Unintended Childbearing and Knowledge of Emergency Contraception:

Analysis of the 1998-1999 Oregon PRAMS Dataset

By

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CERTIFICATE OF APPROVAL

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CDC	Centers for Disease Control and Prevention
CDTA	collaborative drug therapy agreement
CI	confidence interval
EC	emergency contraception
ECPP	Emergency Contraception Promotion Project
FDA	Food and Drug Administration
HMO	health maintenance organization
IUD	intrauterine device
NMIHS	National Maternal and Infant Health Survey
NLSY	National Longitudinal Survey of Youth
NSFG	National Survey on Family Growth
OC	oral contraceptives
OHP	Oregon Health Plan
OR	odds ratio
PATH	Project for Appropriate Technologies in Health
PRAMS	Pregnancy Risk Assessment Monitoring System
PSA	Public Service Announcement
PSI	Population Services Inc.
ROC	Receiver Operating Characteristics
US	United States
WIC	Special Supplemental Nutrition Program for Women, Infants and Children

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ABSTRACT

Background

Unintended pregnancy and childbearing remain important public health issues in the United States (US), despite efforts towards decreasing the frequency of their occurrence. One option for preventing pregnancy is the use of emergency contraception (EC), which is generally a regimen of high dose hormones that are similar to those used in birth control pills. Although it had been in limited use for a couple of decades, it wasn't until the 1990's that public awareness of EC began to increase, due to occasional media coverage. In the late 1990's, the Food and Drug Administration (FDA) approved two dedicated, Food and Drug Administration-labelled EC products, Preven© and Plan B©. Dedicated products designed specifically for use as EC (as opposed to the cut up birth control pill packages used prior to this) were desirable, as it was thought that dedicated products would make EC easier to use and more commonly known. Despite the availability of dedicated products, access to and use of this method remains low in the US and around the world. One factor contributing to low levels of EC use is a widespread lack of knowledge about this method of pregnancy prevention, in potential users, and the health care providers that need to provide such information to women under their care. Increased EC education and access might be a method for decreasing unintended childbearing. The Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) assesses both childbearing intention and knowledge of EC in what is essentially a cross-sectional manner. The 1998-1999 Oregon PRAMS dataset was used to study the relationship between knowledge of EC and unintended childbearing.

Methods

The Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) 1998-1999 dataset was used to study the relationship between knowledge of emergency contraception (EC) and unintended childbearing. Initially, this study focused on identifying risk factors in the population for unintended childbearing among Oregon postpartum women. Lack of knowledge of EC was

identified as an *a posteriori* explanatory variable of interest for unintended childbearing. Therefore, logistic regression models explaining unintended childbearing were constructed including knowledge of EC in the model in each case. Other risk factors of interest, income, age, marital status, education, race, and insurance status at the time of pregnancy, were entered into a model with knowledge of EC. To strengthen the *a posteriori* study of the association of lack of EC knowledge with unintended childbearing, the final model identified, using the 1998-1999 data, was applied to a second year of PRAMS data from 2000. Model parameter estimates were inspected for statistical significance and the discriminatory ability of the 1998-1999 model for the 2000 data was assessed through classification and area under a Receiver Operating Characteristic curve (ROC curve, plot of sensitivity versus 1-specificity).

Results

Unintended childbearing in Oregon in 1998-1999 was significantly associated with lacking knowledge of EC in a simple logistic regression model (crude OR 1.69, 95% CI 1.23, 2.33), but not in a multiple model (adjusted OR 1.32, 95% CI 0.91, 1.93). Unintended childbearing was also associated with being unmarried, being younger, and having lower income and education levels, both in simple and multiple logistic regression models. The model generated with the 1998-1999 data was able to discriminate between women reporting intended and unintended births adequately (area under a ROC curve=0.677, 95% CI 0.651, 0.702) in the 2000 PRAMS data.

Knowledge of EC was more strongly associated with unintended childbearing in the 2000 data; the odds ratios (OR's) were larger, and lack of knowledge of EC was significantly associated with unintended childbearing both in simple and multiple models (crude OR 1.76, 95% CI 1.29, 2.47, adjusted OR 1.68 95% CI 1.14, 2.47).

Conclusions

The results suggest that lack of knowledge of EC may be associated with having an unintended childbirth, and are strengthened by the fact that the model generated from the 1998-1999 PRAMS data explains unintended childbearing in Oregon fairly well as shown by its discriminatory abilities in a second year of PRAMS data. The model results indicate that, although EC education has been undertaken in Oregon, efforts to this end should be continued and expanded as one potential strategy for decreasing unintended births. The study found that the women at risk of unintended pregnancy were young, low income, and unmarried; interventions should be targeted towards these women.

This study was not able to assess a causal relationship between knowledge of EC and unintended childbearing. Knowledge of EC and unintended childbearing were assessed at the same time, so the temporal relationship between these two factors could not be determined. In addition, both childbearing intention and knowledge of EC were assessed after the child was born, which may not provide the most accurate information about intention and knowledge at the time of conception. Further research around the association between knowledge of EC and unintended childbearing is needed to clarify this relationship.

INTRODUCTION

Demographics of Unintended Childbearing and Pregnancy

Unintended pregnancy is a strikingly common problem in the United States. In 1994, 2.65 million women had unintended pregnancies [1]. This corresponded to 49% of pregnancies being unintended in that year [1]. In 1990, half of the women of reproductive age, or 31 million women, were at risk of having an unintended pregnancy [2]. To be considered at risk for unintended pregnancy a woman must be fertile, have been sexually active during the given time period and neither be pregnant nor have been trying to become pregnant during the given time period [2]. At any point in time, about two-thirds of women between the ages of 15 and 44 are at risk of unintended pregnancy [3].

Gathering information about the intendedness of pregnancy has generally been accomplished in the same manner in much of the literature. The same question used to assess pregnancy intention is found on many surveys, such as the Pregnancy Risk Assessment Monitoring System (PRAMS) survey, which is the focus of this study, and the National Surveys on Family Growth (NSFG) [4, 5]. PRAMS is a Centers for Disease Control and Prevention (CDC)-developed, population-based survey that gathers information about maternal behaviours and experiences before, during and after pregnancy among women who have recently had a live birth (see below) [6]. The NSFG is administered by the National Center for Health Statistics and since 1982 has surveyed women between the ages of 15 and 44 in the United States (US) about pregnancy, other aspects of the family, and its health [4]. Besides PRAMS, the NSFG is probably the most common source of data regarding unintended pregnancy. Most recent studies focus on the 1982, 1988 and 1995 NSFG, since surveys prior to that were restricted to ever-married women (women who were either currently married, separated, divorced or widowed) [7]. The 1995 NSFG included extensive pre-testing and gathered more information than previous cycles by using interviews administered via CAPI (computer assisted personal interviewing) [5]. The question used on the PRAMS and NSFG surveys asked:

- Thinking back to just before you were pregnant, how did you feel about becoming pregnant?

The following options were offered for an answer:

1. I wanted to be pregnant sooner.
2. I wanted to be pregnant later.
3. I wanted to be pregnant then.
4. I didn't want to be pregnant then or at any time in the future.
5. I don't know.

Responses #1 and #3 are considered to indicate that a pregnancy was intended. Response #2 is considered to indicate that the pregnancy was mistimed. Answer #4 is considered to indicate an unwanted pregnancy. Answers #3 and #4 are usually grouped together and used to quantify unintended pregnancy as the number of mistimed plus unwanted pregnancies in a given population. Note that PRAMS also includes an "I don't know" option. Many NSFG studies are limited to live births because of problems with abortion under-reporting [2]. PRAMS assesses unintended childbearing rather than unintended pregnancy, since women are chosen and surveyed after giving birth. Women who miscarry or have abortions are not surveyed.

NSFG data shows that through the decade of the 1970's and into the early 1980's, the number of children born through unintended childbearing to ever-married women decreased [2, 8]. However, this trend reversed from 1982 into the 1990's, when the proportion of births resulting from unintended childbearing increased [2, 8]. This trend was stronger in women with less than a high school education and those living below the poverty level [8]. Data from the 1988 NSFG, showed that 57% of the women experiencing births had not intended to become pregnant [3]. However, in 1994, this proportion had decreased to 49% of births [1], suggesting that there may have been a return to the downward trend of the 1970's and early 1980's. Studies using PRAMS showed only one state out of 17 studied between 1997 and 1999 and one state out of 13 studied between 1993 and 1999 had decreases in the prevalence of unintended childbearing, while one state had a significant increase between 1993 and 1997 [9, 10]. As 49%

of all births are still unintended and it is estimated that nearly half of women aged 15-44 have had an unintended birth at some point [1], it is clear that unintended childbearing is still a very common occurrence.

The proportion of women who had a live birth and described their pregnancy as unintended ranges from 29% to 54% in studies between 1988 and 1999 [11-24]. Studies generally find that between two-thirds and three-quarters of unintended births are mistimed, with the remainder being unwanted. A study of low-income women indicated that 57% of pregnancies resulting in childbirth were unintended [25]. The National Maternal and Infant Health Survey (NMIHS) was another survey that examined pregnancy intention, sampling women between 15 and 49 years of age who had a live birth or fetal death in 1988 [26]. Intention was assessed using questions similar to those in the NSFG and PRAMS surveys and 43% of pregnancies were reported to have been unintended [26]. Other studies that included both live births and pregnancies ending in abortion or loss find similar proportions of pregnancies reported as unintended – between 36.2% and 56% [3, 11, 26]. Two studies of pregnancy intention in women who were pregnant at the time of the study discovered that 27% and 39% of the women considered their pregnancy to be unintended [17, 27]. A study assessing pregnancy intention both before and after pregnancy found 28.3% of pregnancies before, and 30.0% after, to be unintended [28]. Sixty-five percent of women obtaining pre-natal care at a clinic, asked about pregnancy planning, described their pregnancy as unplanned [29].

Unintended pregnancy proportions are even higher in teens. Studies (including those using PRAMS and NSFG data) have shown anywhere from 67% to greater than 90% unintended births and pregnancies among teens, with one of the studies at the upper limit being in teens presenting at a clinic for pregnancy testing [1, 3, 11, 12, 14, 30-33]. The proportion of unintended births among African American adolescent women has been found to be two times that of white adolescent women, while their abortion rates were similar [34].

The focus of the unintended pregnancy literature tends to be upon teenagers. It is clear that there is much work to be done in this group to address their high prevalence of unintended

pregnancy and childbirth. However, unintended pregnancies and births occur across all age groups of women able to bear children [1]. First, women between 20 and 24 are currently using contraception at about the same, relatively low, level as those 18 and 19 years of age [35]. Therefore, women between 20 and 24 also need to be targeted regarding contraception. In addition, the proportion of unintended births in 1994 was high among teens, lower among women 20-34 and increased for women 35 and older [1]. Unintended pregnancy and childbirth are important problems for women of all ages.

Risk Factors for Unintended Childbearing and Pregnancy

Age, marital status, socio-economic status, black or Hispanic race and education are associated with unintended pregnancy and birth [1, 3, 8, 11, 14, 28, 29, 36-38]. Studies using PRAMS data collected in various states have found that unintended childbearing varies with age, African American race, Hispanic ethnicity in some studies, marital status, socio-economic status, education and Medicaid insurance coverage at the time of delivery [6, 9, 10, 12, 19, 20, 23]. Teens presenting at a clinic for pregnancy testing were more likely to describe their pregnancy as unintended if they were of African American race, or had previously been pregnant and less likely to describe the pregnancy as unintended if they had been using hormonal contraceptives [32]. Using NMIHS data, it was shown, similar to results from PRAMS data, that women who were young, poor, of African American race, less educated, unmarried and had more children were more likely to describe their pregnancy as unwanted; the same factors were associated with mistimed pregnancies, with the exception of lower education (it was higher education in this case) [26]. A Canadian study showed that women who are young, unmarried, renters, live in low-income homes and are of lower parity are more likely to have an unintended pregnancy [15].

Other factors that have not been as extensively studied have been found to be associated with unintended pregnancy and childbirth. For instance, there is some evidence that alcohol use may be associated with unintended pregnancy and childbirth. A study among teens having had a live birth showed that nearly a third of these had been using alcohol when they

conceived [30]. A 15-state PRAMS study of teen mothers showed a significant relationship between binge drinking (5 or more drinks on one occasion) before pregnancy and unintended childbearing, which remained significant in a multiple regression model in the case of Caucasian women [20]. This study also showed that women that binge drank pre-conception were more likely to be white, unmarried, and to have smoked and suffered physical violence pre-conception [20]. Other studies have found that violence before pregnancy is associated with unintended childbearing [13, 21]. PRAMS studies showed that women who suffered violence before and during pregnancy were 4.1 times more likely to describe their childbirth as unwanted, and 2.5 times more likely to describe it as unintended [18, 39]. Also, women with physical and psychological abuse in childhood have an increased risk of having an unintended first childbirth [40]. Finally, PRAMS data from four states collected between 1988 and 1990 indicated that women with unintended births were more likely to have smoked, drank alcohol, been underweight pre-conception, or had late prenatal care initiation, than were women with planned births [41].

Regarding attitudes towards pregnancy, women who were unhappy about their pregnancy were more likely to be unmarried, of African American race, and to be of parity three or above [42]. In addition, there is some evidence that attitudes towards a woman's current partner and her feelings about experiencing a pregnancy with that partner affect intention status and the likelihood of abortion [25].

It is clear that there are a wide range of potential predictors of unintended pregnancy and childbearing including marital status, age, race, income, use of publicly funded health care, parity, education, alcohol use, exposure to violence, smoking and dietary health.

Public Health Consequences of Unintended Childbearing and Pregnancy

Over half of all unintended pregnancies in the US end in abortion [1, 14, 33]. Twenty to forty percent of maternal deaths are due to complications related to abortion [43]. Abortions

that could have been prevented by use of birth control contribute to increasing health care costs and put women unnecessarily at risk for complications from abortion procedures.

Studies using National Longitudinal Survey of Youth (NLSY-where intention was assessed both during and after pregnancy) and NMIHS data have shown that unintended pregnancies were associated with mothers being more likely to smoke heavily during pregnancy [44, 45]. NMIHS showed that women with unintended pregnancies were less likely to take vitamins and gain weight as advised [45], while Oregon PRAMS data from 1998-1999 indicates that women who did not intend to become pregnant are less likely to take folic acid before pregnancy [46]. Less or late prenatal care (sometimes connected with delayed pregnancy recognition) has been shown in a number of studies to be associated with unintended childbearing/pregnancy [44]}[20, 47]. One study found that low income, Medicaid eligible women were more likely to start prenatal care late if they had considered having an abortion or had mixed or unhappy feelings about the pregnancy initially [42]. In other studies, unintended pregnancy/childbirth was a predictor of late initiation of prenatal care [48-50]. Studies have shown that babies that were mistimed or unwanted were more likely to be of low birth weight (<2500 grams), premature and/or small for gestational age [2, 9, 22, 24, 44, 47]. A study in teens (a population with high unintended pregnancy) showed them to be more likely to suffer pregnancy complications and to have low birth weight babies than women of other ages [31]. Very low birth weight (<1500 grams) was associated with the mother being somewhat or very unhappy about the pregnancy or showing evidence of early denial of the pregnancy [38]. Several studies, including studies using 1995 NSFG, 1988 NMIHS, and NLSY data, show that one of the early infanthood effects of unintended pregnancy/childbearing is a significantly lower likelihood of breastfeeding, although this was confined to women with unwanted pregnancies [16, 44, 47, 51]. There is also some evidence that unintended pregnancy is associated with fewer well-baby visits [45].

Intention status of a spouse or partner and the consistency of women's attitudes toward their pregnancy are also important factors that can affect pregnancy outcomes. In a study using NLSY data collected between 1979 and 1992, partner attitudes were indirectly determined from

the women surveyed. If either parent did not intend the pregnancy, there was a reduced likelihood of early prenatal care and of breastfeeding [52]. Another NLSY study interviewed women regarding intention both before and after pregnancy to see if there were differences in intention based on when the interview was done. This study showed that there were better outcomes (prenatal care initiation, smoking during pregnancy and breastfeeding) if the pregnancy was intended at both interviews during and after pregnancy (compared to unintended at either interview) [28].

In addition to negative effects on pregnancy-related outcomes, such as late or no prenatal care, little or no breastfeeding and low birth weight, there may also be adverse developmental outcomes in childhood and later in life. Many women having unintended pregnancies and births raise their children outside of marriage, which can potentially have detrimental effects [2]. Children who have been raised by single parents tend to have poorer outcomes later in life in terms of school performance, marriage stability and finding a job [2]. However, one study argues that there is only weak evidence for a causal link between unintended pregnancy and such outcomes, as many of the risk factors for unintended pregnancy probably confound the relationship between pregnancy intention and childhood development [44].

Programmatic Issues: Decreasing Unintended Pregnancy/Childbearing

A review of randomized controlled trials of prevention strategies for unintended pregnancies, including classes, discussion groups, empowerment exercises, practical work or volunteer experience in teens showed that these programs have not been successful in reducing the number of pregnancies or improving birth control use [53]. Another review found that programs focused on adolescents have had mixed results [54]. It is also clear from other studies that there has been a dearth of clear information about what interventions will work to decrease the occurrence of unintended pregnancy [54, 55]. There is general agreement that the provider

is an important part of this process, but it is felt that more research is needed to guide provider-implemented interventions [55].

Other reviews argue (citing studies with sound methodological designs and random assignment) that programs do exist that successfully impact teen contraceptive use and teen pregnancy [56, 57]. Perhaps due to apparent contradictions in the literature, it has been noted elsewhere that there is little useful information about the impact of programs in teens and, in fact, in people of other ages, directed at decreasing unintended pregnancy. One potential reason for the lack of impact of some programs is that they will often explain contraception, but will not provide it to people or explain how to get it. It was also noted that only about 21% of the approximately 500 school-based clinics in the US in 1994 give out contraceptives [2]. It seems likely that programs focused on decreasing unintended pregnancy have varied effectiveness. Further careful study of the effective facets of programs could help shape the future approach to this problem.

The importance of continued research was demonstrated by the use of research findings in Montana. A study regarding pregnancy intention and awareness and use of EC was used to convince health insurers that Montana had a problem with unintended pregnancy when the perception was that this was not a concern. The results of the study also prompted health insurers to reconsider the policy that existed disallowing the provision of contraceptive coverage to beneficiaries [27]. It is critical to study such issues in order to provide policy makers with concrete results upon which to base policy decisions.

There has been little success decreasing unintended pregnancy/childbearing despite decades of study and nearly ten years of programmatic efforts to this end since the publication of the Institute of Medicine's The Best Intentions report on unintended pregnancy [2]. EC offers new promise as another tool to use to decrease the number of unintended pregnancies. Education efforts around EC are critical to its success.

Emergency Contraception

Emergency contraception (EC) is the use of a method of preventing pregnancy after sexual intercourse has occurred. The most commonly used method of EC is oral contraceptives (OC's) [58, 59]. Other methods that have been used are postcoitally inserted intrauterine devices (IUDs), the steroid danocrine, and the antiprogestegen mifepristone (also known as RU486) [59, 60]. Yuzpe pioneered the most extensively studied OC-based EC method many years ago. The Yuzpe method is a "high" dose (two doses of 100 mcg ethinyl estradiol and either 0.5 mg of levonorgestrel or 1.0 mg of norgestrel) of oral contraceptives, originally within 72 hours of intercourse, followed by another dose 12 hours later [61, 62]. The earlier EC is taken after intercourse the greater the effectiveness. Hormonal methods are most effective when used within 24 hours after unprotected intercourse and best used within 72 hours. Even so, EC can be used for up to 120 hours (five days) after unprotected intercourse [63-65]. The longer after unprotected intercourse it is taken, the less effective EC will be [66]. It is likely that these OC-based methods of EC affect ovulation, but they could also act through other effects on fertilization and on various aspects of the hospitality of the reproductive system towards fertilization and implantation [59, 64, 67-69].

The Yuzpe method of EC is approximately 75% effective [60, 70]. In other words, the method prevents about 75% of the pregnancies that would be expected without its use [71, 72]. IUD's have higher effectiveness than OC's and can be used as continuing contraception, however, use of this method requires access to a trained provider and willingness to access such a provider [58].

The FDA approved the provision of the Yuzpe regimen and requested applications for dedicated products in 1997 after it had already been in use for many years [73]. One such product is known as Preven©. In 1999, the FDA approved a progestin-only regimen consisting of two 0.75 mg doses of levonorgestrel taken 12 hours apart, called Plan B© [64, 68, 74]. This regimen causes less of the noted gastrointestinal side effects than the Yuzpe regimen of EC (or Preven©) and is even more effective [59, 63, 64, 66-68, 75, 76]. A more recent study using a

double blind, multi-centre, randomized design found that taking a single 1.5 mg dose of levonorgestrel was just as effective as the two-dose regimen [77]. Modelling the regimen on this finding would likely further simplify the use, and thereby increase the efficacy of this form of EC.

