)	2012-13 OR for EBF (compared to 2010)
EBF OR (crude)	1.88 [95% CI 1.70,2.07]	4.87 [95% CI 4.40,5.38]
<i>EBF OR adjusted for each individual variable in univariate analysis:</i>		
Maternal HIV Status	1.87	4.93
Maternal Age	1.88	4.86
Maternal Education	1.89	4.92
Maternal Marital Status	1.88	4.87
House Type	1.88	4.90
Water Source	1.88	4.87
Toilet Type	1.87	4.86
Fuel source	1.88	4.87
Food Insecurity	1.85	4.87
Infant Gender	1.88	4.87
Infant Age	1.85	4.77
Antenatal Breastfeeding Counselling	1.94	4.80

*Notes for reading Table 3: The OR in this table are the OR for EBF adjusted for the individual variable, e.g. Infant Gender or Infant Age as categorized in Table 4. We are not comparing for example OR of EBF by Maternal HIV status (e.g. positive or negative) we are comparing the crude OR for EBF by year to the OR for EBF by year adjusted for maternal HIV status to examine for potential confounding by Maternal HIV Status. This OR is then compared to the crude OR to see if the effect estimate (OR of EBF by year) changes by +/- 10% suggesting potential confounding of OR by year due to the third variable (e.g. variables listed in the first

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3 *column). Note for 2011-2012 compared to 2010 an adjusted OR of <1.69 or >2.07 would reflect*
4 *a greater than 10% difference in OR; while for 2012-2013 an adjusted OR of <4.38 or >5.36*
5 *would reflect a greater than 10% difference in OR. None of the univariate adjusted estimates for*
6 *EBF by year are outside of these ranges suggesting confounding of the OR by year is unlikely*
7 *due to the individual co-variate analysed. Total Observations: 29,981*
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Table 4: Full Adjusted Multivariate Logistic Regression Model for Predictors of EBF at 4-8 Weeks Postpartum, 2010-2013.

Variable	Adjusted Odds Ratio	95% Conf. Interval*	
Year (Ref: 2010)			
2011-12	2.08	1.87	2.32
2012-13	5.51	4.94	6.15
Province (Ref: EC)			
FS	1.22	0.99	1.50
GP	1.70	1.38	2.09
KZN	2.15	1.76	2.64
LP	0.97	0.77	1.22
MP	1.63	1.31	2.03
NC	1.33	1.07	1.66
NW	1.49	1.21	1.84
WC	1.30	1.03	1.64
Mother Age (Ref: <20)			
20-34y	1.07	0.99	1.61
35-50y	1.12	1.01	1.25
Mother Education (Ref: No education)			
Grade 1-7	1.00	0.83	1.21
Grade 8-12	0.86	0.72	1.03
Tertiary	0.62	0.50	0.77
Parity (Ref: Primipara)			
Multipara	1.16	1.09	1.23
Mother Employment (Ref: Employed)			
Other Income	1.53	1.42	1.65
No Income	1.53	1.02	2.31
HIV Status (Ref: Negative)			
Positive	0.66	0.61	0.71

Don't Know	0.74	0.56	0.99
House Type (Ref: Brick)			
Informal/Wood	1.09	1.00	1.19
Traditional/Mud	1.20	1.01	1.42
Water Source (Ref: piped in house/yard)			
Not piped in house/yard	0.84	0.75	0.93
Toilet (Ref: Indoor Flush)			
Pit Latrine	1.19	1.07	1.32
Portable	0.89	0.59	1.33
Other	1.55	0.80	3.02
None	1.03	0.82	1.29
Fuel for cooking (Ref: Electricity)			
Wood/Coal	0.85	0.74	0.98
Other	0.96	0.57	1.62
Food Insecurity (Ref: Yes)			
No	1.13	1.04	1.23
Don't Know	1.65	1.20	2.25
Planned Pregnancy (Ref: Yes)			
No	0.93	0.88	0.99
Delivery Mode (Ref: Vaginal)			
Cesarean	0.84	0.78	0.90
Infant Age Weeks (Ref: 4 weeks)			
5 weeks	0.82	0.66	1.02
6 weeks	0.92	0.75	1.24
7 weeks	0.86	0.71	1.05
8 weeks	0.69	0.55	0.86
Antenatal Breastfeeding counselling (Ref: Yes)			
No	0.74	0.63	0.88
Antenatal Breastfeeding Counselling by Year (Ref: Yes in 2010)**			

