Use of Fertility Treatments in Relation to the Duration of Pregnancy Attempt Among Women Who Were Trying to Become Pregnant and Experienced a Live Birth

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Abstract The purpose of this study was to compare the utilization of medical help for fertility among women who reported up to a year versus more than a year of trying to become pregnant and to describe the characteristics of those women seeking early treatment. Data from the 2004–2008 Pregnancy Risk Assessment Monitoring System (PRAMS) survey were used to assess attempt duration and use of fertility treatments in a sample of 9,517 women who had a recent live birth in Utah. PRAMS respondents who were trying to become pregnant at the time of conception were asked questions about fertility treatments (sampling n = 5,238; representative n = 153,036). Univariate and bivariate analyses were used to describe and compare characteristics of women who sought treatment after attempting pregnancy for a year or less and women who waited at least a year to seek treatment. Among women who were trying to become pregnant, 9.5 % reported using some medical assistance to conceive. Among the women trying to become pregnant, 89.3 % had been trying for ≤12 months and 10.7 % reported having tried >12 months. 5.2 % of those trying to become pregnant for up to a year reported use of fertility treatment, compared with 45.8 % of those trying for a year or more. Women who had previous live births were significantly more likely to use early treatment than nulliparous women (aOR = 2.4, 95 % CI = 1.5, 3.9). The use of fertility drugs and other treatments were more common than ART among recipients of early treatment (aOR = 3.7, 95 % CI = 1.7, 7.9). Some women may be receiving fertility treatment before it is clinically indicated. Instead of invasive treatment, these women may benefit from preconception counseling on folic acid, healthy prepregnancy weight and use of ovulation monitoring to time intercourse.

Keywords PRAMS · ART · Infertility · Utah · Time-trying

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Introduction

According to the national survey of family growth (NSFG), 11.8 % of women of reproductive age in the United States experienced difficulty conceiving and a conservative estimate suggests that slightly more women (11.9 %) received some type of infertility service [1]. Other than the NSFG data, there are limited population-based studies available to describe the use of fertility treatments beyond assisted reproductive technology (ART), or the timing of use of such services in relation to duration of attempt.

The International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) define infertility as a disease of the reproductive system resulting in the failure to achieve a clinical pregnancy after 12 months or more of

regular unprotected sexual intercourse [2]. Some researchers suggest revising the definition of infertility by duration attempt based on a woman's age, since fertility rates are known to decline as a woman ages [3]. Many couples will successfully conceive without treatment even after meeting the criterion for clinical infertility; 50 % of couples that do not conceive during the first 12 cycles will have a spontaneous conception without medical assistance, at some point over the next 2 years [2, 4]. Couples that do not conceive after 48 months of properly timed intercourse likely have more severe infertility and the chance of subsequent spontaneous conception drops to only 5 % [4].

Some couples are utilizing medical interventions and ART sooner than would be recommended by clinical guidelines, even though spontaneous conception is likely to occur even after 12 months of trying to conceive [2, 4–7]. Fertility treatments include any medical intervention intended to influence conception, including medications for ovulation induction or controlled ovarian stimulation, any artificial insemination procedures (AI), using husband/partner or donor semen, and assisted reproduction technologies (ART) including in vitro fertilization (IVF), with or without intracytoplasmic sperm injection (ICSI) [2].

The objective of this study was to use Utah PRAMS data to describe specific types of fertility treatments reported in women who used treatment after having tried to conceive for up to a year (early treatment) versus more than a year. We investigated maternal characteristics associated with early treatment. We also compared women who received early treatment to women who became pregnant after an attempt of 1 year or longer, but who report no treatment.

Methods

The Pregnancy Risk Assessment Monitoring System (PRAMS) is an ongoing survey of women who have had a recent live birth. The PRAMS survey was developed by the Centers for Disease Control and Prevention (CDC) to collect state-specific information on the attitudes and experiences of new mothers through population-based surveillance [7]. PRAMS data focus on preconception, prenatal, and postpartum health of women [6, 8, 9]. PRAMS data are collected in 37 states and New York City [7]. The PRAMS questionnaire uses standardized data collection methods and a core set of questions across participating states [10]. Infertility questions have yet to be included in the core PRAMS questionnaire but some states have elected to include them. Eight PRAMS divisions asked questions regarding infertility during the period of 2004–2008 [8]. Utah and New York were the only two states that collected data on how long the mother had been trying to get pregnant. However, Utah was alone in collecting data on both use of specific fertility treatments and the amount of time the woman had been trying to become pregnant before conceiving. The question, "How many months had you been trying to get pregnant?" was asked to all women who report trying to become pregnant at the time of conception, whether or not they report receiving fertility treatment [7]. For the purposes of this paper, the reported months of trying were used to identify women with normal fertility (≤12 months of trying to conceive) and women with subfertility (>1 year of trying). See Fig. 1.

