Journal of Health Economics 57 (2018) 221–235

Contents lists available at ScienceDirect

Journal of Health Economics

journal homepage: www.elsevier.com/locate/econbase

Causes and consequences of teen childbearing: Evidence from a reproductive health intervention in South Africa

Nicola Branson[a], Tanya Byker[b,*]

[a] Southern Africa Labour and Development Research Unit, School of Economics, University of Cape Town, South Africa
[b] Department of Economics, Middlebury College, United States

ARTICLE INFO

Article history:
Received 6 September 2016
Received in revised form 26 June 2017
Accepted 29 November 2017
Available online 12 December 2017

Keywords:
Teenage childbearing
Maternal and child outcomes
Youth friendly reproductive health services

ABSTRACT

We use a natural experiment to estimate the causal impact of a public health intervention aimed at reducing teenage childbearing. The geographic and timing variation in the rollout of the South African National Adolescent Friendly Clinic Initiative (NAFCI) in the early 2000s provides a plausibly exogenous increase in reproductive health knowledge and clinical access for teens. We investigate the causal pathway from the intervention's initial impact on early-teen childbearing to subsequent consequences for later-life outcomes of prime policy interest — education, employment and child health. Our empirical strategy uses GPS data from the National Income Dynamics Study to geolink women's location of residence during adolescence to the location and timing of the rollout. Our results show that living near a NAFCI clinic during adolescence delayed childbearing, substantially lowering the likelihood of early teen childbearing. We estimate that adolescents who had access to NAFCI completed more years of schooling and, consistent with increased human capital investments, earn substantially higher wages as young adults. Finally, children born to women who had access to youth-friendly services as teens show substantial health advantages, indicating a strong intergenerational benefit of delaying early teen childbearing in a developing country context.

1. Introduction

Teen childbearing is seen as a serious social problem because women who give birth as teens tend to have worse economic outcomes than those who delay first births. But whether this association is due to fertility timing or some joint determinant of teen pregnancy and lower human capital investment and employment prospects is hotly debated and empirically difficult to disentangle. In the extensive US literature on the topic, studies that are able to control convincingly for economic circumstances such as family background find that the negative association is greatly diminished or even reversed.[1] The literature on the impacts of early childbearing in developing economies is much smaller and newer and the findings are, so far, quite different. In South Africa, for example, there is growing evidence using a variety of identification strategies that consistently finds a substantial and significant negative causal relationship between early childbearing and later outcomes including mother's education (Ranchhod et al., 2011; Ardington et al., 2015) and child health (Branson et al., 2015). Research by Lang and Weinstein (2015) suggests a way to reconcile the seemingly contradictory findings in the US and South African contexts. They point out that the consensus debunking the negative consequences of teen motherhood in the US is based on the analysis of teen births that occurred *after* contraceptive access became widespread in the US. Analyzing an earlier period when family planning was not easily accessible to minors—as was the case in South Africa in the early 2000s – they estimate negative causal impacts of teen motherhood.

We use the rollout of the National Adolescent Friendly Clinic Initiative (NAFCI) as a natural experiment to test this hypothesis in post-Apartheid South Africa. The initiative increased adolescent access to reproductive health services and allows us to investigate the causal pathway from contraceptive access to first-birth timing to subsequent outcomes like education, work and child health. We ask, does improving access to contraception delay teen childbearing? And given that the intervention occurred in the context of widespread barriers to teen contraceptive access, does delayed first birth improve outcomes in adulthood for women and their children?

The impact of family planning policies on fertility is another causal pathway that is notoriously difficult to identify. Bongaarts

* Corresponding author.
E-mail addresses: nicola.branson@gmail.com (N. Branson), tbyker@middlebury.edu (T. Byker).

[1] Hoffman (1998) provides a review of this literature.

https://doi.org/10.1016/j.jhealeco.2017.11.006
0167-6296/

(1994) argues that the increased supply of contraception provided by family planning interventions drives down fertility. Pritchett (1994) counters that while increased contraceptive use is *coincident* with falling fertility, reduced demand for children drives fertility decline, and the causal impact of family planning interventions is small. As in any market where we only observe the amount consumed, separating the role of supply and demand drivers is a challenge. In the case of adolescent fertility there are often frictions on both the demand and supply sides. Lack of sex education can break the link between desire to prevent pregnancy and contraceptive use. Social stigma can be a barrier between contraceptive supply and teen access.

In early post-apartheid South Africa, the supply of family planning was technically unconstrained. The Apartheid regime's goal of controlling the non-white population resulted in widespread freely available contraceptives, and the new democratic government elected in 1994 ushered in some of the most progressive reproductive health laws in the world (Cooper et al., 2004). The 1998 South African Demographic and Health Survey reported that 80–90% of 20–30 year olds had ever used a modern contraceptive (DHS, 2002). However, among the 30% of all South African women under 20 who already had at least one child, 79% reported they did "not want" their last pregnancy.[2] Family planning advocates would define this as evidence of an unmet need among teens to delay pregnancy—a supply problem. South African public health researchers and advocates believed that high rates of unintended teen pregnancy which coincided with soaring rates of HIV among young women pointed to a knowledge gap and social and institutional barriers to adolescent access to reproductive health services (Ehlers, 2003; Jewkes et al., 2001; Abdool et al., 1992). Thus, evidence on both the supply and demand side pointed to a more optimal outcome, but informational and social frictions drove a wedge between unmet demand to control fertility and untapped supply of family planning. NAFCI aimed to tackle this wedge.

NAFCI involved intensive clinic accreditation, education and community outreach. We argue that the timing and geographic variation of the rollout led to an exogenous increase in adolescent access to reproductive health knowledge and clinical services. Our analysis is based on geo-linking data from several sources to construct a measure of proximity to NAFCI clinics for South African women. Since an individual's exposure to NAFCI was determined both by the timing and location of the rollout and whether she was in the applicable age range—12–17 years old—we use a difference-in-differences strategy to measure the impact of the initiative. We combine differences in outcomes for women who lived near NAFCI clinics compared to those who did not, with differences across cohorts who were adolescents versus adults (and therefore too old to be affected) during the NAFCI rollout. We find that NAFCI substantially reduced the likelihood of early teen childbearing. When we restrict the sample to women living within 2 km of any public clinic the results become larger in magnitude and more statistically significant indicating that it is access to youth friendly services rather than health services in general that is driving our results.

Given this delay in age at first birth we study later life outcomes and find that access to NAFCI increased average years of schooling, though did not increase the likelihood of completing matric. While we find no impact of NAFCI on employment we do find evidence of increased wages among women who are employed in early adulthood. Finally, we estimate substantial positive impacts on the health of children born to women who had access to NAFCI during adolescence.

[2] Mothers under the age of 20 regarding their last pregnancy in the last 3 years: 20% wanted pregnancy then, 66% wanted later, 13% did not want the pregnancy.

Our results show that delayed childbearing is associated with increased schooling, higher earnings and improved child outcomes and corroborate and extend the growing evidence on the detrimental impacts of teen childbearing in South Africa and other developing economies. The main contribution of this paper is to put these findings in the context of a policy initiative specifically aimed at tackling early childbearing. Our methodology and the detailed retrospective data available in NIDS allows us to trace the causal pathway from increased access to reproductive health in adolescence to delayed childbearing and finally to subsequent outcomes in adulthood. Using the NAFCI rollout as a natural experiment, we provide the first quasi-experimental evidence on the causal relationship between early childbearing and later life outcomes.

This paper also contributes to the public health literature on the effectiveness of youth-friendly health services (YFHS). In the past decade the World Health Organization has put a strong emphasis on using YFHS to fill the gap between pediatric and adult health services for youth who, due to initiation of sexual activity, are particularly vulnerable to unintended pregnancy and sexually transmitted diseases (WHO, 2003). While initiatives like NAFCI have proliferated, there is limited evidence about the impact of these programmes on youth access and usage of reproductive health services and almost no evidence about the impact of YFHS on health outcomes.

The remainder of the paper proceeds as follows: Section 2 provides background, a discussion of existing evidence on early childbearing and youth friendly services, and a description of NAFCI, Section 3 describes the data and empirical strategy, Section 4 presents results and Section 5 concludes.

2. Background and description of the National Adolescent Friendly Clinic Initiative

2.1. Fertility timing and contraceptive access in early post-apartheid South Africa

The 1998 South African Demographic and Health Survey (DHS) provides context for the early post-Apartheid contraceptive and fertility patterns that motivated the National Adolescent Friendly Clinic Initiative.[3] Thirty-five percent of 19 year-olds (and 25% of 18 year olds) reported ever being pregnant (DHS, 2002).[4] While this rate of adolescent childbearing is low compared to other sub-Saharan countries,[5] teen childbearing in South Africa is more likely to be non-marital, rather than the result of early marriage (Macleod and Tracey, 2010; UNFP, 2011). Only 1.2% of South African 15–19 year olds were married in 1998 (DHS, 2002). There was also evidence of "widespread" and "endemic" gender violence and coercive sex experienced by teenage girls in South Africa (Wood et al., 1998; Garenne et al., 2001).[6] And rates of unintended pregnancy

[3] Apartheid was a system of strictly enforced racial segregation in South Africa. Apartheid officially ended with multi-racial democratic elections in 1994. While laws no longer classify citizens by the color of their skin, the classifications of White, Coloured, Black African, and Indian are still used in everyday conversation and are designations in surveys including the South African Census.

[4] Among 19 year-olds, 30.2% report being a mother and among 18 year olds, 19.8% report being a mother.

[5] The adolescent birth rate in South Africa between 1996 and 2008 was 54 per 1000 women aged 15–19, while the average for Sub-Saharan African was 122. The rate in Uganda was 159 and Zambia 151 (UNFP, 2011).

[6] A qualitative study in an African township in peri-urban Cape Town in the mid-1990s found that over 60% of female respondents aged 14–18 reported having sex against their will, and 59% reported having been beaten by a male partner(Wood et al., 1998). Note, however, that rates of physical abuse by teenage girls in reported in DHS (2002) are significantly lower. According to Human Rights Watch, in 1995 South Africa had the highest recorded per capita rate of rape for a country not at war.

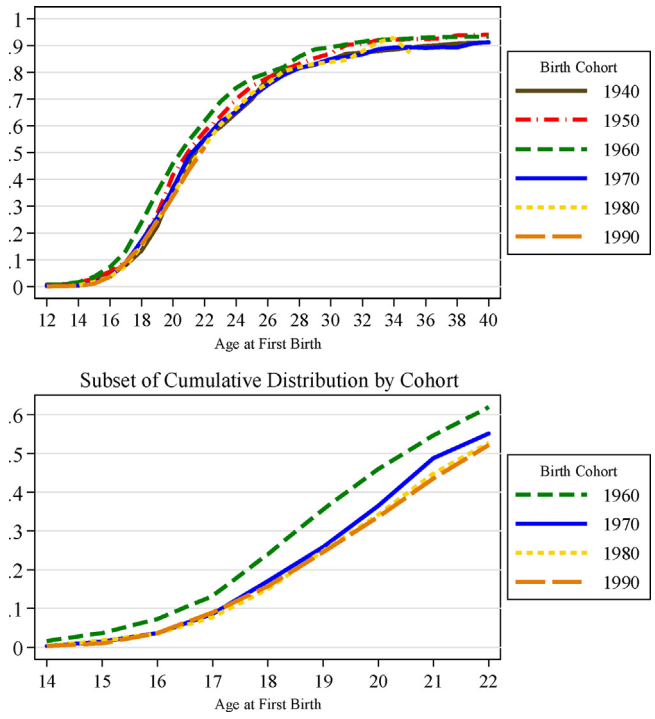

Fig. 1. Cumulative Distribution of Age at First Birth by Cohort.
Notes: Proportion of women who have given birth by a given age for different birth cohorts. Birth cohorts in ten-year groups e.g. 1960 represent those born between 1960 and 1969. The second panel zooms in on births to mother's between the ages of 14 and 22.