High dose hormonal EC (such as Preven© and Plan B©) is not an abortifacient. Implantation does not occur until seven days after fertilization, while EC is administered within five days of intercourse. Therefore, there is not an implanted embryo present for EC to affect when it is administered for a specific act of intercourse [78]. However, if there is an implanted embryo present from previous intercourse it is not affected. High dose hormonal EC affects aspects of ovulation and cannot affect an embryo once it has implanted in the uterus, as can some of the other available methods [58, 59, 63, 75, 78]. Mifepristone is the only oral method that can interrupt a pregnancy after an embryo is already implanted [63]. There are no contraindications for EC [59, 60, 63, 75, 78, 79].

There is little published information about EC vis-à-vis access and use outside of the United Kingdom, Europe, and the US [80]. The studies that have been done show a wide range of levels of understanding of, access to, and use of EC [3, 58, 80, 81]. The fact that abortion rates are lower in countries with better access to EC could mean that EC use could lower the number of unintended pregnancies [76]. However, the use of emergency contraception overall by women has been extremely limited. It is clear, as will be elaborated upon below, that lack of knowledge in and of itself is a barrier to the use of EC [64]. Access to EC can also be difficult due to the requirement in most countries that it be prescribed by a physician [75]. This is further complicated by the usual increased need for EC on the weekends, when it is often difficult to find open clinics and to access providers [82, 83]. EC is under-prescribed and is prescribed most often to rape victims (usually by emergency physicians) [84], suggesting that prescription by other more regular providers of care is still much too low. In addition, some Catholic hospitals will not discuss EC with rape victims, signifying even in the case of rape that access may be limited [85]. It has been widely proposed that EC be more effectively promoted and made more available (such as over the counter) in order to increase its use [60, 75, 80].

A major barrier to getting EC information is embarrassment, suggesting that the current procedures for obtaining EC need to be modified [86]. It was found that 90% of women in a study conducted through the Kaiser Permanente system found EC easy to use with the provision of information, and that 77% of these women were satisfied with EC. Of these women, 97% said they would use EC in the future only in an emergency [87]. Indeed, there is no evidence that EC is used by women in place of a regular form of birth control. This is also true if women were provided with EC before it was needed [59, 64, 75, 80, 81]. In addition, there do not appear to be any health risks associated with non-physician provision of EC [80], although provider contact might lead to use of more effective subsequent contraception. Issues with knowledge and access are clearly negatively impacting the use of EC [80].

Many unintended pregnancies and births happen due to incorrect use of contraception. Therefore, EC could prevent millions of abortions and unintended pregnancies every year if it were used more widely worldwide [60, 63, 70]. However, EC is only used by a very small number of women in the US [59, 63]. In addition, a low frequency of EC use was shown among women having abortions between 2000 and 2001 who reported possible contraceptive failure as the reason for their pregnancy [88]. EC is also an important method of avoiding pregnancy for women not having sex on a regular basis, having it under coercion or force and/or using contraception sporadically [35, 58]. A study showed that reasons that teens requested EC were: unprotected intercourse (54%), a missed pill (11%), and a ruptured condom (30%) [82]. In addition, they often engage in intercourse in an irregular fashion and do not plan for contraception before engaging in sexual activity [81]. One study found that teens cited condoms (54%), no method (33%) and OC's (13%) as their methods of contraception [82]. Therefore, EC would also be beneficial for teens, who are frequently using only condoms or no contraception at all.

As mentioned, it is also thought that requiring women to present for an EC prescription is a method to target women for regular contraceptive counselling [83, 84]. Interestingly, a Swedish study of women visiting a youth clinic for EC found that nearly a tenth of the women

had an unintended pregnancy within the next year despite contraceptive counselling and prescription of OC [82]. These studies indicate that we may need to learn more about how to better serve all women, especially those who struggle with controlling unintended pregnancy through the use of EC and contraception.

Knowledge of Emergency Contraception

Unfortunately, women of all ages overwhelmingly lack knowledge of EC and are faced with clinicians with misperceptions about this method of conception prevention, adding to the problems with access to EC [59, 60, 78, 81]. Lack of knowledge is particularly problematic for this method as it has a very specific time window for use [78, 83].

The breadth of knowledge of EC has been more widely studied in other countries than it has been in the US. Knowledge of EC appears to be better in European countries such as the United Kingdom and the Netherlands and less extensive in less developed countries like Mexico and Nigeria [89]. Knowledge appears to vary by age and to be fairly limited [80]. One issue is that EC is known by many synonyms, such as postcoital contraception, postovulatory conception, morning-after pill, visiting pill and vacation pill [90]. Several terms for the same treatment may lead to confusion about the method. In addition, lack of a dedicated product, which was a long time coming in the US, likely made it difficult even for providers to acquaint themselves with the details of the use of EC [91, 92].

Sources of knowledge of EC cited by potential users do not tend to be providers, as might be hoped. The sources of knowledge cited in a Swedish study were (most common to least common) friends, school, media, the health service and finally parents [82]. A study of EC seekers at clinics in the UK and the US demonstrated that the majority of the women in the UK knew of EC from using it previously. In the US, knowledge came from friends or the media. Only 11% of the US women and 22% of the UK women had heard about EC from a provider [93]. Other studies have similarly found friends and/or media to be the major sources of knowledge with providers somewhere behind these other sources of information [68, 80, 94-

102]. However, one study amongst low-income women did show that they were equally likely to have heard of EC through friends, the media or a provider [103]. Another study found the order of most frequent routes of finding out about EC to be friends, providers, media then schools in that order [104]. It is clear that health care workers need to be providing information about EC more frequently and that schools and media need to be targeted heavily as vehicles for dissemination of information about EC.

Knowledge of Emergency Contraception in Potential Users

Studies show that knowledge of EC among potential users is relatively low. As mentioned above, the understanding of EC use seems to be even worse in countries that are less developed. Studies in Ghana, Kenya, Nigeria, Mexico, South Africa, and Jamaica (where abortion is illegal), among samples of students and individuals attending health clinics indicated that between 11 and 84 percent of those surveyed knew of EC, with the upper limit being among Jamaican university students [86, 94, 95, 97, 100, 102, 104, 105]. Previous use of EC was seen in ten percent or less of the individuals in studies that assessed use [95, 97, 104]. Knowledge of the correct timeline for using EC ranged from nearly nil to just over half [86, 94, 97, 100, 102, 104]. In addition, many of the studies indicated that participants had little knowledge of effectiveness or ingredients [94]. In Kenya, however, many of those aware of this method did know where to obtain EC [94]. EC is actually available over the counter in Nigeria [100], meaning that increased knowledge of this method could have a large effect there due to relatively easy EC access. In the Jamaican study, half knew the ingredients, nearly two-thirds knew its effectiveness and there was fairly wide knowledge of where to get EC [97]. Knowledge of where to access EC in Mexico and South Africa was low [86, 104]. There were widespread concerns about safety and evidence of the misperception that EC is an abortifacient [94, 104, 105]. One of the Mexican studies demonstrated that potential user knowledge, though relatively low, was better than that of providers in Mexico claiming to know of EC [95]. The clients questioned in this study voiced concerns about side effects and "inappropriate" use of EC as a

more regular form of contraception [95]. Factors associated with knowing of EC in various studies were: being sexually active, being younger, nulliparity, previous and current contraceptive use, and higher education level [95, 100, 104]. Attending religious services was often associated with not having heard of EC [97].

Knowledge levels are better in developed countries, as noted, but knowledge and understanding of EC is still not adequate. Studies have been conducted in various parts of the UK, New Zealand, Sweden, Finland, Denmark, and the US, among others. One of the surveys in the US was a large, nationally representative survey conducted by the Kaiser Family Foundation and was called The National Survey of Americans on Emergency Contraception. This survey was conducted in 1994 and 1997. Kaiser also conducted a Survey of Health Care Providers on Emergency Contraception in 1997 [98, 106]. In studies focusing on women presenting for abortion, between 30% and 83% had heard of EC [68, 107-110], and between 38% and 50% properly understood the time window for its use [68, 109, 110]. Sixty-two percent of women presenting for a pregnancy test and getting a positive result were aware of EC [27]. A study of low-income post-partum women in the US indicated that 36% had heard of EC, 3% had used it, and only 7% knew the correct timing [103]. Studies using random samples found between 52% and 95% of those surveyed knew of EC [98, 99, 111, 112], but that only around 40% knew the correct timing of the regimen [99, 112]. Specifically in the Kaiser survey, 61% of women in 1994 and 66% in 1997 knew of EC; EC was familiar to a somewhat smaller proportion of men [98]. Only half of these women also said that a woman could do something in the days after unprotected intercourse to prevent pregnancy [98]. The abortifacient misconception, as well as those regarding safety, effectiveness, and ingredients, was also evident in these studies when assessed [68, 80, 98, 103, 112, 113]. Thinking that EC causes abortion was significantly associated in a multiple regression model in one study with being against using EC [103]. A study of Princeton students indicated that if they had health concerns regarding EC, they were more likely to have ethical concerns as well. Also associated with ethical concerns were religion, Republican Party affiliation and a lack of knowledge of the ingredients of EC [112]. Studies in

developed countries variously found that knowledge was better in women who had had an abortion. Knowledge was also better in women who were: younger, unmarried, regular or prior users of contraception, more educated, more likely employed, renters, of higher income, privately insured, of certain racial groups and nulliparous [27, 68, 98, 99, 103, 109-111]. Predictors of a lack of knowledge of EC in one other study were being a multipara, Asian and never having used contraception [103].

Teens are a group that could particularly benefit from a good understanding of EC and its use. Knowledge in teens varies across the world. School surveys in Scotland and Canada amongst teens indicated 93% (females and males) and 80% (females only), respectively, had heard of EC, while only 25% and 10% knew the correct timeline for EC use [96, 101]. In Scotland, about a third of the girls and a quarter of the boys' partners had used EC. Over 75% knew EC could be obtained from a general practitioner [101]. In the Canadian study, knowledge did not differ by sexual experience [96]. Misconceptions about the safety and efficacy of using EC are also widespread in teens [96, 101, 114]. Of US inner-city teens visiting a clinic, only a small proportion cited EC when asked what could be done to prevent pregnancy after unprotected sex [115]. Eighty-one percent of pregnant UK teens had heard of EC, and, of the teens who had heard of EC, only 12% had tried to use it [116]. Responses from teens participating in the Kaiser survey showed that only just over a quarter had heard of EC and that knowledge varied by age, race and consistency of birth control use [114]. Despite this, a large proportion of these teens said that they would use EC, the greatest proportion being those who had been informed about contraceptive and pregnancy issues by their medical providers [114]. These data point out the potential benefits of more regular provision of such information to teens [114].

Provider Knowledge of Emergency Contraception

The Kaiser study found that provider understanding of EC was good [98]. However, two studies of pediatricians showed that a large number lack knowledge about the correct time

window and the FDA-approved methods for prescribing EC [117, 118]. Pediatricians also report discomfort with prescribing EC [117]. A number of respondents in this study said that they would restrict how often they prescribe EC to a patient and only a small minority said that they would prescribe EC for adolescent females to have on hand, or agreed that EC should be available over the counter [117]. These attitudes, as well as a propensity to prescribe EC far more commonly as an emergency response measure rather than as a part of routine visits, have also been demonstrated elsewhere [80, 98, 119]. The Kaiser Survey of Health Care Providers on Emergency Contraception found that more health professionals were prescribing EC in the US 1997 than in 1994, but prescription writing was still infrequent, in particular providing EC in advance of it's need [98, 106]. Improper understanding of health risks leads to their overstatement by providers [80, 119].

The availability of dedicated products such as Preven© and Plan B© might have opened the door for wider knowledge of EC among providers. However, EC was still needed most often on weekends, when it can be difficult to find a provider. Emergency rooms, which could be the most likely place to obtain EC after hours, have traditionally been willing to provide EC in the case of rape, but have not wanted to do this in the case of consensual sex. Preven© was most often given out in emergency rooms and not often prescribed, so it was not stocked by pharmacies. When Plan B© became available, the Women's Capital Corporation that produced it had few resources with which to educate doctors about the product.

Programmatic Issues: Knowledge of Emergency Contraception

Understanding which groups of women are less likely to know about EC would help policy makers and program developers to most effectively target these groups with educational efforts. This is necessary as all studies that reported EC use uniformly reported use proportions to be quite low. Teens are in particular need of EC education. If misconceptions and restrictive attitudes towards EC exist in providers, it will be very difficult to expand knowledge and use in the population of patients that could benefit from use of EC. Providers must become more

familiar with EC and must incorporate the provision of, and discussion of, EC into their routine practice.

Part of the challenge of informing the public about emergency contraception is the promotion of scientifically inaccurate ideas such as EC is an abortifacient and causes health problems [86]. The abortion misconception is widespread [86] and problematic, as it gives EC a negative stigma and likely decreases its use. After the FDA approval of Preven©, some pharmacists began refusing to fill EC prescriptions and some states, such as South Dakota, passed laws allowing pharmacists to refuse to fill prescriptions for drugs that could be used to "destroy an unborn child" [120].

In order to help increase awareness about EC in the US, Reproductive Health Technologies in Washington, DC, the Office of Population Research at Princeton University, and the communications firm Elgin DDB joined in launching a six-city EC campaign in 1997. This consisted of the production of public service announcements (PSA's) for television, radio, and billboards as well as a national media campaign. The PSA's promoted awareness of EC in general and of a hotline providing EC information and the names and telephone numbers of the five closest providers, 1-888-NOT-2-LATE. The PSA's were placed in six cities: Chicago, Los Angeles, Miami, San Diego, Seattle, and Philadelphia (added in early 1998) [121]. Another effort towards decreasing unintended pregnancies by increasing access to EC was undertaken as pilot project in by staff of the Program for Appropriate Technology in Health (PATH) in Washington state. Pharmacists were able to directly prescribe EC using collaborative drug therapy agreements (CDTA) with doctors, which have traditionally been used for chronic illness rather than public health applications. There exists legislation for CDTA's in 25 states with varying levels of authority allowed to pharmacists. The Washington project began in July 1997. A press conference was held at the end of February 1998, once 30 pharmacies had at least one trained pharmacist each. A media campaign in alternative and college newspapers and radio started at about the same time. The project also garnered national media coverage. The project ended officially in June 1999, but EC education has been incorporated into regular pharmacist training

at the University of Washington and is offered as a continuing education class for pharmacists in Washington [Jane Hutchings, PATH, personal communication, March 8, 2004]. The Washington effort also attempted to get women presenting for EC to begin using regular reproductive services through the pharmacists [83, 122]. This project was followed up by a second PATH project involving pharmacists in eastern Washington. This endeavour included pharmacist training and participation in prescription of EC. Radio advertisements were also run for about 6 weeks. This project lasted for about 13 months and ended in 2000 [Jane Hutchings, PATH, personal communication, March 8, 2004]. In each case, these groups attempted to convey the message that there is something that can be done to potentially prevent pregnancy after sex, and to provide information about where to get EC (various providers on the national hotline and, more specifically in Washington, pharmacists). The data gathered showed that women were satisfied with pharmacist services and increased access to EC. Many of the women getting EC from pharmacists did not have a regular health care provider. Sixty percent of the pharmacists referred women for subsequent care, mostly for contraceptive purposes, suggesting that the goal of increasing the number of women using regular contraception was attained [PATH website, May 2, 2004].

Expansion of these types of projects could help increase the use of EC. In fact, pharmacists can now prescribe EC in the states of California, Alaska, Hawaii and New Mexico in addition to Washington. In addition, a lower occurrence of pregnancy and a savings of $158 per woman having unprotected intercourse and obtaining EC from a pharmacist was found when this group was compared to women not obtaining EC from a pharmacist [123]. More recently, the Food and Drug Administration has been considering EC for over-the-counter sale after their advisory panels voted to recommend that Plan B© be available over-the-counter [124]. Unfortunately, following this decision, opposition arose from conservative members of Congress. The FDA subsequently decided to review this decision for three additional months, delaying their decision until May 2004 [125]. If the FDA follows through with the advisory panel recommendation, it would serve to further increase ease of access to EC.

Between October 1999 and December 2001, during which time the PRAMS data for 2000 was being was being collected, Population Services Inc. (PSI) in Oregon spearheaded an EC education and access program called the Emergency Contraception Promotion Project (ECPP). This project involved marketing of Plan B© using a number of methods. These included: community education through media coverage, mobilization of support from community organizations, recruitment of pharmacies to stock Plan B, provider training, and involvement of the community through an advisory committee and various community presentations. Assessment of the impact of the project found that community support, demand for EC, use of the national EC hotline, and provider knowledge were substantially increased after the implementation of ECPP [126].

Pregnancy Risk Assessment Monitoring System (PRAMS)

PRAMS data were collected for the purpose of studying characteristics that are potentially related to the health of babies and mothers [6, 127, 128]. The first CDC PRAMS questionnaire was developed in 1987 and has since undergone four revisions. The questionnaire consists of a core set of questions to which states can their own questions as dictated by interest or need [6, 128]. PRAMS can allow for cross-state comparisons and the study of trends over time [128, 129]. PRAMS is designed to provide findings that lead to program and policy improvement, and states have used PRAMS findings to obtain funding for expansion of services [128]. Notably, PRAMS data has been used to develop unintended pregnancy programs and policy in Georgia, Washington and Oklahoma. For example, in Georgia, studies using PRAMS data were used to get Title X federal funding to launch an initiative to decrease unintended pregnancy directed at male, female, and hard to reach groups of teens [130].

Oregon PRAMS is based on the CDC-designed surveillance system. The 1998-1999 through 2001 Oregon PRAMS was independent of the CDC system; however, the CDC provided technical assistance to Oregon PRAMS. Therefore, Oregon was not included in CDC reports regarding PRAMS data. Beginning in 2002, Oregon PRAMS became part of the CDC PRAMS

system. Oregon PRAMS uses CDC PRAMS questions in addition to questions of local interest [6, 127].

Oregon PRAMS data has been used to study infant sleep position and periconceptional folic acid use [46]. Some of the risk factors that have been considered before and for this study are: maternal education, insurance status at labour and delivery, annual income, Women, Infants and Children Program (WIC) enrollment, insurance status before pregnancy, marital status, maternal age, prenatal care, tobacco use during the last three months of pregnancy, tobacco use before pregnancy, parity, alcohol use during the last three months of pregnancy, alcohol use three months before pregnancy and race/ethnicity [127]. Among the intentions of the Oregon Office of Family Health for using PRAMS data are to be able to perform state-to-state comparisons and to look at Oregon trends over time [127].

Many studies evaluating the associations of various factors with unintended pregnancy use convenience samples, such as those obtained from a prenatal or other type of clinic. For example, one study looked at unintended pregnancy in women that were members of a large health maintenance organization that had attended a health appraisal clinic [40]. The results of such a study may only be generalizable to certain women. For instance, these women were predominantly white college educated women who were married at the time of their first pregnancy [131]. It is difficult to use such a study to generalize to the diverse population of an entire state. In addition, prenatal clinic-based samples by design only choose women already obtaining prenatal care. These studies are incapable of looking at population-based associations. For this reason, it is of interest to obtain and study population-based information about pregnancy intention and other characteristics of pregnancies, in order to glean results that are more widely applicable to the population of a state.

The Oregon Pregnancy Risk Assessment and Monitoring System (PRAMS) was implemented to obtain population-based information in OR. PRAMS also serves the function of gathering state-specific information for OR. Analysis of childbearing intention using PRAMS data in eight states showed that women had significantly different odds of unintended childbearing

when controlling for race, marital status, age, education, having a previous live birth and participating in WIC, in different states [19]. As factors associated with unintended childbearing may differ state to state, it is important to have state-specific information in order to properly tailor intervention programs. Finally, the relative consistency of PRAMS information gathered in different states allows for state-to-state comparisons or regional studies.

Rationale For Study

Healthy People 2010 guidelines suggest that the proportion of intended pregnancies be raised from 51% to 70% [132]. A better understanding of unintended pregnancy could help to lead to such improvements in support of the health of mothers, children and families. As noted, it is already known that some factors affecting the incidence of unwanted pregnancies are marital status, age and economic status [2]. Unmarried women, poor women, black women, and women at the two extremes of the reproductive age span experience unintended pregnancy disproportionately. It is also of interest to know how such factors as knowledge of EC might be associated with unintended childbearing. Further understanding will allow efforts to be focused on these groups and others that are especially affected. It is therefore of interest to expand the study of the factors associated with unintended pregnancy and childbirth in order to decrease the number of such pregnancies in Oregon and in the US overall. It is likely that there exist other factors in addition to those mentioned above that affect a woman's risk of experiencing unintended conception. Continuing to further such studies could augment efforts already being made to decrease the numbers of unintended pregnancies.

Study Objective

The initial objective of this project was to look for independent risk factors associated with unintended childbearing using the Oregon PRAMS data from 1998-1999. The second objective was identified after the fact while looking at the relationship between knowledge of EC and unintended childbearing. A multiple logistic regression model describing the relationship

between unintended childbearing, knowledge of EC and other factors was developed. This model was then verified by its application to Oregon PRAMS data from 2000.

METHODS

Pre-Study Data Collection and Processing Methods

PRAMS Data Collection

This study used data previously collected as part of the 1998-1999 (12 consecutive months) administration of the Oregon PRAMS survey. The first version of the survey used was administered from November 1998 to March 1999 and the second from April 1999 to October 1999. The surveys asked about babies born in Oregon between August 1, 1998 and August 9, 1999. The only difference between the two versions was in the categorization of the answers about family income (in order to reflect changes in federal poverty level guidelines). The survey was sent to 2,919 women (from 45,043 eligible births) from November 1998 through October 1999 . There were 1,867 responses (64.0% response proportion; unweighted) from first and second mailings and telephone interviews.