During 2004–2008, approximately 200 women were selected to participate in a PRAMS survey each month via systematic stratified sampling of women who had a live birth in the state of Utah during the previous 2–4 months [6]. New mothers were first asked to respond by mail survey and non-respondents were contacted by telephone and interviewed [6]. Mothers who delivered low birth weight babies and mothers who were identified as having less than a high school education on the birth certificate were oversampled. The sample resulted in 11,821 women being selected for participation. A total of 9,517 women responded to the survey, yielding an unweighted response rate of 80.5 %. The responses of the women who responded were weighted to account for non-response and non-coverage in order to represent the 255,061 women who delivered a live birth in Utah during this same time period [6, 10]. The actual questionnaire can be viewed at the following link: http://www.health.utah.gov/mihp/pdf/Utah_PRAMS_Data_Book_07-08.pdf. Weighted data were used to provide percentages and overall association measures. Regression analyses were done on the unweighted data to ensure that sample sizes of subgroups were adequate to progress with regression analysis.

Women were stratified into four groups: Women who had been trying to become pregnant for a year or less and who (1) did and (2) did not receive treatment and women who had been trying to become pregnant for longer than 1 year and who (3) did and (4) did not receive treatment. Univariate analyses were conducted to describe differences between women in these four groups. Multivariable logistic regression was used to calculate unadjusted and adjusted odds ratios for the associations between early utilization of treatment and maternal characteristics, using a referent group of women who sought treatment after 12 months of trying.

In addition, among women reporting use of fertility treatments, the type of treatment reported was also evaluated to determine whether attempt duration was associated with treatment type. In the questionnaire, a woman could report as many treatment types as she used during the month of conception, but for the purposes of the evaluation we created five mutually exclusive treatment categories including: (1) any use of ART with or without other treatments (referred to as ART), (2) any use of artificial

Fig. 1 Flow of Utah PRAMS (phase V) questions regarding fertility treatment and time trying
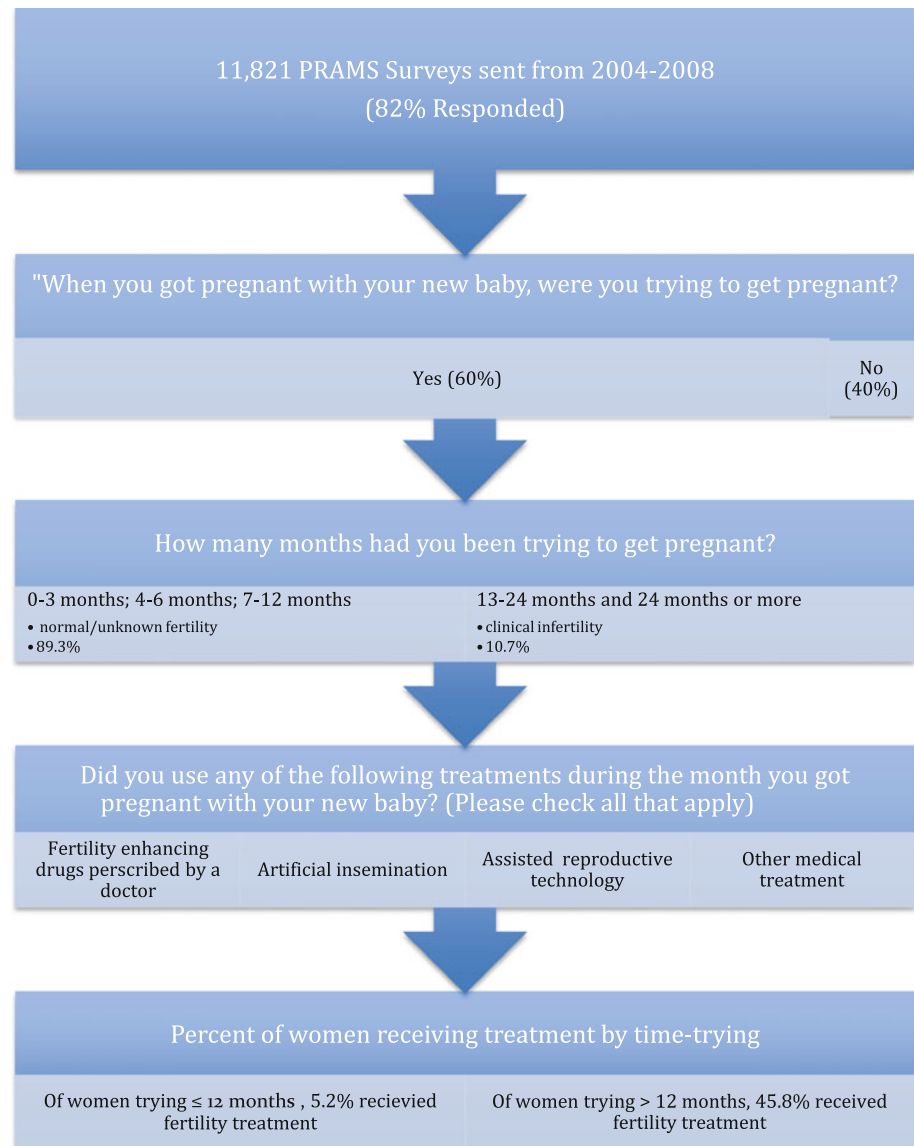
insemination or intrauterine insemination without ART, regardless of whether drugs were also used (referred to as AI), (3) use of fertility-enhancing drugs prescribed by a doctor in the absence of ART or AI, (referred to as drugs), (4) use medical treatment other than ART, AI, or ovulation drugs (referred to as other), and (5) women who reported receiving medical help to become pregnant but who left the type of treatment question blank. The latter group of women was assumed to have used some infertility treatment, but not used during the month of conception. Inclusion of covariates was determined a priori based on availability on the PRAMS survey, previous literature, and relevance to the research question. Covariates included in the analyses were maternal age, insurance status, urban or rural residence, maternal education,

