HHS Public Access

Author manuscript

Matern Child Health J. Author manuscript; available in PMC 2016 May 01.

Published in final edited form as:

Matern Child Health J. 2015 May ; 19(5): 1087–1096. doi:10.1007/s10995-014-1609-6.

Pregnancy Intentions and Maternal and Child Health: An Analysis of Longitudinal Data in Oklahoma

Laura Lindberg,
Guttmacher Institute, llindberg@guttmacher.org

Isaac Maddow-Zimet,
Guttmacher Institute, imaddowzimet@guttmacher.org

Kathryn Kost, and
Guttmacher Institute, kkost@guttmacher.org

Alicia Lincoln
Maternal and Child Health Service, Oklahoma Department of Health, AliciaL@health.ok.gov

Abstract

Objectives—Better understanding of the impact of unintended childbearing on infant and early childhood health is needed for public health practice and policy.

Methods—Data from the 2004-2008 Oklahoma Pregnancy Risk Assessment Monitoring System (PRAMS) survey and The Oklahoma Toddler Survey (TOTS) from 2006-2010 were used to examine associations between a four category measure of pregnancy intentions (intended, mistimed<2 years, mistimed>=2 years, unwanted) and maternal behaviors and child health outcomes up to age two. Propensity score methods were used to control for confounding.

Results—Births mistimed by two or more years (OR =.58) and unwanted births (OR=.33) had significantly lower odds than intended births of having a mother who recognized the pregnancy within the first 8 weeks; they were also about half as likely as intended births to receive early prenatal care, and had significantly higher likelihoods of exposure to cigarette smoke during pregnancy. Breastfeeding was significantly less likely among unwanted births (OR=.68); breastfeeding for at least six months was significantly less likely among seriously mistimed births (OR=.70). We find little association between intention status and early childhood measures.

Conclusions—Measured associations of intention status on health behaviors and outcomes were most evident in the prenatal period, limited in the immediate prenatal period, and mostly insignificant by age two. In addition, most of the negative associations between intention status and health outcomes were concentrated among women with births mistimed by 2 or more years or unwanted births. Surveys should incorporate questions on the extent of mistiming when measuring pregnancy intentions.

Keywords

Unintended pregnancy; pregnancy intentions; PRAMS; child health

Introduction

National public health policy is strongly influenced by the expectation that unintended childbearing has significant negative effects on the behavior of mothers both during pregnancy and afterward, and that such behaviors directly affect the health and wellbeing of the child [1,2]. However, recent reviews highlight weak and often inconsistent research findings on the relationship of pregnancy intentions on maternal behaviors and infant health [3,4]; the handful of studies on early childhood health and development also show mixed findings [5-9]. With unintended births making up about two-fifths of all births that occur each year in the U.S. and little improvement in the past three decades [10], better understanding of the potential impact of unintended childbearing on infant and early childhood health is needed for public health practice and policy.

Some of the ambiguity of prior research reflects methodological challenges in this area. Is it the background characteristics of mothers of intended, mistimed and unwanted births that account for any observed differences in health behaviors and outcomes, or the intention status of the birth? In many studies, bivariate differences in outcomes by intention status are diminished or washed out completely when controls for background characteristics are added [3]. Second, limited attention has been given to the effect of intention status past infancy, into early childhood [11]. Third, problems with the measurement and conceptualization of childbearing intentions further hamper research [12, 13]. Generally, studies of the consequences of unintended pregnancy have only distinguished between two (intended or unintended) or three (intended, mistimed, or unwanted) categories of intention status. Yet these categories may be too broad; newer research has found significant differences in the maternal characteristics of pregnancies that were mistimed by less than two years and pregnancies mistimed by two or more years [14-16]. These distinctions in the timing of pregnancy may be related to women's willingness or ability to engage in health-promoting behaviors.

This paper uses linked longitudinal data from the 2004-2008 Oklahoma Pregnancy Risk Assessment Monitoring System (PRAMS) and The Oklahoma Toddler Survey (TOTS) from 2006-2010 to examine the association between pregnancy intentions and health in the prenatal and postnatal periods and early childhood. These data are integral parts of the MCH monitoring system in Oklahoma [17, 18]. We employ propensity score analysis and an expanded measure of pregnancy intentions to disentangle childbearing intentions from maternal background characteristics and assess the impact of unintended childbearing on health behaviors and outcomes during pregnancy, infancy and early childhood.

Methods

Data and Study Population

We examined survey data for 2004-2008 collected in the annual Oklahoma PRAMS, a random sample of postpartum women who delivered live births in Oklahoma, and data linked from a follow-back survey sent to PRAMS respondents when their child was two years old (TOTS 2006-2010).* The PRAMS and TOTS are mixed-mode surveillance systems; in each, two mail surveys are sent, followed by telephone surveillance for

nonrespondents; all cases are linked to the formal birth certificate as well. Both surveys were approved by the Institutional Review Board of the Oklahoma State Department of Health; detailed methodology is documented elsewhere [19, 20]. No additional IRB approval was required as our study involves only secondary data analysis.

