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~~The effects of the enforcement of a seat belt use law on use rear seat belt among pregnant women in a suburban area of Japan~~

The prevalence of rear seat belt use among pregnant women in a suburban area of Japan

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Abstract

Aim: The aim of this study was ~~to examine pregnant women's rear seat belt use and the influencing factors after the enforcement of the seat belt use law requiring use of both front and rear seat belts, which took effect in 2008 in Japan.~~ to clarify the prevalence of rear seat belt use among pregnant women and its influencing factors.

Methods: Anonymous, self-administered questionnaires were provided to 1,546 pregnant women who visited obstetrics clinics and hospitals for prenatal checkups from October to December 2013. A total of 1494 pregnant women (96.6%) agreed to participate in this study and completed the questionnaires.

Results: Fewer than 20% of the rear-seat passengers "always" used seat belts before and during pregnancy, whereas one-third "never" used a seat belt before or during pregnancy. There was no significant decrease in seat belt use by rear-seat passengers during, as compared to before, pregnancy. Multivariate analysis revealed that age, knowledge of how to use a seat belt during pregnancy, belief in the compulsory use of a rear seat belt, and driver behavioral characteristics before pregnancy were associated with rear seat belt use during pregnancy.

Conclusions: ~~Enforcement of the seat belt use law as it pertains to the rear seat might effectively facilitate pregnant women's rear seat belt use. Moreover, the provision of information concerning the use of rear seat belts during pregnancy might be important for maintaining the safety of both pregnant women and their unborn babies.~~

The prevalence of fastening seat belts was substantially low and provision of information regarding proper seat belt use and its role in protecting the fetus may increase its use.

Keywords: ~~Japan, Multivariate analysis, Pregnancy, Safety, Seat belts~~ Pregnant women, Seat belts, Rear seat, Multivariate analysis, Influencing factors

Introduction

Trauma occurs in approximately 6-7% of pregnancies.[1] Motor vehicle accidents ~~crashes~~ are the leading causes of traumatic injury-related fetal mortality,[~~1,2~~2,3] serious maternal trauma,[~~3~~ 4] and death during pregnancy.[~~4~~ 5] Previous studies have reported that ~~approximately two-thirds~~ 54.6-70.4% and 66% of pregnant women who incurred traumatic injuries in the United

States and Japan, respectively, did so as a result of traffic accidents.~~5,6,~~[1,6,7] Based on the Pregnancy Risk Assessment System, it is estimated that approximately 92,500 ~~and 10,500~~ pregnant women are injured in motor vehicle accidents ~~crashes~~ annually in the United States[~~7~~ 7] ~~and Japan[6],~~ ~~respectively~~. The previous studies reported that using seat belts reduced the adverse maternal and fetal outcomes.[8,9,10] Reports from developed[~~8,9~~ 11,12] and developing[~~10~~ 13] countries have proposed the need for pregnant women to use seat belts appropriately to protect themselves and their unborn babies. The Japan Society of Obstetrics and Gynecology and the Japan Association of Obstetricians and Gynecologists have recommended that pregnant women should use seat belts, since 2008.[~~11~~ 14]

In 2013, the Japan National Police Agency Traffic Bureau ~~Transportation Authority~~ and the Japan Automobile Federation reported that the mortality rates of drivers, and front-seat and rear-seat passengers who did not use seat belts were 56.2-fold, 16.6-fold, and 2.7-fold higher, respectively, than those of their counterparts who used seat belts.[~~12~~ 15] Moreover, another previous report showed that the risk of death for drivers and front-seat passengers

who used seat belts increased about five-fold when rear-seat passengers were unrestrained.~~13~~ 16

A comparative study on the enforcement and non-enforcement of laws relating to seat belt use showed that countries enforcing laws requiring rear-seat passengers to wear seat belts had a higher rate of rear seat belt use compared to countries without such laws.~~14,15,16~~ 17,18,19 In Japan, fastening seat belts became mandatory for rear seats by the revised Road Traffic Act in 2008. ~~In Japan, laws concerning front and rear seat belt use have been enforced since 2008.~~ Several studies have investigated rear seat belt use since then;~~17,18~~ 20,21 however, little is known about the characteristics of pregnant women who use seat belts as rear-seat passengers. We examined the current use of rear seat belts among pregnant women to further elucidate the factors that influence their seat belt use during pregnancy.

