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ORIGINAL PAPER

Seat Belt use, Counseling and Motor-Vehicle Injury During Pregnancy: Results from a Multi-State Population-Based Survey

Hulya Sirin · Harold B. Weiss · Erin K. Sauber-Schatz · Kari Dunning

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Abstract *Objectives:* Motor-vehicle injuries are the leading cause of death and hospitalized trauma during pregnancy. The study objectives were to report the prevalence of seat belt counseling by prenatal care providers during pregnancy, seat belt use during the last trimester, and self-reported motor-vehicle injury during pregnancy. Differences were examined by age, race and education. *Methods:* A cross-sectional study design using self-reported 22 state data from the Centers for Disease Control and Prevention's 2001 Pregnancy Risk Assessment Monitoring System (PRAMS) were used (n = 37,081). Estimates were computed using logistic regression from weighted counts. *Results:* On average, reported prenatal care provider counseling for seat belt use occurred in 48.7% (38.2–58.8%) of prenatal visits. Women most likely to report being counseled were aged 20–29, non-White, Hispanic ethnicity, and less educated. Women 30 years of age or greater and that had a greater than high school education were more likely to report always wearing seat belts in the last trimester. On average, 2.3% (1.2–4.7%) of respondents reported being hurt in a "car accident" during pregnancy. Women less than 20 years old (3.0%), Black (3.9%), and less educated (3.2%) were the most likely to report being hurt in a crash during pregnancy. *Conclusions:* Based on PRAMS, it is estimated that about 92,500 pregnant women are hurt annually in motor-vehicle crashes in the United States. Despite this reported risk and the proven efficacy of restraint use, most pregnant women do not report being counseled about seat belt use during prenatal visits. Limitations of PRAMS methodology make it difficult to determine the association of prenatal counseling with seat belt use.

Keywords Seat belt · Pregnancy · Counseling · Motor-vehicle injury · Injury · Motor vehicle crash

H. Sirin
Department of Public Health, School of Medicine, Gazi University, Ankara, Turkey

H. B. Weiss · E. K. Sauber-Schatz (✉)
Center for Injury Research and Control, Department of Neurological Surgery, University of Pittsburgh, Pittsburgh, PA, USA

K. Dunning
Department of Rehabilitation Sciences, University of Cincinnati College of Allied Health Sciences, College of Medicine, Cincinnati, OH, USA

Introduction

With six to seven percent of pregnancies affected by trauma [1], injuries occurring to pregnant women are a major public health concern. Changes in maternal mortality and morbidity patterns over the last few decades have led to the recognition that motor vehicle related injuries are now the leading cause of death during pregnancy in the United States and other developed countries [2], and the leading cause of hospitalized trauma during pregnancy [3]. Maternal injury has been shown to also cause adverse fetal outcomes including prematurity, low birth weight, fetal distress, and fetal death [4, 5], yet little is known from population based studies about the characteristics and risks of pregnant women involved in motor vehicle crashes [6, 7].

The seat belt was developed by Lavenne in France in 1903 for use in airplanes, it was then adopted for use in motor racing [8], and later widely introduced for occupant protection in the United States in the 1960s [9]. Seat belt use has been shown to reduce the risk of adverse maternal and fetal outcomes in several large population-based studies

[5, 10, 11]. In 1983 the American College of Obstetricians and Gynecologists (ACOG) issued a recommendation that the three-point restraint system (that places the lap belt under the abdomen and across the upper thighs and the shoulder belt between the breast) should be used by pregnant occupants for maximum protection of the mother and fetus [12]. It is important that pregnant women wear their seat belt to prevent secondary collision with interior structures of the vehicle or sudden ejection, to dissipate the force of an impact [13] and to provide both the mother and the fetus with maximum protection. But the seat belt must also be worn correctly to prevent potential significant harm to both mother and fetus. Women are reported to be at an increased risk for intra-abdominal injuries or uterine rupture if restraints are improperly positioned at the time of collision [14]. In 1992 ACOG recommended that all women receive seat belt counseling from prenatal care providers [15]. Nevertheless, many pregnant women report uncertainty about the safety and use of seat belts during pregnancy [16] and lack information regarding proper seat belt use and its role in protecting the fetus [17].

