

# Seat Belt Use During Pregnancy

## Improving Community Education



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## Background and Statistics

Motor vehicle collisions (MVC) are a leading cause of maternal and fetal injury and mortality in the United States. Each year approximately 160,000 pregnant vehicle occupants are involved in traffic collisions, with an estimated 92,500 injuries and 160 maternal fatalities.<sup>1,2</sup> Fetal fatalities are estimated at 1,293 losses annually.<sup>1,3,4</sup>

From 2006 to 2021 an average of 72 infants birth to 12 months old were killed in MVCs each year.<sup>5</sup> With an estimate of 1,293 fetal losses annually this indicates that a child is at eighteen times greater risk of dying in a car crash in the few months before they are born than in the following year after birth.

Maternal and fetal mortality are only part of the picture. Maternal patients can experience major injuries and hospitalization. For fetal patients, MVC leads to higher rates of premature rupture of membranes, placental abruption, premature birth, and low birth weight.<sup>6,7</sup>

As providers, educators, and public safety professionals it is our duty to keep our maternal and fetal vehicle occupants safe. The first step is to understand the source of these injuries.

## Mechanism of Injury

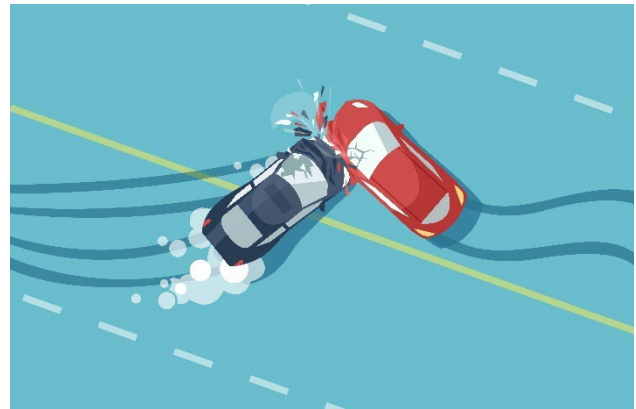
Common causes of fetal loss secondary to MVC include placental abruption, splenic injuries, massive hemorrhage, and maternal death. Placental abruption is the most common, accounting for 60-70% of MVC-related fetal mortality.<sup>2</sup>

Placental abruption is a medical condition where the placenta separates from the uterus, compromising blood and oxygen flow to the fetus. There are several ways placental abruption can occur during an MVC. The momentum of the placenta may generate enough force to detach it from the uterine wall. Shifting amniotic fluid can create a negative pressure on the placenta, pulling it away from the uterine wall.<sup>24</sup> Chest deflection can cause increased intrathoracic pressure and exert a separating force of the placenta and uterus.<sup>25</sup> Also, direct force to the abdomen can damage the placenta.<sup>14</sup>

The spleen and liver can be at a greater risk of injury as the uterus expands and displaces other organs. Forced out of their usual position, these organs may rest closer to the thoracic wall and be more susceptible to external forces.<sup>18</sup> Additionally, there is potential for greater internal force on the liver and spleen. During a collision the vehicle occupant's upper body continues to move forward, compressing the abdomen. In a pregnant occupant

this force is pressing organs into a cavity that is already crowded by the fetus.

Spleen and liver injuries, pelvic fractures, or other injuries can result in massive internal hemorrhage. This can be especially dangerous for pregnant patients as the clinical indications of shock and internal bleeding often do not present as readily as they do in non-pregnant patients.<sup>26</sup> Bleeding that is not recognized quickly can be catastrophic for both maternal and fetal patients.



Although fetal loss can occur with minor maternal injuries, studies have identified an association between higher level of maternal injury and adverse fetal outcome.<sup>8,9</sup> Therefore, reducing injuries to a pregnant vehicle occupant is our main objective when trying to protect a fetal occupant.

To reduce injuries inside the vehicle we utilize seat belts and airbag systems. Seat belts direct crash force to stronger bone groups in the body and keep the occupant positioned inside the vehicle. Airbags slow deceleration and spread remaining crash force across larger surface areas.