From 2004 to 2008, 9,829 mothers completed the PRAMS questionnaire within 2-6 months of the birth of their infant; 6,648 of these mothers (68%) completed the TOTS survey when their child was two years old. We found no significant differences in the distributions of intention status or socio demo graphic measures between PRAMS and TOTS respondents.

Measures

Pregnancy intentions—All state-level PRAMS surveys include a question on pregnancy intentions that allows for the construction of a three-category measure: intended, mistimed or unwanted. Pregnancy intention is based on women's self-reports of their desire to become pregnant right before the conception occurred. The survey asked all women, "Thinking back to *just before* you got pregnant with your *new* baby, how did you feel about becoming pregnant?" possible response categories were "I wanted to be pregnant sooner, I wanted to be pregnant later, I wanted to be pregnant then, I didn't want to be pregnant then or at any time in the future." The Oklahoma PRAMS added a follow-up question for women reporting they wanted to be pregnant later; "How much later did you want to become pregnant?"[†,‡] We combined responses to these two questions into a four-category measure of intention status: intended, mistimed by less than two years, mistimed by two or more years (referred to as seriously mistimed), and unwanted. The retrospective reporting period for pregnancy intentions is only 2–6 months after delivery, likely improving accurate reporting in contrast to surveys with retrospective recall periods extending years after the pregnancy, such as the National Survey of Family Growth [15].

Outcome measures—Based on the measures available in the two surveys, we constructed dichotomous measures of key indicators of health behaviors and outcomes during the prenatal, infancy and early childhood periods [2, 21, 22].

Maternal prenatal behavior:

- Mother recognized she was pregnant within the first eight weeks of the pregnancy
- Prenatal care was initiated in the first trimester[§]
- Mother smoked in last trimester
- Other exposure to cigarette smoke during the pregnancy

[*]Oklahoma is one of only four states with data avaible from follow-up interviews of PRAMS mothers; the others are Alaska, Rhode Island, and Oregon.
[†]Only one other state (Utah) included such a question in the PRAMS survey during the same period.
[‡]Response categories were less than 1 year, 1 year to less than 2 years, 2 years to less than 3 years, 3 years to less than 4 years, 4 years or more.
[§]Mothers slightly overestimate early entry into prenatal care on the PRAMS survey (Oklahoma State Department of Health, PRAMSGRAM Initiation of Prenatal Care Among Women Having a Live Birth in Oklahoma, 1995, 5(2) http://www.ok.gov/health2/documents/PRAMSInitiation%20of%20PNC95.pdf.pdf, accessed 11/21/13); however, these small overestimates are unlikely to affect our final estimates substantially.

Infant health at birth:

- Preterm delivery (at or before 36 weeks of pregnancy
- Low birth weight (LBW) (less than 2500 grams)**

Maternal postnatal behavior:

- Initiated breastfeeding
- Baby was breastfed at least six months (with or without formula supplemention)

Early childhood measures:

- Child had four days or more of limited activity due to health in the past three months
- Child had an illness†† in the last 30 days
- Child was injured seriously enough in the past year to require medical treatment or advice
- Child was currently exposed at least an hour per day to cigarette smoke

The early childhood measures and breastfeeding at six months are measured in TOTS; all other measures are from PRAMS.

Statistical Analysis

We excluded 294 births from PRAMS and 75 births from TOTS because of missing data on intention status; more births were excluded due to missing values on key covariates, resulting in an analytical sample of 8,446 births in PRAMS and 5,808 births in TOTS. Sample sizes vary slightly across outcomes due to small numbers of missing cases. We first examine bivariate associations between pregnancy intentions and health behaviors and outcomes. We then investigate the extent to which births differ in their background characteristics across the four intention status groups. Finally, we use propensity score methods to examine the effect of pregnancy intentions on health behaviors and outcomes after accounting for variation in background characteristics.

Propensity score methods are increasingly being used with observational data to disentangle confounding and causal factors. These methods account for differences between treatment and control groups that affect both group assignment and the outcome under study by modeling the selection process into each group [23, 24], Although matching is most commonly used for propensity analyses, this approach is most appropriate for dichotomous treatment conditions (a single treatment versus a single control) [25].

Since our “treatment”–intention status–has four categories, we used an alternate approach of inverse probability weighting (IPW) [26, 27]. We estimated a multinomial logistic regression model with intention status as the dependent variable (intended births were the reference category), which was then used to calculate predicted propensity scores. We

**This measure was drawn from the linked birth certificate.
††Defined as diarrhea lasting at least three days, an ear infection, or a cold or runny nose with a fever or cough.

included any available covariates in the model known to be predictors of both pregnancy intentions and our other dependent measures [28]. Prior research suggested three sets of confounding measures in the survey: life course status (including maternal age, union status at conception, parity), socioeconomics (including household poverty level, race/ethnicity, education), and access to health care and orientation towards health promotion (including health insurance, maternal alcohol and cigarette use prior to pregnancy). We assessed the adequacy of the propensity score estimation process by comparing the distribution of covariates across the intention status groups before and after the inverse propensity score weighting using the Pearson χ^2 test. When no significant differences remained, we considered the intention status groups "balanced" with respect to the background characteristics of the mothers. This process was iterative as we developed a multinomial logistic regression model that increased balance; covariates were included regardless of statistical significance. The process was conducted separately for the PRAMS and the TOTS samples.