No ANC counselling in 2011-12	0.62	0.49	0.80
No ANC counselling in 2012-2013	0.66	0.52	0.84

**Bold indicate 95%CI does not cross null (1.0); Total Observations:29,288*

***This measures the multiplicative interaction of ANC breastfeeding counseling by year, hence the referent is a combination of having ANC breastfeeding counseling compared to the combination of no ANC breastfeeding counseling in each subsequent year.*

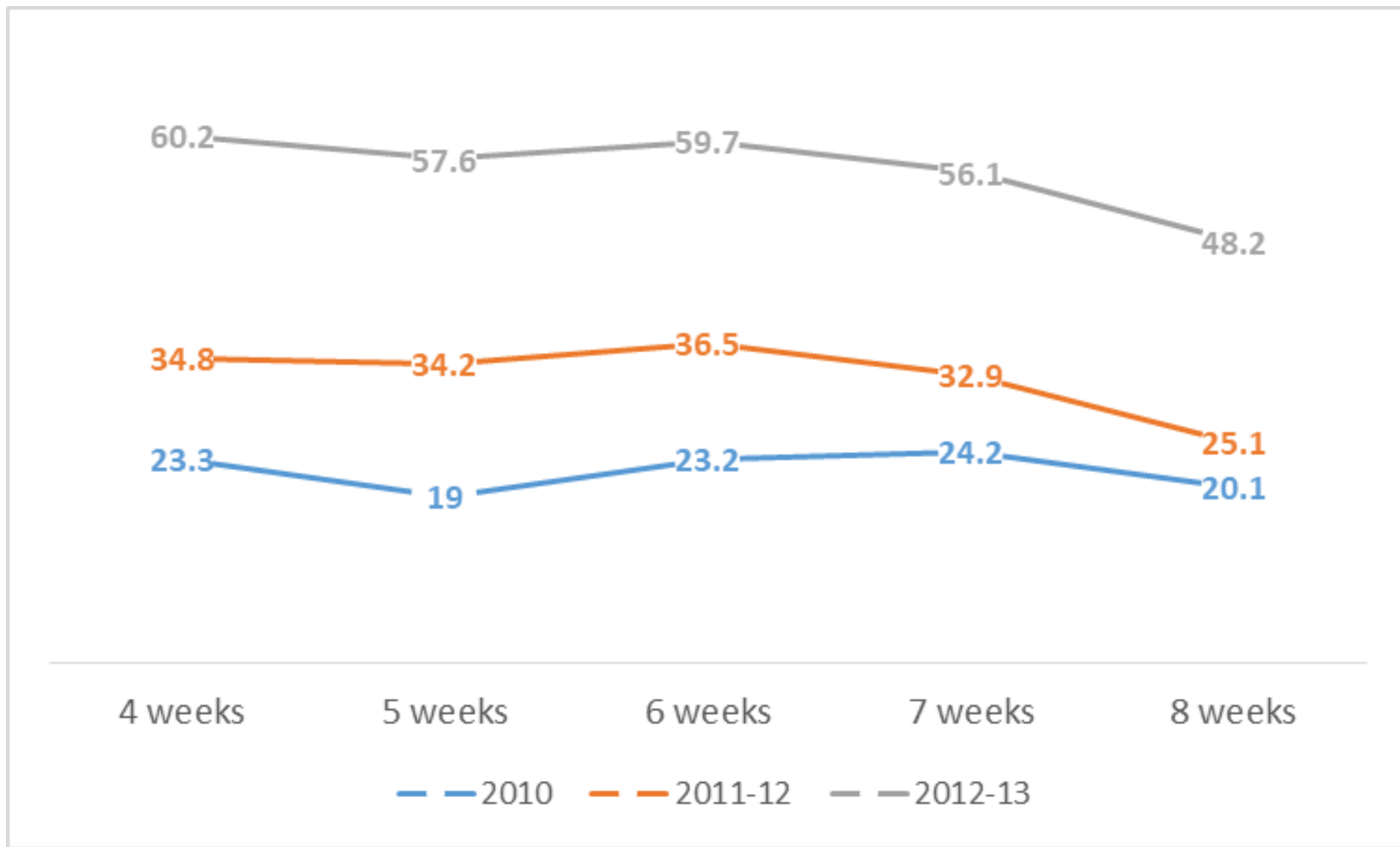


Figure 1: EBF rates by Infant Age in Weeks by Year, 2010-2013