Every month, from August 1998 through July 1999, Oregon's birth certificate file was used to select a stratified random sample. Mothers were generally sampled 60-90 days after giving birth. If the mother had not previously been sampled, if she would have been eligible and if she had not had her child more than 180 days previous (this was generally due to late reporting to Vital Statistics), she was included in a subsequent month's sample. If a baby died after a live birth (determined via Vital Statistics) and the birth was chosen to be a part of PRAMS data collection, the mother received the same questionnaire but a different cover letter. Two to six months after a selected mother delivered her baby, an initial letter was mailed to the mother to make her aware of PRAMS and the fact that she would be receiving a questionnaire. The PRAMS questionnaire was sent about 7 days after this letter. If a woman was described as Hispanic on the baby's birth certificate, she received both a Spanish and an English version of the PRAMS questionnaire. The option of a telephone interview was offered to all mothers with the questionnaire. A tickler note was sent to the mother about 7 days after the original questionnaire was sent. This was to serve as a reminder to the mother in case she had not yet completed the questionnaire. A second questionnaire was sent out to mothers who had not

replied by 14 days after the tickler was sent. A follow-up attempt was then made by telephone if no response had been received by 14 days after the second questionnaire was sent. In other words, PRAMS was a mixed mode surveillance system. Clearwater Research, Inc. in Boise, Idaho did the telephone surveys. The telephone-administered survey contained the same questions as the mailed questionnaire, but some questions were reformatted for use on the telephone. A number of sources were used to obtain telephone numbers. Each number was called at different times of the day on different days of the week. All telephone numbers available for the mother were called a maximum of 15 times over 2-3 weeks. If necessary, a time to call back was arranged at the mother's convenience. The telephone interviews were conducted in either English or Spanish, as requested by the respondent. There was an option to make other arrangements for women who spoke neither language.

The first mailing included a cover letter that described PRAMS, explained how and why the mother was chosen, elicited the mother's cooperation, described procedures for filling out and returning the questionnaire, explained the incentive (see below) and provided a toll-free telephone number for additional information. This letter was modified slightly in the second mailing, primarily by adding an additional appeal for a response. The mailings included a number of other items: the questionnaire booklet, consisting of 20 pages with a colourful cover and two blank pages for comments from the mother, a self-addressed return envelope with postage provided, a "Frequently Asked Questions about PRAMS" fact sheet, a three-year calendar for reference purposes and information about an incentive (one mother who responded to the written survey was selected each month to receive a $200 gift card from a state-wide grocery chain) .

PRAMS Sampling Methodology

Sampling in Oregon was done within six groups. The groups consisted of low birthweight (less than 2500 grams) Non-Hispanic White, normal birthweight (greater than or equal to 2500 grams) Non-Hispanic White, Hispanic, Non-Hispanic Black, Non-Hispanic American Indian/Alaskan Native, and Non-Hispanic Asian/Pacific Islander. Sample sizes for race/ethnicity and birth weight groups were based on the total births in Oregon, to Oregon residents, in 1997. In the case of multiple births to one mother, one baby was randomly sampled before the overall sample was chosen. The mothers of these babies were asked to answer questions about only the selected baby. The sampling scheme aimed for each of the six strata to have about 400 women, and various weighting strategies (described below) were applied to the collected data . The sampling proportions in the various strata are shown in Table 1. If the sampling proportion used was greater than 0.1 (for all but normal birth weight White and Hispanic), the finite population correction factor was used to adjust the allocation to the strata. This helped to avoid violating important assumptions associated with the use of an infinite population. The sample sizes were then inflated by dividing by 0.8 for Non-Hispanic White and Hispanic and 0.7 for the others, reflecting the projected response rates of 80 and 70 percent respectively.

Table 1. Sampling proportions in race strata-Oregon PRAMS (1998-1999)

Race	Total Population in Oregon in Stratum	Sampling Proportion	Number Sampled
Hispanic	6680	0.1	686
Non-Hispanic American Indian/Alaskan Native	660	0.5	339
Non-Hispanic Asian/Pacific Islander	2080	0.25	521
Non-Hispanic Black	910	0.45	422
Non-Hispanic White, normal birth weight	33162	0.015	537
Non-Hispanic White, low birth weight	1562	0.25	414
Total	45054		2919

For analysis, after data collection, the PRAMS data were weighted to reflect the entire population of pregnant women in Oregon. Essentially, this means that each woman sampled was given a weight corresponding to the number of women in Oregon that she represented. The final analysis weight was calculated as the product of the three separate weights: the sampling, non-response and non-coverage weights. In other words, each woman counted in analyses for a certain number of women in Oregon depending on the stratum. A white woman with a normal birth weight baby who completed the survey represented a greater absolute number of women in the population than did an American Indian woman, for example.

The non-response weight was used to account for the fact that women with certain characteristics tended to have lower response frequencies. The responses of women in categories with lower response rates were given a greater weight than responses of women with higher response rates. The CDC found that some of the characteristics that affected response rates were: being married, education, parity, age, and first trimester prenatal care initiation [6]. Levels within these variables were checked for significantly different response rates among demographically similar women using a logistic regression analysis within each of the six strata. For example, in Oregon, white women with low birthweight babies who were unmarried were less likely to answer than married women, so the unmarried respondents were assigned a larger weight. The non-response weight was then the total sample size in a particular group as defined divided by the number of respondents. In the case where there were no discernible differences within a stratum between respondents and non-respondents, the entire stratum was assigned a weight equal to the sample size in the stratum divided by the actual number of respondents [6]. The groups where differences were found were as follows:

White women with normal birth weight babies:

- who had a college education or greater had a different response rate than white women with normal birth weight babies that had less than a college education and were 30 years of age or older.

- who had a college education or greater had a different response rate than women that had less than a college education and were 29 years of age or younger.

White women with low birth weight babies:

- who were married had a different response rate than white women with low birthweight babies that were unmarried.

Hispanic women:

- who were married had a different response rate than Hispanic women with low birthweight babies that were unmarried.

African American women:

- who had a grade 12 education had a different response rate than African American women that had less than a grade 12 education/no education.

American Indian/Alaskan Native women:

- who did not get prenatal care or got it late had a different response rate from American Indian/Alaskan Native women that did get prenatal care and were married or that did get prenatal care and were unmarried and below 19 years of age.
- who did not get prenatal care also had a different response rate from American Indian/Alaskan Native women that got prenatal care, were unmarried and were above age 19.

Asian/Pacific Islander women:

- who had a grade 12 education had a different response rate than Asian/Pacific Islander women that had less than a grade 12 education/no education.

The most common reason for non-coverage was that a duplicate birth certificate was generated and the birth certificate selected had disappeared by the time of data collection. PRAMS responses were linked to the surviving birth certificate file. The non-coverage weight was calculated by dividing the number of files in the current birth certificate list by the number in the sampling frame for the same time period.

Study Data Management and Analysis Methods

Data Analysis

The data were obtained from the Oregon Department of Health and Human Services in a Statistical Package for the Social Sciences (SPSS, SPSS, Inc.) format. SPSS Version 10.0 and SUDAAN Software for the Statistical Analysis of Correlated Data Version 8.0 (Research Triangle Institute, Research Triangle Park, NC) were used to analyze the data. SUDAAN is designed to analyze weighted complex sample survey data using first-order Taylor series approximations to calculate standard errors. This is necessary for data derived from a complex sampling strategy, such as that used for PRAMS. Data that were analyzed using SUDAAN were sorted by sampling strata with weights calculated as described above applied to the data. SPSS was used to generate variable frequencies, crosstabulations, and for continuous variable scaling analyses. SUDAAN was used to generate crosstabulations and to perform simple and multiple logistic regression modelling. Reported significance levels in all cases were determined using SUDAAN.

Question 5 on the PRAMS questionnaire asked: "Thinking back to ***just before*** you got pregnant, how did you feel about becoming pregnant?", and was used to designate births as intended or unintended. The responses "I wanted to be pregnant sooner" and "I wanted to be pregnant then" were taken to indicate that a birth was intended. The responses "I wanted to be pregnant later" (mistimed pregnancy) and "I didn't want to be pregnant then or at any time in the future" (unwanted pregnancy) were taken together to indicate that a birth was unintended. Missing answers (22 survey respondents) and the response "I don't know" (99 survey respondents) were removed from the majority of the analyses, leaving 1746 respondents for study. The risk factors of interest are shown in Table 2. Knowledge of emergency contraception (EC) was chosen as a particular factor of interest. This question was in a section asking about events previous to conception. The knowledge of EC question (number 12b) asked: "Had you ever read or heard about emergency birth control (the "morning-after" pill)? The available responses were, "No" and "Yes". Missing answers (43 survey respondents) were removed from the majority of the analyses, leaving 1843 responses available. Birth certificate data was used

for variables that were not available from PRAMS, except in the case of age, where birth certificate data was used as it was more complete.

Variable Recoding

For use in logistic regression as the outcome variable, the responses "I wanted to be pregnant sooner" and "I wanted to be pregnant then" were recoded for SUDAAN as 0 (referent-intended birth) and the responses "I wanted to be pregnant later" (mistimed birth) and "I didn't want to be pregnant then or at any time in the future" (unwanted birth) were recoded to 1 (unintended birth). For explanatory variables with two levels (see Table 2), and a variable generated for use of the unintended childbirth variable in crosstabulations, the category of interest was recoded to 1, and the referent category was recoded to 2 (SUDAAN uses the highest number as its default referent category).

For the version of the race/ethnicity variable with five levels, the referent category (white) was recoded to 5 and the other four categories were recoded 1 through 4. Binary explanatory variables were coded as shown in Table 2.

Two variables used in the analysis were derived from questions that were part of a skip pattern on the survey. The first was tobacco use in the 3 months before conception. If women answered no to question #33, "Have you smoked at least 100 cigarettes in your entire life?", no matter what they said in response to question #34, "In the 3 months before you got pregnant, how many cigarettes or packs of cigarettes did you smoke on an average day?" their answer was coded as no. If the first answer was affirmative or missing, the answer to the second question was used to determine women's tobacco use status. The second was regarding reasons for not using birth control. If women answered yes to question #8, "***When you got pregnant*** with your new baby, were you or your husband using any kind of birth control?", no matter what they said in response to question #9, "Why were you or your husband or partner not using any birth control?" their answer was not counted. If the first answer was negative or missing, the answer to the second question was used to determine why birth control was not being used. This

answer was a "check all that apply" answer. The analysis was limited in this case to women providing a single answer.

On the 2000 survey, an option was added for question #6. Instead of just having the options "yes" and "no" in answer to the question, "***Just before*** you got pregnant, did you have health insurance?", as in the case of the 1998-1999 survey, the options offered were "Yes, but it did not cover prenatal care", "Yes, it covered prenatal care" and "No" were offered. Both "Yes" answers in the 2000 data were recoded as "yes" for analysis purposes, in order to stay in line with the answer options on the 1998-1999 survey.

Table 2. Recoding of two-level categorical variables for analysis of the Oregon PRAMS dataset (1998-1999)

Variable	Recoded to 1	Recoded to 2 (Referent)	Source
Family Income[1]	<$30,000	>=$30,000	PRAMS
Maternal Age	<18	>=18	Birth Certificate
Maternal Smoking[2]	Yes	No	PRAMS
Insurance prior to pregnancy	None	Any	PRAMS
Marital Status[3]	Not married	Married	Birth Certificate
Maternal Education	<12 years	12+ years	Birth Certificate
Maternal Race/Ethnicity	Other	White	Birth Certificate
Parity	Firstborn	Not firstborn	Birth Certificate
OHP enrollment pre-pregnancy	Yes	No	PRAMS
Maternal alcohol use[4]	Yes	No	PRAMS
Birth control use pre-pregnancy	No	Yes	PRAMS
Knowledge of availability of cheap birth control pre-pregnancy	No	Yes	PRAMS
Knowledge of availability of emergency contraception pre-pregnancy	No	Yes	PRAMS
Coverage of cost of birth control pre-pregnancy	No	Yes	PRAMS
Insurance for prenatal care at time of first pregnancy test	No	Yes	PRAMS
Folic acid use pre-pregnancy	No	Yes	PRAMS

[1]annual family income before pregnancy
[2]maternal smoking in the 3 months before pregnancy
[3]married=married/separated, not married=divorced/annulled/unmarried
[4]maternal alcohol consumption in the 3 months before pregnancy

Descriptive Analysis

PRAMS data for 1998-1999, 2000, and 2001 were obtained. Frequency distributions and cross-tabulations were used to explore variables and the relationship between explanatory variables and unintended childbearing (Tables 3, 5, and 6, for example).

Logistic Regression Analysis

Imputation was not used in this study to estimate missing data values. Respondents with missing values for any explanatory variable added to a model were dropped from modelling analyses by SUDAAN. Of the 1746 respondents with non-missing observations for the childbearing intention question, 8.3% of respondents were missing observations for one or more of the explanatory variables in the final logistic model, leaving 1602 respondents available for logistic regression analysis.

Simple Logistic Regression Analysis

The relationship between the unintended childbirth outcome and the various binary explanatory variables was explored by simple logistic regression modelling. Odds ratios (OR's) from logistic models were used to determine whether there was an association between an explanatory variable and unintended childbirth (see Table 4, page 38). Simple logistic modelling was also used to study the relationship between continuous explanatory variables and unintended childbirth. P-values from modified Wald F statistics [133-135] were used to determine whether there was a significant association ($p<.05$) between these variables and unintended childbirth. From these analyses, knowledge of EC was chosen as an explanatory variable of interest.

Age and income could have been entered in models as continuous variables as these variables were available in this form. In order to determine whether age and income were better entered into models as linear continuous variables, binary variables or otherwise, the scaling of

these variables with respect to the unintended childbirth outcome was examined. Two approaches were taken to study the scaling of the variables. First, the data were divided into quartiles. The patterns of the values of the proportions of unintended births calculated in each quartile were evaluated for linearity across the quartile groups. For example, if the proportions of unintended births (or means of childbirth intention as a 0,1 variable) had steadily increased or decreased with increasing quartile, we would infer that entering the explanatory variable being studied would be best entered into the model in a linear fashion. Secondly, Loess smoothed graphs [136, 137] of age and income as continuous variables were graphed against the unintended childbirth variable, allowing relationship between these variables and childbirth intention to be examined. The Loess procedure generates a line from data smoothed locally through regression techniques that are based on the quantity of local data used (designated by the user, 50% in this case). The shape of the line was used to determine if the relationship between the explanatory variables and the outcome would be better modelled linearly, using a binary form of the explanatory variable, or otherwise.

Multiple Logistic Regression

The method used for constructing multiple logistic regression models was based on looking at the effects of a number of variables of interest after assessing their significance in cross-tabulations and simple regression analyses. These variables were chosen based on their statistical significance, their interest level from a programmatic perspective and also from their known association with unintended pregnancy from the literature. Knowledge of EC was chosen as an explanatory variable of interest because it was significantly associated with unintended childbirth, this relationship had not been extensively studied, and because of the programmatic implications.

Before commencing multiple logistic regression modelling, the relationship between knowledge of EC and unintended childbirth was studied in stratified analyses. The association between knowledge of EC and unintended childbirth was calculated within the different levels of

other variables of interest. In addition, the correlations between each pair of these variables, including knowledge of EC, were calculated in turn using the phi-statistic [138].

EC was entered first into the multiple regression models and left in the models regardless of significance. Other variables of interest were then entered into models. Income was entered first, followed by age, marital status and education. If age or income were found not to be significant at the .05 level, they were removed. Marital status and education were left in the models regardless of significance to control for possible confounding, as they are known to be associated with unintended childbirth. They were also left in the models to assess effect modification of EC knowledge by these variables. Using multiple regression also controlled for any confounding of the relationship between knowledge of EC and unintended childbearing by age or income if they were left in the model.

Interaction terms between all of the variables remaining in the models after adding in knowledge of EC, income, age, marital status and education were stepped into the model one by one to assess their significance. An interaction term was considered significant with a p-value for the Wald F statistic of <.05. One interaction term with the lowest p-value was left in the model. Finally, as secondary control variables of interest, pre-pregnancy insurance status and the two-level race variable were each stepped in one at a time to see if either of these made a significant contribution to the model and were left in if they were found to be significant at the .05 level at this point.

OR's for most of the variables were obtained directly from SUDAAN output. However, OR's for variables in the interaction term must be calculated when there is an interaction term in a model. This was done by calculating the logit equations and substituting marital status equal to one in one equation (unmarried) and equal to zero in the other (married). All other variable values were substituted with their mean value. The two logit equations were subtracted. Most of the terms cancelled out, leaving the equation shown below (Figure 1).

Figure 1. Multiple logistic regression logit equations with interaction term and equation for calculation of odds ratios for marital status at given ages

Logit = $\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2$

Logit equation – Marital status=unmarried $(x_1 = 1)$, Age=C (x_2 =some chosen value, for eg. C)

Logit = $\beta_0 + \beta_1(1) + \beta_2(C) + \beta_3(1)(C)$

Logit equation – Marital status=married $(x_1 = 0)$, Age=C (x_2 =some chosen value, for eg. C)

Logit = $\beta_0 + \beta_1(0) + \beta_2(C) + \beta_3(0)(C)$

Subtract equations:

OR $_{\text{Marital status} \mid \text{Age=C}}$ = EXP $[\beta_1 + \beta_3(1)(C)]$

The values of the logit were calculated for several values of interest of the continuous variable for women that were unmarried. These values were exponentiated to obtain the OR for the categorical variable at certain values of the continuous variable. The CI's for the OR's were calculated by obtaining a covariance matrix for the parameters from SUDAAN and using the appropriate values from the matrix to calculate the variance of the log of the OR. The square root of the variance was calculated to obtain the standard error, which was then used to obtain the upper and lower confidence limits.

Validation of Model Generated from 1998-1999 PRAMS Data

The final model for the 1998-1999 data was applied to a second year of PRAMS data from 2000. In this case, the 2000 data was being used as a validation sample for the 1998-1999 data, not as a population-based sample. The parameter estimates and OR's were calculated and assessed for statistical significance, in order to compare the suitability of the 1998-1999 model to the 2000 data (see Tables 16A and B). Predicted probabilities were then calculated for individuals surveyed in 2000 using the logit equation from the 1998-1999 model. These predicted probabilities for 2000 were used both to classify individuals by calculating the sensitivity and specificity of the 1998-1999 model, and to plot a Receiver Operating Curve (ROC), which

plots sensitivity versus 1-specificity (see Table 17 and Figure 4) [139]. Sensitivity in this case measures the correct classification by the 1998-1999 model of births as unintended that were reported as unintended in 2000 and specificity measures the correct classification by the 1998-1999 model of births that were intended that were reported as intended in 2000. Classification analyses determined a predicted probability cut-off point for the model where sensitivity and specificity were maximized. Measuring the area under the ROC curve assessed the ability of the 1998-1999 model to discriminate between women reporting intended and unintended births in the 2000 data. This was measuring the likelihood that a woman who actually reported her childbirth as unintended in 2000 has a higher probability as estimated by the 1998-1999 model of having an unintended childbirth.

RESULTS

Unintended Childbearing Response Frequencies

Table 3 shows the distribution of responses to the unintended childbirth question. The unintended childbearing proportion in Oregon in 1998-1999 was 36.9%, with 27.0% of women describing their births as mistimed and 9.9% as unwanted.

Table 3. Unintended childbearing resulting in live birth in Oregon (1998-1999)

Response	Weighted Percent	n*
I wanted to be pregnant sooner	15.2%	291
I wanted to be pregnant later[1]	27.0%	566
I wanted to be pregnant then	41.1%	718
I didn't want to be pregnant then or at any time in the future[2]	9.9%	171
I don't know	5.6%	99
Missing	1.1%	22
Total	100%	1867

*unweighted number of respondents
[1]mistimed childbirth
[2]unwanted childbirth

Simple Regression Analyses: Categorical Explanatory Variables

Folic acid and use of birth control were tested to verify expected strong associations between these variables and unintended childbearing (Table 4). In simple regression analysis, women not taking folic acid were 4.72 times more likely than those not taking folic acid to report their pregnancy as unintended. Women who were not using birth control were 8.16 times more likely than those not using birth control to report their pregnancy as unintended.

Unintended childbearing was significantly associated with income, age, marital status, African American and American Indian race, education, tobacco use, alcohol use, lack of insurance and lack of insurance for prenatal care specifically, knowledge of cheap birth control and knowledge of EC (Table 4). Of these variables, marital status had the strongest association with unintended childbearing, generating a crude OR of 3.66. Some other crude OR generated by the association of other variables with unintended childbearing were as follows: 2.73 for

women with incomes below $30,000, 3.17 for women below the age of 18, 2.60 for women without insurance for prenatal care, 1.69 for women that did not know about EC and 1.58 for women with less than a grade 12 education. Parity, which has been shown to be associated with unintended childbearing in some instances, was not significantly associated with pregnancy intention in the 1998-1999 Oregon PRAMS data.

