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A Cross-sectional Study in Suburban Japan**

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## Original

# Exposure to Information and Seat Belt Use among Pregnant Women: A Cross-sectional Study in Suburban Japan

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## Abstract

**Background & Aim:** Wearing seat belt is an effective tool to protect both pregnant women and their unborn babies. Pregnant women are more likely to use seat belt if they have acquired knowledge on how to wear seat belt correctly during pregnancy. This study aims to examine the association between exposure to information on seat belts and usual seat belt use in daily life during pregnancy.

**Methods:** We employed a descriptive analysis of cross-sectional survey data collected through self-administered questionnaires at seven obstetric facilities in Maebashi City, a provincial city in Japan. Between October and December 2013, 1,278 pregnant women completed questionnaires, containing items such as the frequency of rear seat belt use and the sources from which they had received information on the issue.

**Results:** We found that 444 participants (34.7%) received information on seat belt use during pregnancy mainly from magazines or administrative bodies, while 834 (65.3%) did not. We also found that pregnant women who received more information from more sources were more likely to wear seat belts while sitting in the rear seat.

**Conclusions:** These findings suggest that increased information on the correct method of wearing seat belts during pregnancy may increase the number of pregnant women who wear seat belts. Our study has implications for protecting the safety of both pregnant women and their children.

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## I. Introduction

Motor vehicle accidents have been the leading cause of traumatic fetal injury<sup>1-3</sup> and previous studies exploring traffic accidents have reported such accidents as the most common cause of trauma during pregnancy (47–70.4% of the total incidents of trauma in pregnant women).<sup>4-7</sup> Pregnant women in motor vehicle accidents have a higher risk of preterm labor, placental abruption, and cesarean delivery, and infants born to women injured during pregnancy have a higher risk of preterm birth, low birth weight, and subsequent cerebral palsy.<sup>1,5,8,9</sup>

Previous reports conclude that the use of seat belts is an effective tool to protect both pregnant women and their unborn babies.<sup>10-12</sup> While engineers have discovered ways to refine rear seat belts to improve passenger safety, especially for pregnant women,<sup>13</sup> women must still be aware of the importance of using seat belts and how to use them correctly. For example, studies have found that pregnant women are significantly more likely to use seat belts if they have acquired knowledge on how to wear them correctly during pregnancy.<sup>14,15</sup>

In 2007, Japan passed the Road Traffic Act, which, beginning in 2008, required people in both the front and back seats of a car to wear seat belts.<sup>16</sup> Previous studies have found such legislation to be effective: people are

more likely to use rear seatbelts if there are laws enforcing the practice.<sup>17,18</sup> However, most existing studies on vehicular safety and pregnant women focus solely on the use of seat belts in the driver or front passenger seats.<sup>19-23</sup> For example, studies have found that pregnant women who receive education or information on how to use a seat belt during pregnancy are more likely to wear it.<sup>23-26</sup> Other studies report that pregnant women receive information on wearing seat belts during pregnancy from healthcare providers, magazines, and so on.<sup>20,27,28</sup>

Despite this previous research, little is known about how much information pregnant women receive on seat belt use, and whether receiving such information from a variety of sources makes seat belt education more effective. This study aims to examine the association between exposure to information on seat belts and the usual use of seatbelts in daily life during pregnancy by surveying pregnant women visiting obstetrics facilities in Maebashi, Gunma Prefecture, Japan. This study also aims to evaluate the reasons why pregnant women choose to use, or not to use, a seat belt while riding in a rear seat during pregnancy. Our study provides valuable information on the best way of protecting pregnant women and their unborn children while riding in a vehicle.

## II. Methods

### 1. Study design

This study was a cross-sectional survey conducted in association with Maebashi City, Gunma Prefecture, Japan, which operates seven obstetrics clinics and hospitals providing prenatal care. All pregnant women qualify to receive government-subsidized prenatal care at any facility they visit.

The design and results of this study's pre-questionnaire have been described in previous studies.<sup>15,29</sup> In brief, we approached all pregnant women seeking prenatal care between October and December 2013 to seek their participation. Patients who consented were asked to complete an anonymous self-administered questionnaire that included questions seeking information on their personal demographics (i.e., age and education), pregnancy (i.e., length of current pregnancy), and seat belt use (i.e., current and past frequency, knowledge of how to wear a seat belt during pregnancy, perception of its necessity during pregnancy). The survey was conducted in Japanese alone.