Finally, we tested for a relationship between intention status and each of the outcome measures using logistic regression with each observation weighted by the inverse of its propensity score. For the outcomes measured at age two, we also estimated multivariate models with controls for potential mediating factors that occurred temporally between the pregnancy–when intention status was determined–and age two that might directly influence the outcomes; available measures included infant in ICU following birth, LBW, preterm, union status at birth (married, cohabiting, other), and household poverty level at time of TOTS interview; in preliminary analyses, each of these measures had a significant bivariate association with one or more of the toddler outcomes at $p<.05$.

We performed the analyses using *svy* commands in STATA 13.0 to account for the complex sampling designs of the surveys. All analyses were performed using data weighted by the population weights provided in the data. When using propensity weights, we multiplied each observation's inverse propensity weight by the population weight in order to obtain unbiased effects based on the population of all births [29]. We excluded two cases from the PRAMS sample and three cases from the TOTS sample where the propensity values were extreme outliers.

Results

Association of intention status and health outcomes before balancing

Table 1 presents the estimated proportion of births experiencing each outcome, by intention status of the birth, for the unbalanced data. At baseline, 51% of births were reported as intended, 16% as mistimed by less than two years, 22% as mistimed by two or more years, and 11% as unwanted. Overall, high proportions of women recognized their pregnancy within eight weeks (88%) and received prenatal care during the first trimester (86%). Twenty percent of women reported smoking during the last trimester and 40% reported other exposure to cigarette smoke during pregnancy. Seven percent of infants were classified as LBW and 12% as preterm. About three-quarters of infants had mothers who initiated breastfeeding; among this group, 56% were breastfed for at least six months. At age two,

recent illness was common (58%), while rates of limited activity (13%), recent injury (13%) or exposure to cigarette smoke (15%) were substantially lower.

In the unbalanced data, most outcomes varied significantly by intention status. Mothers of intended births were significantly more likely to engage in health promoting prenatal behaviors and to breastfeed than mothers of births in the unintended groups. Unwanted births were slightly but significantly more likely to be LBW as compared to intended births (8% versus 7%). The proportion preterm did not vary significantly by intention status.

Toddlers whose birth had been mistimed–whether by less than two years or by two or more years–were significantly less likely than toddlers whose birth had been intended to have been breastfed to at least six months of age; they were also significantly more likely to be exposed to cigarette smoke and to have had a recent illness. For toddlers whose birth was seriously mistimed, a significantly greater proportion had their activity limited due to health-related issues than did toddlers from intended births (16% vs. 12%). Toddlers from intended and unwanted births did not differ significantly on any measure except for higher rates of exposure to cigarette smoke among the latter (11% vs. 17%). Injury and intention status were not associated in the unbalanced sample.

Association of intention status and covariates

In the unbalanced data, intention status in the PRAMS sample varied significantly on life course, socioeconomic and health orientation measures (Table 2). Statistically significant differences in the distribution of characteristics across intention status groups are indicated by the p-value of the overall chi-square test. Intended births were more likely to occur to older or married women. Seriously mistimed births were most likely to be a first birth (54%), while unwanted births were the least likely to be a first birth (21%). Intention status groups also varied significantly by race/ethnicity, education, and household poverty status. Additionally, births whose mothers were on Medicaid at the time they became pregnant were least likely to be found among intended births (6%), and most likely among seriously mistimed births (17%). Finally, mistimed and unwanted births had mothers with higher levels of drinking and smoking prior to the pregnancy than did intended births.

Compared with births mistimed by less than two years, births that were seriously mistimed were more likely to have teen mothers, to be conceived outside of marriage, to be first births, to be living in a household below the poverty line and to have mothers with low education.[‡‡] Also of note are differences in the characteristics of seriously mistimed births and unwanted births; the latter are less likely to be a first birth and more likely to have older or married mothers.

Key to this analysis, after weighting the observations by the inverse of the propensity scores derived from multinomial regression, distributions of the characteristics of births in the intention status groups were balanced on all of the variables examined ($p>.05$; final column,

[‡‡]Paired comparisons of differences in the size of the proportions for intention status groups for individual attributes were tested for statistical significance using t-tests. Only statistically significant differences are mentioned in the text ($p<.05$).

Table 2). The covariates were also balanced as assessed by the standardized bias approach (results not shown) [25].

Association of intention status and outcomes, after weighting by propensity scores

Table 3 presents results of bivariate logistic regressions estimating the association between intention status and the prenatal and postnatal measures, weighting the data by the inverse propensity scores to balance the sample on background characteristics. Women with seriously mistimed births (OR =.58) or unwanted births (OR=.33) had significantly lower odds than women with an intended birth of recognizing the pregnancy early; they were also about half as likely as women with intended births to obtain early prenatal care, and had significantly higher likelihoods of exposure to cigarette smoke during pregnancy. Maternal smoking was not associated with intention status.