Table 4. Unintended childbearing[1] resulting in live birth by maternal characteristics in Oregon PRAMS (1998-1999)

Characteristic	n*	Childbirth Unintended (weighted)	Simple regression OR[2,3] (95% CI)
Total	1746	39.6%	---
Family Income[4]			
<$30,000	986	51.3%	**2.73 (1.97, 3.79)**
>=$30,000	669	27.8%	Referent
Maternal Age			
<18	89	66.6%	**3.17 (1.47, 6.85)**
>=18	1657	38.6%	Referent
Maternal Smoking[5]			
Yes	424	52.6%	**2.12 (1.48, 3.03)**
No	1295	34.3%	Referent
Insurance prior to pregnancy			
None	519	55.5%	**2.44 (1.77, 3.39)**
Any	1218	33.8%	Referent
Marital Status[6]			
Not married	593	61.9%	**3.66 (2.60, 5.15)**
Married	1153	30.7%	Referent
Maternal Education			
<12 years	429	48.8%	**1.58 (1.12, 2.24)**
12+ years	1303	37.6%	Referent
Maternal Race/Ethnicity			
Non-Hispanic White	651	38.6%	Referent
Non-Hispanic Black	195	53.1%	**1.80 (1.31, 2.47)**
Hispanic	411	41.6%	1.13 (0.86, 1.49)
Non-Hispanic American Indian/Alaskan Native	202	54.3%	**1.89 (1.39, 2.57)**
Non-Hispanic Asian/Pacific Islander	287	41.1%	1.11 (0.83, 1.50)
Maternal Race/Ethnicity			
Other	1095	43.3%	1.22 (0.96, 1.54)
White	651	38.6%	Referent
Parity			
Firstborn	768	39.6%	0.99 (0.73, 1.35)
Not firstborn	978	39.7%	Referent
OHP enrollment pre-pregnancy			
Yes	336	43.7%	1.28 (0.85, 1.94)
No	1279	37.7%	Referent
Maternal alcohol use[7]			
Yes	688	43.6%	**1.44 (1.06, 1.97)**
No	1006	34.9%	Referent
Birth control use pre-pregnancy			
Yes	389	76.8%	**8.16 (5.40, 12.34)**
No	1339	28.8%	Referent
Knowledge of availability of cheap birth control pre-pregnancy			
No	535	48.2%	**1.62 (1.16, 2.27)**
Yes	1185	36.4%	Referent
Knowledge of availability of emergency contraception pre-pregnancy			
No	671	48.5%	**1.69 (1.23, 2.33)**
Yes	1040	35.8%	Referent
Coverage of cost of birth control pre-pregnancy			
No	676	37.8%	1.23 (0.86, 1.75)
Yes	628	42.7%	Referent
Insurance for prenatal care at time of first pregnancy test			
No	489	56.0%	**2.60 (1.86, 3.64)**
Yes	1188	32.8%	Referent
Folic acid use pre-pregnancy			
No	1158	50.3%	**4.72 (3.14, 7.10)**
Yes	471	17.6%	Referent

*unweighted number of respondents (those who did not know or did not respond were excluded)
[1] Unintended includes women who wanted to be pregnant later (mistimed childbirth) plus women who did not want to be pregnant then or at any time in the future (unwanted childbirth)
[2] Odds Ratio
[3] Numbers displayed in bold indicate statistically significant results at the .05 level of significance
[4] annual family income before pregnancy
[5] maternal smoking in the 3 months before pregnancy
[6] married=married/separated, not married=divorced/annulled/unmarried
[7] maternal alcohol consumption in the 3 months before pregnancy

Knowledge of EC

Table 5 shows the distribution of responses to the knowledge of EC question over the years 1998-1999, 2000, and 2001. The proportion of women saying that they had heard of EC increased over these survey years.

Table 6 shows a breakdown of knowledge of EC by age group. While the proportion of women saying that they had heard of EC increased over the three survey years in the 22 through 24 and 30 through 34 years age groups, the age groups of 13 through 18 and over 40 years showed an decreased proportion of women saying that they had heard of EC in 2000, followed by a increase in 2001. The age groups of 19 through 21 and 35 through 39 years showed a increase followed by an decrease in proportions having heard of EC. Notably, EC knowledge in women in the age group of 25 through 29 years of age decreased over the three years of data.

Table 5. Knowledge of EC in Oregon PRAMS (1998-1999, 2000, 2001)

Response to: Had you ever read or heard about emergency birth control (the "morning-after" pill)?	**Weighted Percent** 1998-1999	**n*** 1998-1999	**Weighted Percent** 2000	**n*** 2000	**Weighted Percent** 2001	**n*** 2001
Yes[1, 2]	68.6%	1097	71.4%	1228	73.2%	1102
No[1, 2]	29.2%	727	26.3%	814	24.7%	646
Missing	2.2%	43	2.3%	58	2.1%	47
Total	100%	1867	100%	2100	100%	1795

*unweighted number of respondents
[1]Question header on the survey reads: These questions ask about things you knew about birth control ***before you got pregnant***.
[2]Below the question shown above, the survey states: **This special combination of regular birth control pills is used to prevent pregnancy up to three days after unprotected sex**. Bold and italicized print is shown as it is on the survey.

Table 6. Knowledge of emergency contraception by maternal age in Oregon PRAMS (1998-1999, 2000, 2001)

Response to: Had you ever read of heard about emergency birth control (the "morning-after" pill)?	Yes 1998-1999 weighted percent	Yes 2000 weighted percent	Yes 2001 weighted percent
Age Group			
13-18	55.6%	53.1%	64.9%
19-21	50.2%	67.3%	62.9%
22-24	72.1%	72.8%	77.9%
25-29	75.3%	71.3%	70.8%
30-34	75.8%	81.1%	82.7%
35-39	80.5%	83.7%	82.5%
40+	92.6%	81.4%	91.6%
Total	70.1%	73.1%	74.8%

Age

Analysis of childbearing intention by age groups is shown in Table 7. The most common age group in the sample (25 through 29) was chosen as the referent category. Women 13 through 18 years of age experienced a high proportion of unintended births. In this study group, the proportions of births described as unintended decreased steadily as age increased. Women over 40 reported almost all of their births as intended in this population; however, this age group was relatively small (N=39). All age groups younger than 25 through 29, except 22 through 24, were significantly more likely to report their childbirth as unintended. Women in the age groups above 29 years were overall significantly less likely to report their births as unintended as women 25 through 29 years of age. Unintended childbirth decreased as age increased.

Table 7. Unintended childbearing by maternal age in Oregon PRAMS (1998-1999), age 25-29 referent category

Age	Childbirth Unintended (weighted)	Simple regression OR[1] (95% CI)	n*
13-18	65.1%	**2.90 (1.59, 5.31)**	172
19-21	52.6%	**1.73 (1.08, 2.76)**	298
22-24	44.0%	1.22 (0.76, 1.96)	273
25-29	39.1%	Referent	460
30-34	28.1%	**0.61 (0.37, 0.99)**	337
35-39	23.7%	**0.48 (0.25, 0.91)**	169
40+	6.6%	**0.11 (0.04, 0.28)**	37

*unweighted number of respondents
[1] Numbers displayed in bold indicate statistically significant results at the .05 level of significance

Race/Ethnicity

Race/ethnicity was associated with reporting births as unintended in some cases, but not others (Table 8). In crude analyses, African American and American Indian/Alaska Native women were 1.80 and 1.89 times more likely to report their births, respectively, as unintended than women who are white. Hispanic and Asian women were no more likely to describe a childbirth as unintended as white women. Women of all non-white races grouped together were not significantly more likely than white women to report their births as unintended (Table 8).

Table 8. Unintended childbearing resulting in live birth by maternal race/ethnicity in Oregon PRAMS (1998-1999)

Race/Ethnicity	Childbirth Unintended (weighted)	Simple regression OR[1] (95% CI)	n*
Non-Hispanic African American	53.1%	**1.80 (1.31, 2.47)**	195
Hispanic	41.6%	1.13(0.86, 1.49)	411
Non-Hispanic Asian/Pacific Islander	41.1%	1.11(0.83, 1.50)	287
Non-Hispanic American Indian/Alaska Native	54.3%	**1.89(1.39, 2.57)**	202
Non-Hispanic White (referent)	38.6%	Referent	651

*unweighted number of respondents
[1] Numbers displayed in bold indicate statistically significant results at the .05 level of significance

Simple Regression Analyses: Continuous Explanatory Variables

Maternal age and family income in dollars per year were examined for association with unintended childbearing as continuous variables in simple regression models (Table 9).

A single year increase in age was significantly associated with a decreased likelihood of an unintended birth. A single dollar change in family income was not significantly associated with childbearing intention. It should be noted that family income expressed as a binary variable was associated with unintended childbearing as is described in Table 4.

Table 9. Unintended childbearing by maternal characteristics: Continuous variables, Oregon PRAMS (1998-1999)

Characteristic	Wald Statistic p-value	OR (95% CI)[1]	n*
Mother's age	**<0.0001**	**0.91 (0.89, 0.94)**	1746
Yearly income	0.788	1.00 (1.00, 1.00)	1552

*unweighted number of respondents
[1] Numbers displayed in bold indicate statistically significant results

Scaling of Age and Income Variables (see Methods)

Unintended childbearing (as a 0,1 variable) within the age quartiles was linearly related to unintended childbearing; it increased steadily over increasing quartiles (Table 10). The linear shape of the Loess smoothed graph of the relationship between age and unintended childbearing (Figure 1) support this assertion. Age was defined as a continuous variable on a linear scale.

Family income, however, appears to have a more complex relationship with unintended childbearing than does maternal age. It appears that there is a change in this relationship at approximately $30,000 (Table 11, Figure 2). Income was defined as a binary variable, with a cut point of $30,000.

Table 10. Mean childbirth intention value within quartiles of age in Oregon PRAMS (1998-1999)-weighted data

Quartiles	Quartiles-mother's age in years	Proportion of unintended births in age quartile
1	13-22	.5481
2	23-26	.4007
3	27-31	.3626
4	32+	.2405

Figure 2. **Childbirth intention versus maternal age with Loess smoothed line representing the relationship between childbearing intention and age in Oregon PRAMS (1998-1999)-weighted data**

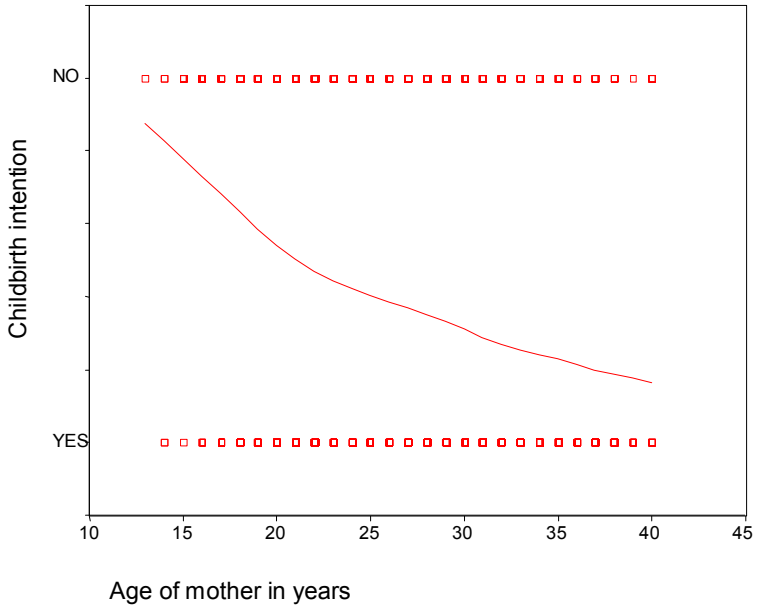
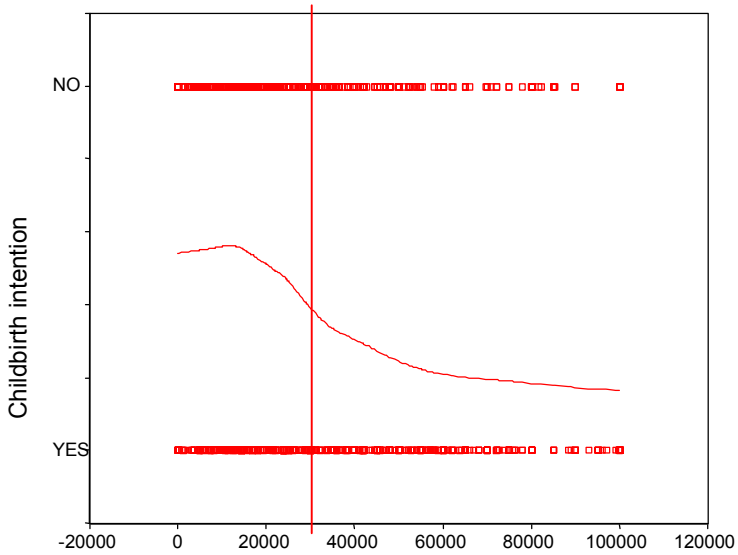


Table 11. **Mean childbirth intention value within quartiles of pre-pregnancy income in Oregon (1998-1999)-weighted data**

Quartiles	Quartiles-yearly income	Proportion of unintended births in income quartile
1	$0-15,600	.5477
2	$15,601-29,000	.5125
3	$29,001-48,000	.3013
4	$48,000+	.2509

Figure 3. Childbirth intention versus family income with Loess smoothed line representing the relationship between childbearing intention and income in Oregon PRAMS (1998-1999)-weighted data[1]



[1]The vertical red line represents $30,000 income.

Results of Stratified Analysis of Knowledge of EC and Unintended Childbearing

To inform modelling, a stratified analysis of the relationship between knowledge of EC and unintended childbearing was performed with the variables of interest: income, age, marital status, education and insurance pre-pregnancy (Table 12). It appears that both income and marital status may be confounders of the relationship between knowledge of EC and unintended childbearing, because in both cases, the crude OR is larger than either of the stratum-specific OR's. Age may be an effect modifier of the relationship between knowledge of EC and unintended childbearing as the OR are different in each age stratum, however, it may be that there were not enough people in the less than age 18 stratum to accurately estimate the OR. Education, insurance, and income also may be effect modifiers of the relationship between knowledge of EC and unintended childbearing. Although the CI of the OR's do overlap between the two strata in each case, the OR's do appear to be different in magnitude between strata for each of these variables.

Table 12. Stratified analysis of the relationship between knowledge of EC and unintended childbearing – Oregon PRAMS (1998-1999)

Stratification Variable	n*	Unstratified OR[1] (95 % CI)	Stratified OR[2,3] (95% CI)
	1623	**1.79 (1.29, 2.48)**	
Income <$30,000	957		1.31 (0.87, 1.98)
Income >=$30,000	666		1.66 (0.90, 3.07)
	1711	**1.69 (1.23, 2.33)**	
Maternal age < 18	89		0.99 (0.23, 4.29)
Maternal age >=18	1622		**1.70 (1.22, 2.36)**
	1711	**1.69 (1.23, 2.33)**	
Marital Status unmarried	580		1.34 (0.76, 2.36)
Marital Status married	1131		1.40 (0.92, 2.13)
	1698	**1.70 (1.23, 2.34)**	
Education <12 years	410		1.06 (0.57, 1.97)
Education 12+ years	1288		**1.77 (1.19, 2.62)**
	1702	**1.70 (1.23, 2.34)**	
Insurance Pre-Pregnancy	497		0.89 (0.52, 1.52)
No Insurance Pre-Pregnancy	1205		**1.85 (1.22, 2.79)**

*unweighted number of respondents

[1] Overall OR for the relationship between knowledge of EC unintended childbearing. This number varies due to different numbers of missing values for variables of interest.
[2] Stratified OR for the association between knowledge of EC and unintended childbearing within the described stratum of the variable at left.
[3] Numbers displayed in bold indicate statistically significant results at the .05 level of significance

In addition, the explanatory variables of interest (knowledge of EC, income, age, marital status, education, insurance pre-pregnancy) were tested in a pair-wise fashion to see if they were correlated with one another using a weighted phi statistic (data not shown). All of the variables were indeed significantly correlated with each other except knowledge of EC and age.

Multiple Logistic Regression Modelling Results

As noted above, the relationship between knowledge of EC and unintended childbearing was significant, as was again seen when EC knowledge was initially entered into a model alone (Table 13). When income was entered into the model, the OR for EC decreased substantially. Age also decreased the OR for EC, as well as that for income. Marital status had a significant effect upon EC and income, lowering the parameter estimates in these cases (Table 13), but not in the case of age. When education was initially entered into the model, it was close to being

significant. The addition of education gave the smallest increase in the pseudo R^2 value; more substantial increases were seen with the addition of income, age and marital status. The only interaction term found to be significant was age*marital status. Finally, adding insurance pre-pregnancy and race into the model one at a time at this point indicated that race was not significant (so it was not left in the model and stratified analyses for this variable are not shown), while insurance pre-pregnancy was found to be significant. The final model therefore included knowledge of EC, income, age, marital status, education, age*marital status interaction and insurance pre-pregnancy (Table 13). Lack of knowledge of EC remained associated with unintended childbearing in that women without knowledge were 1.32 times more likely to have reported their childbirth as unintended, however, this association was not quite significant in the presence of the other variables (95% CI 0.91, 1.93). Income (OR 1.60, 95% CI 1.04, 2.46), education level (OR 0.57, 95% CI 0.36, 0.90), and lack of insurance (OR 1.75, 95% CI 1.13, 2.71) were also significantly associated with unintended childbearing. Marital status and age were also associated with unintended childbearing, as can be seen in the models constructed before stepping in the interaction term (Table 13). The association of marital status and unintended childbearing was different for women of different ages in the final model, as evidenced by the decreasing OR for unintended childbearing in unmarried women as age increased (age 18, OR 4.26, 95% CI 2.38, 7.64, age 20, OR 3.56, 95% CI 2.16, 5.86, age 30 OR 1.45, 95% CI 0.86, 2.44, age 40, OR 0.59, 95% CI 0.21, 1.67). This means that younger unmarried women were significantly more likely to report births as unintended, whereas, in women that were older unintended births were not significantly associated with marital status. Unmarried women of age 40 were significantly less likely to have reported their birth as unintended than married women at that age.

Table 13. Multiple logistic regression model of unintended childbearing – Oregon PRAMS (1998-1999)

Explanatory Variables in Model[1]	Estimated β	Odds Ratio[2]	95% CI	Pseudo R^2 Value for Model[3]
Knowledge of EC	0.53	**1.69**	**(1.23, 2.33)**	0.014
Knowledge of EC	0.35	**1.42**	**(1.01, 2.01)**	0.061
Income	0.92	**2.51**	**(1.79, 3.54)**	
Knowledge of EC	0.28	1.33	(0.93, 1.90)	0.087
Income	0.62	**1.86**	**(1.28, 2.70)**	
Maternal Age (continuous)	-0.07	**0.94**	**(0.91, 0.96)**	
Knowledge of EC	0.22	1.25	(0.87, 1.80)	0.111
Income	0.46	**1.58**	**(1.07, 2.32)**	
Maternal Age (continuous)	-0.05	**0.95**	**(0.92, 0.98)**	
Marital Status	0.85	**2.33**	**(1.59, 3.42)**	
Knowledge of EC	0.30	1.35	(0.93, 1.97)	0.115
Income	0.54	**1.71**	**(1.15, 2.55)**	
Maternal Age (continuous)	-0.06	**0.95**	**(0.92, 0.98)**	
Marital Status	0.86	**2.37**	**(1.61, 3.49)**	
Education	-0.42	0.66	(0.43, 1.01)	
Knowledge of EC	0.31	1.36	(0.93, 1.98)	0.123
Income	0.61	**1.84**	**(1.24, 2.74)**	
Maternal Age (continuous)	-0.03			
Marital Status	2.90			
Education	-0.48	**0.62**	**(0.40, 0.97)**	
Age*Marital Status Interaction Term	-0.08			
OR for Marital Status at Age=18		**4.31**	**(2.39, 7.75)**	
OR for Marital Status at Age=20		**3.67**	**(2.22, 6.05)**	
OR for Marital Status at Age=30		1.65	(0.97, 2.80)	
OR for Marital Status at Age=40		0.74	(0.25, 2.16)	
Knowledge of EC	0.28	1.32	(0.91, 1.93)	0.132
Income	0.47	**1.60**	**(1.04, 2.46)**	
Maternal Age (continuous)	-0.02			
Marital Status	3.07			
Education	-0.56	**0.57**	**(0.36, 0.90)**	
Age*Marital Status Interaction Term	-0.09			
Insurance Pre-Pregnancy	0.56	**1.75**	**(1.13, 2.71)**	
OR for Marital Status at Age=18		**4.26**	**(2.38, 7.64)**	
OR for Marital Status at Age=20		**3.56**	**(2.16, 5.86)**	
OR for Marital Status at Age=30		1.45	(0.86, 2.44)	
OR for Marital Status at Age=40		0.59	(0.21, 1.67)	

[1]Referent categories are as shown in Table 4, page 38

[2] Numbers displayed in bold indicate statistically significant results at the .05 level of significance

[3]Cox and Snell pseudo R^2 [140].