### 2. Study area

Maebashi City is the capital of Gunma Prefecture in the central region of Japan. The city is located about 100 km to the northwest of Tokyo, in the northern Kanto region. In 2013, the total population was 336,402, and the number of new babies born was 2,674.<sup>30</sup>

Although public transport is available in Maebashi City, private motor vehicles are the main source of transportation, as a national census showed that automobile vehicles constituted 75.1% of the transportation for commuters in Gunma Prefecture, and 46.5% of the national average.<sup>31</sup> In Gunma Prefecture, 72% of the population

and 66.5% of women have a driver's license, which is the highest rate of drivers in Japan (the average in 2016 was 64.8% for the total population and 56.7% for women).<sup>32</sup>

### 3. Ethics

This study was conducted with the approval of the Epidemiologic Research Ethics Committee of Gunma University Faculty of Medicine (Approval number 2017-287). We also obtained permission from the director of each hospital and clinic and from the Maebashi Medical Association and Gunma Society of Obstetrics and Gynecology. The questionnaire included a statement assuring participants of the survey's anonymity and informing them that submission was equivalent to providing consent.

### 4. Recruitment process

After the facilities' directors agreed to cooperate with our study, all participants were recruited from obstetrics clinics and hospitals in Maebashi City between October and December 2013. Pregnant women visiting collaborative obstetrics facilities to undergo health checkups were given information on our study by the reception staff. We excluded participants who were unable to read Japanese, as well as emergency cases and puerperal women. Upon agreeing to participate, the women were given the self-administered questionnaire, including an explanation of the study's aims, while they waited to receive prenatal care.

### 5. Questionnaire

This study was a cross-sectional work using a self-administered questionnaire that was developed based on previous studies.<sup>15,29</sup> Previous studies have described the study design and results concerning women with a driver's license and pregnant women who sit in the rear seat of vehicles; women with a driver's license revealed the factors associated with wearing rear seat belts, and pregnant women who sit in the rear seats revealed the characteristics of normal rear seat users.<sup>15,29</sup> The survey used in this study included questions on the information women had received regarding the correct usage of a seat belt during pregnancy; characteristics such as age, education history, parity, possession of a driver's license; seat belt use during pregnancy while in the rear seat (possible responses: "always," "often," "sometimes," and "never"); gestational age (classified as < 14 weeks, 14–27 weeks, or ≥ 28 weeks); and whether they had received any information regarding seat belt use from a variety of sources (e.g., magazines, administrative bodies, media, or health professionals). We investigated whether the amount of information on correct seat belt use during pregnancy is associated with the frequency of seat belt use during pregnancy. Participants were classified into four different groups: those who received information from one source were classified as "One INFO," those who received information from two sources were classified as "Two INFO," those who received information from three or more sources were classified as "Three INFO," and those who did not receive any information at

all were classified as “Non INFO”. The final questions on the survey asked the participants for the reasons why they chose to use or not to use a seat belt while riding in a rear seat during pregnancy as a question specific to this study.

### 6. Statistical analysis

Data analysis was performed using IBM SPSS Statistics 25. We used a Kruskal-Wallis test to compare differences among participants for each question with three or more categorical or numeric values. Cochran-Armitage test for trend was used to examine the association between the quantity of information and the binary scales or the frequency of rear seat belt use during pregnancy using a binary scale: “always”+“often” and “sometimes”+“never”. “Always”+“often” and “sometimes”+“never” was then compared to each of the points in conjunction with the reason they chose to use or not use a seat belt. Figure 1 demonstrates the following: the “positive” seat belt users (frequency of rear seat belt use before pregnancy to during pregnancy; continuous always, continuous often, continuous sometimes, or increased) and the “negative” seat belt users (frequency of rear seat belt use before pregnancy to during pregnancy; reduced or continuous never). Cochran-Armitage test for trend was used examine the trend between quantity of information and two seat belt users (“positive” and “negative” seatbelt users). Cochran-Armitage test for trend was conducted using R version 3.6.1, and other statistical analyses were performed using SPSS version 25. The significance level was set at  $P < 0.05$ .