After balancing, we found no significant differences across the intention status groups in either the likelihood of LBW or preterm births. Compared to women with intended births, only women with an unwanted birth were significantly less likely to initiate breastfeeding (OR=.68).

After balancing the data, few significant differences by intention status in the early childhood measures remain (Table 4) in models without (Model 1) or with controls for potential mediating variables (Model 2). In both models, among women who initiated breastfeeding, continuing for at least six months was significantly less likely among women with births mistimed by less than two years than women with intended births. Additionally, a toddler was significantly more likely to have an activity limitation (OR=1.57) if the birth was seriously mistimed as compared to intended, but only after controlling for mediating variables. Intention status was not significantly associated with exposure to cigarette smoke, recent illness, or recent injury in either set of models.

Discussion

Unintended childbearing is very common in Oklahoma, accounting for nearly half of all live births, as compared with 39% nationally [30]. Our analysis offers four central findings. First, echoing recent studies, we found substantial demographic and socioeconomic differentials in unintended childbearing [10, 15, 31]. Second, we found that while intention status was significantly associated at the bivariate level with many health behaviors and outcomes, these relationships were weakened when background characteristics were adjusted through propensity score analysis. Even so, a number of significant associations remained in the balanced models, such that intended births were associated with better health behaviors and outcomes. Third, most of the negative associations between mistimed childbearing and the health outcomes were concentrated among women with seriously mistimed or unwanted births. (Breastfeeding for at least six months is the one exception, as this health behavior was significantly less likely for women with births mistimed by less than two years.) Finally, we found that the associations of intention status with health behaviors and outcomes were most evident in the prenatal period, limited in the post-natal period, and mostly insignificant by age two.

Oklahoma was one of the first states to incorporate the extent of mistiming in the PRAMS survey, allowing us to identify four categories of pregnancy intentions. As of 2012, revised PRAMS surveys for all participating states include the additional question on extent of mistiming. Our findings highlight the value of this effort; distinguishing among mistimed births delineates important differentiation in many of the associations with the health behaviors and outcomes under study. Intended, mistimed <2 years, mistimed more than 2 years and unwanted likely reflect different aspects of fertility preferences related to the starting, spacing and stopping of childbearing [32], The health consequences of unintended childbearing appear concentrated among seriously mistimed and unwanted births. Long-acting reversible contraceptives, such as intrauterine devices (IUDs) and implants, seem particularly well-suited to reducing seriously mistimed births [33, 34], and access needs to be facilitated, especially for low-income women [35].

This analysis took advantage of unique data to examine the effect of pregnancy intentions at three distinct points in time–the prenatal period, the immediate postpartum period, and the early childhood period. Estimated effects were strongest in the prenatal period, and diminished by age two, suggesting that over time mothers adjust to unintended births and are responsive to the health needs of their young child regardless of intention status. In the prenatal period, women with seriously mistimed and unwanted pregnancies were less likely to engage in health-promoting behaviors than women with intended pregnancies. These early effects are important, as behaviors during the prenatal period can be the foundation for later health and well-being over the life course [36].

A number of prenatal and infant measures were not associated with intention status in the balanced model. While maternal smoking prior to pregnancy was strongly associated with intention status in the unbalanced results, in the balanced data this association disappeared, indicating that socio demo graphic factors, not pregnancy intention, are the main drivers of smoking behavior. The weak associations in even the unbalanced data between intention status and infant health outcomes (preterm, LBW,) stand in contrast to a recent meta-analysis finding consistent evidence of a bivariate relationship between intention status and these outcomes [37]. However, most studies able to control for background characteristics have found little evidence of a relationship between mistimed or unwanted births and these outcomes [38-41].

Although intended births had significantly better health outcomes at age two in the bivariate measures, these differences were almost entirely explained by confounding factors, adjusted in the propensity models. Other recent research in early childhood, focused on developmental and cognitive outcomes, also finds the effects of intention status greatly diminished after controlling for background characteristics of mothers [8, 41]. Although women appear to accommodate an unintended birth over time, so that by two years the health and well-being of children is equalized across intention statuses, background inequalities at the time of pregnancy have longer-term influences on the lives of young children. Policies and programs that help women achieve their desired fertility levels and timing would likely shift the socioeconomic distribution of childbearing and reduce inequalities, as women postpone births until a time of greater economic and life course stability.

Several limitations to this study should be noted. The data are retrospective, creating the potential for recall bias [42, 43]; however, the retrospective recall period is shorter than in many other surveys. Furthermore, as in any self-reports, responses are open to social desirability, whether underreporting of negative health behaviors or overreporting of positive behaviors; all of the outcome measures other than low birth weight are self-reported. Additionally, the available health measures in the survey at age two are limited, and the findings might be different with additional measures. One example would be a maternal rating of overall child health, which may be more robust than the health indicators currently available in the TOTS [44], Additionally, measures of cognitive or other developmental markers might be used to assess if intention status influences how mothers interact with their child and any subsequent consequences. Overall, further research is needed to identify specific pathways between pregnancy intentions, maternal behaviors, and child outcomes.