If women regularly and correctly wear their seat belts, prenatal counseling on seat belt use during pregnancy would not be an important public health issue, but that is not the case. A 2004 study of women ($n = 450$) attending prenatal clinics by McGwin et al., reported that only about 45% ($n = 203$) of women always wear their seat belts (both before and during their current pregnancy) even though 72.5% of subjects were able to demonstrate the proper way to wear a seat belt [17]. In addition, only 58% thought that seat belts would have a positive effect if they were in a motor vehicle crash during pregnancy, 34% were unsure of the effect, and 8% thought the seat belt would cause them to get hurt [17]. When asked if a seat belt would help protect their baby in the event of a crash, only 55.3% of the women thought that the seat belt would help, 10.7% said it would do harm, and 34% were unsure [17]. The women who thought a seat belt would help protect them were significantly more likely to report always wearing a seat belt versus the women who were unsure or thought negatively of the seat belt (84.4% vs. 64.6%, $p < 0.0001$) [17]. Considering this finding, it seems that knowledge and belief in the effectiveness of the seat belt could help motivate women to use a seat belt. Therefore, prenatal care providers should take the opportunity that prenatal visits provide to educate women on the importance of proper use of seat belts during pregnancy to protect both the mother and fetus and the hazards of crashes during pregnancy [18], as well as clear up any misconceptions that a woman may have about seat belt use. However, several questions remain. For instance, what percentage of women are actually receiving seat belt use counseling, how many wear their seat belts during pregnancy, and how many report being hurt in a motor vehicle crash?

To answer these questions, this study's objectives are to utilize the Pregnancy Risk Assessment Monitoring System (PRAMS) to report the prevalence of seat belt counseling by prenatal care providers during pregnancy, seat belt use during the last trimester, and self-reported motor-vehicle injury during pregnancy. Differences will be examined by maternal age, race and education.

Methods

This study is a cross-sectional study that utilized PRAMS, a population-based mixed-mode surveillance system administered by the Centers for Disease Control and Prevention, of self-reported maternal behaviors and experiences before and during pregnancy and during a child's early infancy [19]. Women who deliver live-born infants are sampled from birth certificates at 2 to 6 months after delivery for inclusion into PRAMS. It is the only multi-state population-based survey that attempts to determine what percentage of women are counseled to use seat belts during pregnancy and the only data system currently providing population-based, state-specific data regarding motor vehicle injury during pregnancy and seat belt use by pregnant occupants. PRAMS uses a standardized data collection method, approved by the Institutional Review Board of the Centers for Disease Control and Prevention. Data are collected through a mailed survey and non-responders receive a telephone call for follow-up (many states have also intensified recruitment efforts) [19]. Currently 32 states participate in PRAMS, covering 62% of all births in the United States [19].

Data from 2001 PRAMS was obtained from 22 states (AK, AL, AR, CO, FL, HI, IL, LA, MD, ME, MI, NC, NE, NM, NY, OH, OK, SC, UT, VT, WA, WV) for this study. Only 22 of the 32 states were chosen because these states collect all the variables of interest for this study and they had at least a 70% response rate for the questions of interest. Cases were excluded from PRAMS if they did not receive prenatal care ($n = 479$).

Survey respondents from the 22 states ($n = 37{,}081$) were asked whether, during any prenatal care visit a health care worker talked with them about using a seat belt during pregnancy and whether they were hurt in a car accident during their pregnancy. Seat belt use during the last trimester is an optional question for the PRAMS questionnaire that was only surveyed among Maryland and Vermont respondents ($n = 2{,}265$). Weighted estimates and 95% confidence intervals (CIs) were calculated.