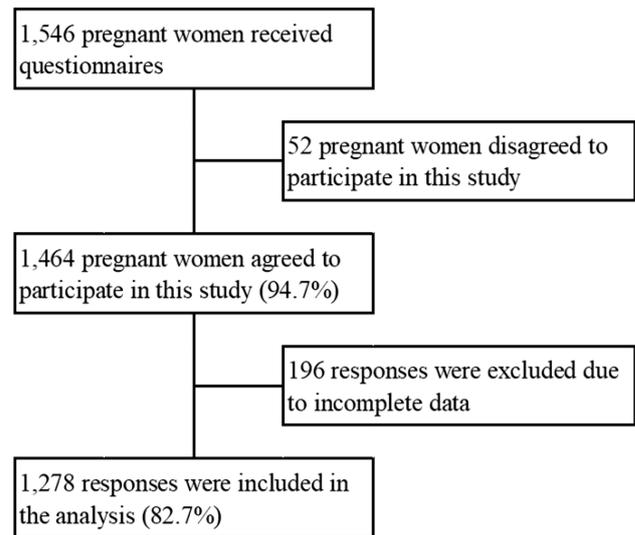
		During pregnancy			
		Always	Often	Sometimes	Never
Before pregnancy	Always	Positive	Negative	Negative	Negative
	Often	Positive	Positive	Negative	Negative
	Sometime	Positive	Positive	Positive	Negative
	Never	Positive	Positive	Positive	Negative

**Fig. 1** The “positive” seat belt users and “negative” seat belt users. Frequency of rear seat belt use before pregnancy to during pregnancy are as follows: The “positive” seat belt users; continuous always, continuous often, continuous sometimes, or increased. The “negative” seat belt users; reduced or continuous never.

### III. Results

A total of 1,546 pregnant women were invited to participate during the study period, and 1,464 (94.7%) of pregnant women agreed to participated. After excluding the questionnaires with missing data, we analyzed the complete data of 1,278 respondents (Fig. 2).

Among the 1,278 participants, 444 (34.7%) received information on seat belt use (INFO) and 834 (65.3%) did not (Non INFO). About 339 out of 444 (76.4%) received



**Fig. 2** Study recruitment process.

information from one source (One INFO), 87 (20.0%) from two or more sources (Two INFO), and 18 (4.1%) from three or more sources (Three INFO).

### 1. Participant characteristics

Table 1 shows the respondents’ characteristics based on the number of information sources. The median age and interquartile range (IQR) of the Non INFO, One INFO, Two INFO groups, and Three INFO groups were 31 (28–35) years, 31 (28–35) years, 32 (30–36) years, and 31.5 (27.75–35.50) years, respectively. The gestational age was 26 (18–33) weeks for the Non INFO group, 28 (21–34) weeks for the One INFO group, 27 (20–34) weeks for the Two INFO group, and 26.5 (16.75–35.00) weeks for the Three INFO group. The Kruskal-Wallis test showed the following variable  $P$  values: age,  $P=0.123$  and gestational age,  $P=0.095$ . The rates of nulliparous women in the Non INFO, One INFO, Two INFO, and Three INFO groups were 50.1%, 44.5%, 48.3%, and 22.2%, respectively ( $P=0.048$ ). In each group, 25.1% 27.7%, 27.6%, and 38.9% respectively had bachelor’s degrees or higher; however, there was no significant difference among the groups ( $P=0.177$ ). Over 98% had a driver’s license, and less than 10% did not drive. There were no significant differences between these two groups (possession of a driver’s license:  $P=0.613$ , non-drivers:  $P=0.287$ ).

### 2. Information sources

The type of sources from which participants received information on seat belt use during pregnancy was based on the number of sources from which they received information. The most common sources of information were “Magazines” (189/444, 42.6%) and “Administrative bodies” (148/444, 33.3%). “Media” (54/444, 12.2%), “Internet” (45/444, 10.1%), “Posters” (42/444, 9.5%), and “Health professionals” (33/444, 7.4%) were less popular sources of information. There was no significant difference in the prevalence of seat