## Seat Belts

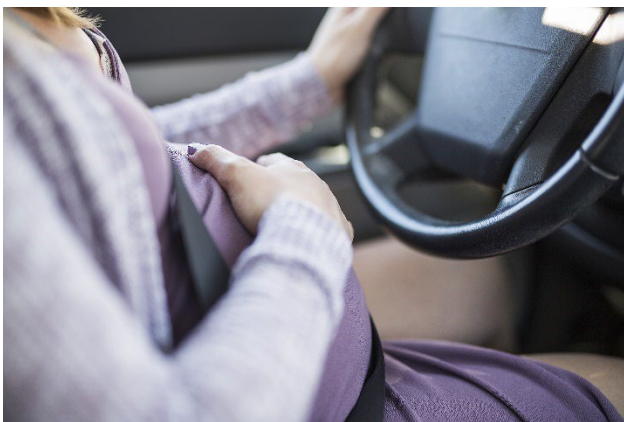
Seat belts are our first line of defense inside the vehicle. The most common style of seat belt found in passenger vehicles is a 3-point seat belt. A 3-point belt rests low across the lap, directing force to the pelvis, then crosses the upper body, distributing force over a larger area and keeping the vehicle occupant in place.

There is strong evidence to demonstrate that wearing a 3-point seat belt in the recommended manner leads to a decrease in adverse fetal and maternal outcomes.

- A study of 25,168 pregnant drivers involved in MVCs in North Carolina found that unbelted women experienced a higher rate of adverse fetal outcomes, particularly fetal loss.<sup>6</sup>



- An analysis of detailed crash reports in Michigan noted adverse fetal outcomes for 29% of properly belted subjects, 50% of improperly belted subjects, and 80% of unbelted subjects.<sup>3</sup>
- A study of 8,938 pregnant vehicle occupants in Utah found that unbelted occupants were 1.3 times more likely to have a low birthweight infant, twice as likely to experience excessive maternal bleeding, and 2.8 times more likely to experience a fetal loss than seat belted occupants.<sup>10</sup>
- A series of front- and rear-impact crash tests using a dummy designed to simulate a 30-week pregnant occupant found a 20% probability of adverse fetal outcome when the dummy was belted and a 60% probability of adverse fetal outcome when unbelted.<sup>11</sup>
- A review of Duke Trauma Registry patients found significantly higher rates of perinatal death among unbelted occupants. Additionally, it found that 73% of unbelted women complained of abdominal pain, versus 54% of belted women. And 25% of unbelted women required non-obstetric surgery following an MVC, compared to 7% of belted women.<sup>12</sup>
- A study of 680 pregnant trauma patients from the National Trauma Data Bank found that unbelted pregnant patients were more severely injured, needed emergent surgery more frequently, and had longer hospital stays than belted pregnant patients.<sup>13</sup>



While seat belts have shown to reduce rates of severe injury and fatality, they cannot completely prevent injury. Pregnant patients often worry that the seat belt can harm them or their baby. This concern is not unfounded. There are documented cases where the seat belt is cited as the mechanism of injury for a fetal loss. However, in four separate case studies where the seat belt may have led to

fetal loss, the seat belt was not correctly positioned when it contacted the abdomen.<sup>14,15,16,17</sup>

Overall, we have sufficient evidence to show that seat belts help despite potential for injury. Using national data of pregnant occupants in MVCs, it was noted that 96.7% of seat belt-related injuries were categorized as minor injuries.<sup>1</sup> And a fifth case study of a pregnant driver and fetus who survived extraordinary injury from an MVC stressed the importance of wearing a seat belt properly, as the driver in the case study wore theirs.<sup>18</sup>

Studies also illustrate the importance not only wearing a seat belt, but wearing it correctly. It has been noted that pregnant occupants who were belted in an MVC were at a similar risk of adverse fetal outcomes to pregnant people who were not involved in MVCs during pregnancy.<sup>10</sup> Properly using a seat belt can reduce risk of fetal loss by 84% and if all pregnant vehicle occupants wore their seat belt correctly, MVC-related fetal loss could decline by more than 50%.<sup>3</sup>

## Airbags

Airbag systems have led to a decrease in MVC injury and fatality, but like seat belts they have potential for injury. Questions arise about the deployment zone of the airbag. The National Highway Traffic Safety Administration recommends that a vehicle occupant's chest should be at least ten inches away from an airbag device to allow the airbag sufficient space to inflate before contacting the occupant. There is concern that a pregnant belly could be inside this deployment zone.