Source: Author's calculations based on birth histories in the South African National Income Dynamics Study (NIDS). Data weighted using the post-stratified weights.

among South African teens were high—78% of women under the age of 20 reported that their last birth was not wanted or wanted later (DHS, 2002).

The Apartheid regime's plan to control the non-white population led to relatively high contraceptive prevalence in South Africa compared to other sub-Saharan countries (Cooper et al., 2004). Contraceptives were widely available at no cost at public clinics, hospitals and through mobile service provision.[7] However, the high rate of unintended pregnancy among teens suggests that South African adolescents had a substantial unmet "need" for family planning.

Based on birth histories from the 2012 wave of the National Income Dynamics Study (NIDS),[8] Fig. 1 shows patterns of age-at-first-birth by cohort, and Fig. 2 shows children-ever-born by age-at-first-birth across cohorts. Fig. 1 shows that after a decrease in the early-teen birth rate between the 1960 and 1970 birth cohorts, the proportion of 18 and 19 year olds who had given birth remains nearly constant for the 1970, 1980 and 1990 cohorts. At the same time, Fig. 2 shows that among women born between 1980 and 1990, who were adolescents in the early post-apartheid era, a teen birth was much more likely to be followed by a substantial space before the next birth than for earlier cohorts (a pattern also found by Timæus and Moultrie (2008) in the DHS). This pattern is consistent with ability to achieve a lower desired rate of completed fertility combined with some women's inability to delay the onset of childbearing—in other words this pattern is consistent with many sexually active adolescents only starting to use contraception after a first birth.[9]

Why were sexually active teens who did not want to get pregnant not using contraceptives when they were widely available for free? Qualitative studies in various South African regions aimed to address this question (Ehlers, 2003; Jewkes et al., 2001; Mfono, 1998; Wood and Jewkes, 2006; Abdool et al., 1992). The findings pointed to social barriers for adolescents accessing family planning. First, teens seemed to lack accurate sexual and contraceptive knowledge. For example, there were widespread fears stoked by religious leaders and even nurses that hormone-based contraceptive use by adolescents could cause permanent infertility.[10] Next, stigmatization of adolescent sex by health care providers often made clinics inhospitable. Teens reported scolding and even physically abusive behavior by staff and nurses at public clinics and hospitals when they sought contraceptives, and in some cases were even refused access to contraceptives.

Concerns among health advocates and the Department of Health about these barriers to adolescent access to reproductive health services were also driven by the increasing prevalence of HIV among youth, particularly teenage girls. Department of Health surveys found that in 1998 and 1999, approximately 20% of pregnant 15–19 year olds were HIV positive (substantially higher in some regions such as KwaZulu Natal) (Allen et al., 2009; Jewkes et al., 2001). HIV prevalence among 15–24 year olds was estimated to be three times higher among young women than young men – 15% versus 4.8% (Pettifor et al., 2005). There is also evidence that early childbearing and HIV risk interact. Ardington et al. (2015) find that early teen births are associated with increased risk of AIDS-related mortality based on longitudinal data from KwaZulu-Natal.

2.2. The National Adolescent Friendly Clinic Initiative

High rates of unintended teen pregnancy and escalating rates of HIV among young people were the driving force behind the establishment of the NGO loveLife in 1999. The National Adolescent Friendly Clinic Initiative (NAFCI) was a key component of loveLife's strategy that also included high profile media campaigns and sporting events promoting "more open and better informed communication about sex, HIV, sexuality and gender relations" (Ashton et al., 2009, 45). loveLife launched NAFCI in consortium with several other non-governmental organizations and in partnership with the South African Department of Health.[11]

According to the architects of the initiative, "[t]he first objective of NAFCI was to make health services accessible and acceptable to adolescents" (Ashton et al., 2009, 36). Prior to implementation, a set of standards were developed to define an adolescent friendly clinic. The standards were based on international standards for care (Franco et al., 2002) tailored to the specific concerns about barriers to adolescent care in South Africa which included non-judgmental staff, privacy and confidentiality and the specific reproductive health concerns of adolescents such as pregnancy and

[7] Long-acting injectable contraception was, and remains, the most common contraceptive method used (DHS, 2002; DHIS, 2013).

[8] More details about NIDS are provided in Section 3.1.

[9] While the 1998 SA DHS does not provide a way to directly confirm this explanation, among respondents who gave birth by 16 and ever used contraception (82%), only 14% started using contraception when they had no living children. Garenne et al. (2001) conducted interviews in rural South Africa in the mid-1990s and found that among adolescents (12–17) who had given birth 3.6% had used contraception prior to birth, but 40% were using contraception after their first birth (Table 1).

[10] Jewkes et al. (2001, p. 734) report that teen "mothers often indicate that teenage pregnancy is infinitely preferable to the possibility of infertility caused by contraceptive use . . . This is widely perceived by women and family planning nurses to be a side-effect of progesterone based injectable contraceptives, particularly Depo-Provera." This notion was also espoused by "preachers at local African churches" (Wood and Jewkes, 2006, p. 111).

[11] Other organizations involved in the consortium were Planned Parenthood, the Reproductive Health Research Unit (RHRU) at the University of Witwatersrand and the Health System Trust.

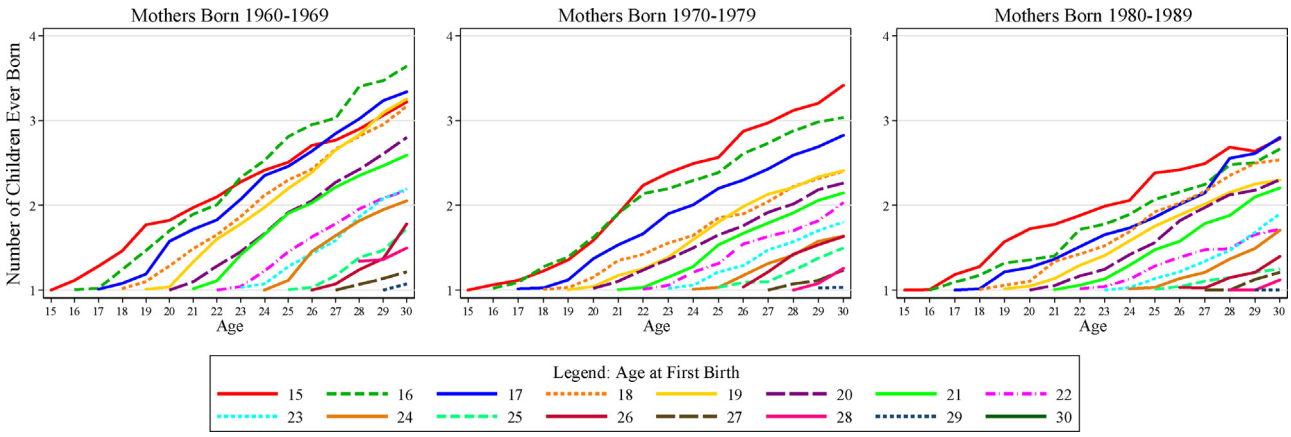

Fig. 2. Children Ever Born by Age at First Birth, across Cohorts.
Notes: Number of children ever born by age. Each line in a figure represents the number of children at each age for women grouped by age at first birth.
Source: Author's calculations based on birth histories in the South African National Income Dynamics Study (NIDS). Data weighted using the post-stratified weights.

sexually transmitted diseases (Dickson et al., 2007). The ten NAFCI standards and 41 supporting criteria are listed in Appendix Table A2 along with the essential service package that targets adolescent sexual and reproductive health.

A clinic accreditation model was chosen because it was seen as the best way to motivate change that in large part involved a shift in attitudes towards adolescent patients and a new emphasis on adolescent health.[12] The multistage accreditation process took roughly nine months to a year from initiation to external assessment (Khotseng, 2013; Mlisana, 2013). The first stage involved getting buy-in from clinic staff and the community and forming a "quality improvement team." The team involved all levels of staff at a clinic from nurses and physicians to receptionists and guards (this was seen as particularly important as intimidation upon even approaching clinics had been shown to be a relevant barrier for adolescents). The second stage involved a self-assessment of the clinic's score relative to the NAFCI standards. Next, in conjunction with an external NAFCI-trained coordinator, the clinic engaged in quality improvement that targeted areas where the clinic fell short of the standards. Examples of initiatives during this phase included training workshops on emergency contraception and pre- and post-termination of pregnancy counseling (Ashton et al., 2009, 32). Another frequently cited example was the introduction of a "fast lane" at clinics for youth who had limited availability during business hours due to overlap with school hours and furthermore felt uncomfortable sitting in waiting rooms with adults who might know them from their community.

loveLife believed that local youth involvement in the NAFCI process was crucial to making reproductive health accessible and acceptable to adolescents. Each NAFCI clinic was assigned at least one full-time peer educator (known as a groundBREAKER), aged 18–25 hired from the community and paid by loveLife. Most clinics also designated a youth space called a "chill room" on the clinic property for youth gatherings and education programmes facilitated by groundBREAKERS. In many cases small separate buildings were built with loveLife funding on clinic grounds to serve as chill rooms. Placing chill rooms on clinic grounds aimed at making clinics more approachable. Fig. 3 gives an example of "youth friendly" signage that was installed during the quality improvement phase.

Fig. 3. Youth Friendly Clinic Signage.
Notes: The figure presents an example of youth-friendly signage used at a NAFCI clinic in the Western Cape province. The program was implemented in existing clinics and focused on providing clinical and informational services specific to the needs of youth. See for example the extended opening hours.

In the final stage of accreditation, external assessments were conducted over one to two days by a team that included a professional nurse or physician and a youth representative. The data collection involved interviews with the clinic manager, health-care providers and non-clinical staff, a document review, inventory of the clinic including an accounting of supplies of drugs and equipment specific to adolescent reproductive health, observations of client-provider interactions (either actual client visits or simulations), and adolescent exit interviews. This data was used to determine how many of the 10 NAFCI standards and 41 criteria had been met. Clinics were awarded a gold rating if they achieved a score over 90%, a silver award for a score between 60% and 89% and bronze for a score between 30% and 59%. In order to maintain accreditation the clinic needed to be reassessed within two years.

[12] "Health workers in South Africa are keen on receiving certificates of achievement, and therefore developing a system that gave them an award would encourage health workers to participate. In addition, it was felt that by giving a clinic award the clinic staff would be encouraged to work together as a team" (Ashton et al., 2009, 16; Khotseng, 2013).

Researchers involved in the design and rollout of NAFCI conducted a non-randomized assessment of the accreditation process comparing 11 NAFCI accredited clinics to 11 non-accredited clinics (Dickson et al., 2007). The study found that while control clinics scored similarly on generic quality of care criteria, NAFCI clinics scored substantially and statistically significantly higher on criteria directly related to provision of adolescent friendly services. While a complete historical record of assessment scores by clinic is not available, loveLife reported that at the end of 2005, 212 external assessments had been completed and that the majority of clinics achieved scores of 80–90% and that 35% scored above 90%. The average score was 85% while the average recorded baseline score had been 29% (Ashton et al., 2009, 36). The only other published evaluation of NAFCI we are aware of involved sending simulated adolescent clients to clinics in the Western Cape Province for HIV testing and compared experiences at NAFCI and non-NAFCI clinics. They find that adolescent clients are significantly less likely to be turned away when requesting an HIV test—evidence of improved accessibility. However, they do not find significant differences for some other NAFCI criteria, for example confidentiality of service (Mathews et al., 2009).