income category, pre-pregnancy body mass index (BMI), use of tobacco and alcohol in the 3 months prior to pregnancy, parity, marriage status, and ethnicity. Due to small cell sizes, categories of income during the 12 months prior to pregnancy, race and maternal education were collapsed into dichotomous variables. BMI categories were also created: underweight (BMI < 18.5), normal weight (BMI 18.5–24.9), and overweight/obese (BMI ≥ 25). Data were analyzed accounting for the PRAMS complex sampling scheme in STATA 11.0 (STATACorp, College Station, TX). Both the University of Utah and the Utah Department of Health provided Institutional Review Board (IRB) oversight and gave the study exempt status as the secondary analysis of a de-identified dataset.

Results

A total of 5,239 women with a recent live birth, who were trying to become pregnant when they conceived their new baby, responded to the Utah PRAMS survey between 2004 and 2008. These women were weighted to represent 142,722 women and make up 60 % of women who gave birth in the state of Utah during those years (Table 1). Of these women, 9.5 % reported receiving fertility treatments, 89.3 % reported trying for ≤12 months and 10.7 % reported trying for >12 months. Of women who tried for >12 months, and therefore met the definition of clinical infertility, 45.8 % reported receiving fertility treatment. Additionally, 5.2 % of women who tried for ≤12 months reported receiving fertility treatment, although they had not yet met the time criterion for clinical infertility (see Fig. 1). Among all women who reported receiving medical assistance to become pregnant, 48.1 % reported attempt duration of ≤12 months while 51.2 % reported an attempted duration of >12 months.

Multivariable logistic regression was used to examine factors associated with the utilization of fertility treatment at ≤12 months of trying, referred to as "early treatment," compared with >12 months of trying, referred to as "later treatment." The analysis can be seen in Table 2. Multiparous women were 2.4 times as likely to report early treatment compared to women who were nulliparous (aOR = 2.4, 95 % CI = 1.5, 3.9) when controlling for maternal age, insurance status, urban or rural residence, maternal education, income category, pre-pregnancy body mass index (BMI), use of tobacco and alcohol in the 3 months prior to pregnancy, and marriage status. Women who had early treatment, regardless of parity, were 3.7 times more likely to use fertility enhancing drugs (95 % CI = 1.7, 7.9), and 4.8 times as likely to report the use of "other" fertility treatment (95 % CI = 2.0, 11.5) than women who received later treatment. Women who sought treatment early were also more likely (aOR = 3.2, 95 % CI = 1.4, 7.4) to not indicate any particular treatment type during the month of conception. Women who received early treatment were 1.5 times more likely to have an income greater than $50,000 (aOR = 1.5, 95 % CI = 0.9, 2.5). Maternal education level, pre-pregnancy BMI, marital status, having insurance, urban versus rural location, treatment type and the report of smoking tobacco and/or drinking alcohol during the 3 months prior to pregnancy were included as covariates in the logistic regression model but were not identified as significant predictors of early treatment. Variables representing race and ethnicity were omitted from the model as the sample size was insufficient in some of these categories.