Methods

Study site

This quantitative study used a cross-sectional design. The study sites were two obstetrics clinics and five hospitals with obstetrics facilities in Maebashi

City, Gunma Prefecture, Japan. Maebashi City is the capital of Gunma Prefecture and is located about 100 km northwest of Tokyo. In 2013, its population was 336,402, including 2,674 newborns. While public transportation is available, the use of private motor vehicles is much more common, as it is the main form of transportation among the residents of Maebashi City.

Ethics

The Epidemiologic Research Ethics Committee of Gunma University Faculty of Medicine approved this study (No. 25-36). The permission of the directors at each participating clinic and hospital was also obtained. Furthermore, we obtained approval from the Maebashi Medical Association and Gunma Society of Obstetrics and Gynecology to conduct the study.

Recruitment process

We recruited participants from all obstetrics clinics and hospitals in Maebashi City whose directors agreed to cooperate in the completion of this study. All pregnant women who received prenatal care from October to

December 2013 were invited to participate in this study. Those unable to read Japanese were excluded.

~~Figure 1 shows the recruitment process.~~ The self-administered questionnaire, consisting of an explanation of the study aim, was given to pregnant women at the reception areas of the participating facilities, while they awaited their prenatal care consultations with their obstetricians. The questionnaire included a statement assuring the participants of the survey's anonymity and informing them that submission was equivalent to providing participation consent. A total of 1,546 pregnant women who visited the obstetrics clinics and hospitals for prenatal checkups received the questionnaires. Of these, 1,494 (response rate: 96.6%) agreed to participate in this study and anonymously completed the questionnaires. Questionnaires with 192 incomplete ~~missing~~ data were excluded; therefore, the data of only 1,302 pregnant women were analyzed.

Questionnaire

The questionnaire items are shown in Tables 1 and 2. The questionnaire elicited information regarding characteristics such as participants' ages and

education levels, and gravida. Participants were also required to indicate gestational age, classified as less than 14 weeks, 14–27 weeks, and ≥28 weeks.

The questionnaire included questions regarding seat belt use (response options: “always,” “often,” “sometimes,” and “never”) before and during pregnancy when the participants were in the driver’s seat, front passenger seat, or rear passenger seat.

Participants also provided information regarding the possession of a driver’s license, driving history, ownership of car driven, whether they drove a car daily, knowledge of how to wear a seat belt correctly during pregnancy, wearing a seat belt prior to starting the engine when driving before pregnancy, and whether seat belt use during pregnancy was perceived as compulsory.

Statistical analysis

As potential determinants of seat belt use during pregnancy, we considered age, gestational age, gravida, whether participants drove a car daily, information acquired regarding how to wear a seat belt correctly during

pregnancy, education level, the perception of compulsory seat belt use during pregnancy, and driving history based on previous studies.~~[19,20,21,22,23,24]~~ [22,23,24,25,26,27] Moreover, we added an item about seat belt use before starting the engine when driving prior to pregnancy from the viewpoint of the influence of habitual behavior by habit.[28] Then, a total of nine ~~eight~~ items were analyzed as potential determinants of seat belt use during pregnancy. The variables were considered for multivariate analysis if their univariate P-value was < 0.05. We estimated the contribution of these factors to seat belt use during pregnancy and compared the seat belt use group ("always") and the non-seat belt use group ("often" or "sometimes" or "never") using logistic regression analysis. Furthermore, we estimated the odds ratio and 95% confidence intervals for rear passenger seats. SPSS version 23 was used for the statistical analysis, and the significance level was $P < 0.05$.

Results

Participant characteristics

Participants' demographic characteristics are shown in Table 1. The mean age was 31.2 years (SD = 4.77), with a mean gestational age of 25.6 weeks

(SD = 8.88). Gestational age was found to be ≥28 weeks for approximately half of the participants (47.2%) at the time of the survey. Moreover, 633 (48.6%) participants were primigravida, with a mean age of 30.1 years (SD = 4.79). Further, 669 pregnant women (51.4%) were multigravida, and the mean age of the multigravida women was 32.1 years (SD = 4.54). In total, 341 pregnant women (26.2%) had a high education level (university or graduate school).