**Table 1** Demographic information based on number of seat belt safety information sources

Items		Total	None INFO	One INFO	Two INFO	Three INFO	P-value (Kruskal Wallis test)
		N=1,278	N=834	N=339	N=87	N=18	
		Number (%)					
Age	Median (IQR)	31 (28–35)	31 (28–35)	31 (28–35)	32 (30–36)	31.5 (27.75–35.5)	0.123
Parity	Nulliparous	615 (48.1)	418 (50.1)	151 (44.5)	42 (48.3)	4 (22.2)	0.048*
	Parous	663 (51.9)	416 (49.9)	188 (55.5)	47 (51.7)	14 (77.8)	
Gestational age	Median (IQR)	27 (19–34)	26 (18–33)	28 (21–34)	27 (20–34)	26.50 (16.75–35)	0.095
Trimester ‡	< 14 weeks	160 (12.5)	112 (13.4)	34 (10.0)	12 (13.8)	2 (11.1)	0.105
	14-27 weeks	511 (40.0)	344 (41.2)	126 (37.2)	34 (39.1)	7 (38.9)	
	28 weeks	607 (47.5)	378 (45.3)	179 (52.8)	41 (47.1)	9 (50.0)	
Educational attainment	High school or less	376 (29.4)	251 (30.1)	104 (30.7)	19 (21.8)	2 (11.1)	0.177
	Junior or technical college	568 (44.4)	374 (44.8)	141 (41.6)	44 (50.6)	9 (50.0)	
	University or more	334 (26.1)	209 (25.1)	94 (27.7)	24 (27.6)	7 (38.9)	
Possession of drivers' license		1265 (99.0)	826 (99.0)	334 (98.5)	87 (100.0)	18 (100.0)	0.613
Non-drivers		50 ( 3.9)	27 ( 3.2)	19 ( 5.6)	3 ( 3.4)	1 ( 5.6)	0.287

\*\*\* $P < 0.001$

None INFO: Women had not gained any information about correct seat belt use during pregnancy, One INFO: Women had gained information about correct seat belt use from one source, Two INFO: Women had gained information about correct seat belt use from two sources, Three INFO: Women had gained information about correct seat belt use from three sources, SD: Standard deviation, IQR: Interquartile range.

**Table 2** Seat belt use during pregnancy according to number of information sources

Item		Total	None INFO	One INFO	Two INFO	Three INFO	P-value (Cochran Armitage test for trend)
		N=1278	N=834	N=339	N=87	N=18	
		Number (%)					
Rear seat belt use after pregnancy	Always + Often	518 (40.5)	291 (34.9)	164 (48.4)	51 (58.6)	12 (66.7)	<0.001***
	Sometimes + Never	760 (59.5)	543 (65.1)	175 (51.6)	37 (42.0)	7 (36.8)	
Change of rear seat belt use from before to after pregnancy	Positive	822 (63.6)	505 (59.8)	232 (68.0)	69 (79.3)	16 (88.9)	<0.001***
	Negative	459 (39.7)	331 (39.7)	108 (31.9)	18 (20.7)	2 (11.1)	

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$

None INFO: Women had not gained any information about correct seat belt use during pregnancy, One INFO: Women had gained information about correct seat belt use from one source, Two INFO: Women had gained information about correct seat belt use from two sources, Three INFO: Women had gained information about correct seat belt use from three sources

**Table 3** Reasons to use of seat belts (Always + Often) by amount of information received

Items	Total	None INFO	One INFO	Two INFO	Three INFO	P-value (Cochran Armitage test for trend)	
	Always+Often N=518	Always+Often N=291	Always+Often N=164	Always+Often N=51	Always+Often N=12		
		Number (%)					
To protect themselves	363 (70.1)	199 (68.4)	117 (71.3)	39 (76.5)	8 (66.7)	0.353	
To protect their fetuses	299 (57.7)	163 (56.0)	98 (59.8)	33 (64.7)	5 (41.7)	0.561	
Obligation to wear seatbelts	297 (57.3)	168 (57.7)	87 (53.0)	32 (62.7)	10 (83.3)	0.360	
Wearing seat belts before pregnancy	174 (33.6)	91 (31.3)	56 (32.2)	23 (45.1)	4 (33.3)	0.125	
To protect other passengers	89 (17.2)	48 (16.5)	26 (15.9)	10 (19.6)	5 (41.7)	0.163	
Others	16 ( 3.1)	11 ( 3.8)	3 ( 1.8)	2 ( 3.9)	0 ( 0.0)	0.437	

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$

None INFO: Women had not gained any information about correct seat belt use during pregnancy, One INFO: Women had gained information about correct seat belt use from one source, Two INFO: Women had gained information about correct seat belt use from two sources, Three INFO: Women had gained information about correct seat belt use from three sources

belt use during pregnancy based on the type of information sources (data not shown).