Examining level of injury with airbags presents a challenge for researchers. While seat belts are a variable in all levels of collision severity, airbags only deploy after a certain threshold of collision severity is met.

A study at University of Colorado Hospital and Denver Health Medical Center examined records for pregnant patients who were involved in an MVC with airbag deployment. Out of the 30 cases in the study, only one patient experienced placental abruption with fetal loss. This suggests a low incidence of fetal loss associated with airbag deployment.<sup>19</sup> The Duke Trauma Registry study found a correlation between airbag deployment and adverse fetal outcomes, potentially contradicting the previous findings. However, the study authors observed that this correlation is likely due to the severity of the collision, not the airbag deployment.<sup>12</sup>

While airbag injuries may occur, there is evidence that airbags are worth the potential risk. Evidence also demonstrates that properly wearing a

seat belt is important for minimizing this potential. The North Carolina study mentioned earlier found that rates of placental abruption and preterm birth were lower for MVCs involving vehicles equipped with airbags than those without.<sup>6</sup> Nationally, 98.9% of injuries attributed to the front airbags were minor. And of the pregnant occupants injured by the airbag, 58.1% were unbelted.<sup>1</sup> This corroborates crash test results that found an increased risk of placental abruption or fetal injury with airbag deployment when the maternal occupant was not properly positioned by the seat belt.<sup>19</sup>

## Education

Through the tireless efforts of thousands of providers, educators, and public safety professionals the number of fatalities in children birth to five years old due to MVC has fallen from 697 deaths in 2006 to 358 deaths in 2021.<sup>5</sup> This 51% reduction in fatalities shows that interdisciplinary collaboration and community education can generate positive results in injury prevention.



We can take the system that has been developed for child passenger safety and apply the same approach to seat belt use during pregnancy. In child passenger safety programs, we employ informational materials, in-person instruction, and vehicle-side checks.

Many providers and educators already include information about seat belt use during pregnancy in the materials they provide patients and clients. This is a good first step and does appear to increase proper seat belting. However, education should not stop there.

In-person education about seat belt use during pregnancy only takes a few minutes and greatly increases proper seat belt use. Most people climb into their car and buckle up without a second thought. As a result, people do not often think about the specific manner in which they are wearing their

seat belt. Taking a moment to slow down and talk through seat belt use with a pregnant patient or client has immense value.

The most reliable way to ensure proper seat belt use and provide a complete education is a vehicle-side seat belt check. The concept may seem unconventional, but thousands of similar child car seat checks are completed each year.

UCHealth EMS has added seat belt checks for pregnant women to car seat and CPR appointments. Staff use a checklist to gather information about the pregnant vehicle occupant and how they are seat belted and positioned. After gathering the information, staff give recommendations regarding any misuses that were identified. The process takes approximately five to ten minutes.

From January 15, 2022 to August 17, 2023:

- 1,724 Seat belt checks performed
- 991 Pregnant occupants' safety improved

## Education and Proper Use

During vehicle-side seat belt checks data is also gathered about the amount of education the pregnant vehicle occupant has received during their pregnancy. The table below shows the rate of correct seat belt use and vehicle seat positioning for each level of seat belt use education.

Level of Education	Correct Use
No Seat Belt Education	15.28%
Informational Materials Only	29.05%
In-Person Seat Belt Education	61.26%
Vehicle-Side Seat Belt Check*	91.22%

\*Data gathered at follow-up checks

The data clearly demonstrates that even a small amount of time spent talking with pregnant patients and clients improves safety. The continuous improvement from one level of education to the next shows us that any amount of education helps, but the more education a pregnant person can receive, the greater increase in safety.

Unfortunately, most pregnant people do not receive counseling on their seat belt use. Out of 1,246 women surveyed by UCHealth only 21.51% reported receiving in-person seat belt education.

## Second Trimester Education

While encouraging patients to wear their seat belt should start at the first appointment, detailed instruction on seat belt use during pregnancy should be performed during the second trimester.



During the first trimester the fetus is relatively well protected and seat belt fit is not yet notably affected. Patients and clients also receive a great deal of information during their initial prenatal visits. Spreading out some of the instruction and information could be beneficial.