Data were examined by maternal socio-demographic variables including age (<20 years, 20–29 years, or ≥30), race (White, Black, or Other), Hispanic ethnicity (yes or no), and educational level (less than high school, high school, or greater than high school). Odds ratios were calculated by

Table 1 Weighted prevalence of prenatal counseling for seat belt use during pregnancy, by socio-demographic characteristics, PRAMS, 22 states, 2001

Characteristics	(Weighted) %	Odds Ratio	CI (95%)
Age group (yrs)			
<20	11.7	1.02	0.90–1.16
20–29	51.9	1.13	1.04–1.23
≥30	36.4	referent	
Race			
White	78.1	referent	
Black	17.1	1.57	1.44–1.72
Other	4.9	1.30	1.14–1.50
Hispanic ethnicity			
Yes	13.0	1.29	1.14–1.45
No	87.0	referent	
Education			
<High school	18.7	1.53	1.36–1.72
High school	33.0	1.23	1.13–1.34
>High school	48.3	referent	

Table 3 Weighted prevalence of being hurt in a car accident during the pregnancy, by selected socio-demographic characteristics, 22 States, PRAMS, 2001

Characteristics	Weighted %	CI (95%)
Age group (years)		
<20	3.0	2.3–3.9
20–29	2.6	2.2–3.0
≥30	1.6	1.3–2.0
Race		
White	2.0	1.7–2.3
Black	3.9	3.1–4.7
Other	1.6	1.1–2.4
Hispanic ethnicity		
Yes	2.2	1.6–3.0
No	2.3	2.1–2.6
Education		
<High school	3.2	2.5–4.0
High school	2.5	2.1–3.0
>High school	1.8	1.5–2.1

logistic regression using SPSS Complex Sampling (2004, SPSS base v13.0.1 for Windows, SPSS Inc, Chicago, IL). Estimates and 95% CIs for being counseled to use a seat belt during pregnancy were calculated by state and socio-demographic characteristics. Estimates and 95% CIs for counseling topics were calculated and ranked. The data were then examined to evaluate the association between socio-demographic characteristics and the outcome variables (counseling on seat belt use, being hurt in a car accident, and wearing a seat belt). Weighted odds ratios and prevalence estimates were calculated to assess the magnitude and direction of association with 95% CIs.

Results

The overall prevalence of seat belt use counseling during prenatal visits was 48.7%. State specific prevalence ranged from 38.2% (Arkansas) to 58.8% (Washington). Women who were most likely to report being counseled were aged 20–29 (OR = 1.13, 95% CI = 1.04–1.23), non-white (Black OR = 1.57, 95% CI = 1.44–1.72; other OR = 1.30, 95% CI = 1.14–1.50), Hispanic ethnicity (OR = 1.29, 95% CI = 1.14–1.45), and less educated (less than high school OR = 1.53, 95% CI = 1.36–1.72; high school OR = 1.23, 95% CI = 1.13–1.34) (Table 1). In the PRAMS questionnaire, respondents were asked if they received prenatal counseling on 11 different topics; counseling for seat belt use (48.7%) ranked second to last. The only counseling topic reported to be discussed less often than seat belt use was physical abuse by husband/partner (38.6%) (Table 2).

The prevalence of being hurt in a car "accident" ranged from 1.2% (Alabama) to 4.7% (Maryland) with a weighted mean of 2.3%. Women who were less than 20 years old (3.0%), Black (3.9%) and had less than high school education (3.2%) were most likely to report being hurt in a crash during pregnancy. There was no difference by Hispanic ethnicity (Table 3).