We use administrative data collected independently of NAFCI at all public clinics to test for an impact of NAFCI accreditation on service provision. Public health facilities are required by the Department of Health to report routine health service data to the District Health Information System (DHIS). We use this facility-level data to measure changes in reproductive health services relevant to adolescents provided at NAFCI relative to non-NAFCI clinics before and after accreditation using an event-study framework (Jacobson et al., 1993). Appendix Fig. A1 shows the overall trends in service provision of male condoms, the two major injectable contraceptives, Depo-Provera and NET-N, and reports of new sexually transmitted infections (STIs) from 2001 to 2011. The figure shows a strong upward trend in condom distribution and a fall in new STI cases over the period. Injectable contraception provision was relatively flat with evidence of some switching between the two types.

Fig. 4 shows *relative* changes in service provision at NAFCI clinics after accreditation, accounting for the national trends shown in Appendix Fig. A1 using non-NAFCI clinics as controls and calendar year-fixed effects. Fig. 4 provides evidence that while NAFCI clinics were not trending differently than non-NAFCI clinics prior to accreditation, condom distribution increased at a faster rate at NAFCI than non-NAFCI clinics after accreditation and the new STI infection rate fell more quickly at NAFCI clinics.[13] This analysis shows a statistically significant trend break in clinical outcomes related to reproductive health coincident with the timing of NAFCI accreditation.[14]

Fig. 5 shows the rollout of accredited clinics by activation year and province. NAFCI was piloted at 10 clinics in 2000 and thereafter the number of accredited clinics increased each year. A major scale-up occurred in 2004 and 2005 resulting in 350 active NAFCI sites by the end of 2005. By 2010, almost 500 clinics, or approximately twelve percent of all public clinics across the country, were accredited as "youth friendly." In 2013, more than a decade after NAFCI was piloted, 1200 groundBREAKERS were employed nationwide, assisted by 6000–8000 part-time youth volunteers.[15]

In 2002, the World Health Organization issued a call to develop youth friendly health services (YFHS) globally to close the gap between pediatric and adult health services for youth who, due to initiation of sexual activity, are particularly vulnerable to unintended pregnancy and sexually transmitted diseases (WHO, 2003).[16] Two studies have reviewed evidence from initiatives aimed at providing YFHS (Tylee et al., 2007; Dick et al., 2006). Both conclude that while existing studies generally find improvements in service provision, adolescent access to health services, usage of health services, and health-risk behaviors, the evidence on the impact of YFHS is "weak" and inconclusive due to research methodologies that "threatened the validity of most of the assessments made of these programmes" (Tylee et al., 2007, 1569) In particular, most are observational studies with no control group.

However, two randomized control trials involving YFHS interventions provide evidence relevant to NAFCI. In Bolivia, a pharmacy-based randomization tested the impact of provider training and educational materials on adolescent access to health services (Save the Children 2004). Mystery shoppers found that treatment pharmacies engaged in less age-related discrimination and showed improved information provision. Sales records showed increases in condom sales at treatment versus control pharmacies. In Nigeria, a randomized study evaluated the impact of package interventions targeted at in-school adolescents and health providers aiming to improve sexually transmitted disease (STD) treatment-seeking behavior and reduce STD prevalence (Okonofua et al., 2003). The interventions included community participation, creating health clubs in schools, peer-mentoring, and training local providers (pharmacists, medicine dealers, and doctors) about STD prevention and treatment. These elements are similar to the package loveLife and the South African DoH provided, although the NAFCI clinic accreditation element was far more formal and extensive. The Nigerian study found significant improvements in knowledge about sexually transmitted diseases, condom use, and STD treatment-seeking behavior among students at treated versus control high-schools as well as a significant reduction in STD symptoms. This is the only study we are aware of that estimates the impact of YFHS on health outcomes.

2.3. Evidence from sub-Saharan Africa on the impact of teen childbearing on maternal and child outcomes

Several recent studies have estimated a negative causal relationship between teen childbearing and educational attainment in Sub-Saharan Africa, most analyzing South African data. Using propensity score reweighting in data from the Cape Area Panel Study, Ranchhod et al. (2011) estimate the impact of teen childbearing on high school graduation rates among women in Cape Town, South Africa. As with US studies, they find that controlling for background characteristics diminishes the negative association, but in contrast to US studies, the estimated impact of teen childbearing remains negative and substantial. Ardington et al. (2015), use a longitudinal survey from rural KwaZulu-Natal, South Africa, to show that even after controlling for a rich set of observable characteristics, teen childbearing is associated with fewer years of schooling and increased mortality risk. They find that earlier teen births are more detrimental than later teen births, with women giving birth before age 17 a full year behind non-teen mothers

[13] There is also evidence, albeit weaker, in the lower two panels Fig. 4 for trend breaks in the two main injectable contraceptives, though the provision of NET-EN decreases while the provision of Depo-Provera increases. Based on interviews, the authors learned that NAFCI-trained clinic staff attempted to dispel the perception that Depo-Provera is "not for youth" which may explain these patterns. Depo-Provera is much more likely than NET-EN to cause temporary amenorrhea (absence of a menstrual period) (Draper et al., 2006). This leads some to believe it causes infertility or other health problems and is therefore not suitable for youth (Wood and Jewkes, 2006).

[14] Time zero in the event study figures is set to start date plus one year based on indications from those involved with accreditation that the time from initiation to accreditation was roughly nine months to a year.

[15] http://www.lovelife.org.za/corporate/lovelife-programmes/youth-leadership-development/groundbreakers.

[16] Other health concerns for adolescents include depression and suicide.

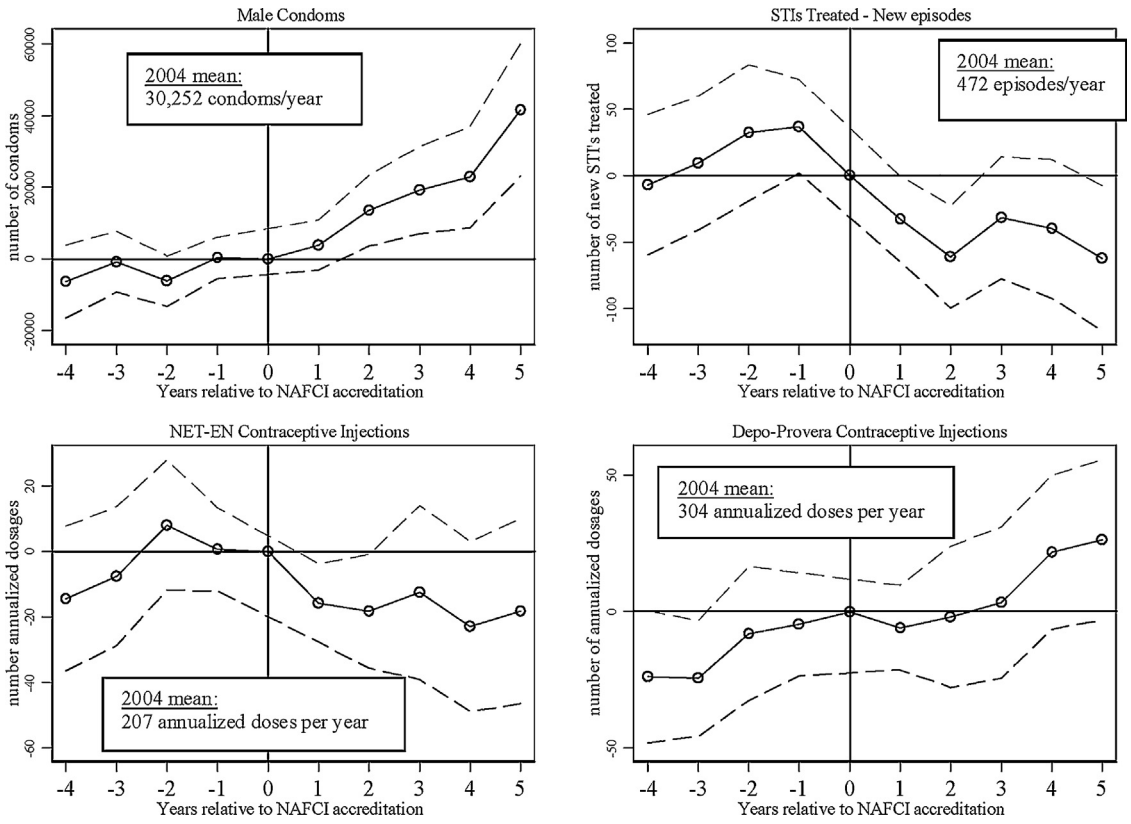

Fig. 4. Changes in Reproductive Health Service Provision Relative to Year of NAFCI Accreditation.
Notes: Each plot shows the change in amount of a given service/contraceptive provided at the clinic relative to the level in year zero (one year after the accreditation process started). These estimates control for national trends in service provision by including controls for trends among non-NAFCI accredited clinics and calendar year fixed effects. Results (not shown) including province fixed-effects and year × province fixed-effects show very similar patterns. Depo-provera (depot medroxyprogesterone acetate) and NET-EN (norethisterone oenanthate) are long-acting injectable contraceptives. Depo-provera is given every three months and NET-EN every two months. In the figures above the number of injections are annualized by dividing the number of Depo-Provera injections by six and the number of NET-EN injections by four. The 2004 mean levels listed in each section of the graph are calculated among all public clinics. See Appendix Fig. A1 for average trends from 2001 to 2011.
Source: Service provision data from the South African District Health Information System. Information on the timing of clinic accreditation from loveLife Project Monitoring Databases.

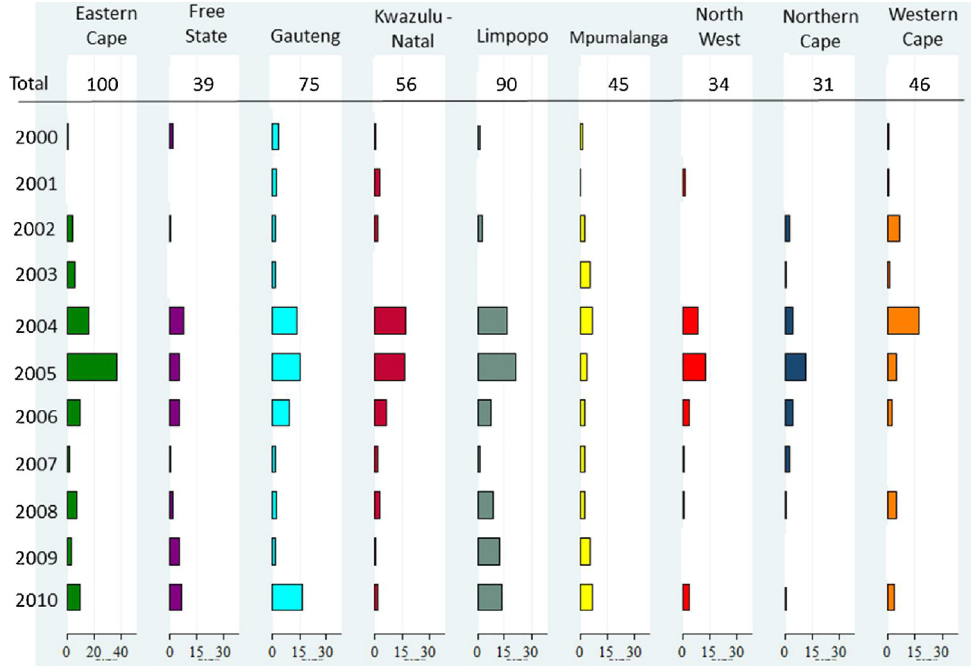

Fig. 5. Rollout of National Adolescent Friendly Clinic Initiative by Year of Accreditation and Province.
Notes: The figure shows the number of clinics accredited as NAFCI by year and province. The total row indicates the number of clinics as at 2010. Legends differ by province.
Source: loveLife project monitoring database.

compared to mothers who give birth between 17 and 19 who are only 0.3 years behind. In a nation-wide analysis using the National Income Dynamic Study, Timæus and Moultrie (2015) show that South African youth who give birth between the age of 15 and 18 have a higher likelihood of dropping out of high school and failing to graduate. In Madagascar, Herrera and Sahn (2013) find that among 21–23 year old women, those who give birth before age 20 are 44% less likely to graduate from lower secondary school.