Model Validation Using Oregon PRAMS data from 2000

The proportions across answers to the unintended childbearing question were similar in the 2000 data (Table 14). Simple regression analysis of the variables significant in the model for the 1998-1999 data also gave similar results. Except in the case of education, these variables were also significant in simple regression analyses in the 2000 data (Tables 15A and B). The simple regression OR for having insurance pre-pregnancy was somewhat lower in the 2000 data than this value was in the 1998-1999 data (Tables 15A and B). The results for race are fairly similar between the two years, except in the case of African American women, who showed a greater likelihood of reporting their births as unintended in the year 2000 data (Tables 15A and B). Lack of knowledge of EC is more strongly associated with unintended childbearing in the 2000 data where women were 1.76 times more likely to report their childbirth as unintended versus 1.69 times in 1998-1999 in crude analyses (Tables 15A and B).

Multiple regression results from applying the 1998-1999 model to 2000 data were fairly similar to those for the 1998-1999 data (Tables 16A and B). However, income and pre-pregnancy insurance were not significantly associated with unintended childbearing, while knowledge of EC was significantly associated with unintended childbearing in the 2000 data (adjusted OR 1.68, 95% CI 1.14, 2.47). The age*marital status interaction term was not significant in the model when applied to this second year of data. This can be seen in the lower magnitude of the OR's for marital status at different ages in the presence of the interaction term. Despite the lower magnitude of these OR's, their general pattern was the same as that seen for the 1998-1999 model in terms of significance in that the OR's for age 18 and 20 are significant, while those for ages 30 and 40 are not.

Table 14. Unintended childbearing resulting in live birth in Oregon PRAMS (1998-1999 versus 2000)

Response	Weighted Percent ('98-'99)	n* ('98-'99)	Weighted Percent (2000)	n* (2000)
I wanted to be pregnant sooner.	15.2%	291	16.4%	344
I wanted to be pregnant later.	27.0%	566	30.5%	676
I wanted to be pregnant then.	41.1%	718	43.0%	809
I didn't want to be pregnant then or at any time in the future.	9.9%	171	8.0%	217
I don't know.	5.6%	99	0.5%	18
Missing	1.1%	22	1.6%	36
Total	100%	1867	100%	2100

*unweighted number of respondents

Table 15A. Unintended childbearing[1] resulting in live birth by maternal characteristics in Oregon PRAMS (2000)

Characteristic	n*	Childbirth Unintended (weighted)	Simple regression OR[2,3] (95% CI)
Total	2046	39.3%	---
Family Income[4]			
<$30,000	1115	49.3%	**2.46 (1.77, 3.40)**
>=$30,000	704	28.4%	Referent
Maternal Age			
<18	103	76.6%	**5.43 (2.45, 12.01)**
>=18	1943	37.6%	Referent
Insurance prior to pregnancy			
None	690	49.0%	**1.76 (1.29, 2.40)**
Any	1342	35.3%	Referent
Marital Status[5]			
Not married	779	59.8%	**3.31 (2.39, 4.57)**
Married	1267	43.6%	Referent
Maternal Education			
<12 years	536	45.3%	1.34 (0.97, 1.87)
12+ years	1460	38.1%	Referent
Maternal Race/Ethnicity			
Non-Hispanic White	678	38.5%	Referent
Non-Hispanic Black	244	64.6%	**2.92 (2.17, 3.93)**
Hispanic	574	39.4%	1.04 (0.81, 1.34)
Non-Hispanic American Indian/Alaskan Native	236	54.2%	**1.90 (1.43, 2.51)**
Non-Hispanic Asian/Pacific Islander	314	36.1%	0.90 (0.68, 1.21)
Maternal Race/Ethnicity			
Other	1368	41.8%	1.15 (0.92, 1.44)
White	678	38.5%	Referent
Knowledge of availability of emergency contraception pre-pregnancy			
No	794	49.5%	**1.76 (1.29, 2.39)**
Yes	1212	35.8%	Referent

*unweighted number of respondents (those who did not know or did not respond were excluded)
[1] Unintended includes women who wanted to be pregnant later (mistimed childbirth) plus women who did not want to be pregnant then or at any time in the future (unwanted childbirth)
[2]Odds Ratio
[3] Numbers displayed in bold indicate statistically significant results at the .05 level of significance
[4]annual family income before pregnancy
[5]married=married/separated, not married=divorced/annulled/unmarried

Table 15B. Unintended childbearing[1] resulting in live birth by maternal characteristics in Oregon PRAMS, 1998-1999 versus 2000

Characteristic	Simple regression OR[2,3] (95% CI) 1998-1999	Simple regression OR[2,3] (95% CI) 2000
Family Income[4]		
<$30,000	**2.73 (1.97, 3.79)**	**2.46 (1.77, 3.40)**
>=$30,000	Referent	Referent
Maternal Age		
<18	**3.17 (1.47, 6.85)**	**5.43 (2.45, 12.01)**
>=18	Referent	Referent
Insurance prior to pregnancy		
None	**2.44 (1.77, 3.39)**	**1.76 (1.29, 2.40)**
Any	Referent	Referent
Marital Status[5]		
Not married	**3.66 (2.60, 5.15)**	**3.31 (2.39, 4.57)**
Married	Referent	Referent
Maternal Education		
<12 years	**1.58 (1.12, 2.24)**	1.34 (0.97, 1.87)
12+ years	Referent	Referent
Maternal Race/Ethnicity		
Non-Hispanic White	Referent	Referent
Non-Hispanic Black	**1.80 (1.31, 2.47)**	**2.92 (2.17, 3.93)**
Hispanic	1.13 (0.86, 1.49)	1.04 (0.81, 1.34)
Non-Hispanic American Indian/Alaskan Native	**1.89 (1.39, 2.57)**	**1.90 (1.43, 2.51)**
Non-Hispanic Asian/Pacific Islander	1.11 (0.83, 1.50)	0.90 (0.68, 1.21)
Maternal Race/Ethnicity		
Other	1.22 (0.96, 1.54)	1.15 (0.92, 1.44)
White	Referent	Referent
Knowledge of availability of emergency contraception pre-pregnancy		
No	**1.69 (1.23, 2.33)**	**1.76 (1.29, 2.39)**
Yes	Referent	Referent

*unweighted number of respondents (those who did not know or did not respond were excluded)
[1] Unintended includes women who wanted to be pregnant later (mistimed childbirth) plus women who did not want to be pregnant then or at any time in the future (unwanted childbirth)
[2]Odds Ratio
[3] Numbers displayed in bold indicate statistically significant results at the .05 level of significance
[4]annual family income before pregnancy
[5]married=married/separated, not married=divorced/annulled/unmarried

Table 16A. Validation of 1998-1999 multiple logistic regression model of unintended childbearing using data from 2000 Oregon PRAMS[1]

Explanatory Variables in Model[2]	Estimated β	Odds Ratio[3]	95% CI	Pseudo R^2 Value for Model
Knowledge of EC	0.56	**1.76**	**(1.29, 2.39)**	0.015
Knowledge of EC	0.32	1.38	(0.96, 1.99)	0.050
Income	0.83	**2.29**	**(1.62, 3.24)**	
Knowledge of EC	0.31	1.37	(0.95, 1.96)	0.074
Income	0.53	**1.69**	**(1.15, 2.49)**	
Maternal Age (continuous)	-0.07	**0.94**	**(0.91, 0.97)**	
Knowledge of EC	0.32	1.38	(0.96, 2.00)	0.090
Income	0.33	1.40	(0.93, 2.10)	
Maternal Age (continuous)	-0.05	**0.95**	**(0.92, 0.99)**	
Marital Status	0.70	**2.02**	**(1.37, 2.98)**	
Knowledge of EC	0.52	**1.68**	**(1.15, 2.46)**	0.104
Income	0.31	1.36	(0.89, 2.07)	
Maternal Age (continuous)	-0.06	**0.94**	**(0.91, 0.98)**	
Marital Status	0.85	**2.35**	**(1.57, 3.50)**	
Education	-0.60	**0.55**	**(0.37, 0.83)**	
Knowledge of EC	0.53	**1.70**	**(1.16, 2.50)**	0.106
Income	0.33	1.39	(0.91, 2.13)	
Maternal Age (continuous)	-0.05			
Marital Status	1.91			
Education	-0.63	**0.53**	**(0.35, 0.81)**	
Age*Marital Status Interaction Term	-0.04			
OR for Marital Status at Age=18		**2.75**	**(1.49, 5.04)**	
OR for Marital Status at Age=20		**2.48**	**(1.49, 4.14)**	
OR for Marital Status at Age=30		1.51	(0.85, 2.66)	
OR for Marital Status at Age=40		0.91	(0.28, 2.98)	
Knowledge of EC	0.52	**1.68**	**(1.14, 2.47)**	0.107
Income	0.29	1.33	(0.86, 2.06)	
Maternal Age (continuous)	-0.05			
Marital Status	1.96			
Education	-0.67	**0.51**	**(0.33, 0.78)**	
Age*Marital Status Interaction Term	-0.05			
Insurance Pre-Pregnancy	0.17	1.18	(0.79, 1.78)	
OR for Marital Status at Age=18		**2.89**	**(1.57, 5.30)**	
OR for Marital Status at Age=20		**2.61**	**(1.57, 4.35)**	
OR for Marital Status at Age=30		1.58	(0.89, 2.83)	
OR for Marital Status at Age=40		0.96	(0.29, 3.21)	

[1] A final model was developed using the 1998-1999 data as described in the text and then applied to 2000PRAMS data
[2]Referent categories are as shown in Table 4, page 38
[3]Numbers displayed in bold indicate statistically significant results at the .05 level of significance

Table 16B. Comparison of results of 1998-1999 Oregon PRAMS multiple logistic regression model and its application to Oregon PRAMS 2000 for validation[1]

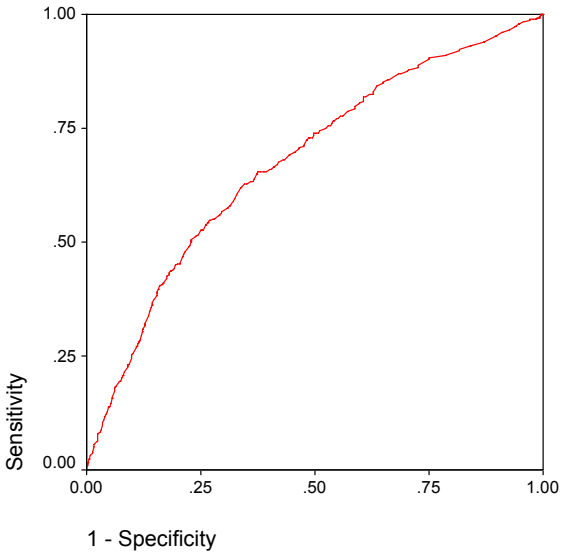
Explanatory Variables in Model[2]	1998-1999 Odds Ratio (95% CI)[3]	2000 Odds Ratio (95% CI)
Knowledge of EC	**1.69 (1.23, 2.33)**	**1.76 (1.29, 2.39)**
Knowledge of EC	**1.42 (1.01, 2.01)**	1.38 (0.96, 1.99)
Income	**2.51 (1.79, 3.54)**	**2.29 (1.62, 3.24)**
Knowledge of EC	1.33 (0.93, 1.90)	1.37 (0.95,1.96)
Income	**1.86 (1.28, 2.70)**	**1.69 (1.15, 2.49)**
Maternal Age (continuous)	**0.94 (0.91, 0.96)**	**0.94 (0.91, 0.97)**
Knowledge of EC	1.25 (0.87, 1.80)	1.38 (0.96, 2.00)
Income	**1.58 (1.07, 2.32)**	1.40 (0.93, 2.10)
Maternal Age (continuous)	**0.95 (0.92, 0.98)**	**0.95 (0.92, 0.99)**
Marital Status	**2.33 (1.59, 3.42)**	**2.02 (1.37, 2.98)**
Knowledge of EC	1.35 (0.93, 1.97)	**1.68 (1.15, 2.46)**
Income	**1.71 (1.15, 2.55)**	1.36 (0.89, 2.07)
Maternal Age (continuous)	**0.95 (0.92, 0.98)**	**0.94 (0.91, 0.98)**
Marital Status	**2.37 (0.61, 3.49)**	**2.35 (1.57, 3.50)**
Education	0.66 (0.43, 1.01)	**0.55 (0.37, 0.83)**
Knowledge of EC	1.36 (0.93, 1.98)	**1.70 (1.16, 2.50)**
Income	**1.84 (1.24, 2.74)**	1.39 (0.91, 2.13)
Maternal Age (continuous)		
Marital Status		
Education	**0.62 (0.40, 0.97)**	**0.53 (0.35, 0.81)**
Age*Marital Status Interaction Term		
OR for Marital Status at Age=18	**4.31 (2.39, 7.75)**	**2.75 (1.49, 5.04)**
OR for Marital Status at Age=20	**3.67 (2.22, 6.05)**	**2.48 (1.49, 4.14)**
OR for Marital Status at Age=30	1.65 (0.97, 2.80)	1.51 (0.85, 2.66)
OR for Marital Status at Age=40	0.74 (0.25, 2.16)	0.91 (0.28, 2.98)
Knowledge of EC	1.32 (0.91, 1.93)	**1.68 (1.14, 2.47)**
Income	**1.60 (1.04, 2.46)**	1.33 (0.86, 2.06)
Maternal Age (continuous)		
Marital Status		
Education	**0.57 (0.36, 0.90)**	**0.51 (0.33, 0.78)**
Age*Marital Status Interaction Term		
Insurance Pre-Pregnancy	**1.75 (1.13, 2.71)**	1.18 (0.79, 1.78)
OR for Marital Status at Age=18	**4.26 (2.38, 7.64)**	**2.89 (0.57, 5.30)**
OR for Marital Status at Age=20	**3.56 (2.16, 5.86)**	**2.61 (1.57, 4.35)**
OR for Marital Status at Age=30	1.45 (0.86, 2.44)	1.58 (0.89, 2.83)
OR for Marital Status at Age=40	0.59 (0.21, 1.67)	0.96 (0.29, 3.21)

[1] A final model was developed using the 1998-1999 data as described in the text and then applied to 2000 PRAMS data
[2]Referent categories are as shown in Table 4, page 38
[3]Numbers displayed in bold indicate statistically significant results at the .05 level of significance

Classification analyses indicated that the predicted probability cut point maximizing both the sensitivity and specificity of classification of the 1998-1999 model on 2000 data was 0.40. Using this cut point, sensitivity of 0.628 and specificity of 0.661 were obtained when classifying births in 2000 as unintended using the 1998-1999 model. Classification counts are shown in Table 17; at this cut-point, 64.7% of women were correctly classified with respect to childbearing status, while 35.3% were incorrectly classified (17.1% of the observations were missing for the

modelling). A ROC curve plot using the estimated probabilities generated from applying this final multiple unintended childbearing model to Oregon PRAMS data from 2000 is shown below (Figure 4). The area under the curve is 0.677 (95% CI 0.651, 0.702), which indicates that the 1998-1999 model discriminates adequately [between 0.7 and 0.8 is acceptable discrimination [139]] between those that have intended and unintended births in an independent data set.

Figure 4. Receiver Operating Characteristic Curve for application of final multiple regression unintended childbearing model for Oregon PRAMS 1998-1999 to 2000 Oregon PRAMS data



Area under the ROC curve=0.677 (95% CI 0.651, 0.702)

Table 17. Results of classification by 1998-1999 Oregon PRAMS multiple logistic regression model in Oregon PRAMS 2000 data at cutpoint maximizing sensitivity and specificity

	Observation in 2000 Oregon PRAMS data		
Classification by predicted values from 1998-1999 model for 2000 data	Birth Reported as Intended in 2000 data	Birth Reported as Unintended in 2000 data	Total
Birth Predicted to be Intended by 1998-1999 model	664	295	959
Birth Predicted to be Unintended by 1998-1999 model	325	457	782
Total	989	752	1741

DISCUSSION

Childbearing Intention and Knowledge of EC

EC awareness has been found to range from about a third to nearly all women surveyed in randomly selected, student, and clinic samples of women, either presenting for abortions or pregnancy tests. [27, 68, 98, 99, 107-112]. Here it was found that nearly 69% of women surveyed for 1988-1999 Oregon PRAMS were aware of EC. The Oregon PRAMS proportion was very similar to that found in the nationally representative survey conducted by Kaiser, where 66% of women surveyed in 1997 were aware of EC [98].

Knowledge of EC appears to have increased over time, from 68.6% of women surveyed knowing of EC in 1998-1999 to 73.2% in 2001 (Table 5, page 39). This was consistent with the Kaiser study findings of an increase in EC knowledge between 1994 and 1997 [98]. Our finding may be due to the fact that the Population Services Inc. (PSI) Emergency Contraception Promotion Project (ECPP) began operating in Oregon after the 1998-1999 data were collected, but over the time when the 2000, and before the 2001, data were being collected [126]. In addition, the EC promotion projects in WA were operating between 1997 and 2000, and likely affected EC knowledge in Oregon as well, especially in areas bordering Washington. There may also have been some effect of national programs and efforts to expand knowledge of EC over this time period; for example, the Princeton University 1-888-NOT-2-LATE hotline became available in 1997 and continues to operate [121]. Taken together, these projects may have increased EC knowledge in Oregon over the time period during which the PRAMS data was collected, which could in turn have affected responses to the PRAMS questionnaires.

One of the goals of the Oregon ECPP project was to target women 15 through 24 years of age [126]. PRAMS data shows that knowledge of EC increased in women under 25 years old (Table 6, page 40). Changes among older women were inconsistent. Consideration should therefore be given to further study of knowledge in older women. Other strategies for education and efforts to target women in their late 20's should be undertaken.

This study suggests that there may be an association between unintended childbearing and being unaware of EC (crude OR 1.69, 95% CI 1.23, 2.33; adjusted OR 1.32, 95% CI 0.91, 1.93). This discovery is supported by the fact that a significant association was found in a second year of data (crude OR 1.76, 95% CI 1.29, 2.47; adjusted OR 1.68 95% CI 1.14, 2.47). Note also that the OR for knowledge of EC was larger in magnitude in 2000 than in 1998-1999. Two caveats should be kept in mind in interpreting these findings. Firstly, studying the association between unintended childbearing and knowledge of EC was not an *a priori* hypothesis in this case, so caution must be taken in interpreting the association. Secondly, modelling with 2000 PRAMS data was strictly for validation purposes and consisted of applying the 1998-1999 model directly to 2000 data rather than fitting a model using this data independently. With these thoughts in mind, taking the stronger second year association together with the finding that EC knowledge was increasing over this time period in Oregon may indicate that, although knowledge was increasing, it was increasing more in women with intended rather than unintended births. In other words, this finding could be explained by increasing numbers of women aware of EC in women with intended births, or decreasing numbers in women with unintended births (or both). The data indicate that while the numbers of women aware of EC was higher in the second year both in women with intended and unintended births, that a greater increase in awareness was seen in women with intended pregnancies (data not shown). This suggests that education efforts so far may have been unsuitable for women who are more likely to have an unintended pregnancy. This is troubling, as these women are most in need of knowledge about the availability of EC. It could also be that there are specific reasons that women who are more likely to have unintended pregnancies are less likely to know about EC and are less likely to be benefiting from EC education projects. If EC knowledge in the US continues to increase, it would be hoped that it would increase as much or more in women that are at risk of unintended pregnancy than in women planning their pregnancies. If this were the case, we would expect that the association between unintended pregnancy and childbearing would eventually decrease over time.

There have been few studies so far of a potential association between unintended childbearing and knowledge of EC. Comparing the timing of EC education and access efforts in Washington and trends in unintended childbearing from PRAMS could provide us with some information about how presumed increased EC knowledge in Washington State has been affecting unintended childbearing. The project to increase knowledge and use of EC in Washington was described on pages 17-18 [Jane Hutchings, PATH, personal communication, March 8, 2004, 83, 121, 122]. Pharmacists began to provide EC directly to women without the need of a doctor's prescription through the use of CDTA's in July 1997. A media campaign to promote EC began in March 1998, with the project continuing officially until June 1999 [Jane Hutchings, PATH, personal communication, March 8, 2004]. Studying this information indicates that increased availability and publicity about EC in the state of WA has not yet had an appreciable effect upon unintended pregnancy. WA PRAMS between 1994 and 2001 indicated that unintended pregnancy hovered between 37 and 39% [Table 18, Tom Bell, Washington Department of Health, personal communication, March 3, 2004].

Table 18. Unintended pregnancy proportions, Washington PRAMS 1994-2001[1]

Year	Childbirth Unintended (Weighted)
1994	39%
1995	39%
1996	38%
1997	37%
1998	38%
1999	38%
2000	38%
2001	39%

[1]Provided by Tom Bell, WA PRAMS

One study of a nationally representative sample in the US found that EC knowledge was no different in women at risk of an unintended pregnancy (those that are sexually active, fertile, and do not wish to become pregnant) than women not at risk. Women who had had a previous unintended pregnancy were more likely to say that they would use EC [98]. Two studies that did

assess unintended childbearing and knowledge of EC in pregnant women at time of their pregnancy test found that knowledge of EC and pregnancy intention were not associated [17, 27]. These findings could be different than ours for several reasons. PRAMS asked both about unintended childbearing and knowledge of EC between 2 and 6 months after the delivery of the baby, although the mother was asked in both cases to refer to the time before she got pregnant. There is, therefore, a temporal issue with our assessment of EC knowledge, as it was done after the woman had given birth and it could be argued that her knowledge at that time was irrelevant to her intention to conceive. Assessing EC knowledge at the time of pregnancy test could be argued to have more relevance to pregnancy intentions. However, it could be that our finding of an association could be due to the fact that our study was population-based and not based on a convenience sample, as were the other two studies.