A second multivariable logistic model was examined to see if the results changed when the various types of fertility treatment were taken out of the model (Table 2). In this model, history of a previous live birth remained the only significant predictor of early treatment (aOR = 2.4, 95 % CI = 1.5, 3.9) when controlling for maternal education level, pre-pregnancy BMI, marital status, having insurance, urban versus rural location, treatment type and the report of smoking tobacco and/or drinking alcohol during the 3 months prior to pregnancy.

Since a woman's parity was strongly associated with early treatment, we estimated a multivariable logistic regression on the subgroup of nulliparous women receiving treatment (Table 3). In this model, nulliparous women who pursued treatment prior to 1 year of trying were significantly more likely to be married when controlled for treatment types (aOR = 5.9, 95 % CI = 1.1, 32.3). Nulliparous women who received early treatment were more likely to report use of fertility-enhancing drugs (aOR = 14.4, 95 % CI 2.8, 74.9) than ART. Maternal education level, BMI, insurance, ethnicity, urban versus rural location, and self-reported smoking and drinking during the 3 months prior to pregnancy were also included in the model but had no significant effect on the odds ratio for early treatment.

Discussion

Among all women trying to become pregnant who used fertility treatment, nearly half (48.1 %) reported early treatment The use of early treatment was significantly associated with a previous live birth (i.e., secondary infertility), and borderline associated with income of over $50,000. Including types of treatment in the models, the use of ovulation enhancing drugs, and fertility treatments categorized as "other" were also associated with early treatment. Women who received treatment later (after 1 year of trying) were more likely to use the more invasive fertility treatments such as ART/IVF, and less likely to use fertility enhancing drugs or "other" treatments.

The demographic composition of women in Utah must also be considered when determining the external generalizability of the study. Utah's population is less racially and ethnically diverse than the United States as a whole. Compared to the demographic distribution of the United States, Utah has fewer Hispanics, fewer African Americans, fewer foreign-born persons and fewer households where English is not spoken as the primary language [12]. The fertility rate in Utah is 93.1 births per 1,000 individuals, which is the highest of any state in the nation [13]. The average age of mother at first birth in Utah it is 23.9 years of age, which is lower than the nationwide average of 25 years of age [14]. Over half of people living in Utah consider themselves "very religious." The self-identification with religious beliefs may influence a

Table 1 Weighted percentages (and 95 % CI) for different characteristics of PRAMS respondents, by whether fertility treatment was received and by duration of trying to conceive