We are aware of only one other paper that studies the impact of teen childbearing on health outcomes for children. Branson et al. (2015) use propensity score reweighting with an extensive set of observable characteristics including mother's childhood background, sexual activity and contraception use and find that children born to women who give birth before the age of 20 are more likely to have low birthweight, are shorter and are more often stunted than children born to older mothers. They investigate potential mechanisms for these adverse effects and find evidence of behavioral choices related to maternal maturity may be driving the results. We know of only one other study assessing the impact of teen childbearing on women's work outcomes in developing countries and none in Africa.[17]

3. Data and empirical strategy to measure the impact of NAFCI on early teen childbearing, education, employment and child health

This paper's research design is facilitated by geo-linking data on the timing and location of the NAFCI rollout to birth histories in nationally representative survey data. Our empirical specification uses *proximity* to a NAFCI clinic *during adolescence* as a plausibly exogenous measure of access to reproductive health services and education and estimates the impact on early teen childbearing and later life outcomes.

3.1. Data to geo-link NAFCI rollout to adolescent birth histories

We geo-link several datasets to implement our research design: 1) loveLife Project Monitoring Database, 2) District Health Information System (DHIS) GPS and Service Provision by Facility files, 3) National Income Dynamics Study (NIDS) Secure Data, and 4) the 2001 South African Census. Appendix Table A1 summarizes how each data source is used in the analysis.

The loveLife Project Monitoring Database provides names of each NAFCI clinic and the month and year the accreditation process began. Based on interviews with loveLife and clinic staff, we estimate that the effective start date of "youth friendly" services is one year after accreditation began. District Health Information System (DHIS) facility-level files provide GPS coordinates and monthly service provision data for every public health facility in South Africa from 2001 to 2012.[18] Appendix Fig. A2 shows the location and start year of NAFCI clinics from 2000 to 2010 based on linking the loveLife database with the DHIS. We also use contraceptive distribution (including the two major injectable contraceptives, pills, IUDs and condoms) and reported sexually transmitted infections (STIs) aggregated to an annual level to track changes in service provision by facility type—NAFCI or non-NAFCI.

Table 1
NIDS Sample: Teen Birth by Cohort and Proximity to a NAFCI Clinic.

	NAFCI Clinic w/in 1 km of residence?			
	Younger cohort		Older cohort	
Birth by 17	Yes	No	Yes	No
Yes	22	364	18	169
No	186	3222	113	1748
Total	208	3586	131	1917
Birth by 18	Yes	No	Yes	No
Yes	45	624	29	343
No	168	2893	102	1574
Total	213	3517	131	1917

Source: Respondents from the NIDS geo-linked to NAFCI clinics using data from District Health Information System and loveLife Project Monitoring Databases.
Notes: Analysis sample sizes by whether a women gave birth by 17 (18), cohort (young/older) and whether residence was within 1 km of a NAFCI clinic. For the birth by 17 outcome, younger cohort refers to female NIDS respondents who were ages 5–16 in 2001 and could have been impacted by the initiative. Older cohort is women who were 18–27 in 2001 who were too old during the NAFCI rollout to be eligible for adolescent friendly services and serve as a comparison group in our differences strategy. Similarly, for the birth by 18 outcome younger cohort refers to women 5–17 in 2001 and older cohort to women 18–27 in 2001. Sample includes all respondents who live within 5 km of a clinic.

The National Income Dynamics Study (NIDS) is a nationally representative longitudinal household survey of over 28,000 individuals in 7300 households that started in 2008 and is fielded every two years (SALDRU 2016a,b). NIDS includes detailed birth histories for all women over the age of 14 at the time of interview. NIDS secure data includes GPS coordinates of residence at time of interview as well as a residency history including city/suburb of birth and residence in 1994, 2006, 2009 and 2011.[19]

We begin by defining a group of women who are old enough to have completed high school and potentially enter the work force by the time of the 2014/15 NIDS wave 4 survey, but also young enough to have been adolescents during the NAFCI rollout. We further restrict the sample to women who lived within 5 km of a clinic. Given that two thirds of South African's live within two kilometers of a public health facility, this does not reduce sample size dramatically (McLaren et al., 2014). This gives us a sample of approximately 3794 female NIDS respondents who were ages 8–16 in 2001 at the start of the NAFCI rollout; and who are 18–29 when we last observe. We refer to this group as the "Adolescent" sample whose teenage fertility, based on their age, could have been affected by NAFCI. We then define a comparison sample of older women. This "Adult" sample consists of 2048 NIDS respondents who were 17–28 in 2001.[20] Table 1 presents the sample stratified by cohort and NAFCI clinic proximity status.

We use retrospective residence questions in addition to location information from the NIDS survey years to determine where each woman lived from 2001 to 2010. If, when interviewed, she still resides at the location she did during adolescence, we have the GPS of her residence during adolescence; otherwise we use the GPS of the centroid of the "main-place" of residence to approximate her location in adolescence.[21] Using this residential information and clinic GPS coordinates, we calculate the distance in kilometers

[17] Buvinic (1998) compares employment and earnings outcomes in the 1990s for teen versus adult mothers in Chile and finds that mothers have substantially lower earnings (though the author does not control for age).

[18] The District Health Information System (DHIS) is a health management information system and data warehouse developed by the Health Information Systems Programme (HISP) used by the South African Department of Health (DOH) to collect and monitor routine health data. This data is the basis of the annual South African District Health Barometer that provides indicators of the health system at district level. Monthly facility-level data was obtained with authorization from the DOH and with assistance from HISP.

[19] Secure NIDS data can only be accessed at the DataFirst secure facility at the University of Cape Town upon approval by the NIDS management committee.

[20] These counts are for our analysis of birth by age 17; when we assess birth by 18, we shift the ages up by one year.

[21] Since we use a respondents' location separately in each year from 2001 to 2010 there are some for whom we always need to use main place—approximately 3% of our sample, and some for whom we use both main place (earlier) and GPS (later)—approximately 7% of our sample. Appendix Table A4 shows the robustness

from residence to the nearest NAFCI accredited public health clinic for each respondent in each year.[22] We create a series of indicator variables for whether she lived near a *NAFCI accredited* clinic (within one, two, three, four or five kilometers) when she was between the ages of 12 and 16 based on when and where clinics became accredited and the respondent's age during the rollout. For women in the Adult cohort we define a "placebo" age range of exposure (age 22–26) since they could not technically have had their teen fertility affected by the NAFCI intervention.[23] Main results are shown for living within one kilometer of a NAFCI clinic.[24]

We begin by studying the impact of NAFCI on fertility timing, specifically early teen childbearing. Using NIDS birth histories we create a set of indicator variables for having a first birth by age 17 or 18 years old. Next we investigate the impact of NAFCI on years of education, completion of secondary school (matric), employment outcomes (proportion employed, and earnings) and child health. We measure impacts on child health using the height-for-age of first born children who were aged one to 15 at the time of the survey. NIDS also provides a series of time-invariant demographic characteristics such as race and parental education that serve as controls in our analysis.

The 2001 South African census provides information on socio-economic characteristics at the fine level of geographic detail.[25] We geolink each NIDS respondent to her reported neighborhood of residence in 2001 and construct a set of variables describing characteristics for each neighborhood from the 2001 South African census including population size, share urban, a dependency ratio measure (the ratio of children and adults over 65 to prime age adults), the sex ratio, the share of adults over 20 in different education categories (some primary, completed primary, some secondary, matric and higher education) and the proportion of the households with no piped water and no electricity. These serve as pre-policy control variables—NAFCI was piloted as early as 1999, but the main rollout occurred in the mid-2000s.

3.2. Empirical strategy to use NAFCI rollout as a plausibly exogenous measure of increased access to reproductive health services

Our empirical strategy exploits NAFCI's staged rollout across South Africa to identify the impact of changes in adolescent access to contraception and sex education on early teen childbearing. We provide both empirical and institutional evidence to suggest that the geographic distribution of NAFCI clinics was plausibly random after controlling for observable characteristics and unobserved time invariant characteristics common across cohorts.

Regarding exogenous rollout, the first piece of evidence is based on interviews with people involved with the rollout of NAFCI. It is our understanding that clinics were chosen in a relatively ad hoc way that varied by province and district.[26] According to the first director of loveLife, statistics on teen pregnancy and HIV were not used as selection criteria as those statistics did not exist with any geographic detail at the time. We were told on multiple occasions that since clinics were usually chosen by provincial or district level departments of health, and that varying personalities and agendas of provincial or district managers were involved, this led to a "random" mix of clinics across the country (though they did not mean a formal random selection process was used). In some cases "struggling" clinics were targeted, and in other cases clinics perceived to be doing relatively well were rewarded by being chosen for the program. What is clear is that there were many more clinics that either wanted to be involved, or whose district managers wished for them to be included, than could be accommodated due to the intensity and expense of the program. Only around 12% of all public clinics were accredited as youth friendly by 2009. Thus, while NAFCI was targeted at high-need communities (see Appendix Table A3), there are an abundance of high-need communities across South Africa. We feel confident that many clinics that were otherwise similar to chosen clinics were not selected simply due to lack of funds, organization and time.

Appendix Table A3 provides evidence on the characteristics of areas where NAFCI clinics were accredited. Using data for small areas in the 2001 census, we regress an indicator of whether the small area had at least one clinic NAFCI accredited, on the demographic and infrastructure characteristics of the neighborhood. Many of the coefficients are statistically significant showing that the initiative was generally focused on areas of high need and low socio-economic status. We control for all of these variables, and other unobserved time invariant characteristics of the district council of birth, when estimating the impact of NAFCI. We also include the rate of early teen childbearing in 1996 (from the 1996 census) to these regressions and find that the coefficients are small and not statistically significant providing evidence that, controlling for socio-economic status, NAFCI accreditation was not based on the pre-existing rate of teen childbearing in the neighborhood.

Since access to NAFCI depended both on the location of the rollout and whether an individual was an adolescent during the rollout, we can use cohorts that were too old to be affected as a comparison group for those who were in the relevant age range. This difference-in-differences strategy allows us to further confirm that there was not some other factor about the locations that received NAFCI clinics, rather than the clinics themselves, which drives our results. This strategy requires only that the location and timing of clinic accreditation is uncorrelated with other determinants of *changes* in fertility timing. While the assumption that clinic locations were not chosen where *trends* in teen fertility were different cannot be tested empirically, showing a lack of pre-trends in outcomes or related variables provides suggestive evidence that the assumption is valid.