Data obtained from Maryland and Vermont showed that women who were 30 years of age or older (89.1%, 95%

Table 2 Un-weighted prevalence of prenatal care counseling by a health care worker during pregnancy, by topic, PRAMS, 22 states, 2001

Rank	Counseling Topic	%	CI (95%)
1	Medicines that are safe to take during pregnancy	88.9	(88.3–89.4)
2	Testing birth defects or diseases that run in family	83.9	(83.3–84.6)
3	What to do if your labor starts early	83.3	(82.7–84.0)
4	Breastfeeding	82.7	(82.1–83.4)
5	HIV testing	82.3	(81.7–82.9)
6	Postpartum birth control	80.5	(79.8–81.2)
7	How smoking could affect baby	72.3	(71.6–73.1)
8	How drinking alcohol could affect baby	72.1	(71.3–72.9)
9	How using illegal drugs could affect baby	63.2	(62.4–64.1)
10	Using a seatbelt during pregnancy	48.7	(47.9–49.6)
11	Physical abuse by husband/partner	38.6	(37.8–39.5)

Table 4 Weighted prevalence of wearing seat belt the last three months of the pregnancy, by selected socio-demographic characteristics- Maryland and Vermont, PRAMS, 2001

Characteristics	Total	Always %	Always CI (95%)	Almost Always %	Almost Always CI (95%)	Sometimes %	Sometimes CI (95%)	Rarely %	Rarely CI (95%)	Never %	Never CI (95%)
Age group (years)											
<20	466	73.1	(68.6–77.2)	12.2	(9.4–15.7)	7.6	(5.4–10.7)	4.9	(3.2–7.5)	2.1	(1.2–3.5)
20–29	996	81.4	(76.3–85.7)	4.2	(2.9–6.0)	4.3	(2.4–7.6)	1.0	(0.5–2.2)	1.1	(0.5–2.3)
≥30	1364	89.1	(85.7–91.8)	5.4	(3.7–7.9)	2.6	(1.4–4.8)	1.6	(0.7–3.9)	1.3	(0.5–3.0)
Race											
White	2269	83.3	(79.9–86.1)	7.9	(6.0–10.4)	3.8	(2.4–5.8)	2.6	(1.5–4.3)	2.5	(1.4–4.2)
Black	457	86.1	(80.7–90.1)	6.8	(4.1–10.9)	4.7	(2.6–8.6)	1.7	(0.5–5.3)	0.7	(0.3–1.6)
Other	87	87.1	(70.9–94.9)	12.1	(4.5–28.7)	0.3	(0.1–1.2)	0.5	(0.1–3.2)	0	0
Hispanic ethnicity											
Yes	111	79.3	(64.3–89.1)	4.1	(0.8–18.1)	3.3	(0.8–12.6)	7.6	(2.3–22.6)	5.6	(1.7–17.2)
No	1326	86.0	(82.8–88.6)	7.5	(5.6–10.0)	3.6	(2.3–5.6)	1.5	(0.8–3.0)	1.4	(0.6–2.9)
Education											
<High school	378	73.9	(65.2–81.0)	9.4	(5.5–15.4)	8.4	(4.5–15.3)	2.1	(1.2–3.7)	6.2	(2.7–13.5)
High school	947	77.8	(72.2–82.6)	9.4	(6.4–13.7)	5.3	(3.1–8.9)	5.4	(3.0–9.4)	2	(1.0–4.2)
>High school	1471	90.7	(87.6–93.1)	6.5	(4.6–9.3)	1.6	(0.8–3.5)	0.3	(0.2–0.5)	0.8	(0.2–2.5)

CI = 85.7–91.8) or had a greater than high school education (90.7%, 95% CI = 87.6–93.1) were more likely to report always wearing seat belts during the last three months of their most recent pregnancy. Reported seat belt use during the last three months of pregnancy in Maryland and Vermont did not differ by race or Hispanic ethnicity (Table 4).

Discussion

In summary, reported prenatal care provider counseling for seat belt use occurred in 48.7% of prenatal visits; women aged 20–29, non-White, Hispanic ethnicity, and less educated were the most likely to report being counseled on seat belt use, women who were 30 or older and had a greater than high school education were more likely to report always wearing seat belts in the last trimester, and on average, 2.3% of respondents reported being hurt in a "car accident" during pregnancy. Women less than 20 years old, of Black race, and less educated were the most likely to report being hurt in a crash during pregnancy.