Table 2 shows the pregnant women's driver characteristics. All 1302 (100.0%) participants had a driver's license. The mean length of their driving history was 11.9 years (SD = 5.03). Moreover, 1151 (80.4%) participants reported daily car use, 1180 (90.6%) reported their own car use, and 562 (43.2%) reported seat belt use before starting the engine when driving prior to pregnancy. A total of 456 (35.0%) participants had received information regarding seat belt use during pregnancy; 1076 (82.6%) knew that rear passenger seat belt use was compulsory during pregnancy.

Results of seat belt use

Table 3 shows information regarding the Kruskal-Wallis analysis of self-reported seat belt use before and during pregnancy by rear passengers according to pregnancy trimester. Fewer than 20% of the rear-seat passengers always used a seat belt before and during pregnancy for each trimester, and one-third never used seat belts before (30.0%) or during (31.7%) pregnancy. The Kruskal-Wallis test showed no significant differences in seat belt use among the pregnancy trimesters.

To examine this issue further, we ran a Wilcoxon signed rank test, the results of which are shown in Table 4. The Wilcoxon signed rank test revealed trimester differences in rear seat belt use before and during pregnancy; namely, pregnant women in their first trimester were more likely to use rear seat belts than when before they were pregnant.

Factors influencing seat belt use by rear-seat passengers

Table 5 shows the relative effects of five ~~six~~ factors influencing seat belt use based on being seated in the rear of a car during pregnancy. Univariate analyses revealed significant effects of those five factors on rear seat belt use during pregnancy, including being “30 years of age or older,” having a

212 “university-level education or higher,” “acquiring information on how to wear
213 a seat belt correctly during pregnancy,” having “the perception that seat belt
214 use is compulsory during pregnancy,” and “using the seat belt before starting
215 the engine when driving prior to pregnancy” ($P < 0.05$). Multivariate
216 analyses revealed that age, information acquisition regarding seat belt use
217 during pregnancy, seat belt use before the engine starts when driving prior to
218 pregnancy, and the perception that seat belt use during pregnancy was
219 compulsory significantly increased seat belt use after pregnancy.
220 Multivariate analyses also revealed that “a high education level” was not
221 significantly associated with increased use of a rear seat belt.
222

223 Discussion

224 This study demonstrated seat belt use during pregnancy in a suburban area
225 of Japan~~, following the enforcement of the seat belt use law stipulating that~~
226 ~~pregnant women should wear seat belts when seated in both the front and~~
227 ~~rear seats of a motor vehicle~~.
228 It ~~This study~~ showed low rear seat belt use during pregnancy; however, there
229 was no significant decrease in the use of a rear seat belt during, compared to

before pregnancy. We did find a ~~significant~~ decrease in the total lack of rear seat belt usage both pre- and during pregnancy compared to a previous study conducted in 2001,~~21~~ 24 ~~before the enforcement of the rear seat belt use law.~~ before fastening seat belts became mandatory for rear seats by the revised Road Traffic Act in 2008. ~~The observed decrease in the lack of pregnant women's rear seat belt usage could be explained as a natural result of the enforcement of the 2008 seat belt use law, which forced rear-seat passengers to also use seat belts.~~ A previous study of non-pregnant women showed that rear seat belt use in states with laws enforcing the practice was higher compared to that in states without such laws.~~16,25~~ 19,29 ~~Enforcement of seat belt use might be effective for increasing the seat belt use of both pregnant and non-pregnant women.~~ However, to clarify the effectiveness of the law, we need further comprehensive studies comparing the situation before and after the enforcement of fastening seat belts for rear seats by the revised Road Traffic Act in 2008.

Multivariate analysis revealed that the factors significantly influencing rear seat belt use were "being 30 years of age or older," "having acquired information on how to wear a seat belt correctly during pregnancy,"

"perceiving that seat belt use is compulsory during pregnancy," and "having engaged in seat belt use before starting an engine when driving prior to pregnancy." Previous studies have also shown that age, information acquired concerning how to wear a seat belt correctly during pregnancy, and the perception that seat belt use is compulsory during pregnancy were significant influencing factors of seat belt use.~~[22,26,27]~~ [25,30,31] The compatibility between our study results and those of previous studies might point to the reliability of our study findings.