The first piece of evidence is provided in the event studies in Fig. 4, which show the relative changes in service provision at NAFCI versus non-NAFCI clinics before and after accreditation. The pre-accreditation trend in the provision of contraceptives is relatively flat, which lends credibility to the assumption that the initiative did not target clinics that had different growth trajectories in contraceptive provision from the average clinic. Next, we use a sample of women older than the control cohort in our main analysis to conduct a placebo test, comparing outcomes for two successive cohorts that were both too old to be affected. If the placebo results

of our results to including or excluding respondents for whom we estimate residence with main place.

[22] Distances are calculated using the user-written command geonear: "geonear finds the nearest neighbors using geodetic distances, i.e. the length of the shortest curve between two points along the surface" of a mathematical model of the earth" (Picard, 2012).

[23] This strategy is similar to the approach used by (Duflo, 2001) and (Tanaka, 2014).

[24] We find that the impacts of NAFCI clinics is only significant when respondents live within one kilometer of the clinic, therefore all results in the paper are for an indicator of living within one kilometer. Results for all other distances are available upon request.

[25] We use small area level (SAL) data to define neighborhoods. SAL geographical units are equivalent to enumeration areas in most cases except those with few households, where a SAL will contain multiple EAs. There were 56,255 SAL in the 2001 census. See Appendix Fig. A3.

[26] Byker visited NAFCI-accredited clinics in Gauteng, Eastern Cape and Western Cape and met with nurses and local loveLife youth peer educators. Byker conducted extensive interviews with eight current and past employees and consultants of loveLife in total. Two provincial managers interviewed were at loveLife during the initial implementation of the program.

Table 2
Difference-in-Differences Matrices for Means of Early Teenage Childbearing.

	NAFCI Clinic w/in 1 km of residence?		
	Yes	No	Difference
Birth by 17			
Younger cohort	0.097	0.079	0.016
	(0.032)	(0.006)	(0.032)
Older cohort	0.154	0.069	0.085
	(0.039)	(0.009)	(0.04)
Difference	−0.057	0.01	−0.069
	(0.037)	(0.01)	(0.038)
Birth by 18			
Younger cohort	0.015	0.137	0.015
	(0.037)	(0.01)	(0.03)
Older cohort	0.266	0.158	0.108
	(0.055)	(0.015)	(0.056)
Difference	−0.11	−0.021	−0.093
	(0.057)	(0.014)	(0.057)

Source: Respondents from NIDS geo-linked to NAFCI clinics using data from District Health Information System and loveLife Project Monitoring Databases.
Notes: Proportion giving birth by age 17 and 18, younger versus older cohort and whether their residence was within 1 km of a NAFCI clinic. Robust standard errors in parentheses. Post stratification weights used. For the birth by 17 outcome, younger cohort refers to female NIDS respondents who were ages 5–16 in 2001 and could have been impacted by the initiative. Older cohort is women who were 18–27 in 2001 who were too old during the NAFCI rollout to be eligible for adolescent friendly services and serve as a comparison group in our differences strategy. Similarly, for the birth by 18 outcome younger cohort refers to women 5–17 in 2001 and older cohort to women 18–27 in 2001.

were similar to what we find in our main results it would suggest that we have mistaken a continuation in pre-trends for a treatment effect. We do not find evidence of pre-trends (except for education which shows an opposite trend). These results are discussed in detail below.

3.3. Empirical specifications

We use a difference-in-differences strategy to examine the impact of the NAFCI program on teenage childbearing, education and employment outcomes by comparing the outcomes of those exposed and not exposed to the program, where exposure is based on birth cohort (relevant age or too old) and proximity (near or far) of residence to a NAFCI clinic during the applicable age.

Specifically, we compare outcomes of respondents too old to be affected by the program (age 17–26 in 2001) to those who were born in years where they could be exposed and who we saw after the age of 17 (5–16 in 2001)-*Adolescent*. Access to a NAFCI clinic is defined as the respondent being of the applicable age and living within 1 km of a clinic that was NAFCI accredited during the rollout between 2001 and 2010 – *Near*. For the Adolescent cohort the applicable age range is 12–16.[27] Recall that for the Adult cohort, we have defined a placebo age range, since they are always technically too old to be affected by NAFCI.

Table 2 presents the identification strategy in a simple two-by-two table. The means and standard errors of each of the outcome variables are presented for different cohorts and access areas. In both age groups, those who lived near NAFCI clinics have higher teen childbearing levels, reflecting the allocation of clinics to areas of high need. In both access and no access areas, teen childbearing decreases over time, however the decline is much larger in access areas. The difference-in-differences estimate of −0.069 can be interpreted as a 6.9% point decrease in teenage childbearing by age 17 as a result of the NAFCI program under the assumption that, in the absence of the program, the decrease in the teenage childbearing rates would have been equivalent in access and no access areas.

Generalizing this empirical strategy to a regression framework we estimate equations of the form:

$$Birthby17_{ijk} = \alpha_0 + \beta_1(Near_i \times Adolescent_j) + \beta_2 Near_i + \beta_3 Adolescent_j + \boldsymbol{X}'_i\beta_4 + \boldsymbol{X}'_{SAL}\beta_5 + \delta_k + \epsilon_{ijk} \quad (1)$$

where $Birthby17_{ijk}$ is an indicator for whether individual i in cohort j born in area k gave birth before age 17, α_0 is a constant, $Near_i$ indicates whether individual i's household was within 1 km of a NAFCI clinic, $Adolescent_j$ is a dummy indicating whether the individual is in the younger cohort, $\boldsymbol{X}_i$ is a vector of individual characteristics including population group dummies (race), parental education, and distance to closest clinic in 2002 (prior to the main rollout), $\boldsymbol{X}_{SAL}$ is a vector of demographic characteristics of neighborhood of residence in 2001 as per the 2001 census (prior to the rollout), δ_k are district of birth fixed effects. The coefficient of interest is β_1, which gives the differences-in-differences estimate of the impact of access to a NAFCI clinic. All standard errors are clustered at the NIDS cluster level (enumeration area) and we use the post-stratification weights that incorporate sampling weights that account for the sampling design.

In order to control more flexibly for age and test for robustness to cohort-specific trends, we replace the *Adolescent* dummy with year of birth dummies and in some specifications interact year of birth dummies with geographic controls as in the following equation:

$$Birthby17_{ijk} = \alpha_0 + \beta_1(Near_i \times Adolescent_j) + \beta_2 Near_i + yob_i + \boldsymbol{X}'_i\beta_4 + \boldsymbol{X}'_{SAL}\beta_5 + (\boldsymbol{X}'_{SAL} \times yob_i)\beta_6 + \delta_k + \epsilon_{ijk} \quad (2)$$

All standard errors are clustered at the NIDS cluster level (enumeration area) and we use the post-stratification weights that take account of the sampling design, baseline non response and are calibrated to mid-year population estimates in the year of the survey. After estimating results for the impacts of NAFCI on teenage childbearing, we estimate Eq. (2) for later life outcomes such as education, employment and child health.

4. Estimates of the impact of NAFCI on teen childbearing, education, employment and child health outcomes

We begin by presenting estimates of the impact of NAFCI on early teen childbearing, building up from the basic differences estimates shown in Table 2 to estimates of regression Eq. (2) with a full set of controls and tests for robustness to differential trends. Next we present results for a series of later life outcomes that previous research has shown are negatively impacted by early teen childbearing—education and child health. We also present estimates of the impact of NAFCI on employment and earnings, making this one of only two papers we are aware of to study the association between early childbearing and employment outcomes in a developing country context and the only one in Africa.

Table 2 presents estimates of Eq. (1) where the outcomes are indicators for having a first birth by age 17 or by age 18. Column 1 is analogous to the estimates from Table 2 only controlling for respondents age with year-of-birth dummies. Columns 2 and 3 add additional controls—all controls are either time-invariant such as race, parents' education and region of birth or based on pre-policy characteristics of the respondent's neighborhood. The coefficient of

[27] We define cohorts based on age in 2001 –the beginning of the rollout-but the key factor in being treated by NAFCI is being 12–16—the target age range of youth friendly services is 12–17 (Burnett, 2013)—between 2001 and 2010. Anyone who was 5–16 in 2001 was at least 12 sometime between 2001 and 2010 and thus both had the possibility to being treated by NAFCI and was young enough to prevent a birth by age 17. When testing for birth by 18, the cohorts are shifted up by one year.

Table 3
Effect of NAFCI Access on Early-Teen Childbearing: Coefficients on the interactions between proximity to a NAFCI clinic and being an adolescent during the NAFCI rollout.

	Dependent Variable: Teenage childbearing				
	(1)	(2)	(3)	(4)	(5)
Birth by 17					
Adolescent X Near	−0.076*	−0.074*	−0.063*	−0.065*	−0.068*
	(0.042)	(0.039)	(0.038)	(0.036)	(0.038)
Near	0.086*	0.084**	0.080**	0.084***	0.084**
	(0.044)	(0.041)	(0.035)	(0.031)	(0.034)
Observations	5842	5842	5842	5842	4009
Year of birth dummies	Yes	Yes	Yes	Yes	Yes
Race and Parental education	No	Yes	Yes	Yes	Yes
SAL controls, dist to any clinic	No	No	Yes	Yes	Yes
District council of birth dummies	No	No	Yes	Yes	Yes
SAL controls × yob dummies	No	No	No	Yes	Yes
Living within 2 km of any clinic	No	No	No	No	Yes
Birth by 18					
Adolescent X Near	−0.098*	−0.092*	−0.084	−0.113**	−0.117**
	(0.056)	(0.053)	(0.053)	(0.053)	(0.050)
Near	0.100*	0.099**	0.095**	0.126***	0.140***
	(0.053)	(0.050)	(0.047)	(0.041)	(0.040)
Observations	5778	5778	5778	5778	3991
Year of birth dummies	Yes	Yes	Yes	Yes	Yes
Race and Parental education	No	Yes	Yes	Yes	Yes
SAL controls, dist to any clinic	No	No	Yes	Yes	Yes
District council of birth dummies	No	No	Yes	Yes	Yes
SAL controls × yob dummies	No	No	No	Yes	Yes
Living within 2 km of any clinic	No	No	No	No	Yes

Source: Respondents from the South African National Income Dynamics Study geo-linked to NAFCI clinics using data from District Health Information System and loveLife Project Monitoring Databases.