	All women trying % (95 %CI)	Received fertility treatment		Did not receive fertility treatment		p value
		Trying for ≤ 12 months	Trying for > 12 months	Trying for ≤ 12 months	Trying for > 12 months	
Total weighted N (%)	142,722 (60)	6,660 (4.7)	6,989 (4.9)	121,313 (84.7)	8,250 (5.8)	
Maternal age**						**<0.001**
<35	74.9 (73.6,76.23)	73.3 (66.1,79.4)	66.7 (59.6,73.2)	76.0 (74.5,77.5)	66.2 (59.6,72.1)	
≥35	25.1 (23.8,26.4)	26.8 (20.6,22.9)	33.3 (26.9,40.4)	24.0 (22.5,25.5)	33.8 (27.9,40.4)	
Previous LB**						**<0.001**
No	33.6 (32.1,35.6)	34.2 (27.5,41.5)	56.7 (49.5, 63.7)	68.2 (66.5,69.8)	56.8 (50.4,63.3)	
Yes	66.4 (64.9,67.9)	65.8 (58.4,72.5)	43.3 (36.3,50.5)	31.2 (30.2,33.5)	43.0 (36.7,49.6)	
Education level**						**<0.001**
High school grad or less	34.6 (33.8,35.5)	27.3 (21.9, 33.5)	28.2 (22.8,34.3)	33.7 (33.1,34.3)	44.83 (38.8,51.1)	
Some college or more	65.4 (64.5,66.3)	72.7 (66.5,78.1)	71.8 (65.7,77.2)	66.3 (65.7,66.9)	55.2 (48.9,61.3)	
Ethnicity**						**<0.001**
Non-hispanic	87.8 (84.0,85.3)	92.6 (88.6,95.2)	93.3 (89.5,95.8)	88.51 (87.6,89.4)	83.9 (79.3,87.6)	
Hispanic	15.3 (14.7,16.0)	7.4 (4.8,11.4)	6.7 (4.2,10.5)	11.5 (10.6,12.4)	16.13 (12.4,20.7)	
Race**						0.004
White	97.0 (96.4,97.5)	95.6 (91.7, 97.7)	97.4 (93.5,99.0)	97.3 (96.7,97.8)	93.4 (89.7,95.8)	
Other, non-white	3.0 (2.5,3.6)	4.4 (2.3,8.3)	2.6 (1.1,6.5)	2.7 (2.1,3.3)	6.62 (4.2,10.3)	
Insurance prior to pregnancy**						**<0.001**
No	21.2 (20.1,22.3)	11.4 (7.8,16.2)	9.6 (6.3,14.3)	20.9 (19.7,22.2)	29.3 (24.1,35.1)	
Yes	78.8 (77.7,79.9)	88.6 (83.8,92.2)	90.4 (85.6,93.7)	79.1 (77.8,80.3)	70.73 (64.9,75.9)	
BMI prior to pregnancy**						**<0.001**
<18.5 (underweight)	14.2 (14.6,15.9)	10.3 (6.5,15.9)	17.4 (12.34,23.9	14.9 (13.7,16.3)	12.5 (8.6,17.8)	
18.5–24.9 (normal)	58.3 (56.7,59.8)	54.0 (46.4,61.4)	51.0 (42,8,58.2)	59.2 (57.4,61.0)	49.6 (42.9,56.3)	
25.0–29.9 (overweight)	11.4 (10.5, 13.5)	14.1 (9.5,20.4)	10.0 (6.5,15.1)	11.7 (10.6,12.9)	9.2 (6.1,13.6)	
≥30 (obese)	15.6 (14.5,16.7)	21.6 (16.2,28.2)	21.6 (16.4,27.9)	14.2 (13.0,15.4)	28.8 (23.2,35.1)	
Smoked 3mo prior to pregnancy*						0.043
No	94.7 (94.1,95.3)	95.7 (92.3,97.7)	95.5 (91.5,97.7)	94.9 (94.2,95.5)	91.0 (87.0,93.9)	
Yes	5.3 (4.7,5.9)	4.3 (2.3,7.7)	4.5 (2.3,8.5)	5.1 (4.5,5.9)	9.0 (6.1,13.0)	
Drank alcohol 3mo prior to pregnancy*						0.002
No	83.8 (82.6,84.5)	89.9 (85.2,93.3)	84.7 (78.8,89.2)	84.3 (83.0,85.5)	74.9 (68.9, 89.1)	
Yes	16.2 (15.1,17.4)	10.1 (6.7,14.9)	15.3 (10.8,21.2)	15.7 (14.5,17.0)	25.11 (22.0, 31.2)	
Married**						**<0.001**
No	7.5 (6.9,8.2)	4.6 (2.7,8.0)	2.0 (0.8,4.5)	7.4 (6.7,8.2)	10.0 (7.0,14.1)	
Yes	92.5 (91.8,93.1)	95.4 (92.0,97.3)	98.1 (95.5, 99.2)	92.6 (91.8,93.3)	90.0 (86.0,93.0)	
Fertility treatment						**NA**
No	90.5 (89.5,91.4)	~	~	100	100	
Yes	9.5 (8.6,10.5)	100	100	~	~	
Type of treatment**						0.006
ART	12.6	6.4 (3.7, 10.9)	18.2 (13.3,24.5)	NA	NA	
AI	11.6	9.8 (6.0, 15.6)	13.5 (9.2, 19.3)			
Drugs	44.4	47.3 (39.9, 54.8)	41.4 (34.5, 48.8)			
Other	13.9	17.0 (11.9, 23.6)	11.0 (7.1, 16.5)			
Type not reported	17.6	19.6 (14.3, 26.2)	15.9 (11.3, 21.9)			
Drugs				NA	NA	0.404
No	62.5 (58.4,66.6)	44.4 (37.1,52.0)	40.0 (33.1,47.3)			
Yes	37.5 (33.6,41.6)	55.6 (48.0,62.9)	60.0 (52.7,66.9)			