Analysis of the factors associated with lacking knowledge of EC could inform program design. A preliminary analysis of factors that may be associated with lack of knowledge of EC in the 1998-1999 PRAMS data is shown in Table 19, page 59. Income, marital status, education, race, and possibly age were associated with lack of knowledge of EC. This may indicate a need to focus EC education programs on younger, less educated, unmarried, minority women with lower incomes. The fact that these groups of women are also those that are more likely to have unintended pregnancies stresses the importance of education in these groups. Further study of factors associated with knowledge of EC will be needed to refine education efforts.

Table 19. Simple and multiple logistic regression modelling of factors associated with lack of knowledge of EC in Oregon PRAMS (1998-1999)

Explanatory Variables in Model[1]	Estimated β	Odds Ratio[2]	95% CI
Simple Logistic Regression – Crude OR's			
Income	1.10	**3.02**	**(2.14, 4.26)**
Age (continuous)	-0.07	**0.93**	**(0.90, 0.95)**
Marital Status	0.88	**2.41**	**(1.74, 3.32)**
Education	1.44	**4.22**	**(2.97, 5.99)**
Race/Ethnicity			
Non-Hispanic Black	0.88	**2.40**	**(1.72, 3.35)**
Hispanic	1.62	**5.06**	**(3.78, 6.79)**
Non-Hispanic Asian/Pacific Islander	1.31	**3.72**	**(2.74, 5.07)**
Non-Hispanic American Indian/Alaskan Native	0.99	**2.68**	**(1.94, 3.70)**
Multiple Logistic Regression – Adjusted OR's			
Income	0.49	**1.63**	**(1.05, 2.53)**
Maternal Age (continuous)	-0.02	0.98	(0.95, 1.01)
Marital Status	0.43	**1.54**	**(1.02, 2.32)**
Education	0.74	**2.10**	**(1.35, 3.26)**
Race/Ethnicity			
Non-Hispanic Black	0.55	**1.73**	**(1.17, 2.57)**
Hispanic	1.17	**3.24**	**(2.27, 4.62)**
Non-Hispanic Asian/Pacific Islander	1.52	**4.56**	**(3.23, 6.45)**
Non-Hispanic American Indian/Alaskan Native	0.63	**1.87**	**(1.30, 2.70)**

[1]Referent categories are as shown in Table 4, page 38
[2]Numbers displayed in bold indicate statistically significant results at the .05 level of significance

Programs designed to increase EC knowledge in the future should involve testing and then including some strategies for reaching women at higher risk of an unintended pregnancy. Targeting women who have low income, are unmarried, are of minority races, have less education, and possibly younger women, will likely be important. Successful efforts towards decreasing unintended pregnancy will probably require a better understanding of unintended childbearing and the association between unintended childbearing and knowledge of EC. The implications of this association are that increasing knowledge of EC could decrease unintended pregnancy, and that focusing on women with a higher risk for unintended pregnancy in particular could have an even greater effect. While these are the implications, there is, however, no evidence to date that a decrease in unintended childbearing will follow an increase in EC

knowledge. It remains to be seen whether affecting knowledge of EC will actually have an impact on the numbers of unintended births. A further consideration, then, is the quantitation of changes in unintended childbearing. Changes in unintended childbearing may be difficult to detect using PRAMS if they are small. Also, attempting to quantitate effects using abortion information may be complicated by increasing efforts to pass more restrictive abortion legislation. PRAMS may be a good place to start to gather information about the level of EC knowledge and coincident trends in unintended childbearing. However, work needs to be done regarding the best way to measure impacts of EC education and other programs on unintended childbearing. This is further complicated by the difficulties with measuring unintended pregnancy/childbearing itself, which are elaborated below.

Childbearing Intention and Other Factors

The proportions of both mistimed and unwanted pregnancies were similar here to those reported in other studies. In addition, for each of the covariates (age, income, race, marital status, education, and having insurance pre-pregnancy), our findings (Table 4, page 38) were similar to other studies, which found that these characteristics were all associated with childbearing/pregnancy intention.

In this study, low income, younger age, and being unmarried were associated with unintended childbearing in multiple models, and the effect of marital status differed at different ages. In addition, lack of insurance was associated with unintended childbearing (adjusted OR 1.75; 95% CI 1.13, 2.71)(Table 13, page 47), which is similar to the association found in a number of studies with having Medicaid as the source of health insurance. In this case, the association between unintended childbearing and race was not as strong as was seen in some studies, as it did not reach significance even in a simple regression model when categorized as white/other (crude OR 1.22; 95% CI 0.96, 1.54) (Table 4, page 38).

The general pattern of pregnancy intention by age (Table 7, page 41) resembled that seen in many studies. A high proportion of teenagers reported their births as unintended, and the proportion of women reporting their births as unintended steadily decreased with age. Younger age was found to be significantly associated with unintended childbearing (crude OR 0.91; 95% CI 0.89, 0.94). An interaction term between marital status and age was significant, indicating that the relationship between marital status and unintended childbearing was different for women of different ages. Marital status had a stronger association with unintended childbearing in younger women (Table 13, page 47). This makes sense, as younger women are less likely to want to become pregnant if they are not married. There was no evidence in this data of an increase in unintended births towards the upper limit of childbearing age as was seen elsewhere [1]. It could be that Oregon did not reflect the case in the US overall. Here, women over age 40 were more likely to perceive their pregnancies as intended than younger women, whether they were married or not. The increase in unintended childbearing in this age group seen previously was attributed to babies conceived by accident, after a woman has planned to cease childbearing. The result in this study may reflect women of this age either choosing to wait to have children or experiencing a pregnancy after a period of infertility. Pregnancy occurs less easily as a woman ages, potentially making the likelihood that a pregnancy in later childbearing years is planned and intended, regardless of marital status.

The relationship between unintended pregnancy and education in the presence of other explanatory variables (Table 13, page 47) was somewhat unexpected. As noted in the introduction, lower education has often been associated with unintended pregnancy/childbearing in the literature. Lower education was associated with a higher risk of unintended childbearing in a simple model (crude OR 1.58; 95% CI 1.12, 2.24), however, in the multiple model with knowledge of EC, age, income, and marital status, lower education was protective for unintended childbearing (adjusted OR 0.57; 95% CI, 0.36, 0.90). This is probably due to the correlation of education with other explanatory variables in the model. Education was correlated with all other variables in the model (data not shown). Calculating OR's for the association between

unintended childbearing and education in the presence of different combinations of the other variables indicated that each of the other explanatory variables, except for pre-pregnancy insurance, decreased the OR for education and unintended childbearing to some extent, including knowledge of EC (Table 20, page 63). The association between education and unintended childbearing seen in the simple model was probably accounted for in the multiple model by the effects of the other variables.

Table 20. Effect of other variables of interest on education in multiple model – 1998-1999 Oregon PRAMS

Explanatory Variables in Model[1]	Odds Ratio for Education in Model	95% CI
Education	**1.58**	**(1.12, 2.24)**
Education Knowledge of EC	**1.46**	**(1.00, 2.11)**
Education Knowledge of EC Income	0.95	(0.63, 1.43)
Education Knowledge of EC Maternal Age (continuous)	0.94	(0.62, 1.41)
Education Knowledge of EC Marital Status	0.96	(0.57, 1.60)
Education Knowledge of EC Maternal Age (continuous) Marital Status	0.79	(0.45, 1.36)
Education Knowledge of EC Income Marital Status	0.58	(0.33, 1.03)
Education Knowledge of EC Income Maternal Age (continuous)	0.74	(0.48, 1.13)
Education Knowledge of EC Income Maternal Age (continuous) Marital Status	0.66	(0.43, 1.01)
FINAL MODEL:		
Education Income Maternal Age (continuous) Marital Status Knowledge of EC Age*Marital Status Interaction Term Insurance Pre-Pregnancy	**0.57**	**(0.36, 0.90)**

[1]Referent categories are as shown in Table 4, page 38

The final model generated from the 1998-1999 data was validated on a second year of data, with the area under a ROC curve found to be 0.677 (95% CI 0.651, 0.702). This indicated adequate discrimination of childbearing intention status by the model constructed with this data. This argues against the model being a spurious finding from a single year of data, and gives credence to the results of this study despite the fact that they began in a more exploratory

fashion. It is therefore likely that future studies will continue to find age, income, marital status, insurance, and education to be important predictors for unintended childbearing. This will also likely be true for knowledge of EC; at least until EC knowledge and use become more widespread. A future direction of particular interest is to more carefully study the relationship between knowledge of EC and unintended childbearing in studies that begin with this association as an *a priori* hypothesis.

It was difficult to determine how to best interpret the "I don't know" response to the pregnancy intendedness questions. One way to handle this response is as was done in this study: the 99 women answering, "I don't know" were excluded from most analyses. An alternative way to interpret this response is by classifying these responses as unintended. In order to see whether using this alternative interpretation would have made a difference, the final model was re-run with individuals answering that they didn't know whether their pregnancy was unintended classified as unintended. The significance of the variables in the models for 1998-1999 was not changed appreciably (Table 21, page 65). With the exception of OR's for marital status at ages 30 and 40, the odds ratios for the other variables, including knowledge of EC, did not change by more than 10% when "I don't know" responses were included as unintended births. Therefore, it appears that the results are essentially the same whether these responses to the intention question were included in the analysis or not.

Table 21. Comparison of results of final unintended childbearing model with and without "I don't know" answers included as unintended births –1998-1999 Oregon PRAMS

Explanatory Variables in Model[1]	Odds Ratio (95% CI)[12]with "I don't know" responses excluded	Odds Ratio (95% CI) with "I don't know" responses included in unintended births
Knowledge of EC	1.32 (0.91, 1.93)	1.36 (0.94, 1.95)
Income	**1.60 (1.04, 2.46)**	**1.52 (1.02, 2.28)**
Maternal Age (continuous)		
Marital Status		
Education	**0.57 (0.36, 0.90)**	**0.53 (0.34, 0.83)**
Age*Marital Status Interaction Term		
Insurance Pre-Pregnancy	**1.75 (1.13, 2.71)**	**1.86 (1.23, 2.81)**
OR for Marital Status at Age=18	**4.26 (2.38, 7.64)**	**4.30 (2.44, 7.59)**
OR for Marital Status at Age=20	**3.56 (2.16, 5.86)**	**3.67 (2.25, 5.97)**
OR for Marital Status at Age=30	1.45 (0.86, 2.44)	**1.64 (1.00, 2.71)**
OR for Marital Status at Age=40	0.59 (0.21, 1.67)	0.74 (0.27, 2.00)

[1]Referent categories are as shown in Table 4, page 38
[2]Numbers displayed in bold indicate statistically significant results at the .05 level of significance

Potential Cost Savings of Prevention of Unintended Pregnancy

It has been estimated that the personal health care costs associated with each unintended pregnancy are $3200 per year [34]. Costs determined using 1993 PRAMS data in Florida showed that some 61% of the Medicaid expenditures for Florida in that time period for prenatal and obstetrical care was spent for unintended births [23]. This group estimated that a savings of over $185 million dollars a year could be expected if the prevalence of unintended childbearing was reduced to that seen in non-Medicaid mothers [23]. NSFG data were used to estimate a savings of $1.2 billion dollars for Medicaid programs for decreasing unplanned births and abortions [141]. Further work showed that contraceptive use to prevent unintended pregnancy could not only potentially save money for public payers, but also for third party payers [142]. All contraceptive methods are cheaper than the consequences of non-use. Even less effective contraceptive methods could save money compared to non-use [142]. It was also estimated that providing contraception for adolescents at risk for unintended pregnancy could save up to as much as $1000 per individual to the private sector and about half that much to the public sector [143]. In addition to the prevention of health-related outcomes, it appears that

prevention of unintended pregnancies could provide considerable savings to the health care system, which is important in light of steadily increasing health care costs.

Methodological Limitations

PRAMS used a mixed-mode survey administration methodology. Women who did not respond to mailed questionnaires were telephoned. Some bias could have been introduced because women may respond differently to questions when they are speaking to someone over the phone versus responding by questionnaire. A study of mixed mode effects in PRAMS showed that women were significantly less likely to describe their pregnancy as unintended by mail than by phone, meaning that there may have been some bias introduced by assessing unintended childbearing different ways in different women in this study [Whitehead, Shulman, and the PRAMS Working Group, unpublished manuscript].

Another potential source of bias was the use of self-reported information. It is necessary, however, when collecting information about intention, to use self-reported information. The other self-reported variables used (including knowledge of EC) may have also been subject to recall bias. Many other variables used in this study were collected from birth certificates. This could also have been a source of bias due to missing information or differences in accuracy when the certificates are filled out.

Most surveys seeking to assess pregnancy intention have been retrospective in nature, which means that recall bias could also be affecting the results [144, 145]. Because of this potential for recall bias, studies of this kind regarding unintended pregnancy may also suffer specifically from problems of over- or under-reporting of unintended pregnancies. Intention is usually assessed after delivery of a live baby rather than closer to the time of conception. A study using NLSY data showed that when asking about pregnancy intention after birth the results were biased upwards in terms of intended births [146]. One study found that the proportion of women feeling unsure about their intentions regarding pregnancy at the time of a pregnancy test

was much higher (21%) than was found here, where women were asked about intention after delivery (5.6% "I don't know" responses, Table 3) [27].

When pregnancy intendedness was assessed before or during a pregnancy and again afterwards, it was relatively common for intention status to be different at the two time points [28, 147, 148]. These changes in wantedness varied within subgroups of women of different ages, incomes, and education levels [148]. There is evidence of individuals switching both from intended to unintended and vice versa, although a study addressing this noted that a larger proportion switched from unintended to mistimed or intended or from mistimed to intended, than switched to either mistimed or unintended [149]. A study looking at women presenting for a pregnancy test and asking about intention before they got the test results found that nearly half of the women said that they would be somewhat or very happy about the pregnancy even though it would be unintended [150]. Such changes in intendedness can also affect studies of pregnancy outcomes; the effect of intention upon initiation of prenatal care, smoking during pregnancy and breastfeeding were found to be smaller when pregnancy intention was assessed after birth versus when it was assessed during pregnancy, though these differences were not significant [28].

PRAMS has tried to limit recall bias by surveying women within six months of delivery [144]. The optimal time to ask about pregnancy intention is just before the first pregnancy test. Studies are needed that ask about pregnancy intention at this time and again in women after delivery to carefully assess the effects of retrospective determination of intention. Future studies should ask women at the time of the first pregnancy test whether they want the test to be positive or negative, although this may be difficult due to the availability of home pregnancy tests.

An additional consideration is that the method of assessing pregnancy intention after a live birth also means that pregnancies in women having miscarriages or other fetal deaths or electing to have abortions are excluded [1, 2, 14]. PRAMS suffers from this bias, as it only

assesses childbearing intention in women having had a live birth. This could mean that the results are not generalizable to women whose pregnancy did not end in a live birth.

Another limitation of using PRAMS to assess knowledge of EC is that PRAMS is vague about when the woman knew about EC. The question is in a section about events that occurred before pregnancy, but it does not gather information about when the woman first heard about EC. It is likely that the EC knowledge reported was gained before the pregnancy, but this is not certain. The findings here cannot support an argument that lack of knowledge of EC is part of the causal chain leading to unintended pregnancy as these two questions were asked at the same time.

There could also be problems with ascertainment of knowledge of EC because, as noted in the introduction, EC has traditionally been called by various different names. The PRAMS questionnaire uses two terms to describe EC, "morning-after pill" and "emergency birth control," and provides further explanation ("this special combination of regular birth control pills is used to prevent pregnancy up to three days after unprotected sex"). However, women may be more familiar with other names for EC, such as "vacation pill". A study in Australia asked a similar question to that asked on the PRAMS questionnaire about having heard of the morning-after pill. Seventy percent of these women (who were presenting for abortion) had heard of EC [151]. This is comparable to findings here indicating that 69% of women surveyed had heard of EC using this nomenclature. In addition, response rates can be low in EC studies due to the sensitivity of the topic [80].

As with many studies, non-response was an issue with PRAMS. This undoubtedly influenced the results of the multiple logistic regression modelling, as women missing any of the variables used in a model were excluded from that analysis. Imputation was not used in this study to attempt to choose likely values for the missing variables in order to include these individuals in the analyses. However, as mentioned in the Methods section, PRAMS weighting methodology accounted for some of the non-response bias, and increased the validity of the results. It is difficult to know if more heavily weighting the answers of the women who did

respond in categories known to have lower response rates is a sufficiently unbiased method for estimating how the non-respondents would have answered the questions. Women who do answer are probably fairly representative of the women who didn't answer, but some bias was likely introduced by using this method.

Unintended Pregnancy/Childbearing Definition

A major issue with the current methodologies used to assess unintended pregnancy is that the questions have become outdated. The questions were originally designed as a way of measuring surplus fertility in the baby boom era, not to measure pregnancies occurring before they were planned. Another point of note is that surveys were originally generally conducted only amongst married women [4, 144, 152, 153]. Obviously, marriage and sexual activity are quite different since the questions were crafted and meanings were connected to the answers to them [154].

It is also clear that there are issues with the current unintended pregnancy categorizations and the simple dichotomization of this phenomenon into intended and unintended [147, 155]. The questions imply that pregnancy intention has to do almost exclusively with intendedness based upon timing, which is clearly only part of the story [38, 155]. The meanings of the terms that are currently commonly used are not clear [154], and are not well defined in the literature [144]. For instance, the current questioning route defines unwanted pregnancy (which along with mistimed pregnancies, are classed as unintended), as someone never wanting a child then, or in the future ("I didn't want to be pregnant then or at any time in the future") [155]. It is easy, however, to imagine a woman feeling that she didn't want to be pregnant then, but yet wanting a pregnancy in the future. Researchers expect that women in this situation would choose the "I wanted to be pregnant later" option, but that may not accurately capture a woman's feeling at that time. An additional problem with this "unwanted" option was noted by NSFG researchers in that many teenagers were choosing this answer indicating that they did not want children in the future [154], which suggests that they may not be correctly understanding

the question. Also, the pregnancies that are currently classed as mistimed are lumping together many different situations that could have very different burdens for the woman, child and others involved. The classifications are muddied further as mistimed pregnancies then get lumped into the group of pregnancies classed as unintended with unwanted pregnancies [154]. Therefore, by definition, mistimed pregnancies are generally not included in the group of pregnancies that are defined as wanted, which also may not be accurate [154].

It is clear from several small qualitative studies that the terms that are used relating to pregnancy such as intended, unintended, wanted, unwanted, planned, unplanned, etc., did not have quite the same definition for any of the women participating in these studies [147, 155-157]. When researchers talk to women about a pregnancy being unwanted, this term often carries very negative connotations, whereas talking about a pregnancy as being unplanned is perceived in a more neutral manner by women [147]. One study noted that women did not use the terms planned, unplanned, intended, unintended, wanted, unwanted spontaneously to talk about their pregnancies and rather talked about an unintended pregnancy as an "accident" or a "mistake." This study also noted that women tended to apply quite strict criteria to a planned pregnancy, which included not only an intention to become pregnant and to stop using contraception, but also agreement with a partner and proper timing in life [157]. This is important information to have to ensure that we understand responses to questions about these issues, otherwise there could be underreporting of planning. Another example of an unexpected connotation of terminology is that calling a pregnancy intended can also be perceived as very negative, meaning to some women a pregnancy that was conceived in a plotting manner, perhaps to trap a partner [147]. It has also been found that the terms wanted and unwanted are qualitatively different from planned and unplanned, and that the concept of wanted/unwanted is more connected to whether or not the woman intends to continue pregnancy [155, 158]. This supports the argument that the PRAMS questionnaire probably asks about intention at a less than optimal time and further emphasizes the problem with not surveying women who had an abortion [158]. Intendedness has been found to be associated

with life circumstances, support, attitudes towards children and abortion, and feelings of readiness. A pregnancy can be wanted, yet not planned [158]. Questionnaires must be as clear as possible in order that we can be more confident that what we believe we are assessing is in fact the information that we are gathering. Sometimes these terms were actually found not to be relevant to women at all in terms of feelings around pregnancy [147]. For instance, one study showed that religious women had a hard time relating to the idea of an unwanted pregnancy [158].

Interestingly, the actual "planning" of pregnancies was found not to be part of many women's experiences [147] and was looked upon as negative in some cases. A couple of reasons for this were that planning for a pregnancy could mean disappointment and that it is not natural to plan something of this nature [147, 159]. Women could conceptualize the idea of planning a pregnancy, but few had planned their own pregnancies; this was more of an abstract concept to them [147]. A common theme throughout the literature exploring these ideas was variations on a sort of fatalism about pregnancy, an "if it happens, it happens" sentiment [147, 159]. Researchers found that adaptation to unintended pregnancies occurred readily [147, 159]. These findings highlight some of the problems with the current definitions of pregnancy intention.