Notes: The table presents the β_1 and β_2 coefficients from Eq. (2) with controls and sample as noted in the lower rows of each panel. All estimates are weighted using the post-stratification weights and take account of the complex sample design, standard errors are in parentheses. ** Significant at the 5% level, * significant at the 10% level. Small Area controls are based on pre-policy measures from the 2001 Census including population size, share urban, a dependency ratio measure (the ratio of children and adults over 65 to prime age adults), the sex ratio, the share of adults over 20 in different education categories (some primary, completed primary, some secondary, matric, higher) and the proportion of the households with no piped water and no electricity. The final column restricts the sample to those who were living within 2 km of any clinic.

interest is on the interaction of living near a NAFCI clinic and being an adolescent during the rollout (*Near* × *Adolescent*). The estimates are reduced slightly with the addition of geographic controls. The estimated effect in Column 3 indicates that living within one kilometer of a NAFCI clinic between the ages of 12 and 16 led to a 6.3% point reduction in the likelihood of having a first birth by age 17 with a p-value of 0.09. Panel B, Column 3 shows that living near a NAFCI clinic during adolescence led to a 8.4% point reduction in the likelihood of a birth by age 18 (p-value = 0.11). These estimates are at or near conventional levels of significance and reflect a level of precision commensurate with the small sample sizes in the NIDS for the relevant age groups. Column 4 shows results from a specification that interacts pre-policy geographic controls with year-of-birth dummies. This allows these very precise geographic controls to have a differential trend for each birth cohort—for both birth by 17 and by 18 this more flexible specification increases the magnitude and significance of the results. Finally, column 5 restricts the sample to women who lived within two kilometers of any public clinic during adolescence. This specification allows us to isolate the impact of youth friendly services versus standard health services. The results in Column 5 are larger in magnitude and more statistically significant than those in Column 1.[28]

The first two entries of Table 4 carry over the results from our base specification in column 3 of Table 3 for impacts on birth by 17 and birth by18. The final column of Table 4 gives the mean of each outcome among women in the sample who were adolescents during the NAFCI rollout. Given the average levels of early-teen childbearing, our estimates imply that NAFCI had a substantial impact on fertility timing. In results not shown, but available upon request, we find no statistically significant impact of NAFCI on birth by age 19 which suggests that the impact of the initiative was to delay rather than decrease fertility. As seen in Table 4, we estimate that among women who gave birth by Wave 4, access to a NAFCI clinic delayed childbearing by approximately 0.5–0.7 years on average though the estimates are not statistically significant.

Turning to education and employment outcomes in early adulthood, we estimate that women who lived near a NAFCI clinic in adolescence attained approximately one additional year of schooling on average, though we find no impact on the likelihood of completing matric. These findings are roughly in line with the magnitudes for impacts of early childbearing found by Ardington et al. (2015). Employment rates among non-white young adults are notoriously low in South Africa, particularly for young women as can be seen by the 60% employment estimate in Table 4. We do not find that delaying early childbirth is associated with increased employment. However, among women who have jobs, those who had NAFCI access as an adolescent report substantially higher earnings—roughly 30% higher monthly earnings. Together these results suggest that delayed childbearing is associated with greater human capital investment resulting in improved earnings potential.

Finally, we examine the intergenerational impacts of early teen childbearing. Approximately seventy percent of the sample who were adolescents during the NAFCI rollout have given birth when we last see them. Table 4 shows substantial and statistically significant improvements in child health consistent with recent findings that even delaying early births by a year can have strong positive impacts (Branson et al., 2015). Among first-born resident children, the likelihood of stunting is more than 15% points lower for children born to mothers who had NAFCI access as teens compared to

[28] When we study the characteristics of the subgroup that appears in Column 4 but not in Column 5, we find that the sample excluded is more likely to be white and rural than the subsample in Column 5.

Table 4
Effect of NAFCI Access on Birth, Education, Employment and Child Outcomes: Coefficients on the interactions between proximity to a NAFCI clinic and being an adolescent during the NAFCI rollout.

	Experiment of Interest	Addressing Potential Pre-Trends		
		SAL × Year of Birth trends	Placebo Experiment	Mean
Birth outcomes				
Birth by 17	−0.063*	−0.065*	0.030	0.08
	(0.038)	(0.036)	(0.045)	
	5842	5842	3505	
Birth by 18	−0.084	−0.113**	0.029	0.14
	(0.053)	(0.053)	(0.071)	
	5778	5778	3505	
Age at first birth	0.517	0.743	−0.474	19.86
	(0.573)	(0.568)	(0.811)	
	4154	4154	3246	
Education outcomes:				
Years of Education	0.911*	1.188***	−0.943**	11.20
	(0.492)	(0.428)	(0.405)	
	5994	5994	3676	
Completed Matric	0.082	0.084	−0.086	0.49
	(0.100)	(0.090)	(0.071)	
	5994	5994	3676	
Labour market outcomes:				
Employed	0.000	0.062	−0.002	0.59
	(0.070)	(0.072)	(0.059)	
	3497	3497	2606	
Log Wages	0.385**	0.320*	−0.177	R4616/mnth
	(0.187)	(0.182)	(0.213)	
	1703	1703	1523	
Child outcomes:				
First born height for age	0.736*	0.623**	–	−1.07
	(0.381)	(0.264)		
	2176	2176		
First born child stunted	−0.153*	−0.146*	–	0.25
	(0.087)	(0.078)		
	2176	2176		

Source: Respondents from the South African National Income Dynamics Study geo-linked to NAFCI clinics using data from District Health Information System and loveLife Project Monitoring Databases.
Notes: The first row for each outcome is the β_1 coefficient from estimating Eq. (2) for the relevant dependent variable. The second row gives standard errors in parentheses. The third row gives the relevant sample size. All estimates are weighted using the post-stratification weights and take account of the complex sample design. Column 1 presents results from the base specification in Column 3 of Table 1. Column 2 shows results including interactions between small-area controls and year-of-birth dummies. Column 3 presents the results of a placebo experiment comparing two unaffected cohorts. The final column gives the mean for the relevant outcome among the young cohort. Regressions for child outcomes also include controls for child's age in days and sex.
** Significant at the 5% level.
* Significant at the 10% level.
*** Significant at the 1% level.

those whose mothers did not.[29] Mothers' NAFCI access is estimated to increase children's height-for-age by 0.8 standard deviations, which is in line with findings from the Branson et al. (2015) study.

Branson et al. (2015) find that behavioral choices and maturity of older mothers may explain better outcomes for children. Access to reproductive health services initially targeted at contraception may serve as a stepping stone to the health system resulting in improved maternal and child health. As seen in Appendix Table A2, one element of the NAFCI Essential Service Package is antenatal and postnatal care.

Columns 3 and 4 of Table 4 address potential pre-trends that would violate our identification assumption. Column 3 gives results for specifications that include geographic controls interacted with year of birth fixed effects allowing for differential trends by age at a fine level of geographic detail. Results for all outcomes are robust to this specification. Finally, we show results for a placebo experiment comparing women who were 18–27 in 2001 to those who were 28–37 in 2001. The coefficients in the placebo regressions are all small and statistically insignificant except for the education outcome which shows a statistically significant coefficient with the opposite sign of our main regression.[30]

5. Conclusion

In South Africa in the early 2000s, social and institutional barriers blocked teen access to family planning despite a well-established contraceptive infrastructure. Starting in 2001, the NGO loveLife in conjunction with the Department of Health implemented an intensive initiative which increased access to reproductive health services and information for some teens. The rollout of the South African National Adolescent Friendly Clinic

[29] Stunted is an indicator for having a height-for-age z-score more than two standard deviations below the median score for the World Health Organization reference population (WHO, 2006).

[30] There are two potential interpretations of the negative coefficient on educational attainment in the placebo test. First, access to NAFCI could have reversed a negative trend in treatment vs. control areas. Alternatively, this pattern could suggest that we have found evidence of mean reversion. Since none of the other outcomes show this pattern, we find the former explanation more likely, but this opposite sign in the placebo test means we should be more cautious in our interpretation of the education results. We cannot conduct this falsification test for the child outcomes as the oldest group is much less likely to have children young enough to have measures on the relevant outcomes.

Initiative provides a natural experiment to investigate the mechanisms linking contraceptive access with fertility timing and the subsequent impacts of delaying births on human capital accumulation, earnings and child health. Using the location and timing of the rollout geolinked to rich data on location of residence, birth history and outcomes in adulthood from the National Income Dynamics Study, we find that living near a NAFCI clinic during adolescence delayed childbearing substantially lowering the likelihhod of giving birth before age 17 or 18. We estimate that adolescents who had access to NAFCI completed more years of schooling and, consistent with increased human capital investments, earn substantially higher wages as young adults. Finally, children born to women who had access to youth-friendly services as teens show substantial health advantages, indicating a strong intergenerational benefit of delaying early teen childbearing in the South African context.

While this paper deals with a policy intervention in the context of post-Apartheid South Africa, our findings provide important evidence about whether and how fertility timing affects women's economic outcomes more broadly. To explain why the observed correlation between teen childbearing and worse economic outcomes falls away in the US after controlling for factors like household environment in adolescence, researchers have argued that women for whom early childbearing is costly prevent early births using contraception or abortion (Geronimus and Korenman, 1992; Lang and Weinstein, 2015). Given this line of reasoning, when adolescent access to family planning is *limited,* as it was in the US prior to the 1960s or in many developing countries today, it is not surprising to find evidence that early childbearing *causes* worse outcomes.

These results corroborate recent research showing that early teen childbearing has substantial negative consequences for women's economic outcomes in many developing economies. Our study provides the added contribution of estimating the impacts of teen childbearing in a setting where contraceptive access for teens was initially limited and then later expanded. We find that a reproductive health intervention targeted directly at youth has the immediate intended goal of delaying childbearing and also provides the longer term benefits of improved later-life outcomes indicating an important role for youth friendly health services.

Acknowledgements

This project was generously supported by a William and Flora Hewlett Foundation/Institute of International Education Dissertation Fellowship in Population, Reproductive Health and Economic Development and the Hewlett/PRB Global Teams of Research Excellence in Population, Reproductive Health, and Economic Development. Tanya Byker also received support from an NICHD training grant to the Population Studies Center at the University of Michigan (T32 HD007339). We are grateful to Cally Ardington, Martha Bailey, Diane Cooper, Robert Garlick, David Lam, Murray Leibbrandt, and Jeff Smith for helpful comments and guidance.

Appendix A.

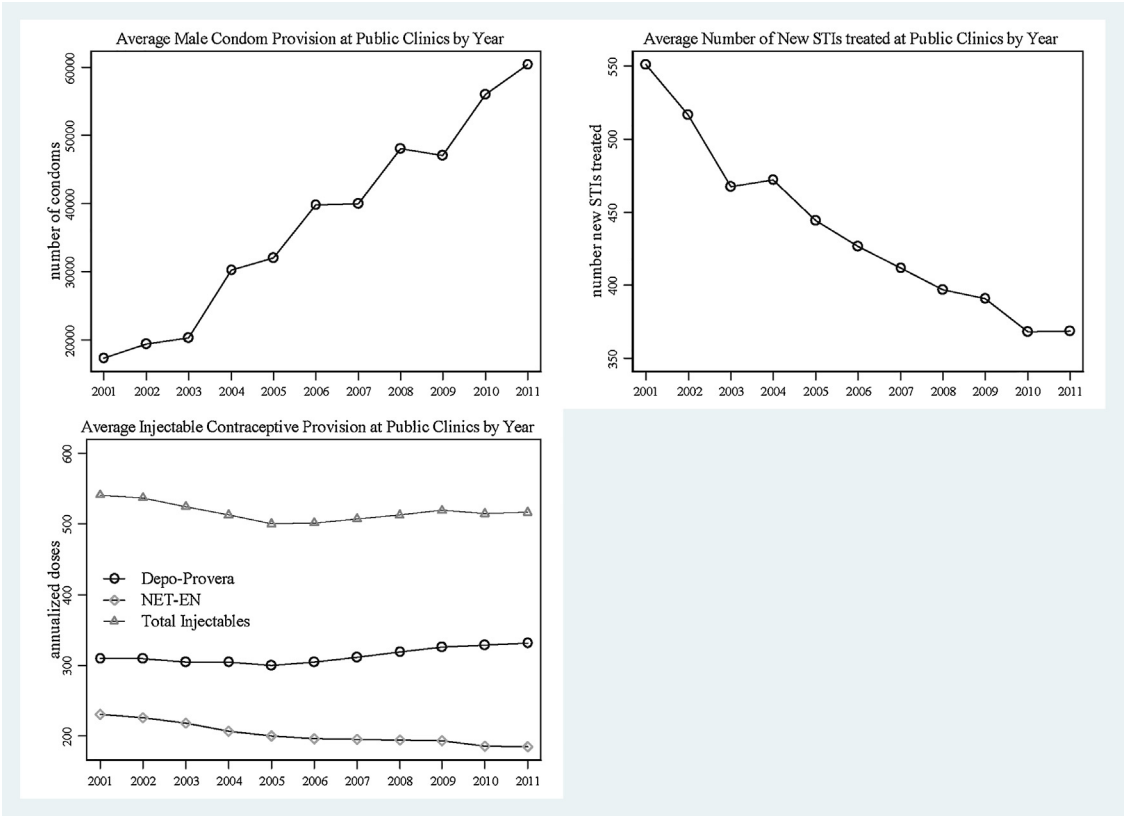

Fig. A1. Trends in Reproductive Health Service Provision – All Public Clinics by Year.
Notes: Depo-Provera (depot medroxyprogesterone acetate) and NET-EN (norethisterone oenanthate) are long-acting injectable contraceptives. Depo-Provera is given every three months and NET-EN every two months.
Source: Service provision data from the South African District Health Information System facility-level data.