Table 1 continued

	All women trying % (95 %CI)	Received fertility treatment		Did not receive fertility treatment		p value
		Trying for ≤ 12 months	Trying for > 12 months	Trying for ≤ 12 months	Trying for > 12 months	
Artificial insemination				NA	NA	0.179
No	92.1 (89.5,94.1)	91.2 (84.4,94.0)	85.3 (79.3,89.8)			
Yes	7.9 (5.9,10.5)	9.9 (6.1,15.7)	14.7 (10.3,20.7)			
Assisted reproductive Technology (IVF and/or ICSI)**				NA	NA	**0.006**
No	91.7 (89.1,93.7)	93.6 (89.1,96.3)	81.7 (75.5,86.7)			
Yes	8.3 (6.3,10.9)	6.4 (3.7,11.0)	18.3 (13.3,24.5)			
Other				NA	NA	0.300
No	88.4 (85.4,90.8)	79.8 (73.0,85.3)	84.1 (78.1,88.7)			
Yes	11.6 (9.2,14.6)	20.2 (14.7,27.0)	15.9 (11.3,21.9)			
Pregnancy feelings**						**<0.001**
Sooner	31.9 (30.5,33.3)	60.5 (53.1,67.5)	91.4 (86.8,94.5)	24.3 (22.8,25.9)	74.5 (68.7,79.6)	
Later	3.6 (3.0,4.2)	2.3 (1.0,6.2)	~	4.0 (3.3,4.7)	1.0 (0.5,2.2)	
Then	64.1 (62.6,65.6)	36.1 (29.3,43.5)	8.4 (5.3,13.1)	71.3 (69.6,72.9)	24.1 (19.2,29.9)	
Never	~	1.1 (0.3,3.5)	0.2 (0,0.7)	0.4 (0.3,0.7)	0.3 (0,2.2)	
Urban/rural						0.189
Urban	77.6 (76.3,78.8)	78.32 (71.5, 83.9)	83.7 (77.8,88.2)	77.3 (75.8,78.8)	75.4 (69.4,80.6)	
Rural	22.4 (21.2,23.7)	21.7 (16.2,28.5)	16.4 (11.8,22.2)	22.7 (21.3,24.2)	24.6 (19.4, 30.6)	
Income**						**<0.001**
< $50,000 per year	52.2 (50.6,53.8)	38.0 (31.0,45.6)	41.8 (34.8,49.1)	53.4 (51.6,55.2)	48.1 (41.5,54.8)	
≥ $50,000 per year	47.8 (46.2,49.4)	62.0 (54.4,69.0)	58.2 (50.9, 65.2)	46.6 (22.8,48.4)	51.9 (45.2,58.5)	

NA is not applicable

~ Indicates raw data <5 or COV >0.50

* p value <0.05

** p value <0.01

Bold values are statistically significant (p < 0.05)

couple's reproductive goals, since the predominant religion in Utah (The Church of Jesus Christ of Latter-Day Saints) is pronatalist [15, 16]. Therefore, the specific proportion of women seeking treatment may not be generalizable to the rest of the United States. However, many of the factors that influence a woman's decision to access treatment prior to meeting the criterion for infertility diagnosis may be similar for women in other locations. Thus these findings may prove useful in designing future studies on a national or international level.

Estimating time trying to conceive serves as a useful tool in identifying women who may be experiencing sub-fertility or infertility. Clinical recommendations suggest waiting for a basic infertility workup until a couple has experienced 12 months or more of trying, except in cases where the woman has a known ovulation disorder or is older than 35 years of age [5]. Predictive models on spontaneous conception indicate that about half of women of unknown fertility who do not conceive during the first year may conceive in the subsequent year [4, 17].

To the extent that fertility treatment may be over utilized, it is important to ascertain the possible role of primary and specialty providers in the overtreatment. The current study had no information on what types of health care professionals provided treatment, nor whether the treatment was requested by the woman or recommended by the provider. Simulation studies have suggested that fertility treatments will not improve the cumulative pregnancy probabilities for couples who do not have severe male infertility, tubal obstruction or anovulation [18]. Exposing primary care providers to predictive models such as this may aid clinicians in estimating when patients could expect to conceive spontaneously rather than encouraging the premature use of more invasive treatment options [5, 17].

Conceptions that result from medical treatment or IVF are associated with an increased likelihood of multiple fetuses, higher likelihood of low birth weight, increased likelihood of preterm delivery, an increased incidence in placental abnormalities and of pregnancy related hypertension [8, 19]. In the United States, 30 % of all live births

Table 2 Logistic regression models predicting early treatment (with ≤12 months trying) versus later treatment (>12 months trying) among all women trying