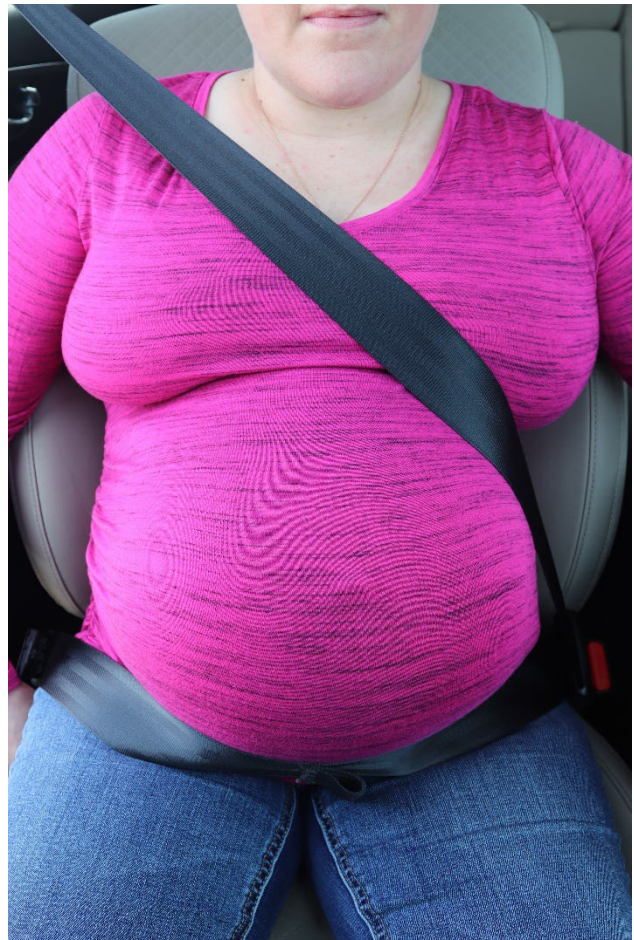
During the second trimester the physical changes that affect seat belt use are more pronounced. There is also a greater chance of being in a collision. Studies in North Carolina and Ontario both found an increase in MVC involving pregnant vehicle occupants during the second trimester.<sup>20,21</sup> Therefore, the second trimester is the ideal time for detailed seat belt discussion and instruction.

## Recommended Use

The following is the method of seat belt fit and vehicle seat positioning for pregnant vehicle occupants recommended by the National Highway Traffic Safety Administration and American College of Obstetricians and Gynecologists.<sup>22,23</sup>

### Seat Belt Fit

- Lap belt placed under the curve of the belly and resting on the hips.
- Shoulder belt to the side of the belly and diagonally across the center of the chest.
- Shoulder belt crossing the middle of the clavicle, resting on the shoulder.



### Vehicle Seat Adjustment

- Seat back upright, or as upright as the pregnant person can tolerate.
- Seat adjusted back so the belly does not press against the steering wheel and there are at least ten inches of space between the center of the steering wheel and the chest.
- Seat also close enough so the pregnant driver can fully depress the pedals comfortably.

### Steering Wheel

- Tilted so the airbag is directed towards the chest, not the belly or face.
- Steering column distance adjusted so driver can comfortably reach the top of the steering wheel while providing space for airbag deployment.



## Good, Better, Best

There are occasions where the ideal seat belt fit and vehicle position are not achievable. The child passenger safety field utilizes the concept of “good, better, best.”

Following all recommendations and best practices is the “best” circumstance. The “better” circumstance occurs when recommendations may not be fully met, but the current conditions are close to best practice. If recommendations are only met to the minimum it may still be considered the “good” circumstance, even if it is not ideal.

### Example

The picture below is the same model from the previous set of pictures. In the previous pictures she was 34 weeks pregnant. In this picture she is 39 weeks pregnant. She cannot tolerate a fully upright position and has reclined her seat back. There is now a gap between her shoulder and the shoulder belt, but effort was made to minimize the gap. Her seat and steering column are adjusted to give her as much room as possible while still allowing her to safely reach the pedals and steering wheel.



“Best” would be for her to follow all of the recommendations in the Recommended Seat Belt Use section. Lap and shoulder belt worn properly, seat upright, sitting back from the steering wheel. However, in this instance the best practice cannot be achieved.