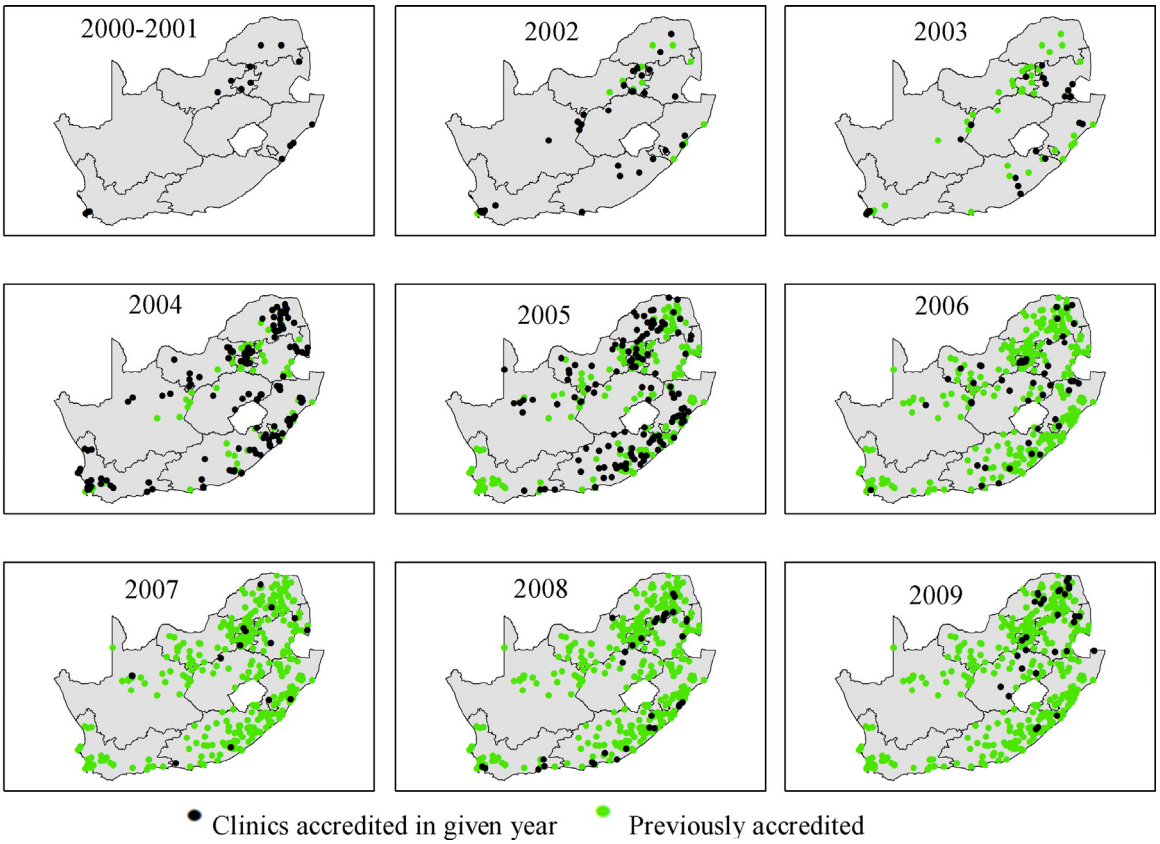

Fig. A2. Geography and Timing of National Adolescent Friendly Clinic Initiative Rollout.
Notes: The figure shows the rollout of NAFCI clinics between 2000 and 2009. The black (dark) spots indicate newly accredited clinics, while the green (light) spots represent clinics previously accredited. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
Source: loveLife project monitoring database and District Health Information System (DHIS)

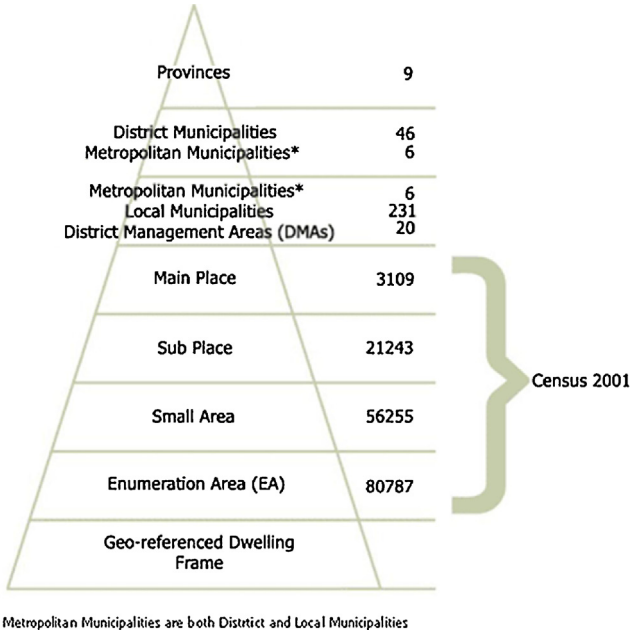

Fig. A3. South African Census 2001 geographical area hierarchy structure.
Source: (Statistics South Africa) http://www.statssa.gov.za/census01/html/Geography_Metadata.htm.

Table A1
Data Sources.

Variable	Source
Outcomes Y_{itj}: Birth, education, labor market, and child outcomes.	National Income Dynamics Study (NIDS). The most recent wave with relevant information for a respondent is used.
Regressors $Near_i$, $Adolescent_j$: Proximity to NAFCI clinic at a given age	Geolinking between: i) Secure NIDS data on respondents' age and residence history ii) loveLife NAFCI monitoring database (NAFCI rollout by clinic) iii) District Health Information System (GPS coordinates of clinics)
$\boldsymbol{X}'_i$: Time invariant Individual-level controls (ex. parental education, race)	National Income Dynamics Study (NIDS). The most recent wave with relevant information for a respondent is used.
Proximity to any clinic in 2002	Geolinking between i) Secure NIDS data on age and residence in 2002 ii) District Health Information System (GPS coordinates of clinics)
$\boldsymbol{X}'_{SAL}$: Geographic Controls (at Small Area Level in 2001—prior to main NAFCI rollout)	Geolinking between i) Secure NIDS data on small area of residence in 2001 ii) 2001 South African Census

Table A2
National Adolescent Friendly Clinic Initiative Standards.

NAFCI Standards:
1. Management systems are in place to support the effective provision of adolescent-friendly services.
2. The clinic has policies and processes that support the rights of adolescents.
3. Clinic services appropriate to the needs of adolescents are available and accessible.
4. The clinic has a physical environment conducive to the provision of adolescent friendly health services.
5. The clinic has the drugs, supplies and equipment necessary to provide the **Essential Service Package** for adolescent-friendly health care.
6. Information, education and counseling consistent with the **Essential Service Package** are provided.
7. Systems are in place to train staff to provide effective adolescent-friendly services.
8. Adolescents receive an accurate psychosocial and physical assessment.
9. Adolescents receive individualized care based on standard service delivery guidelines.
10. The clinic provides continuity of care for adolescents.

The Essential Service Package:
1. Information and education on sexual and reproductive health.
2. Information, counseling and referral for violence/abuse and mental health problems.
3. Contraceptive information and counseling, and provision of methods including oral conceptive pills, emergency contraception, injectables and condoms.
4. Pregnancy testing and counseling, antenatal and postnatal care.
5. Pre- and post-termination of pregnancy counseling and referral.
6. Sexually transmitted infections (STIs) information, including information on the effective prevention of STIs and HIV, diagnosis and syndromic management of STIs.

Source: Ashton et al. (2009) "Evolution of the National Adolescent-Friendly Clinic Initiative in South Africa", World Health Organization.

Table A3
Determinants of NAFCI Placement.

Dependent variable: NAFCI clinic in small area, regressors from 2001 Census				
	(1)	(2)	(3)	(4)
Birth by 17	0.005	0.007		
	(0.006)	(0.006)		
Birth by 18			0.002	0.003
			(0.004)	(0.004)
Birth info not linked	−0.004***	−0.003***	−0.004***	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Urban		−0.003***		−0.003***
		(0.001)		(0.001)
Population/1000		0.003***		0.003***
		(0.001)		(0.001)
Dependency ratio		−0.001		−0.001
		(0.001)		(0.001)
Sex Ratio		−0.002		−0.002
		(0.001)		(0.001)
Proportion of 20 + population with:		0.003		0.003
Tertiary		(0.005)		(0.005)
		−0.001		−0.001
Matric		(0.005)		(0.005)
		0.012***		0.012***
Incomplete secondary		(0.004)		(0.004)
		0.016		0.016
Completed primary		(0.011)		(0.011)
		−0.001		−0.001
No electricity		(0.001)		(0.001)
		−0.003**		−0.003**
No pipied water		(0.001)		(0.001)
		−0.003*		−0.003*
Informal		(0.001)		(0.001)
Observations	56,255	54,881	56,255	54,881

Sources: District Health Information System and loveLife Project Monitoring Databases linked to the 2001 and 1996 South African Census data.
Notes: Probit models estimated at the Census 2001 small area level (SAL). Marginal effects displayed. Area characteristics are from the Census 2001 data. Age at birth information is from the Census 1996 enumeration areas (EAs). There is no direct match between Census 1996 EAs and Census 2001 SALs, therefore the GPS of the centroid of the 2001 SAL is matched to its respective 1996 EA to attain birth information at the Census 2001 SAL. In addition, we find that the number of EAs in the Census 1996 community profiles does not match the number in the attributes tables of the respective shape files. This is because the 1996 Census EA demarcation was paper based and was only captured after the census was completed. During the capturing process, some EAs were found not to be properly spatially separated as they did not have boundary descriptions e.g. unstructured informal settlements. As a result, these EAs were deliberately lumped together resulting in more data records than spatial entities (email communication with StatsSA). Given the spatial issues described above, some 2001 Census SALs are not matched with a 1996 Census EA and therefore no birth information can be provided for these SALs. The variable 'birth information not linked' represents this scenario.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table A4
Testing Robustness to Precision of Residence Location Information.