	Unadjusted OR	Adjusted OR in a model that includes treatment type as a variable	Adjusted OR in a model that does not includes treatment type as a variable
Maternal age			
<35	REF	REF	REF
≥35	1.2 (0.7, 1.7)	1.2 (0.7, 1.9)	1.1 (0.7, 1.8)
Previous LB			
No	REF	REF	REF
Yes	2.5 (1.6, 3.9)	2.4 (1.5, 3.9)	2.4 (1.5, 3.9)
Education level			
High school grad or less	REF	REF	REF
College or more	(0.6,1.4)	0.9 (0.5, 1.4)	1.0 (0.6, 1.6)
Married			
No	REF	REF	REF
Yes	2.6 (0.6,11.8)	2.3 (0.6,9.3)	2.2 (0.6,8.2)
Insurance prior			
No	1.2 (0.6, 2.2)	0.8 (0.2, 2.3)	0.8 (0.3, 1.6)
Yes	REF	REF	REF
Pre-pregnancy BMI			
Under	0.6 (0.2, 1.9)	0.7 (0.2, 2.3)	0.7 (0.2, 2.4)
Normal	REF	REF	REF
Overweight/ obese	1.05 (0.7, 1.6)	1.1 (0.6,1.8)	1.1 (0.7, 1.7)
Smoked 3mo prior to pregnancy			
No	REF	REF	REF
Yes	1.0 (0.4, 2.4)	1.1 (0.4, 2.9)	1.1 (0.6, 1.7)
Drank alcohol prior to pregnancy			
No	REF	REF	REF
Yes	0.6 (0.3, 1.1)	0.6 (0.3, 1.3)	0.6 (0.3, 1.1)
Type of treatment			
ART	REF	REF	
AI	2.1 (0.8, 5.2)	1.7 (0.7, 4.5)	
Drugs	3.2 (1.6, 6.7)	3.7(1.7, 7.9)	
Other	4.4 (1.8, 10.5)	4.8 (2.0, 11.5)	
No type reported	3.4 (1.5, 7.8)	3.2 (1.4, 7.4)	
Urban/rural			
Urban	REF	REF	REF
Rural	0.7 (0.4, 1.2)	0.7 (0.4, 1.3)	0.7 (0.4, 1.2)

Table 2 continued

	Unadjusted OR	Adjusted OR in a model that includes treatment type as a variable	Adjusted OR in a model that does not includes treatment type as a variable
Income			
<$50,000	REF	REF	REF
≥$50,000	1.2 (0.8,1.8)	1.5 (0.9, 2.5)	1.2 (0.7, 2.0)

resulting from ART are multiple gestation, which contributes to an increased financial burden [20]. The finding that 48.8 % of all women who received fertility treatment in our study reported time trying of up to a year indicates a potential public health problem because spontaneous conception is probable in these women and through the use of such early treatments, they may be exposing themselves and their children to unnecessary risks [21]. There are also high costs associated with medical fertility treatments, for both treatments themselves and the potential medical complications associated with preterm births as well as multiple births that may result from fertility treatment [20].

This observational study has several noteworthy strengths. The PRAMS questionnaire has been used since 1987 and is well validated for many exposures and outcomes [10]. The Utah PRAMS regularly receives a response rate over 80 % and is highly representative of the Utah population. Overall, PRAMS is an excellent platform for gaining a greater understanding of women's health and behaviors before, during and after pregnancy.

There are several important limitations to this study. The cross-sectional design does not allow causal inference. In addition, self-reported data have a potential for reporting bias, especially when dealing with items of a personal nature such as income, BMI, use of tobacco and alcohol before and during pregnancy and the use of fertility treatments. A central component of this study is the use of self-reported attempt duration, which may be subject to inaccuracies due to recall as well as individual interpretations of what counts as time "trying" to conceive. Depending on the person, "trying" may mean the time one was at risk for pregnancy or the time one was actively trying to become pregnant [11]. It's also unclear from the questionnaire whether the time "trying" should refer only prior to treatment or include the time of treatment. Thus, there is a need for additional population-based studies with specific questions to explore what constitutes "trying" to more accurately examine the use of fertility treatments in regards to duration of attempt.

Although we believe that PRAMS is the best retrospective population-based data available when looking at behaviors surrounding pregnancy, there is a certain amount

Table 3 Logistic regression models predicting early treatment (with ≤12 months trying) versus later treatment (>12 months trying) among nulliparous women receiving treatment

	Unadjusted OR	Adjusted OR in a model that includes treatment type as a variable	Adjusted OR in a model that does not includes treatment type as a variable
Maternal age			
<35	REF	REF	REF
≥35	1.3 (0.6, 2.4)	1.3 (0.6, 2.8)	1.4 (0.7, 3.0)
Education level			
High school grad or less	REF	REF	REF
Some college or more	0.9 (0.6, 1.4)	1.3 (0.5, 3.0)	1.6 (0.7, 3.4)
Married			
No	REF	REF	REF
Yes	4.6 (1.2, 17.4)	5.9 (1.1, 32.2)	3.4 (0.7, 17.2)
Insurance			
No	1.3 (0.6, 3.7)	0.5 (0.1, 2.2)	0.6 (0.2, 1.7)
Yes	REF	REF	REF
Pre-pregnancy BMI			
Under	0.7 (0.2, 1.8)	0.5 (0.1, 2.8)	0.4 (0.1, 2.4)
Normal	REF	REF	REF
Over/obese	1.2 (0.6, 2.3)	1.2 (0.5, 2.6)	1.0 (0.5, 2.1)
Smoked 3mo prior to pregnancy			
No	REF	REF	REF
Yes	0.2 (0.4, 1.5)	0.1 (0.0, 1.5)	0.2 (0.0, 1.2)
Drank alcohol prior to pregnancy			
No	REF	REF	REF
Yes	0.4 (0.2 1.0)	0.6 (0.2, 1.8)	0.4 (0.2, 1.2)
Type of treatment			
ART	REF	REF	
AI	4.1 (0.7, 25.1)	2.2 (0.3, 14.3)	
Drug	16.1 (3.4, 76.5)	14.4 (2.8, 74.9)	
Other	4.7 (0.8, 29.4)	5.0 (0.7, 35.9)	
No type reported	6.3 (1.2, 33.8)	5.1 (0.8, 30.8)	
Urban/rural			
Urban	REF	REF	REF
Rural	0.6 (0.2, 1.3)	0.5 (0.2, 1.2)	0.5 (0.2, 1.3)