It is encouraging that this study determined that Black women are the most likely to report being counseled on seat belt use during pregnancy because, this study also determined that black women were more likely to report being hurt in a crash. To further support this finding, from 2001–2005, Black women of reproductive age [15–44] were more likely to be involved in a non-fatal motor vehicle crash than White women [20]. Although there are groups of women who are more at risk for experiencing a crash during pregnancy, it has been demonstrated that less than half of women always wear their seat belt (including before and during pregnancy) [17]. For this reason, all women should be counseled on the importance of seat belt use and how to properly wear a seat belt during pregnancy regardless of age, race, ethnicity, or education.

Extrapolating from the reported PRAMS rates in 2001 to the US population, it is estimated that at least 92,500 pregnant women (rate = 2.3/100 live births) are hurt in motor vehicle crashes each year in the United States. This finding is important because it is one of the few such estimates available from population-based multi-state data sources. The only previous estimate came from analysis of crashes reported by the National Automotive Sampling System (NASS) from the period 1955–1999 [7]. The latter reported only about 33,000 pregnancy related crashes (not injuries) annually. The current PRAMS data portrays the magnitude of the level of under-reporting in the NASS data system, because by definition, pregnancy status is 100% complete in PRAMS.

The findings regarding seat belt counseling were similar to the findings of earlier studies. Specifically, the percentages of women who reported being counseled were 48.7% in 22 PRAMS states surveyed in this study, 53% in 14 PRAMS states during 1997 and 1998 by Petersen et al. [21] and 48% in 19 PRAMS states in 2000 by Beck et al. [18]. The consistently low prevalence of seat belt use counseling during pregnancy suggests that this issue has not yet been properly addressed. Interventions needs to be put in place to ensure that women are educated and counseled on the importance of and proper use of a seat belt during pregnancy.

Prenatal counseling is a time where topics related to the health of the mother and the baby are discussed and proper seat belt use should be included. It is important to note that the literature is not unanimous on whether prenatal counseling is the best way to increase the use and proper use of seat belts during pregnancy. One issue with seat belt counseling during pregnancy is that some women have been reported to forget some of the topics that were discussed during prenatal counseling, including seat belt use. Tyroch et. al. did a follow-up survey in pregnant women after their initial prenatal visit and showed that 73% of the women did not recall having received advice on seat belt use even though they received brief counseling by a clinician and a pamphlet on seat belt use during pregnancy during their initial visit [22]. The authors suggested that new teaching methods such as audiovisual aids, mannequins, or having women demonstrate proper seat belt use to the health care provider may increase knowledge retention [22]. However, among the population in general, some research suggests educational initiatives have been ineffective at increasing seat belt use when compared with successful legislative and enforcement efforts [23].

On the other hand, several studies have reported positive effects due to prenatal counseling. For instance, Pearlman and Philips administered a survey to women ($n = 350$) who consecutively presented for their first prenatal visit and re-administered the survey at their second visit (28–32 weeks gestation) to assess the attitudes toward and usage of lap and shoulder belts. The authors showed that women who received seat belt use instructions were more likely to use restraints and properly identify restraint position than those who received no information [24]. Similar findings were reported by Johnson et al. for pregnant women who recalled being advised on correct placement [8]. Thus, studies show that education by prenatal care providers increases the number of pregnant women correctly using seat belts [8, 24, 25]. Therefore, instruction by health care providers is an important component to solving the problem of incorrect seat belt placement [8] and lack of use among pregnant women.