“Better” would be sitting in the passenger seat, wearing her seat belt and reclining her seat as shown. While there is a gap between her shoulder and the shoulder belt, the belt is still positioned over

the middle of her clavicle and she is wearing the lap belt properly.

“Good” is the circumstance pictured here. The seat belt is worn correctly except for the shoulder belt gap. Her belly is not physically touching the steering wheel, but the gap between her belly and the wheel is small and can increase the potential for contact with the wheel during a sudden stop or collision. She could drive if she needed to, but it would be advisable to ride in the passenger seat when possible.

When educating patients or clients it is important to emphasize recommendations, but also understand that best practice may simply not be possible. In these cases we work to get as close to recommendations as conditions allow. While they may not have the ideal protection, the pregnant person and their baby are still better protected than they would be if they were unrestrained.

## Troubleshooting Tips

Below are some of the common issues faced by pregnant vehicle occupants and tips for achieving recommended use.

- Lap belt riding up over belly.
  - Advise pregnant person to lift their belly to place the lap belt underneath.
  - Advise pregnant person to turn lap belt over as it passes underneath belly.
  - Adjust vehicle seat recline to a more upright angle.
- Gap between clavicle and shoulder belt.
  - Adjust height of shoulder belt where it comes out of vehicle wall.
  - Adjust vehicle seat recline to a more upright angle.
  - Move seat forward to line shoulder up with B pillar.
- Belly/chest too close to steering wheel.
  - Move vehicle seat back.
  - Adjust steering column distance.
  - Use caution when adjusting seat and steering column distance. A pregnant driver must be able to safely reach the pedals and the top of the steering wheel.

## Educational Resources

A set of educational resources has been created to assist providers, educators, and public safety professionals in their efforts to increase safety for pregnant vehicle occupants.



## Seat Belt Use Graphic

There are a number of informational materials on seat belt use during pregnancy available online. However, after looking at the available materials and working with providers and patients a need was identified for a new graphic.

Patients and providers expressed that they wanted to see pictures of a real woman, as opposed to an illustration. They also wanted to see a woman who was far enough along that the seat belt fit was notably affected. Also, none of the available materials addressed seat belt positioners.

UCHealth EMS staff along with a volunteer took a series of photographs in the woman's vehicle and assembled them into a graphic.

## Seat Belt Use During Pregnancy



The model is 60 inches tall and 34 weeks pregnant with one baby. She is seated in an SUV. The graphic includes recommended usage, denoted by green borders and check marks in the corner. Common errors are also included, denoted by red borders and "no" symbols in the corner. The graphic intentionally uses minimal text so it can be employed with multilingual populations.

The graphic is free to use and available for educational purposes.

## Seat Belt Use Teaching Tool

To assist providers, educators, and public safety professionals there is a teaching tool using the Seat Belt Use During Pregnancy graphic.

The teaching tool is on a letter sized sheet. The Seat Belt Use During Pregnancy graphic is on the front side and all of the talking points for the person providing the education are on the back. A PDF version is available and free to use.

## Seat Belt Use Flyer

A Seat Belt Use During Pregnancy flyer for distributing to patients or clients was developed to accompany the graphic and teaching tool. The flyer is currently available in multiple languages and the branding can be customized for your organization.



## HCPVS.org

A website has been launched to assist you with everything you need to increase the safety of pregnant drivers and passengers on the road. It is under the name Hudson Center for Prenatal Vehicle Safety. The address is [www.hcpvs.org](http://www.hcpvs.org). There is also a QR code at the end of this report.

The website has resources for pregnant drivers and passengers including how to wear your seat belt, frequently asked questions, how to ride safely in other modes of transportation, and information on pregnancy seat belt adjusters.

For professionals, the website has a resources page with downloadable copies of the seat belt use graphic, teaching tool, and flyer. The flyer is available in multiple languages. This report is also available to download. On the Research Articles page there are links to the articles cited in this report as many other articles on vehicle safety for pregnant vehicle occupants.

## Conclusion

Motor vehicle collisions present a significant hazard to maternal and fetal vehicle occupants. The good news is that the safety devices available in passenger vehicles have been shown to mitigate some of the risk. However, improving and increasing community education is essential for protecting expecting families and their babies out on the road.



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## Hudson Center for Prenatal Vehicle Safety QR Code





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