### 3. Seat belt use during pregnancy based on the number of sources of information

Table 2 shows the relationship between the amount of information received on seat belt use and corresponding seat belt use behavior derived using the Cochran-Armitage test for trend. The results were compared between “positive” users and “negative” users and showed significant differences in seat belt use among those who received information from a varying number of sources. Increased rear seat belt compliance from

before to during pregnancy is associated with receiving information on seat belt use. The more sources of information respondents reported, the more likely they were to use their rear seat belts. Similarly, pregnant women who received information on correct seat belt use from multiple sources were less likely to report that they “never” used or “decreased” their use of rear seat belts from before to during pregnancy.

### 4. Reasons for using or not using a seat belt while riding in the rear seat during pregnancy

Table 3 shows participants' reasons for using or not using a seat belt while riding in the rear seat during preg-

**Table 4** Reasons not to use seat belts (Sometimes+Never) by amount of information received

Items	Total	None INFO	One INFO	Two INFO	Three INFO	<i>P</i> -value (Cochran Armitage test for trend)
	Sometimes+Never N=760	Sometimes+Never N=543	Sometimes+Never N=175	Sometimes+Never N=36	Sometimes+Never N=6	
	Number (%)					
Not wearing seat belts before pregnancy	317 (41.7)	222 (40.9)	72 (41.1)	18 (50.0)	5 (83.3)	0.131
To press their abdomen	162 (21.3)	116 (21.4)	39 (22.3)	6 (16.7)	1 (16.7)	0.717
Tightening is uncomfortable	144 (18.9)	102 (18.8)	35 (20.0)	7 (19.4)	0 ( 0.0)	0.854
Not to feel necessary to wear seat belts	89 (11.7)	68 (12.5)	18 (10.3)	3 ( 8.3)	0 ( 0.0)	0.192
To press their breasts	30 ( 3.9)	20 ( 3.7)	8 ( 4.6)	2 ( 5.6)	0 ( 0.0)	0.637
Wearing exemption	25 ( 3.3)	16 ( 2.9)	8 ( 4.6)	1 ( 2.8)	0 ( 0.0)	0.668
A bad influence on their fetuses	10 ( 1.3)	6 ( 1.1)	4 ( 2.3)	0 ( 0.0)	0 ( 0.0)	0.788
Others	50 ( 6.6)	29 ( 5.3)	17 ( 9.7)	4 (11.1)	0 ( 0.0)	0.068

\**P*<0.05; \*\**P*<0.01; \*\*\**P*<0.001

None INFO: Women had not gained any information about correct seat belt use during pregnancy, One INFO: Women had gained information about correct seat belt use from one source, Two INFO: Women had gained information about correct seat belt use from two sources, Three INFO: Women had gained information about correct seat belt use from three sources

nancy. Among pregnant women who reported “Always” and “Often” wearing seat belts while riding in a rear seat, the most commonly reported reasons for their use of the seat belt during pregnancy were to protect themselves (363/518, 70.1%) and their fetuses (299/518, 57.7%) and the legal obligation to use a seat belt while riding in a rear seat (297/518, 57.3%), while about one-third (174/518, 33.6%) of those who used a seat belt while riding in a rear seat reported that they had already consistently done so before pregnancy.

Table 4 shows the reasons why participants did not use a seat belt while riding in a rear seat during pregnancy. Among pregnant women who reported “Sometimes” and “Never” using a seat belt while riding in a rear seat, the main reasons they did not use a seat belt during pregnancy were the non-use of seat belts before pregnancy (317/760, 41.7%), feeling that seat belts were too tight across the abdomen (162/760, 21.3%), and that seat belts made them uncomfortable (144/760, 18.9%). The Cochran-Armitage test for trend did not show statistically significant differences between quantity of information and the self-reported reasons for using or not using seat belts while riding in a rear seat during pregnancy.