We hypothesize that some of the weak relationships observed in this study reflect the relatively severe economic challenges among childbearing women in Oklahoma. For example, 37% of births in the Oklahoma PRAMS were to women living below the federal poverty line, a level far higher than the national average (27%) [15]. And in 2008, 61% of births in Oklahoma were publicly funded (through programs such as Medicaid and the Indian Health Service), compared to 48% of US births overall [30]. Indeed, available sociodemographic measures are likely only part of an otherwise unmeasured constellation of economic and life course constraints. Substantial challenges of motherhood may exist for many of these women, regardless of their pregnancy intentions. Ethnographic research highlights the less salient influence of intention status as compared to other constraints for women in contexts in which unintended childbearing is common [45]. This phenomenon may be reflected in our findings such that the effects of intention status have less of an impact than the socioeconomic context of a birth.

Acknowledgements

This study was supported by grant R40 MC 25692 from the Maternal and Child Health Research Program, Maternal and Child Health Bureau (Title V, Social Security Act), Health Resources and Services Administration, Department of Health and Human Services and the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number R01HD068433. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Department of Health and Human Services

References

1. Institute of Medicine. Report of the Committee on Preventive Services for Women. National Academy of Sciences Press; Washington, DC: 2011. Clinical preventive services for women: Closing the gaps.
2. U.S. Department of Health and Human Services. Healthy People 2020 topics & objectives. 2010. Available from: http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=13
3. Gipson JD, Koenig MA, Hindin MJ. The effects of unintended pregnancy on infant, child, and parental health: a review of the literature. Studies in Family Planning. 2008; 39(1):18–38. [PubMed: 18540521]

4. Logan, C.; Holcombe, E.; Manlove, J.; Ryan, S. The consequences of unintended childbearing: A white paper. Child Trends and The National Campaign to Prevent Teen and Unplanned Pregnancy; Washington, DC: 2007.
5. Joyce TJ, Kaestner R, Korenman S. The effect of pregnancy intention on child development. Demography. 2000; 37(1):83–94. [PubMed: 10748991]
6. Baydar N. Consequences for children of their birth planning status. Family Planning Perspectives. 1995; 27(6):228–34. 245. [PubMed: 8666086]
7. Crissey SR. Effect of pregnancy intention on child well-being and development: combining retrospective reports of attitude and contraceptive use. Population Research and Policy Review. 2005; 24(6):593–615.
8. Carson C, et al. Effect of pregnancy planning and fertility treatment on cognitive outcomes in children at ages 3 and 5: longitudinal cohort study. BMJ. 2011; 343:d4473. [PubMed: 21791498]
9. Hummer RA, Hack KA, Raley RK. Retrospective reports of pregnancy wantedness and child well-being in the United States. Journal of Family Issues. 2004; 25(3):404–28.
10. Finer LB, Zolna MR. Unintended pregnancy in the United States: incidence and disparities, 2006. Contraception. 2011; 84(5):478–85. [PubMed: 22018121]
11. Rosenberg KD, et al. New options for child health surveillance by state health departments. Maternal and Child Health Journal. 2011; 15(3):302–9. [PubMed: 20232127]
12. Santelli J, et al. The measurement and meaning of unintended pregnancy. Perspectives on Sexual and Reproductive Health. 2003; 35(2):94–101. [PubMed: 12729139]
13. Klerman LV. The intendedness of pregnancy: a concept in transition. Maternal and Child Health Journal. 2000; 4(3):155–62. [PubMed: 11097502]
14. Pulley L, Klerman LV, Tang H, Baker BA. The extent of pregnancy mistiming and its association with maternal characteristics and behaviors and pregnancy outcomes. Perspectives on Sexual and Reproductive Health. 2002; 34(4):206–11. [PubMed: 12214911]
15. Mosher, WD.; Jones, J.; Abma, JC. Intended and unintended births in the United States: 1982-2010. National Center of Health Statistics; Hyattsville, MD: 2012.
16. Lindberg, LD.; Finer, LB.; Stokes-Prindle, C. Refining measures of pregnancy intention: Taking timing into account; 2008 Annual meetings of the Population Association of America; New Orleans, LA. 2008;
17. Oklahoma State Department of Health. PRAMSGRAM: Unintended Pregnancy. 2006. Available from: http://www.ok.gov/health2/documents/PRAMS_Unintended_Pregnancy_06.pdf.pdf
18. Oklahoma State Department of Health.. TOTS Brief: The Oklahoma Toddler Survey. 2010. Available from: http://www.ok.gov/health2/documents/Imm_Brief_final_Dec_2010.pdf
19. Centers for Disease Control and Prevention. PRAMS model surveillance protocol, 2009 CATI version. 2009. Available from: http://www.cdc.gov/prams/PDF/ProtocolFiles/ProtocolZipFile.zip.
20. Oklahoma State Department of Health. TOTS 2012 Protocol. 2012. Unpublished manuscript available upon request at TOTS@health.ok.gov
21. Singh G, Siahpush M, Kogan MD. Disparities in children's exposure to environmental tobacco smoke in the United States, 2007. Pediatrics. 2010; 126(5):1052.
22. Hagan, JF.; Shaw, JS.; Duncan, PM., editors. Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents. Third Edition. American Academy of Pediatrics; Elk Grove Village, IL: 2008.
23. Rosenbaum PR, Rubin DB. The central role of the propensity score in observational studies for causal effects. Biometrika. 1983; 70(1):41–55.
24. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivariate Behavioral Research. 2011; 46(3):399–424. [PubMed: 21818162]
25. Stuart EA. Matching methods for causal inference: A review and a look forward. Statistical Science. 2010; 25(1):1–21. [PubMed: 20871802]
26. Imbens GW. The role of the propensity score in estimating dose-response functions. Biometrika. 2000; 87(3):706–10.