	Full Sample	Excluding Always MP	Excluding Ever MP
Birth outcomes			
Birth by 17	−0.063*	−0.061	−0.082*
	(0.038)	(0.038)	(0.044)
	5842	5702	5427
Birth by 18	−0.084	−0.069	−0.078
	(0.053)	(0.053)	(0.060)
	5778	5637	5355
Age at first birth	0.517	0.481	0.364
	(0.573)	(0.565)	(0.671)
	4154	4065	3838
Education outcomes:			
Years of Education	0.911*	0.928*	0.885*
	(0.492)	(0.498)	(0.491)
	5994	3865	5852
Completed Matric	0.082	0.074	0.025
	(0.100)	(0.099)	(0.098)
	5994	5852	5569
Labour market outcomes:			
Employed	0.000	−0.032	0.002
	(0.070)	(0.000)	(0.071)
	3497	2308	3410
Log Wages	0.385**	0.311	0.377**
	(0.187)	(0.000)	(0.183)
	1703	1149	1658
Child outcomes:			
First born height for age	0.736*	0.710*	0.695*
	(0.381)	(0.378)	(0.387)
	2176	2139	2034
First born child stunted	−0.153*	−0.144	−0.151*
	(0.087)	(0.088)	(0.086)
	2176	2139	2034

Source: Respondents from the South African National Income Dynamics Study geo-linked to NAFCI clinics using data from District Health Information System and loveLife Project Monitoring Databases.
Notes: The first column of this table repeats the first column of Table 4. Columns 2 and 3 test the robustness of these results to excluding respondents for whom we have main place of residence rather than GPS coordinates of residence between 2001 and 2010. Since we use a respondents' location separately in each year from 2001 to 2010 there are some for whom we *always* need to use main place, and some for whom we *ever* use main place (earlier) and for whom we later have GPS.
** Significant at the 5% level.
* Significant at the 10% level.

References

Abdool, Karim Q., Preston-Whyte, E., Abdool, Karim S.S., 1992. Teenagers seeking condoms at family planning services. Part I. A user's perspective. S. Afr. Med. J. = Suid-Afrikaanse tydskrif vir geneeskunde 82 (5), 356–359.

Allen, David M., Simelela, Nolhemba P., Makubalo, Lindiwe, 2009. Epidemiology of HIV/AIDS in South Africa. South. Afr. J. HIV Med. 1 (1).

Ardington, Cally, Menendez, Alicia, Mutevedzi, Tinofa, 2015. Early childbearing, human capital attainment and mortality risk: evidence from a longitudinal demographic surveillance area in rural-KwaZulu-Natal, South Africa. Econ. Dev. Cult. Change 63 (2), 281–317.

Ashton, Joanne, Dickson, Kim, Pleaner, Melanie, 2009. The Evolution of the National Adolescent Friendly Clinic Initiative in South Africa. WHO/CAH, Geneva.

Bongaarts, John., 1994. The impact of population policies: comment. Popul. Dev. Rev. 20 (3), 616–620.

Branson, Nicola, Ardington, Cally, Leibbrandt, Murray, 2015. Health outcomes for children born to teen mothers in Cape Town, South Africa. Econ. Dev. Cult. Change 63 (3), 589–616.

Burnett, Scott, 2013. Group Director, Programmes loveLife, Interviewed by February 25.

Buvinic, Mayra., 1998. The costs of adolescent childbearing: evidence from Chile, Barbados, Guatemala, and Mexico. Stud. Fam. Plann., 201–209.

Cooper, Diane, Morroni, Chelsea, Orner, Phyllis, Moodley, Jennifer, Harries, Jane, Cullingworth, Lee, Hoffman, Margaret, 2004. Ten years of democracy in South Africa: documenting transformation in reproductive health policy and status. Reprod. Health Matters 12 (24), 70–85.

DHS, 2002. South Africa Demographic and Health Survey 1998. Department of Health/South Africa Pretoria, South Africa https://dhsprogram.com/publications/publication-FR131-DHS-Final-Reports.cfm.

Dick, Bruce, Ferguson, Jane, Chandra-Mouli, Venkatraman, Brabin, Loretta, Chatterjee, Subidita, Ross, David A., 2006. Review of the evidence for interventions to increase young people's use of health services in developing countries. Technical Report Series–World Health Organization, vol. 938., pp. 151.

Dickson, Kim Eva, Ashton, Joanne, Smith, Judy-Marie, 2007. Does setting adolescent-friendly standards improve the quality of care in clinics? Evidence from South Africa. Int. J. Qual. Health Care 19 (2), 80–89.

Draper, Beverly H., Morroni, Chelsea, Hoffman, M., Smit, J., Beksinska, M., Hapgood, J., Van der Merwe, Lize, 2006. Depot medroxyprogesterone versus norethisterone oenanthate for long-acting progestogenic contraception. Cochrane Database Syst. Rev. 3, CD005214.

Duflo, Esther, 2001. Schooling and labor market consequences of school construction in Indonesia: evidence from an unusual policy experiment. Am. Econ. Rev. 91 (4), 795–813.

Ehlers, Valerie J., 2003. Adolescent mothers' utilization of contraceptive services in South Africa. Int. Nurs. Rev. 50 (4), 229–241.

Franco, Lynne Miller, Silimperi, Diana R., Veldhuyzen van Zanten, T., MacAulay, Catherine, Askov, Karen, Bouchet, Bruno, Marquez, Lani, 2002. Sustaining quality of healthcare: institutionalization of quality assurance. QA Monogr. Ser. 2 (1), 1–59.

Garenne, Michel, Tollman, Stephen, Kahn, Kathleen, Collins, Terri, Ngwenya, Shirley, 2001. Understanding marital and premarital fertility in rural South Africa. J. South. Afr. Stud. 27 (2), 277–290.

Geronimus, Arline T., Korenman, Sanders, 1992. The socioeconomic consequences of teen childbearing reconsidered. Q. J. Econ., 1187–1214.

Herrera, Catalina, Sahn, David E., 2013. The impact of early childbearing on schooling and cognitive skills among young women in Madagascar. In: Cornell University Food and Nutrition Policy Program forthcoming in Demography., pp. 247 https://catalinaherrera.weebly.com/research.html.

Hoffman, Saul D., 1998. Teenage childbearing is not so bad after all. . . or is it? A review of the new literature. Fam. Plann. Perspect. 30 (5), 236–243.

Jacobson, Louis S., LaLonde, Robert J., Sullivan, Daniel G., 1993. Earnings losses of displaced workers. Am. Econ. Rev., 685–709.

Jewkes, Rachel, Vundule, Caesar, Maforah, Fidelia, Jordaan, Esme, 2001. Relationship dynamics and teenage pregnancy in South Africa. Soc. Sci. Med. 52 (5), 733–744.

Khotseng, Mamotho, 2013. Director Provincial Health Programmes, Wits Reproductive Health and HIV Institute, University of the Witwatersrand, Interviewed by Tanya S Byker, February 25.

Lang, Kevin, Weinstein, Russell, 2015. The consequences of teenage childbearing before roe v. wade. Am. Econ. J.: Appl. Econ. 7 (4), 169–197.

Macleod, Catriona Ida, Tracey, Tiffany, 2010. A decade later: follow-up review of South African research on the consequences of and contributory factors in teen-aged pregnancy. S. Afr. J. Psychol. 40 (1), 18–31.

Mathews, Catherine, Guttmacher, Sally J., Flisher, Alan J., Mtshizana, Yolisa Y., Nelson, Tobey, McCarthy, Jean, Daries, Vanessa, 2009. The quality of HIV testing services for adolescents in Cape Town, South Africa: do adolescent-friendly services make a difference? J. Adolesc. Health 44 (2), 188–190.

McLaren, Zoë M., Ardington, Cally, Leibbrandt, Murray, 2014. Distance decay and persistent health care disparities in South Africa. BMC Health Serv. Res. 14 (1), 1.

Mfono, Zanele, 1998. Teenage contraceptive needs in urban South Africa: a case study. Int. Fam. Plann. Perspect., 180–183.

Mlisana, Nomalizo, 2013. loveLife Trust, Provincial Manager, Eastern Cape, Interviewed by Tanya S Byker, May 28.

Okonofua, Friday E., Coplan, Paul, Collins, Susan, Oronsaye, Frank, Ogunsakin, Dapo, Ogonor, James T., Kaufman, Joan A., Heggenhougen, Kris, 2003. Impact of an intervention to improve treatment-seeking behavior and prevent sexually transmitted diseases among Nigerian youths. Int. J. Infect. Dis. 7 (1), 61–73.

Pettifor, Audrey E., Rees, Helen V., Kleinschmidt, Immo, Steffenson, Annie E., MacPhail, Catherine, Hlongwa-Madikizela, Lindiwe, Vermaak, Kerry, Padian, Nancy S., 2005. Young people's sexual health in South Africa: HIV prevalence and sexual behaviors from a nationally representative household survey. AIDS 19 (14), 1525–1534.

Picard, Robert, 2012. GEONEAR: stata module to find nearest neighbors using geodetic distances. In: Statistical Software Components.

Pritchett, Lant H., 1994. Desired fertility and the impact of population policies. Popul. Dev. Rev., 1–55.

Ranchhod, Vimal, Branson, Nicola, Lam, David, Marteleto, L., 2011. Estimating the effect of adolescent childbearing on educational attainment in Cape Town using a propensity score weighted regression. In: SALDRU Working Paper.

Southern Africa Labour and Development Research Unit, 2016. National Income Dynamics Study 2014–2015, Wave 4 [dataset]. Version 1.1. Cape Town: Southern Africa Labour and Development Unit [producer], 2016. Cape Town: DataFirst [distributor], 2016. Pretoria: Department of Planning Monitoring and Evaluation [commissioner], 2014.

Southern Africa Labour and Development Research Unit, 2016. National Income Dynamics Study: 2012 Wave 3, Version 2.1; 2010–2011 Wave 2, Version 3.1; 2008 Wave 1, Version 6.1 [datasets]. Cape Town: Southern Africa Labour and Development Unit [producer], 2016. Cape Town: DataFirst [distributor], 2016.

Tanaka, Shinsuke, 2014. Does abolishing user fees lead to improved health status? Evidence from post-apartheid South Africa. Am. Econ. J.: Econ. Policy 6 (3), 282–312.

Timæus, Ian M., Moultrie, Tom A., 2008. On postponement and birth intervals. Popul. Dev. Rev. 34 (3), 483–510.

Timæus, Ian M., Moultrie, Tom A., 2015. Teenage childbearing and educational attainment in South Africa. Stud. Fam. Plann. 46 (2), 143–160.

Tylee, Andre, Haller, Dagmar M., Graham, Tanya, Churchill, Rachel, Sanci, Lena A., 2007. Youth-friendly primary-care services: how are we doing and what more needs to be done? Lancet 369 (9572), 1565–1573.

UNFP, United Nations Population Fund, 2011. The State of World Population. United Nations Fund for Population Activities.

WHO, World Health Organization, 2003. Adolescent Friendly Health Services: an Agenda for Change.

WHO, World Health Organization, 2006. World Health Organization Child Growth Standards. WHO Press, Geneva.

Wood, Kate, Jewkes, Rachel, 2006. Blood blockages and scolding nurses: barriers to adolescent contraceptive use in South Africa. Reprod. Health Matters 14 (27), 109–118.

Wood, Katharine, Maforah, Fidelia, Jewkes, Rachel, 1998. He forced me to love him: putting violence on adolescent sexual health agendas. Soc. Sci. Med. 47 (2), 233–242.