Another problem that points to potential shortcomings of the current methodologies for quantitation of intended pregnancies is despite wider availability of more effective contraception, these pregnancies are not decreasing [154]. This brings to the forefront the concept that there is more to this issue than just simple non-intention to get pregnant; women must also acquire contraceptives and use them effectively. Women's thought processes are likely not working at the level of choosing and intending to conceive, but instead choosing not to take contraception [159]. Many studies are finding ample evidence of ambivalence towards conception [147, 159, 160], which is not being addressed by the current questions. The Commonwealth Fund's Survey of Children Under Three (administered to adults) found that respondents offered answers such as "had not wanted to become pregnant but was not trying to avoid it either" and "had not wanted

to become pregnant but was happy when it happened" [154]. Using NLSY data to look at pregnancy in women before, during, and after pregnancy, researchers found that certain women were more likely to be aware of their pregnancy than others earlier on. This meant that the women more likely to recognize their pregnancy earlier were more likely to have had intention assessed during their pregnancy. The women less likely to recognize their pregnancy were surveyed under the impression that they were not pregnant, when it was clear later that they had been pregnant at the time of the survey and had not recognized the pregnancy. In these latter women, actual intention was therefore more likely to be assessed after the fact. This difference was not random and varied with certain characteristics, which suggests that further understanding of ambivalence and denial issues could be critical as the measurement of unintended pregnancy evolves [161]. Part of this quest must include understanding ambivalence in terms of contraceptive use. It has been suggested that questions need to be asked from the perspective of strength of intention not to become pregnant, and reasons for contraceptive non-use, rather than from the point of view of intention to become pregnant [162]. Women must be clear in their feeling that they do not wish to become pregnant, be in favour of using contraception, then, finally, they must use contraception properly, in order for contraception to be effective [160].

Better understanding the reasons why women do not use birth control and its connection to pregnancy/childbirth intention could help elucidate information about what might make a pregnancy potentially unhealthy. It is known from the literature that there is an apparent under-use of contraception by women not intending to become pregnant. One study found that almost half of women presenting for a pregnancy test at health department clinics in Missouri that were over the age of 18, and that would consider an affirmed pregnancy unintended, were inconsistent contraception users, with 16% reporting never using contraception. As might be expected, these women did tend to fit more often into the mistimed and happy categories than the unhappy about the pregnancy category [150]. A study of pregnant women with an unplanned pregnancy demonstrated that they were more likely not to have been using

contraception, or to be using a less effective method of contraception [29]. Trussell et al. found, using NSFG data, that 90% of women using contraception yet saying their baby's birth was intended were happy or very happy to have their baby. This seems consistent, but then it is unclear why these women were using contraception. In some cases, this may have happened because the women wanted to become pregnant, but the women's partners did not. Trussell et al. also found that 59% of women using contraception and saying that their childbirth was unintended were unhappy or very unhappy about the birth, but yet 25% said that they were happy or very happy about the birth [163]. This work indicates that not all contraceptive failures are necessarily unintended pregnancies. This also supports the idea that the research definitions of contraceptive failures and how they are measured do not match. Trussell et al. suggested that intended pregnancies could be thought of as being in "the residual category: an intended pregnancy is one that is not unintended rather than one that is deliberately intended" [163]. In the 1998-1999 PRAMS data, over a quarter of the women who said that they were not using birth control at the time of conception described their birth as unintended (Table 22). The reasons that the women surveyed had not been using birth control are shown in Table 22. The most common response among women who were not using birth control and did not intend to get pregnant was that they did not think that they were going to have sex. Note also that nearly six percent of women said both that they wanted to get pregnant (in response to the reason for not using birth control question) and that their childbirth was unintended (to the intention question that uses the traditional definition of intention). This supports the notions of ambivalence and the difficulties in interpreting childbirth *intendedness* based on the traditional method of assessing childbirth *timing*.

Table 22. Unintended childbearing and use of birth control in Oregon PRAMS (1998-1999) among women whose pregnancies were unintended

Response to: (#8) When you got pregnant with your new baby, were you or your partner using any kind of birth control?	Weighted Percent Childbirth Unintended	n* - Unintended Childbirth*
Yes	76.8%	287
No	28.8%	441
Response to: (#9) Why were you or your husband or partner not using any birth control (among women who said "no" to question #8)?[1]		
I wanted to get pregnant	5.9%	47
I didn't think I could get pregnant	67.4%	126
I had been having side effects from the birth control I used	59.5%	70
I didn't want to use birth control	51.2%	71
I didn't think I was going to have sex	87.2%	57
My husband or partner didn't want to use birth control	51.6%	32
Other	63.2%	106

*unweighted number of respondents
[1]N for all response categories does not add to 441 as this question allowed marking of multiple responses

Defining and measuring unintended pregnancy is clearly a very complex issue. Another facet of the story alluded to in the introduction is the finding by several researchers that partner attitude also greatly affects women's feelings and intentions with respect to pregnancy and childbearing [25, 147, 155, 158, 159, 164]. NLSY data has shown that in most cases the intention status of the mother and father was the same. However, there was more likely to be a difference in intention status between partners if the couple was unmarried [52]. The magnitude of this effect of this has rarely been assessed, but one study showed that a difference in partner attitude was the most important predictor of a woman switching intention status over the course of pregnancy and birth [28]. To complicate things further, intention may also be affected by factors beyond a woman's control, such as having limited access to resources and health services [164].

There is also a dearth of information about the effect of differences in cultural understanding and religious affiliation on the measurement of pregnancy intendedness. One focus group study has reported a lower proportion of unintended pregnancy in Mexican and Puerto Rican women in a group including African American, Caucasian, Mexican and Puerto Rican women, for reasons that were not explored [165]. This is similar to findings here that Hispanic

women had the second lowest proportion of unintended pregnancy (Table 8, page 41). There has been an increase in religious practice in the US in the last several years. Some religious women might not identify with the idea of planning a pregnancy, or intention around pregnancy, as in this case pregnancy is usually seen as being due to the intervention of a higher being. Religious women may therefore be less likely to choose answer options indicating that they wanted to be pregnant later, or not at all in the future.

It is important to mention that there are positive aspects to the intendedness question used on the PRAMS questionnaire. It has been shown, using NLSY data to look at intention in the same women during and after pregnancy, that although some individual women switched intention between an initial assessment during pregnancy and after they delivered, overall aggregate estimates of unintended pregnancy proportions were similar whether intention was assessed during or after pregnancy due to similar numbers of women switching in each direction. Therefore, retrospective assessment of pregnancy intention does not much affect estimates of overall proportions of unintended births [28, 166]. This and other studies suggest that unintendedness measures are useful at the population level [28, 149, 161, 164], giving support to PRAMS findings. In addition, one study found that the concept of pregnancy intendedness in terms of timing (that is, whether or not the woman wanted the baby now, sooner or later) may be fairly stable from person to person [147]. This gives credence to the traditional questioning route used in PRAMS since PRAMS focuses on assessing the suitability of pregnancy timing in this manner.

Efforts to improve measurement of unintended pregnancy have already begun. There were a number of additions to the newest cycle of the NSFG to get a richer picture of feelings around childbearing [153]. It has been noted that the responses to the questions regarding happiness and ambivalence around pregnancy that have been added to NSFG have ended up being pretty consistent with the traditional intendedness measure [154], indicating that the original measurement method may not be as far off the mark as was feared. There is also the problem of changing methodologies and therefore losing or lessening the ability to compare

future to previous studies [155]. Computer assisted self-interviewing (CASI) in the NSFG has been implemented as a measure to improve abortion reporting, with the idea that women would be more comfortable with this method versus having to discuss abortion with an interviewer [5]. This augments the validity of efforts to study unintended pregnancy in women electing to have abortions.

Many ideas have been put forth to improve the study of unintended pregnancy/childbearing. A potential need for distinguishing planning (a behaviour) from intention (an attitude) has been pointed out [154]. An unplanned pregnancy could then be defined as a pregnancy occurring when birth control is being used or when it is not being used in a situation where the woman does not want to get pregnant [2]. Klerman has for such reasons asked why our focus is not therefore on planning rather than intention, and questions whether a pregnancy that occurs when a woman is using birth control incorrectly or not at all can be considered unplanned or not [154]. This harkens back to needing a better understanding of how ambivalence plays into the pregnancy intention issue, and the need for its inclusion in the definition of unintended pregnancy [145, 147, 154]. Other potential concepts to add to the list of possibilities are to ask about trying/not trying to have a child, or about readiness for a child, which may better assess intention [147, 154]. Some qualitative underlying concepts of pregnancy intention that were found using qualitative interviews were: preconception desire for pregnancy, preparation for pregnancy, perceptions of, and behaviour around, fertility, post-conception desire for pregnancy, and adaptation to pregnancy [155]. This study also noted three types of fertility behaviour: active non-use of birth control to get pregnant, active use of birth control to prevent pregnancy, and again the more passive, "if it happens, it happens" attitude. Sable reported an example of the difference between asking traditional questions about pregnancy intention versus asking about happiness, which is an approach that researchers have begun to take [145]. Low birth weight did not differ by intendedness status determined using the traditional question (although this association has been shown in other studies, as mentioned), but mothers of low birth weight babies asked post-partum about their feelings

during pregnancy were more likely to report that they felt somewhat or very unhappy about their pregnancy or to give answers indicating denial of the pregnancy [38]. Moos et al. have suggested adding a sub-intended category to our current construct for women who are ambivalent about their pregnancy [159]. Another idea that has been put forth is the conceptualization of intendedness as a continuum and incorporation of the fact that both positive and negative feelings may co-exist in women around a pregnancy [146]. So, addressing concepts such as readiness, trying to have a child, planning vis-à-vis birth control, happiness with the pregnancy, ambivalence, pregnancy denial, and a woman's thoughts on whether or not she will later marry and have children may give a more accurate picture of how the pregnancy is or was perceived [145, 160].

It seems important, in light of these findings, to tease out the aspects of unplanned pregnancies that actually lead to health problems in mothers and babies. First, we need to understand what specific characteristics of unplanned pregnancies result in poorer outcomes. We also need a greater understanding of the attitudes and behaviours involved in pregnancy intention [55, 154]. Then, these attitudes and motivations need to be accurately measured. The body of literature on this subject indicates that this is easier said than done. There are few quantitative studies focusing on improving measures of unintended pregnancy to date, and this will need to change in order for us to be more confident that we are improving upon this measure.

CONCLUSIONS

This study found an association between lack of knowledge of EC and unintended childbearing. Such a finding can lead to the next step: increasing women's knowledge of EC to explore whether that knowledge leads to decreased unintended pregnancy. This study also supports past findings that unintended childbearing is associated with younger age, lower income, being unmarried, having less education and not having insurance.

Programs designed to decrease unintended pregnancy and increase knowledge of EC in Oregon might benefit most from focusing on young, low-income, uninsured women. The measurement of unintended pregnancy/childbearing needs to be improved concurrently. Further understanding of the factors rendering a pregnancy unintended and unhealthy for the mother and/or baby is important. Helping women use more effective methods of birth control, and to use them correctly and consistently, is an important goal that must be preceded by an understanding of ambivalence around pregnancy and women's reasons for not using birth control. Such information could assist policy makers to construct interventions that have greater impact upon poor birth and childhood outcomes that stem from improper preparation for pregnancy and raising a child. There also needs to be a continued focus on increased education about birth control, particularly EC education, and innovative methods for making EC and other methods of birth control more readily available.

Future research directions to decrease unintended pregnancy are: improving the measurement of unintended pregnancy, quantitation of changes in unintended pregnancy, better understanding of the association between knowledge of EC and unintended pregnancy (including studies assessing unintended pregnancy and knowledge of EC at the time of the first pregnancy test, and study of this association as an *a priori* hypothesis), the effect of increasing knowledge of EC on unintended pregnancy, and important target groups for EC education and unintended pregnancy reduction efforts. Oregon could take the same approach as Washington state, and provide for direct pharmacist prescription of EC through the use of CDTA's, concomitant with an EC public awareness campaign. Testing could then be done to see if such efforts were followed

by a decrease in unintended pregnancy. If the FDA approves EC for over-the-counter sale, this would also provide an opportunity in Oregon to study the relationship between increased EC access and knowledge, and unintended pregnancy.

REFERENCES

1. Henshaw, S.K., *Unintended pregnancy in the United States.* Fam Plann Perspect, 1998. **30**(1): p. 24-9, 46.

2. Brown, S.S., L. Eisenberg, and Committee on Unintended Pregnancy, Division of Health Promotion and Disease Prevention, Institute of Medicine, *The Best Intentions: Unintended Pregnancy and the Well-Being of Children and Families.* 1995, Washington, D.C.: National Academy Press.

3. Forrest, J.D., *Epidemiology of unintended pregnancy and contraceptive use.* Am J Obstet Gynecol, 1994. **170**(5 Pt 2): p. 1485-9.

4. Campbell, A.A. and W.D. Mosher, *A history of the measurement of unintended pregnancies and births.* Matern Child Health J, 2000. **4**(3): p. 163-9.

5. Mosher, W.D., *Design and operation of the 1995 National Survey of Family Growth.* Fam Plann Perspect, 1998. **30**(1): p. 43-46.

6. United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Reproductive Health,, *Detailed PRAMS Methodology.* 1999.

7. Piccinino, L.J. and W.D. Mosher, *Trends in contraceptive use in the United States: 1982-1995.* Fam Plann Perspect, 1998. **30**(1): p. 4-10.

8. Williams, L.B., *Determinants of unintended childbearing among ever-married women in the United States: 1973-1988.* Fam Plann Perspect, 1991. **23**(5): p. 212-5, 221.

9. Beck, L.F., et al., *Prevalence of selected maternal behaviors and experiences, Pregnancy Risk Assessment Monitoring System (PRAMS), 1999.* MMWR Surveill Summ, 2002. **51**(2): p. 1-27.

10. Colley Gilbert, B.J., et al., *Prevalence of selected maternal and infant characteristics, Pregnancy Risk Assessment Monitoring System (PRAMS), 1997.* MMWR CDC Surveill Summ, 1999. **48**(5): p. 1-37.

11. Woelfel, M.L., R. Walsh, and D.L. Morse, *Unintended pregnancy--New York, 1988-1989.* MMWR Morb Mortal Wkly Rep, 1991. **40**(42): p. 723-5.

12. DePersio, S.R., et al., *Unintended childbearing: pregnancy risk assessment monitoring system--Oklahoma, 1988-1991.* MMWR Morb Mortal Wkly Rep, 1992. **41**(50): p. 933-6.

13. VandeCastle, M., et al., *Physical violence during the 12 months preceding childbirth--Alaska, Maine, Oklahoma, and West Virginia, 1990-1991.* MMWR Morb Mortal Wkly Rep, 1994. **43**(8): p. 132-7.

14. Forrest, J.D. and S. Singh, *The sexual and reproductive behavior of American women, 1982-1988.* Fam Plann Perspect, 1990. **22**(5): p. 206-14.

15. Denton, A.B. and K.E. Scott, *Unintended and unwanted pregnancy in Halifax: the rate and associated factors.* Can J Public Health, 1994. **85**(4): p. 234-8.

16. Dye, T.D., et al., *Unintended pregnancy and breast-feeding behavior.* Am J Public Health, 1997. **87**(10): p. 1709-11.

17. Hellerstedt, W.L., et al., *Differences in preconceptional and prenatal behaviors in women with intended and unintended pregnancies.* Am J Public Health, 1998. **88**(4): p. 663-6.

18. Gazmararian, J.A., et al., *The relationship between pregnancy intendedness and physical violence in mothers of newborns. The PRAMS Working Group.* Obstet Gynecol, 1995. **85**(6): p. 1031-8.

19. Dietz, P.M., et al., *Live births resulting from unintended pregnancies: is there variation among states? The PRAMS Working Group.* Fam Plann Perspect, 1999. **31**(3): p. 132-6.

20. Naimi, T.S., et al., *Binge drinking in the preconception period and the risk of unintended pregnancy: implications for women and their children.* Pediatrics, 2003. **111**(5 Part 2): p. 1136-41.

21. Saltzman, L.E., et al., *Physical abuse around the time of pregnancy: an examination of prevalence and risk factors in 16 states.* Matern Child Health J, 2003. **7**(1): p. 31-43.

22. Orr, S.T., et al., *Unintended pregnancy and preterm birth.* Paediatr Perinat Epidemiol, 2000. **14**(4): p. 309-13.

23. Hopkins, R.S., H. Marshall, and S. Hoecherl, *Medicaid costs of live births from unintended pregnancies in Florida.* J Fla Med Assoc, 1995. **82**(8): p. 540-3.

24. Sharma, R., et al., *Intermediate variables as determinants of adverse pregnancy outcome in high-risk inner-city populations.* J Natl Med Assoc, 1994. **86**(11): p. 857-60.

25. Zabin, L.S., et al., *Partner effects on a woman's intention to conceive: 'not with this partner'.* Fam Plann Perspect, 2000. **32**(1): p. 39-45.

26. Kost, K. and J.D. Forrest, *Intention status of U.S. births in 1988: differences by mothers' socioeconomic and demographic characteristics.* Fam Plann Perspect, 1995. **27**(1): p. 11-7.

27. Spence, M.R., K.K. Elgen, and T.S. Harwell, *Awareness, prior use, and intent to use emergency contraception among Montana women at the time of pregnancy test.* Maternal Child Health J, 2003. **7**(3): p. 197-203.

28. Joyce, T., R. Kaestner, and S. Korenman, *The stability of pregnancy intentions and pregnancy-related maternal behaviors.* Matern Child Health J, 2000. **4**(3): p. 171-8.

29. Rosenfeld, J.A. and K.D. Everett, *Factors related to planned and unplanned pregnancies.* J Fam Pract, 1996. **43**(2): p. 161-6.

30. Flanigan, B., et al., *Alcohol use as a situational influence on young women's pregnancy risk-taking behaviors.* Adolescence, 1990. **25**(97): p. 205-14.

31. Felice, M.E., et al., *Adolescent pregnancy--current trends and issues: 1998 American Academy of Pediatrics Committee on Adolescence, 1998-1999.* Pediatrics, 1999. **103**(2): p. 516-20.

32. Raine, T., et al., *Race, adolescent contraceptive choice, and pregnancy at presentation to a family planning clinic.* Obstet Gynecol, 2002. **99**(2): p. 241-7.

33. Spitz, A.M., et al., *Pregnancy, abortion, and birth rates among US adolescents--1980, 1985, and 1990.* JAMA, 1996. **275**(13): p. 989-94.

34. Klima, C.S., *Unintended pregnancy. Consequences and solutions for a worldwide problem.* J Nurse Midwifery, 1998. **43**(6): p. 483-91.

35. Glei, D.A., *Measuring contraceptive use patterns among teenage and adult women.* Fam Plann Perspect, 1999. **31**(2): p. 73-80.

36. Williams, L.B. and K.A. London, *Changes in the planning status of births to ever-married U.S. women, 1982-1988.* Fam Plann Perspect, 1994. **26**(3): p. 121-4.

37. Gazmararian, J.A., M.M. Adams, and E.R. Pamuk, *Associations between measures of socioeconomic status and maternal health behavior.* Am J Prev Med, 1996. **12**(2): p. 108-15.

38. Sable, M.R., et al., *Pregnancy wantedness and adverse pregnancy outcomes: differences by race and Medicaid status.* Fam Plann Perspect, 1997. **29**(2): p. 76-81.

39. Goodwin, M.M., et al., *Pregnancy intendedness and physical abuse around the time of pregnancy: findings from the pregnancy risk assessment monitoring system, 1996-1997. PRAMS Working Group. Pregnancy Risk Assessment Monitoring System.* Matern Child Health J, 2000. **4**(2): p. 85-92.

40. Dietz, P.M., et al., *Unintended pregnancy among adult women exposed to abuse or household dysfunction during their childhood.* JAMA, 1999. **282**(14): p. 1359-64.

41. Adams, M.M., et al., *Pregnancy planning and pre-conception counseling. The PRAMS Working Group.* Obstet Gynecol, 1993. **82**(6): p. 955-9.

42. McComb Hulsey, T., *The influence of attitudes about unintended pregnancy on use of prenatal and postpartum care.* J Perinatal, 2000. **20**: p. 513-519.

43. Puffer, R.R., *Family planning issues relating to maternal and infant mortality in the United States.* Bull Pan Am Health Organ, 1993. **27**(2): p. 120-34.

44. Joyce, T.J., R. Kaestner, and S. Korenman, *The effect of pregnancy intention on child development.* Demography, 2000. **37**(1): p. 83-94.

45. Kost, K., D.J. Landry, and J.E. Darroch, *Predicting maternal behaviors during pregnancy: does intention status matter?* Fam Plann Perspect, 1998. **30**(2): p. 79-88.

46. Rosenberg, K.D., J.M. Gelow, and A.P. Sandoval, *Pregnancy intendedness and the use of periconceptional folic acid.* Pediatrics, 2003. **111**(5 Part 2): p. 1142-5.

47. Kost, K., D.J. Landry, and J.E. Darroch, *The effects of pregnancy planning status on birth outcomes and infant care.* Fam Plann Perspect, 1998. **30**(5): p. 223-230.