27. Guo, S.; Fraser, MW. Propensity Score Analysis: Statistical Methods and Applications. SAGE Publications, Inc.; Los Angeles, CA: 2010.
28. Lunceford JK, Davidian M. Stratification and weighting via the propensity score in estimation of causal treatment effects: a comparative study. Statistics in Medicine. 2004; 23(19):2937–60. [PubMed: 15351954]
29. Dugoff EH, Schuler M, Stuart EA. Generalizing Observational Study Results: Applying Propensity Score Methods to Complex Surveys. Health Services Research. 2013
30. Sonfield, A.; Kost, K. Public costs from unintended pregnancies and the role of public insurance programs in paying for pregnancy and infant care: Estimates for 2008. Guttmacher Institute; New York: 2013.
31. Hayford SR, Guzzo KB. Age, relationship status, and the planning status of births. Demographic Research. 2010; 23(13):365–98.
32. D'Angelo DV, et al. Differences between mistimed and unwanted pregnancies among women who have live births. Perspectives on Sexual and Reproductive Health. 2004; 36(5):192–7. [PubMed: 15519961]
33. American College of Obstetricians and Gynecologists (ACOG) Committee on Gynecologic Practice & Long-Acting Reversible Contraception Working Group. Increasing use of contraceptive implants and intrauterine devices to reduce unintended pregnancy. Obstetrics and Gynecology. 2009; 114(6):1434–8. [PubMed: 20134301]
34. Speidel JJ, Harper CC, Shields WC. The potential of long-acting reversible contraception to decrease unintended pregnancy. Contraception. 2008; 78(3):197–200. [PubMed: 18692608]
35. Baldwin MK, Rodriguez MI, Edelman AB. Lack of insurance and parity influence choice between long-acting reversible contraception and sterilization in women postpregnancy. Contraception. 2012; 86(1):42–7. [PubMed: 22240179]
36. Braveman P, Barclay C. Health disparities beginning in childhood: a life-course perspective. Pediatrics. 2009; 124(Suppl3):S163–S175. [PubMed: 19861467]
37. Shah PS, et al. Intention to become pregnant and low birth weight and preterm birth: a systematic review. Maternal and Child Health Journal. 2011; 15(2):205–16. [PubMed: 20012348]
38. Durousseau S, Chavez GF. Associations of intrauterine growth restriction among term infants and maternal pregnancy intendedness, initial happiness about being pregnant, and sense of control. Pediatrics. 2003; 111(5 Part 2):1171–1175. [PubMed: 12728133]
39. Kost K, Landry DL, Darroch JE. The effects of pregnancy planning status on birth outcomes and infant care.". Family Planning Perspectives. 1998; 30(5):223–230. [PubMed: 9782045]
40. Joyce TJ, Kaestner R, Korenman S. The effect of pregnancy intention on child development. Demography. 2000; 37(1):83–94. [PubMed: 10748991]
41. McCrory C, McNally S. The effect of pregnancy intention on maternal prenatal behaviours and parent and child health: results of an Irish cohort study. Paediatric and Perinatal Epidemiology. 2013; 27(2):208–15. [PubMed: 23374066]
42. Guzzo KB, Hayford SR. Revisiting retrospective reporting of first-birth intendedness. Maternal and Child Health Journal. 2014:1–7. [PubMed: 23483413]
43. Joyce T, Kaestner R, Korenman S. The stability of pregnancy intentions and pregnancy-related maternal behaviors. Maternal and Child Health Journal. 2000; 4(3):171–8. [PubMed: 11097504]
44. Lewis CC, Pantell RH, Kieckhefer GM. Assessment of children's health status: field test of new approaches. Medical Care. 1989; 27(Suppl. 3):S54–S65. [PubMed: 2921887]
45. Edin, K.; Kefalas, M. Why Poor Women Put Motherhood Before Marriage. University of California Press; Berkeley, CA: 2005.

Table 1

Proportion of births with selected prenatal, infant and child behaviors and outcomes, by intention status group, sample weights, Oklahoma PRAMS 2004-2008 and TOTS 2006-2010.