#### IV. Discussion

The main aim of this study was to evaluate seat belt use among pregnant women according to the number of information sources to which they have been exposed. Approximately one-third (34.7%) of pregnant women received information about correct seat belt use during pregnancy. This number supports previous studies that found that between one-fifth and one-third of pregnant women receive such information.<sup>20,27,33,34</sup>

Previous studies have also shown that pregnant women who receive information on how to use seat belts during pregnancy are more likely to wear seat belts during pregnancy than those who do not.<sup>23-26</sup> This study demonstrated that pregnant women who received information from multiple sources were more likely to wear seat belts while sitting in the rear seat. To foster an increase in rear seat belt use by pregnant women, it may

be best to provide information from not just one source but, rather, multiple and different sources.

Most pregnant women received information on how to wear seat belts correctly during pregnancy from sources such as magazines and administrative bodies. Only 7.4% reported getting information from healthcare professionals. However, previous studies have found that information provided by healthcare professionals has a large impact on the number of pregnant women wearing seat belts correctly<sup>35</sup> and that instructions from healthcare professionals has an important role in solving incorrect seat belt placement.<sup>34</sup> Hence, it is paramount that healthcare professionals provide instructions on seat belt use during prenatal care or counseling.

Finally, we found that if women were exposed to more sources of information, they were more likely to wear a seat belt while sitting in the rear seat during pregnancy. However, only one-third of the pregnant women in this study received any information, and only approximately 10% acquired information through media, the Internet, posters, and healthcare professionals. It is necessary to make better use of these resources to provide safety information for pregnant women who are not familiar with proper seat belt use. In recent years, social network services (SNS) have become popular especially among young people.<sup>36</sup> And governments and local governments are using SNS to provide information.<sup>36</sup> The provision of safety information using SNS might become a useful tool for pregnant women who may not be familiar with proper seat belt use.

Another aim of this study was to evaluate reasons for using or not using a seat belt while riding in a rear seat during pregnancy among pregnant women attending obstetrics facilities in Maebashi City, Gunma Prefecture, Japan. Our results showed that each self-reported reason to use or not to use a seat belt showed no statistically significant differences, despite an increase in related information sources on seat belt use during pregnancy. Future studies should explore the reasons for these results.

This study had some limitations. The results may not be applicable to all pregnant women in Japan, as the sample was from one of Japan’s provincial cities, where almost all participants had a driver’s license; this may

limit the generalizability of the results to women in Japan's suburban areas.<sup>15,29</sup> The characteristics of women who do not have a driver's license may, therefore, differ from those of our participants. Responses explaining the reasons for wearing or not wearing a seat belt were provided as choices, rather than the question being open-ended. Participants may have other reasons besides the options provided to them. Further studies need to clarify the exact reasons why pregnant women choose to use or not to use a seat belt.

## V. Conclusion

We found that only one-third of pregnant women had received information on correct seat belt use during pregnancy. Of this group, two-fifths received information from magazines, one-third from administrative bodies, and approximately 10% through healthcare professionals, media, the Internet, and posters. Increasing this percentage is necessary to increase the safety of pregnant women and their unborn children. Previous studies have suggested that publishing more accurate safety information in maternity magazines can help pregnant women acquire specific safety knowledge.<sup>28</sup> It has also been suggested that prenatal care providers should educate their clients, and that obstetric doctors and nurses should be encouraged to provide advice concerning continued seat belt use throughout pregnancy.<sup>20,27</sup>

This study proposes that increasing the available information on correct seat belt use may increase the rear seat belt use rate among pregnant women in Japan. Wearing seat belts reduces risks to pregnant women and adverse fetal outcomes from motor vehicle accidents.<sup>37,38</sup> The "Guidelines for Obstetrical Practice in Japan" of the Japan Society of Obstetrics and Gynecology (JSOG)/Japan Association of Obstetricians and Gynaecologists (JAOG) recommends proper seat belt use during pregnancy.<sup>39</sup> Obstetrics providers can increase the safety of pregnant women and their children by providing information on correct seat belt use. We also recommend that health providers provide magazines and posters with information on correct seat belt use during pregnancy in both administrative offices and obstetrics facilities to provide more women with information. Future studies should investigate the effectiveness of seat belt education during pregnancy according to the source of information. Implementing such programs will increase the number of pregnant women who wear seat belts in rear seats during pregnancy and enhance their protection.

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## Disclosure

There are no conflicts of interest to declare.

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