48. Hulsey, T.M., *Association between early prenatal care and mother's intention of and desire for the pregnancy.* J Obstet Gynecol Neonatal Nurs, 2001. **30**(3): p. 275-82.

49. Mayer, J.P., *Unintended childbearing, maternal beliefs, and delay of prenatal care.* Birth, 1997. **24**(4): p. 247-52.

50. Roberts, R.O., et al., *Barriers to prenatal care: factors associated with late initiation of care in a middle-class midwestern community.* J Fam Pract, 1998. **47**(1): p. 53-61.

51. Taylor, J.S. and H.J. Cabral, *Are women with an unintended pregnancy less likely to breastfeed?* J Fam Pract, 2002. **51**(5): p. 431-6.

52. Korenman, S., R. Kaestner, and T. Joyce, *Consequences for infants of parental disagreement in pregnancy intention.* Perspect Sex Reprod Health, 2002. **34**(4): p. 198-205.

53. DiCenso, A., et al., *Interventions to reduce unintended pregnancies among adolescents: systematic review of randomised controlled trials.* BMJ, 2002. **324**(7351): p. 1426.

54. Jaccard, J., *Adolescent contraceptive behavior: the impact of the provider and the structure of clinic-based programs.* Obstet Gynecol, 1996. **88**(3 Suppl): p. 57S-64S.

55. Moos, M.K., N.E. Bartholomew, and K.N. Lohr, *Counseling in the clinical setting to prevent unintended pregnancy: an evidence-based research agenda.* Contraception, 2003. **67**(2): p. 115-32.

56. Kirby, D., *Effective approaches to reducing adolescent unprotected sex, pregnancy, and childbearing.* J Sex Res, 2002. **39**(1): p. 51-7.

57. Kirby, D., et al., *School-based programs to reduce sexual risk behaviors: a review of effectiveness.* Public Health Rep, 1994. **109**(3): p. 339-60.

58. Westley, E., *Emergency contraception: a global overview.* J Am Med Womens Assoc, 1998. **53**(5 Suppl 2): p. 215-8, 237.

59. Grimes, D.A. and E.G. Raymond, *Emergency contraception.* Ann Intern Med, 2002. **137**(3): p. 180-9.

60. Trussell, J. and F. Stewart, *Emergency contraceptive pills: a simple proposal to reduce unintended pregnancies.* Fam Plann Perspect, 1992. **24**(6): p. 269-273.

61. Yuzpe, A.A., *Postcoital contraception.* Int J Gynaecol Obstet, 1978. **16**(6): p. 497-501.

62. Yuzpe, A.A., *Postcoital contraception.* Clin Obstet Gynaecol, 1984. **11**(3): p. 787-97.

63. Wertheimer, R.E., *Emergency postcoital contraception.* Am Fam Physician, 2000. **62**(10): p. 2287-92.

64. Gold, M.A., *Emergency contraception.* Adv Pediatr, 2000. **47**: p. 309-34.

65. Piaggio, G., et al., *Timing of emergency contraception with levonorgestrel or the Yuzpe regimen.* Lancet, 1999. **353**: p. 721.

66. *Randomised controlled trial of levonorgestrel versus the Yuzpe regimen of combined oral contraceptives for emergency contraception.* Lancet, 1998. **352**: p. 428-433.

67. Croxatto, H.B., et al., *Mechanism of action of hormonal preparations used for emergency contraception: a review of the literature.* Contraception, 2001. **63**(3): p. 111-21.

68. Aneblom, G., et al., *Knowledge, use and attitudes towards emergency contraceptive pills among Swedish women presenting for induced abortion.* BJOG, 2002. **109**(2): p. 155-60.

69. Glasier, A., *Emergency contraception.* Best Pract Res Clin Obstet Gynaecol, 2002. **16**(2): p. 181-91.

70. Trussell, J. and F. Stewart, *The effectiveness of postcoital hormonal contraception.* Fam Plann Perspect, 1992. **24**(6): p. 262-265.

71. Trussell, J., C. Ellertson, and F. Stewart, *The effectiveness of the Yuzpe regimen of emergency contraception.* Fam Plann Perspect, 1996. **28**(2): p. 58-64, 87.

72. Trussell, J., G. Rodriguez, and C. Ellertson, *Updated estimates of the effectiveness of the Yuzpe regimen of emergency contraception.* Contraception, 1999. **59**(3): p. 147-51.

73. Food and Drug Administration, United States Department of Health and Human Services, *Prescription Drug Products; Certain Combined Oral Contraceptives for Use as Postcoital Emergency Contraception.* Federal Register, 1997. **62**(37): p. 8609-8612.

74. Rosenberg, K., *Emergency contraception pills and the need for advance prescriptions.* CD Summary-An Epidemiology Publication of the Oregon Department of Human Services., 2002. **51**(11): p. 1-2.

75. Glasier, A., *Emergency contraception.* Br Med Bull, 2000. **56**(3): p. 729-38.

76. Haspels, A.A., *Emergency contraception: a review.* Contraception, 1994. **50**(2): p. 101-8.

77. von Hertzen, H., et al., *Low dose mifepristone and two regimens of levonorgestrel for emergency contraception: a WHO multicentre radomised trial.* Lancet, 2002. **360**: p. 1803-1810.

78. Glasier, A., *Emergency postcoital contraception.* N Engl J Med, 1997. **337**(15): p. 1058-64.

79. Glasier, A., *Safety of emergency contraception.* J Am Med Womens Assoc, 1998. **53**(5 Suppl 2): p. 219-21.

80. Ellertson, C., et al., *Emergency contraception: a review of the programmatic and social science literature.* Contraception, 2000. **61**(3): p. 145-86.

81. Haggai, D.N., *Emergency contraception: the journey so far.* BJOG, 2003. **110**(4): p. 339-45.

82. Falk, G., et al., *Young women requesting emergency contraception are, despite contraceptive counseling, a high risk group for new unintended pregnancies.* Contraception, 2001. **64**(1): p. 23-7.

83. Hayes, M., J. Hutchings, and P. Hayes, *Reducing unintended pregnancy by increasing access to emergency contraceptive pills.* Matern Child Health J, 2000. **4**(3): p. 203-8.

84. Grossman, R.A. and B.D. Grossman, *How frequently is emergency contraception prescribed?* Fam Plann Perspect, 1994. **26**(6): p. 270-271.

85. Smugar, S.S., B.J. Spina, and J.F. Merz, *Informed consent for emergency contraception: variability in hospital care of rape victims.* Am J Public Health, 2000. **90**(9): p. 1372-1376.

86. Gould, H., C. Ellertson, and G. Corona, *Knowledge and attitudes about the differences between emergency contraception and medical abortion among middle-class women and men of reproductive age in Mexico City.* Contraception, 2002. **66**(6): p. 417-26.

87. Harvey, S.M., et al., *Women's experience and satisfaction with emergency contraception.* Fam Plann Perspect, 1999. **31**(5): p. 237-40, 260.

88. Jones, R.K., J.E. Darroch, and S.K. Henshaw, *Contraceptive use among U.S. women having abortions in 2000-2001.* Perspect Sex Reprod Health, 2002. **34**(6): p. 294-303.

89. Glasier, A., et al., *Case studies in emergency contraception from six countries.* Int Fam Plan Perspect, 1996. **22**(2): p. 57-61.

90. Bartfai, G., *Emergency contraception in clinical practice: global perspectives.* Int J Gynaecol Obstet, 2000. **70**(1): p. 49-58.

91. Weisberg, E., et al., *Emergency contraception. General practitioner knowledge, attitudes and practices in New South Wales.* Med J Aust, 1995. **162**(3): p. 136-8.

92. Steiner, M.J., et al., *Provider knowledge about emergency contraception in Ghana.* J Biosoc Sci, 2000. **32**(1): p. 99-106.

93. Blanchard, K., et al., *Differences between emergency contraception users in the United States and the United Kingdom.* J Am Med Womens Assoc, 2002. **57**(4): p. 200-3, 214.

94. Muia, E., et al., *Emergency contraception in Nairobi, Kenya: knowledge, attitudes and practices among policymakers, family planning providers and clients, and university students.* Contraception, 1999. **60**(4): p. 223-32.

95. Langer, A., et al., *Emergency contraception in Mexico City: what do health care providers and potential users know and think about it?* Contraception, 1999. **60**(4): p. 233-41.

96. Langille, D.B. and M.E. Delaney, *Knowledge and use of emergency postcoital contraception by female students at a high school in Nova Scotia.* Can J Public Health, 2000. **91**(1): p. 29-32.

97. Sorhaindo, A., et al., *Emergency contraception among university students in Kingston, Jamaica: a survey of knowledge, attitudes, and practices.* Contraception, 2002. **66**(4): p. 261-8.

98. Delbanco, S.F., et al., *Are we making progress with emergency contraception? Recent findings on American adults and health professionals.* J Am Med Womens Assoc, 1998. **53**(5 Suppl 2): p. 242-6.

99. Smith, B.H., et al., *Emergency contraception: a survey of women's knowledge and attitudes.* Br J Obstet Gynaecol, 1996. **103**(11): p. 1109-16.

100. Aziken, M.E., P.I. Okonta, and A.B. Ande, *Knowledge and perception of emergency contraception among female Nigerian undergraduates.* Int Fam Plan Perspect, 2003. **29**(2): p. 84-7.

101. Graham, A., L. Green, and A.F. Glasier, *Teenagers' knowledge of emergency contraception: questionnaire survey in south east Scotland.* BMJ, 1996. **312**(7046): p. 1567-9.

102. Baiden, F., E. Awini, and C. Clerk, *Perception of university students in Ghana about emergency contraception.* Contraception, 2002. **66**(1): p. 23-6.

103. Jackson, R., et al., *Knowledge and willingness to use emergency contraception among low-income post-partum women.* Contraception, 2000. **61**(6): p. 351-7.

104. Smit, J., et al., *Emergency contraception in South Africa: knowledge, attitudes, and use among public sector primary healthcare clients.* Contraception, 2001. **64**(6): p. 333-7.

105. Thorburn Bird, S., S.M. Harvey, and L.J. Beckman, *Emergency contraceptive pills: An exploratory study of knowledge and perceptions among Mexican women from both sides of the border.* J Am Med Womens Assoc, 1998. **53**(5 Suppl 2): p. 262-265.

106. Delbanco, S.F., J. Mauldon, and M.D. Smith, *Little knowledge and limited practice: emergency contraceptive pills, the public, and the obstetrician-gynecologist.* Obstet Gynecol, 1997. **89**(6): p. 1006-11.

107. Bromham, D.R. and R.S. Cartmill, *Knowledge and use of secondary contraception among patients requesting termination of pregnancy.* BMJ, 1993. **306**(6877): p. 556-7.

108. Young, L.K., et al., *The contraceptive practices of women seeking termination of pregnancy in an Auckland clinic.* N Z Med J, 1994. **107**(978): p. 189-191.

109. Perslev, A., et al., *Emergency contraception: knowledge and use among Danish women requesting termination of pregnancy.* Contraception, 2002. **66**(6): p. 427-31.

110. Sorensen, M.B., B.L. Pedersen, and L.E. Nyrnberg, *Differences between users and non-users of emergency contraception after a recognized unprotected intercourse.* Contraception, 2000. **62**(1): p. 1-3.

111. Kosunen, E., S. Sihvo, and E. Hemminki, *Knowledge and use of hormonal emergency contraception in Finland.* Contraception, 1997. **55**(3): p. 153-7.

112. Harper, C.C. and C.E. Ellertson, *The emergency contraceptive pill: a survey of knowledge and attitudes among students at Princeton University.* Am J Obstet Gynecol, 1995. **173**(5): p. 1438-45.

113. Harper, C. and C. Ellertson, *Knowledge and perceptions of emergency contraceptive pills among a college-age population: a qualitative approach.* Fam Plann Perspect, 1995. **27**(4): p. 149-54.

114. Delbanco, S.F., et al., *Missed opportunities: teenagers and emergency contraception.* Arch Pediatr Adolesc Med, 1998. **152**(8): p. 727-33.

115. Cohall, A.T., et al., *Inner-city adolescents' awareness of emergency contraception.* J Am Med Womens Assoc, 1998. **53**(5 Suppl 2): p. 258-61.

116. Pearson, V.A.H., et al., *Pregnant teenagers' knowledge and use of emergency contraception.* BMJ, 1995. **310**(6995): p. 1644.

117. Golden, N.H., et al., *Emergency contraception: pediatricians' knowledge, attitudes, and opinions.* Pediatrics, 2001. **107**(2): p. 287-92.

118. Sills, M.R., J.M. Chamberlain, and S.J. Teach, *The associations among pediatricians' knowledge, attitudes, and practices regarding emergency contraception.* Pediatrics, 2000. **105**(4 Pt 2): p. 954-6.

119. Gold, M.A., A. Schein, and S.M. Coupey, *Emergency contraception: a national survey of adolescent health experts.* Fam Plann Perspect, 1997. **29**(1): p. 15-9, 24.

120. Cohen, S.A., *Objections, confusion among pharmacists threaten access to emergency contraception.* Guttmacher Rep Public Policy, 1999. **2**(3): p. 1-3.

121. Trussell, J., et al., *Call 1-888-NOT-2-LATE: Promoting emergency contraception in the United States.* J Am Med Womens Assoc, 1998. **53**(5 Suppl 2): p. 247.

122. Wells, E.S., et al., *Using pharmacies in Washington state to expand access to emergency contraception.* Fam Plann Perspect, 1998. **30**(6): p. 288-90.

123. Marciante, K.D., et al., *Modeling the cost and outcomes of pharmacist-prescribed emergency contraception.* Am J Public Health, 2001. **91**(9): p. 1443-5.

124. Sessions Stepp, L., *With Birth Control, Plan B is Topic A*, in *Washington Post*. 2004: Washington, DC. p. C01.

125. Goodman, E., *Plan B stalled by Plan A: abstinence or else*, in *The Oregonian*. 2004: Portland, OR. p. E3.

126. Lowell, A. and A. Mobley, *Emergency Contraception Promotion Project*. 2002, PSI: Portland, OR.

127. Oregon Department of Human Services, Office of Family Health, Portland, OR., *Oregon PRAMS First Year Report 1998-99.* 2000.

128. Rogers, M.M., I.B. Ahluwalia, and C.L. Melvin, *The pregnancy risk assessment monitoring system (PRAMS).* J Womens Health, 1998. **7**(7): p. 799-801.

129. Ahluwalia, I.B., et al., *Pregnancy Risk Assessment Monitoring System (PRAMS): unintended pregnancy among women having a live birth. PRAMS Working Group.* J Womens Health Gend Based Med, 1999. **8**(5): p. 587-9.

130. Melvin, C.L., et al., *Pregnancy intention: how PRAMS data can inform programs and policy. Pregnancy Risk Assessment Monitoring System.* Matern Child Health J, 2000. **4**(3): p. 197-201.

131. Gross, K.H., et al., *Correlates of self-reports of being very depressed in the months after delivery: results from the Pregnancy Risk Assessment Monitoring System.* Matern Child Health J, 2002. **6**(4): p. 247-53.

132. US Department of Health and Human Services, *Healthy People 2010, With Understanding and Improving Health and Objectives for Improving Health.* 2nd Ed. 2000, Washington, DC: US Government Printing Office.

133. Rao, C.R., *Linear Statistical Inference and Its Application*. Second Edition ed. 1973, New York: Wiley, Inc.

134. Korn, E.L. and B.I. Graubard, *Simultaneous testing of regression coefficients with complex survey data: Use of Bonferroni t statistics.* American Statistician, 1990. **79**: p. 270-276.

135. Thomas, D.R. and J.N.K. RAo, *Small-sample comparisons of level and power for simple goodness-of-fit statistics under cluster sampling.* Journal of the American Statistical Association, 1987. **82**: p. 630-636.

136. Cleveland, W.S., *Visualizing Data.* 1993, New Jersey: Hobart Press.

137. Cleveland, W.S., *Robust locally weighted regression and smoothing scatterplots.* Journal of the American Statistical Association, 1979. **74**: p. 829-836.

138. Fleiss, J., *Statistical Methods for Rates and Proportions*. 1982, New York: John Wiley & Sons, Inc.

139. Hosmer, D.W. and S. Lemeshow, *Applied Logistic Regression*. 2nd ed. 2000, New York: John Wiley & Sons, Inc.

140. Cox, D.R. and E.J. Snell, *Analysis of Binary Data*. 2nd ed. 1989, London: Chapman & Hall.

141. Forrest, J.D. and J.J. Frost, *The family planning attitudes and experiences of low-income women.* Fam Plann Perspect, 1996. **28**(6): p. 246-55, 277.

142. Trussell, J., et al., *The economic value of contraception: a comparison of 15 methods.* Am J Public Health, 1995. **85**(4): p. 494-503.

143. Trussell, J., et al., *Medical care cost savings from adolescent contraceptive use.* Fam Plann Perspect, 1997. **29**(6): p. 248-55, 295.

144. Petersen, R. and M.K. Moos, *Defining and measuring unintended pregnancy: issues and concerns.* Womens Health Issues, 1997. **7**(4): p. 234-40.

145. Sable, M.R., *Pregnancy intentions may not be a useful measure for research on maternal and child health outcomes.* Fam Plann Perspect, 1999. **31**(5): p. 249-50.

146. Bachrach, C.A. and S. Newcomer, *Intended pregnancies and unintended pregnancies: distinct categories or opposite ends of a continuum?* Fam Plann Perspect, 1999. **31**(5): p. 251-2.

147. *"If it happens, it happens" -- A qualitative assessment of unintended pregnancy in south King County*. 2002, Seattle King County Health Department: Seattle, WA.

148. Williams, L. and J. Abma, *Birth wantedness reports: a look forward and a look back.* Soc Biol, 2000. **47**(3-4): p. 147-63.

149. Poole, *Changes in intendedness during pregnancy in a high-risk multiparous population.* Matern Child Health J, 2000. **4**(3): p. 179-182.

150. Sable, M.R. and M.K. Libbus, *Pregnancy intention and pregnancy happiness: are they different?* Matern Child Health J, 2000. **4**(3): p. 191-6.

151. Weisberg, E. and I.S. Fraser, *Knowledge and use of emergency contraception among women seeking termination of pregnancy in New South Wales.* Med J Aust, 1997. **166**(6): p. 336.

152. Luker, K.C., *A reminder that human behavior frequently refuses to conform to models created by researchers.* Fam Plann Perspect, 1999. **31**(5): p. 248-9.

153. Peterson, L.S. and W.D. Mosher, *Options for measuring unintended pregnancy in cycle 6 of the National Survey of Family Growth.* Fam Plann Perspect, 1999. **31**(5): p. 252-3.

154. Klerman, L.V., *The intendedness of pregnancy: a concept in transition.* Matern Child Health J, 2000. **4**(3): p. 155-62.

155. Stanford, J., *Defining dimensions of pregnancy intendedness.* Matern Child Health J, 2000. **4**(3): p. 183-189.

156. Gilbert, B.C., et al., *The Pregnancy Risk Assessment Monitoring System (PRAMS): methods and 1996 response rates from 11 states.* Matern Child Health J, 1999. **3**(4): p. 199-209.

157. Barrett, G. and K. Wellings, *What is a 'planned' pregnancy? Empirical data from a British study.* Soc Sci Med, 2002. **55**(4): p. 545-57.

158. Fischer, R.C., et al., *Exploring the concepts of intended, planned, and wanted pregnancy.* J Fam Pract, 1999. **48**(2): p. 117-22.

159. Moos, M.K., et al., *Pregnant women's perspectives on intendedness of pregnancy.* Womens Health Issues, 1997. **7**(6): p. 385-92.

160. Zabin, L.S., *Ambivalent feelings about parenthood may lead to inconsistent contraceptive use--and pregnancy.* Fam Plann Perspect, 1999. **31**(5): p. 250-1.

161. Joyce, T., R. Kaestner, and S. Korenman, *On the validity of retrospective assessments of pregnancy intention.* Demography, 2002. **39**(1): p. 199-213.

162. Stevens-Simon, C., R.K. Beach, and L.V. Klerman, *To be rather than not to be--that is the problem with the questions we ask adolescents about their childbearing intentions.* Arch Pediatr Adolesc Med, 2001. **155**(12): p. 1298-300.

163. Trussell, J., B. Vaughan, and J. Stanford, *Are all contraceptive failures unintended pregnancies? Evidence from the 1995 National Survey of Family Growth.* Fam Plann Perspect, 1999. **31**(5): p. 246-7, 260.

164. Santelli, J., et al., *The measurement and meaning of unintended pregnancy.* Perspect Sex Reprod Health, 2003. **35**(2): p. 94-101.

165. Peacock, N.R., et al., *Pregnancy discovery and acceptance among low-income primiparous women: a multicultural exploration.* Matern Child Health J, 2001. **5**(2): p. 109-18.

166. Jones, R.K., J.E. Darroch, and S.K. Henshaw, *Patterns in the socioeconomic characteristics of women obtaining abortions in 2000-2001.* Perspect Sex Reprod Health, 2002. **34**(5): p. 226-35.

APPENDIX 1. 1998-1999 Oregon PRAMS Survey

APPENDIX 2. 2000 Oregon PRAMS Survey