Table 3 continued

	Unadjusted OR	Adjusted OR in a model that includes treatment type as a variable	Adjusted OR in a model that does not includes treatment type as a variable
Income			
<$50,000	REF	REF	REF
≥$50,000	0.9 (0.5,1.7)	1.2 (0.5, 2.6)	0.8 (0.4, 1.7)

of selection bias to be expected when examining infertility treatments among women who successfully achieved a pregnancy and subsequent live birth. The data do not account for treatment seeking behaviors of women who never conceived or those who experienced a miscarriage or stillbirth. This selection bias limits our ability to make any reliable estimate of early utilization of fertility treatments among women of reproductive age as a whole; we are limited to concluding about women who successfully conceived following treatment and subsequently delivered a live-born infant. In addition, since PRAMS is cross-sectional and only asks about the most recent pregnancy, the data do not account for women who had known infertility during a previous pregnancy attempt and would therefore have reason for seeking treatment prior to 1 year of trying. Nor do the data contain information on clinical characteristics that may warrant earlier treatment, such as female amenorrhea or known male factor subfertility.

Conclusion

Among Utah women who were trying to become pregnant and delivered a live birth in Utah, 9.5 % reported the use of fertility treatment in attempting to conceive. Nearly half of these women (48.8 %) reported seeking fertility treatment prior to meeting the clinically accepted definition for infertility. Women who had previous live births were significantly more likely to use early treatment than nulliparous women (aOR = 2.4, 95 % CI = 1.5, 3.9). Women who had previous live births were significantly more likely to receive early treatment; this may be a result of secondary or known infertility. However, women who had early treatment, regardless of parity, were 3.7 times more likely to use fertility drugs (95 % CI = 1.7, 7.9), and 4.8 times as likely to report the use of "other" fertility treatment (95 % CI = 2.0, 11.5) than women who received later treatment.

Women who receive early treatment may contribute substantially to the public health impact of infertility treatment and associated risks and cost even if they are not seeking the more invasive treatments such as IVF. At

present ongoing systematic surveillance of infertility treatments in the United States is limited to surveillance of ART, which is conducted by the Society for Assisted Reproduction Technology (SART). Less is known about specific trends in the use of other, more common and less invasive types of fertility treatments. Increased surveillance of the full spectrum of fertility treatments is essential to future research and understanding the wider public health impact of fertility treatment. Additionally, this observational analysis supports the inclusion of questions regarding infertility treatments and time trying in the core PRAMS questionnaire nationwide. The PRAMS questionnaire would also benefit from greater specification about how respondents should regard "time-trying" to achieve more standardized and reliable answers regarding time at risk of pregnancy, as well as possible indications for early treatment and clinician involvement in recommending early treatment, so that attempt duration and the use of fertility treatments can be better understood in the future.

This preconception period provides an unique opportunity to counsel women about folic acid, conception, and early pregnancy issues as well as a chance to educate patients on optimal timing of infertility treatment [22]. Physicians may benefit from targeting advice and treatment based on the duration of time trying without pregnancy success and delay the more expensive, invasive procedures such as IUI and IVF until the women have truly met the clinical diagnosis criteria. In the absence of clinical factors such as azospermia or anovulation, providers could counsel patients about preconception health, and simple, low-cost evidence based interventions such as cervical fluid self-assessment and the use of LH monitoring kits to optimize the timing of intercourse [23]. Women, who are seeking treatment prior to 1 year of trying, could be prescribed folic acid and counseled on obtaining a healthy prepregnancy weight and the importance of proper nutrition during this critical time. Health care providers may need to be reminded about the clinical definition of infertility and encouraged to use these visits, in which individuals are seeking treatment early, for preconception interventions rather than infertility treatment, thereby reducing the risk of pregnancy complications associated with fertility treatments such as ART.

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