This study is not without several limitations due to the way that PRAMS collects data. The first limitation is potential misclassification. Since it has been shown that some women forget about counseling [22] it is possible that some women are misclassified as never having received prenatal counseling on seat belt use in the PRAMS data, when in fact they did. Another limitation is potential recall bias due to the fact that PRAMS collects data from women within two to six months postpartum. This means that some women are asked to recall counseling information and topics that were provided or discussed potentially over a year before the data were collected and those who had uneventful pregnancies may be less likely to remember specific counseling topics. However, this is a common limitation with retrospective studies and as discussed, perhaps a more impressionable counseling approach would increase the number of women who use and correctly use their seat belts during pregnancy and consequently are better able to recall counseling. Future research is needed to determine the effectiveness of different educational strategies.

Another limitation of this study is that out of the 22 states in this study, only Maryland and Vermont collected data on seat belt use during pregnancy and the data they collected is only for the last three months of pregnancy. This limits the generalizability of the seat belt use data not only for women in those two states, but also to only women in their third trimester of pregnancy. Seat belt use might change as a woman's pregnancy advances due to the growing abdomen and increasing level of discomfort, but with incomplete and limited PRAMS data on seat belt use throughout pregnancy these practices cannot be adequately measured. Nevertheless, the sample from these two states was large enough to provide useful results on these issues and can show other states the usefulness of adding these variables to their PRAMS surveys.

Another limitation of this study is that women who did not receive prenatal care were excluded from PRAMS. It is likely that women who do not receive prenatal care are different than those who do and might also differ in seat belt use habits; therefore potential selection bias is introduced. However only 1.3% of birth records were excluded based on this stipulation so the influence of selection bias on this study was minimal. Along these same lines there could be confounding due to the type of clinic a women received prenatal counseling from. This information was not assessed in this study.

The prenatal data collected by PRAMS is also limited by the format of the questions and the answers that women have to chose from. The PRAMS questionnaire asks whether or not women experienced any of a long list of problems during their pregnancy including; if they were hurt in a car accident. Women are allowed to choose more than one problem. The next question asks if the woman went to the hospital, emergency room, or stayed home due to any of the problems that she indicated on the previous question. Due to the way the questions are asked, a woman may indicate that she experienced several of the listed problems during her pregnancy and there is no way to know if they were independent events, all related, or which of them or what combination of events caused her to go to the hospital, emergency room or stay home. Furthermore, PRAMS does not have any independent way to capture the severity of injury such as the Injury Severity Score (ISS), where on the body the injury occurred, if a seat belt was being worn at the time of injury, what treatments were administered or recommendations given, or length of hospital stay. Therefore, interpretation of injury mechanism and severity during pregnancy are missing from the current structure of the PRAMS questions. Unfortunately, the same question formats are used in the latest version of PRAMS for 2004–2007. We hope that by highlighting the limitations of PRAMS it will motivate the PRAMS investigators to improve its design and usefulness for injury research.

The prevalence of counseling on seat belt use and proper seat belt use during pregnancy are of public health importance because establishing these rates are the first steps in determining if women are receiving, retaining, and applying the information that a prenatal care provider should be providing. The consistently low reported prevalence of prenatal counseling on seat belt use during pregnancy, coupled with the fact that some women do not wear or incorrectly wear their seat belts and some women have misconceptions about the use of seat belts during pregnancy, shows that this important maternal and child health issue has not improved over the years of PRAMS data collection. This study demonstrated that prenatal care providers need to counsel all women, no matter their demographics, about the importance and proper use of seat belts during pregnancy for the health and safety of the mother and fetus. In addition, prenatal care providers probably need to provide seat belt use information in better ways in order to make more of a lasting and effective impression on pregnant women. Through these changes, women and their babies will be better protected in the event of a motor vehicle crash.

Conclusion

Based on PRAMS, it is estimated that about 92,500 pregnant women are hurt annually in motor-vehicle crashes in the United States. Despite this risk and the proven efficacy of restraint use, the majority of pregnant women do not report being counseled about seat belt use. Limitations of PRAMS methodology makes it difficult to determine the severity of the injuries and the association of pre-natal counseling with seat belt use. Nevertheless, prenatal counseling on proper seat belt use during pregnancy should become more of a priority for prenatal care providers and new ways of providing counseling need to be explored.

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