Acquiring information regarding how to wear a seat belt correctly during pregnancy was a significant factor influencing rear seat belt use during pregnancy. Previous studies showed that pregnant women who reported having received seat belt use information specifically targeting mothers were more able to wear a seat belt correctly during pregnancy.~~[26,27,28]~~ [30,31,32] The current study also showed that ~~an understanding of seat belt use laws~~ the perception that seat belt use is compulsory during pregnancy was an influential factor, as was the acquisition of information regarding how to wear a seat belt correctly. ~~This result seems to support the effectiveness of seat belt use law enforcement.~~ One previous study suggested prenatal care

providers should offer beneficial educational opportunities to their clients in this regard, and that obstetric doctors and nurses should be encouraged to provide advice concerning continued seat belt use throughout the course of the pregnancy.[21,29] [24,33] In this study, we could not show when pregnant women obtained information about seat belt use during pregnancy; future studies should examine this further.

Seat belt use before starting the engine when driving prior to pregnancy was a significant factor influencing rear seat belt use during pregnancy. Recently built cars have reminder systems that sound an alarm when a passenger is not wearing a seat belt after the car engine has started and is in motion. A previous study showed that these reminder systems could be effective in increasing seat belt use.[30,31] [34,35] The development of a system that would disable a car engine from starting until after the driver and passengers have fastened their seat belts might prove useful in encouraging pregnant women to use seat belts while seated in the rear of vehicles.

This study had several limitations. A high response rate was received from individuals at the participating facilities. All the participants had a driver's license, which might indicate the uniqueness of the study site being a

Japanese suburban city. People who do not possess a driver's license might be characteristically different from the participants featured in the current study. Thus, these study results might not be fully representative of pregnant women throughout Japan.

Reporting bias might also have occurred because actual seat belt-use practices were not observed. Previous studies have reported that mismatch between observed and self-reported use rates is more prominent in countries with low seat belt use.~~[32,33,34,35]~~ [36,37,38,39] In this study, the mismatch between observed and self-reported use rates would have some effect because of the relatively low seat belt use rates among rear-seat passengers. Moreover, the observed rate of seat belt use among Maebashi's general population of non-pregnant women was close to our respondents' self-reported pre-pregnancy levels among rear-seat passengers ("always" and "often"; 49.7% vs. 37.6%, respectively).~~[26]~~ [40] Hence, this mismatch among rear-seat passengers was within the expected range.

In a study utilizing visual observations of actual seat belt use, it might be difficult to clearly distinguish between pregnant and non-pregnant women who use cars. It is particularly difficult to distinguish between non-pregnant

women and those in the early stages of pregnancy. However, a self-reported study might be a reasonable approach for evaluating pregnant women's seat belt use, despite its limitations.

This study examined whether women wore seat belts during pregnancy, without observing their actual seat belt-fastening practices. Although previous studies have shown that most pregnant women (i.e., 75% to 96%) wear seat belts during pregnancy, not all of them (i.e., only 47% to 76%) wear seat belts properly.~~29,37~~ 33,41 Since this study did not accurately portray the number of pregnant women who wear seat belts correctly while they are in the rear passenger seat, further research into this issue is necessary.

In conclusion, the prevalence of fastening seat belts among pregnant women in the rear seat was substantially low, and a provision of information regarding proper seat belt use and its role in protecting the fetus may increase rear seat use among pregnant women. Further studies will be needed to elucidate the effectiveness of the revised Road Traffic Act. ~~this study investigated actual seat belt use during pregnancy in a suburban area of Japan, following the enforcement of the seat belt use law stipulating that pregnant women should wear seat belts while seated in the rear passenger~~

~~seat, as well as the front seat. A multivariate analysis revealed that the significant influencing factors of seat belt use while in the rear passenger seat were being "30 years of age or older," having "acquired information on how to wear a seat belt correctly during pregnancy," having "the perception that seat belt use is compulsory during pregnancy," and "using the seat belt before starting the engine when driving prior to pregnancy." This study suggested that enforcing the seat belt use law and providing information concerning the use of seat belts while in the rear seat of a vehicle during pregnancy might be important for enhancing the safety of both pregnant women and their unborn babies.~~

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Disclosure

The authors declare that they have no conflicts of interest.