Outcomes	Total	Intended	Mistimed <2 years	Mistimed >=2 years	Unwanted	N
All births	1.00	0.51	0.16	0.22	0.11	8,444
Prenatal						
Recognized pregnancy within 8 weeks	0.88	0.93	0.89*	0.83*	0.74*	8,027
Early prenatal care	0.86	0.92	0.86*	0.78*	0.73*	8,220
Smoked in last trimester	0.20	0.14	0.23*	0.26*	0.30*	8,439
Other cigarette smoke exposure	0.40	0.29	0.44*	0.56*	0.48*	8,301
Infant						
Low birthweight	0.07	0.07	0.07	0.07	0.08*	8,327
Preterm	0.12	0.12	0.11	0.11	0.14	8,103
Ever breastfed	0.76	0.80	0.75*	0.71*	0.66*	7,824
Early Childhood Outcomes						
Breastfed for 6 months	0.56	0.60	0.48*	0.52*	0.54	4,709
Limited activity	0.13	0.12	0.13	0.16*	0.11	5,780
Illness in the last 30 days	0.58	0.55	0.63*	0.62*	0.58	5,792
Injured	0.13	0.13	0.15	0.12	0.12	5,744
Cigarette smoke exposure	0.15	0.11	0.20*	0.18*	0.17*	5,701

* p-value <=.05 for test of statistically significant difference compared to intended births.

Table 2

Proportionate distribution of mother's background characteristics by intention status group, and p-values for χ-square tests of significance across intention status groups for unbalanced and balanced samples; Oklahoma PRAMS 2004-2008.

	Distribution Before Balancing					Unbalanced	Balanced[†]
Variable Name	**Total**	**Intended**	**Mistimed <2 years**	**Mistimed >=2 years**	**Unwanted**	**p-value**	**p-value**
Life Course							
Age at birth							
15-20	0.11	0.06	0.09	0.25	0.08	0.00	0.81
20-24	0.32	0.25	0.40	0.46	0.25	0.00	0.64
25-29	0.31	0.35	0.31	0.22	0.31	0.00	0.95
30-44	0.26	0.34	0.19	0.08	0.37	0.00	0.49
First birth	0.41	0.41	0.36	0.54	0.21	0.00	0.39
Relationship at conception							
Married	0.55	0.73	0.53	0.25	0.39	0.00	0.91
Cohabitating	0.22	0.17	0.26	0.30	0.25	0.00	0.98
Other	0.22	0.10	0.21	0.45	0.35	0.00	0.71
SES factors							
Race							
White, Not Hispanic	0.69	0.72	0.69	0.65	0.62	0.00	0.89
Hispanic	0.10	0.11	0.11	0.08	0.08	0.25	0.63
Black, Not Hispanic	0.08	0.04	0.08	0.13	0.14	0.00	0.98
Other, Not Hispanic	0.12	0.11	0.11	0.13	0.15	0.14	0.88
Education							
Less than high school	0.17	0.14	0.18	0.25	0.19	0.00	0.64
High school	0.38	0.33	0.40	0.47	0.42	0.00	0.94
College or more	0.44	0.53	0.42	0.29	0.39	0.00	0.87
Above federal poverty line *	0.63	0.74	0.60	0.46	0.54	0.00	0.42
Health Orientation and Access							
On Medicaid**	0.10	0.06	0.11	0.17	0.11	0.00	0.82
On other insurance**	0.50	0.62	0.42	0.33	0.35	0.00	0.32
Cigarettes per day ***							
11+	0.15	0.11	0.20	0.19	0.22	0.00	0.65
1-6	0.18	0.14	0.18	0.26	0.24	0.00	0.34
0	0.66	0.76	0.62	0.54	0.54	0.00	0.24
Drinks per week ***							
7+	0.04	0.02	0.04	0.06	0.13	0.00	0.53
1-6	0.49	0.48	0.51	0.53	0.46	0.07	0.24
0	0.47	0.51	0.45	0.41	0.41	0.00	0.34

	Distribution Before Balancing					Unbalanced	Balanced†
Variable Name	**Total**	**Intended**	**Mistimed <2 years**	**Mistimed >=2 years**	**Unwanted**	**p-value**	**p-value**
Frequency of drinking 5+ drinks in one sitting ***							
4+	0.05	0.03	0.06	0.07	0.13	0.00	0.89
1-3	0.16	0.15	0.15	0.19	0.15	0.09	0.97
0	0.79	0.82	0.79	0.74	0.72	0.00	0.97

* in 12 months before baby was born.

** Before pregnancy.

*** In three months before pregnancy.

† Other factors also varied significantly by intention status and were therefore included in the multivariate regression used to calculate propensity scores: abuse by partner in 12 months prior to birth (yes/no), Spanish questionnaire (yes/no), all sources of income, stressful life events in year before birth, number of dependents in household, visited dentist in past year (yes/no), dieting in order to lose weight 3 months prior to pregnancy (yes/no), heard or read about benefits of folic acid (yes/no), and tested for HIV (yes/no). Interaction terms between several of the above variables, as well as for the year of survey administration, were also included in the propensity model but are not listed here due to space constraints.

Table 3

Odds ratios of selected prenatal and infant behaviors and outcomes by intention status group, balanced sample, Oklahoma PRAMS 2004-2008.

	Prenatal				Infant		
Intention Status	**recognized pregnancy within 8 weeks**	**received prenatal care during first trimester**	**smoked during last trimester**	**other smoke exposure during pregnancy**	**low birthweight**	**preterm**	**ever breastfed**
Intended	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mistimed<2 years	0.76 (0.48, 1.2)	0.88 (0.59, 1.31)	0.77 (0.57, 1.03)	1.04 (0.82, 1.31)	0.95 (0.80, 1.12)	0.89 (0.67, 1.19)	1.04 (0.79, 1.36)
Mistimed>=2years	0.58* (0.37, 0.90)	0.45* (0.29, 0.69)	1.07 (0.79, 1.44)	1.42* (1.10, 1.84)	0.85 (0.70, 1.02)	0.93 (0.67, 1.28)	0.82 (0.62, 1.08)
Unwanted	0.33* (0.21, 0.54)	0.47* (0.30, 0.73)	0.92 (0.64, 1.32)	1.40* (1.02, 1.93)	1.19 (0.93, 1.53)	1.18 (0.83, 1.69)	0.68* (0.48, 0.96)

Note: In the table, single values represent ORs and values in parentheses are 95% CI.

* p-value <=.05 for test of statistically significant difference compared to intended births.

Table 4

Odds ratios of early childhood outcome measures by intention status group, balanced sample; Oklahoma TOTS 2006-2010.

Intention Status	Breastfed for 6 months**		Health-related limited activity		Illness		Injured		Exposed to cigarette smoke	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intended	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mistimed>2 years	0.73* (0.54, 1.00)	0.70* (0.51, 0.96)	1.01 (0.68, 1.49)	1.05 (0.71, 1.57)	1.17 (0.88, 1.55)	1.23 (0.92, 1.65)	1.22 (0.8, 1.88)	1.17 (0.75, 1.82)	1.00 (0.65, 1.53)	1.11 (0.72, 1.7)
Mistimed>=2years	0.81 (0.58, 1.15)	0.79 (0.55, 1.14)	1.49 (1.00, 2.23)	1.57* (1.03, 2.38)	1.19 (0.89, 1.61)	1.31 (0.96, 1.79)	0.84 (0.56, 1.26)	0.84 (0.55, 1.3)	0.89 (0.57, 1.37)	0.80 (0.51, 1.26)
Unwanted	0.77 (0.46, 1.29)	0.86 (0.50, 1.47)	0.91 (0.54, 1.55)	0.96 (0.55, 1.67)	1.08 (0.70, 1.67)	1.09 (0.71, 1.68)	0.82 (0.47, 1.46)	0.80 (0.45, 1.41)	1.24 (0.65, 2.37)	1.19 (0.61, 2.33)
Marital Status at Birth										
Single		1.00		1.00		1.00		1.00		1.00
Cohabiting		1.18 (0.64, 2.15)		1.38 (0.8, 2.37)		0.84 (0.50, 1.41)		0.78 (0.42, 1.46)		0.75 (0.40, 1.39)
Married		1.51 (0.83, 2.73)		1.82* (1.07, 3.09)		1.02 (0.63, 1.64)		0.60 (0.35, 1.03)		0.62 (0.34, 1.14)
Percent of poverty level										
0-99		1.00		1.00		1.00		1.00		1.00
100-299		1.16 (0.72, 1.87)		0.97 (0.61, 1.55)		0.70 (0.48, 1.01)		1.06 (0.66, 1.72)		0.33* (0.19, 0.58)
300+		1.20 (0.71, 2.01)		1.07 (0.61, 1.88)		0.96 (0.62, 1.46)		1.29 (0.72, 2.31)		0.11* (0.05, 0.24)
Missing***		0.77 (0.48, 1.24)		0.95 (0.53, 1.69)		0.94 (0.63, 1.41)		0.99 (0.56, 1.77)		0.66 (0.38, 1.12)
Preterm		1.74* (1.04, 2.9)		1.25 (0.69, 2.28)		1.23 (0.82, 1.87)		0.82 (0.33, 2.03)		1.03 (0.55, 1.94)
Low Birthweight		0.48* (0.31, 0.75)		0.96 (0.54, 1.72)		0.93 (0.66, 1.33)		0.53* (0.29, 0.98)		0.98 (0.61, 1.57)
Infant in ICU		0.76 (0.48, 1.19)		1.96* (1.15, 3.35)		1.16 (0.77, 1.73)		1.44 (0.75, 2.77)		0.75 (0.43, 1.28)

Notes: In the table, single values represent ORs and values in parentheses are 95% CI.

* p-value <=.05 for test of statistically significant difference compared to intended births.

** Only among toddlers ever breastfed.

*** A significant proportion (14%) of the TOTS sample has missing values on poverty level; for purposes of this analysis we group these missing cases into a separate category.