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~~Figure legend~~

~~Figure 1 Recruitment process: 1546 pregnant women were invited to this study, 1494 pregnant women (96.6%) agreed to participate; the final sample consisted of 1302 pregnant women (84.2%).~~

515 Table 1. Pregnant women's demographic characteristics (N = 1302)

Variable			
Age	Mean	31.2±4.77 years	
Gravida	Primigravida	633	(48.6%)
	Mean age	30.1±4.79 years	
	Multigravida	669	(51.4%)
	Mean age	32.1±4.54 years	
Gestational age	Average	25.6±8.88 weeks	
	<14 weeks	167	(12.8%)
	14–27 weeks	520	(39.9%)
	≥28 weeks	615	(47.2%)
Education	Junior high school	45	(3.5%)
	High school	340	(26.4%)
	Junior college	231	(17.7%)
	Technical college	344	(26.4%)
	University	316	(24.3%)
	Graduate school	25	(1.9%)

516 Table 2. Pregnant women's characteristics as drivers (N = 1302)

Variable			
Possession of a driver's license		1302	(100.0%)
Driving history	Mean	11.9±5.03 years	
Car being used	My car	1180	(90.6%)
Participants who drive a car daily (Yes)		640	(49.2%)
Acquired information on how to wear a seat belt correctly during pregnancy (Yes)		456	(35.0%)
Seat belt use before switching on engine (as a driver, before pregnancy) (Yes)		562	(43.2%)
Perception that rear seat belt use is compulsory during pregnancy (Yes)		1076	(82.6%)

517

Table 3. Self-reported seat belt use before and during pregnancy in rear seat position (1302 rear passengers), according to pregnancy trimester; n (%)

	<14 weeks		14–27 weeks		≥28 weeks		Total	
Seat belt use	Before (%)	During (%)	Before (%)	During (%)	Before (%)	During (%)	Before (%)	During (%)
Rear passenger seat								
Always	23 (13.8)	28 (16.8)	90 (17.3)	98 (18.8)	116 (18.1)	123 (20.0)	229 (17.6)	249 (19.1)
Often	37 (22.2)	42 (25.1)	101 (19.4)	97 (18.7)	122 (19.6)	124 (20.2)	260 (20.0)	263 (20.2)
Sometimes	63 (38.5)	51 (30.5)	166 (31.9)	166 (30.8)	193 (31.1)	166 (27.0)	422 (32.4)	377 (29.0)
Never	44 (25.7)	46 (27.5)	163 (31.3)	165 (31.7)	184 (31.1)	202 (32.8)	391 (30.0)	413 (31.7)
Total	167	167	520	520	615	615	1302	1302

The Kruskal-Wallis test revealed no significant trimester differences in seat belt use among pregnancy trimesters.

521 Table 4. Differences in rear seat belt use before and during pregnancy for each trimester

	n	Rear seat belt use (During pregnancy − Before pregnancy)			Z	P
		Improved (%)	Worsened (%)	Same (%)		
<14 weeks	167	19 (11.4)	9 (5.4)	139 (83.2)	2.148	0.032*
14-27 weeks	520	47 (9.0)	38 (7.3)	435 (83.7)	0.907	0.364
≥28 weeks	615	55 (8.9)	57 (9.3)	503 (81.8)	0.157	0.875
Total	1302	121 (9.3)	104 (8.0)	1077 (82.7)	1.193	0.233

522 Note: Reported on a 4-point Likert scale (1 = Always, 2 = Often, 3 = Sometimes, 4 = Never), the median IQRs for each
523 trimester were 3.0, 2.0, and 4.0, respectively. The Wilcoxon signed rank test revealed that pregnant women in their first
524 trimester were more likely to use rear seat belts than they were before their pregnancies.

525 *< 0.05

526

Table 5. Effects of factors influencing rear seat belt use during pregnancy, according to a multiple logistic regression analysis ("Always" vs. "Often" + "Sometimes" + "Never")

Factor	Odds ratio	95% Confidence Interval		
Age (≥30 years) (Yes/No)	1.045	1.013	~	1.078
Education level (University+) (Yes/No)	1.025	0.993	~	1.059
Acquired information on how to wear a seat belt correctly during pregnancy (Yes/No)	1.747	1.307	~	2.335
The perception that seat belt use is compulsory during pregnancy (Yes/No)	5.960	3.089	~	11.498
Seat belt use (before/after) starting engine when driving before pregnancy	1.075	1.044	~	1.107