Seat Belt Use During Pregnancy

Improving Community Education

Gregory Colton
UCHealth EMS

uchealth

Background and Statistics

Motor vehicle collisions (MVC) are the leading cause of severe obstetric trauma in the United States. Each year approximately 160,000 pregnant vehicle occupants are involved in MVCs, with an estimated 92,500 injured and 194 pregnant occupants killed. Fetal fatalities are estimated at 1,405 losses annually. [1,2,3,4,5,6,7,8,9,10]

From 2017 to 2021 an average of 70 infants birth to 12 months old were killed in MVCs each year.[11] With an estimate of 1,405 fetal losses annually this indicates that a child is at twenty 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. MVC during pregnancy is also associated with elevated rates of placental abruption, fetal distress, premature rupture of membranes, preterm birth, low birth weight, cesarean delivery, and cerebral palsy.[12,13]

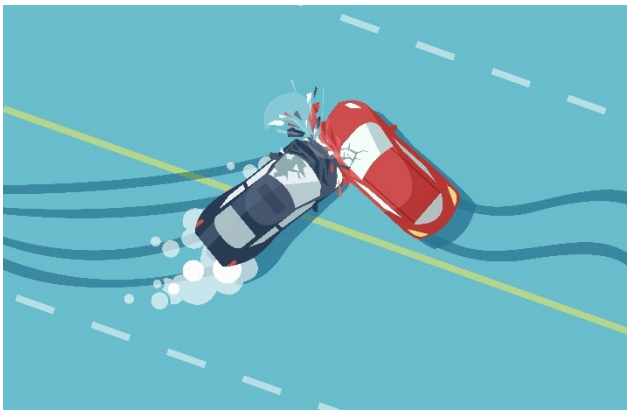
Mechanism of Injury

Common causes of fetal loss secondary to MVC include placental abruption, direct fetal injury, uterine rupture, maternal shock, and maternal death. Placental abruption is the most common, accounting for up to 70% of MVC-related fetal mortality.[14]

Placental abruption is a medical condition where the placenta separates from the uterus, compromising oxygen and nutrient flow to the fetus. It is the predominant cause of fetal loss for several reasons.

- A large variety of different forces created by an MVC that can lead to abruption.
- Placental abruption can occur even if the pregnant vehicle occupant sustains only minor injuries.[15]
- Abruption due to MVC is equally likely no matter where the placenta is located within the uterus.[16]
- Placental abruption can occur with or without external force applied to the abdomen.
- Low- speed MVCs can result in placental abruption.[14]
- The symptoms of placental abruption may take time to appear, causing a delay in care. [1]

The uterus and placenta have different characteristics and plasticity. This becomes important during an MVC because the uterus will rapidly shift and deform due to the forces of the collision. If the uterus deforms more quickly or more



significantly than the placenta can tolerate then a shearing force is created across the plane between the placenta and uterus. This shearing force can cause the two of them to separate.[17]

There are four main forces that can be generated by an MVC and lead to placental abruption:

- External force applied directly to the location of the placenta.
- External force applied opposite of the location of the placenta.
- Internal force created by the amniotic fluid in the uterus.
- Internal force created by the deflection of the upper body.

External force acting on the abdomen such as contact with the seat belt, steering wheel, vehicle interior, or a projectile inside the vehicle can affect the placenta if that force is applied directly against where the placenta is positioned on the uterus.[18]

External force acting on the abdomen in a location opposite of the placement of the placenta can also cause abruption. Amniotic fluid is incompressible so an external force on one side of the uterus can cause the opposite side of the uterus to deform outward and cause abruption.[19]

Internal forces are generated by the amniotic fluid within the uterus. At a basic level the uterus is a fluid filled container. During the sudden velocity changes of an MVC this fluid will shift violently. Shifting amniotic fluid that is moving away from the placenta can create a negative pressure that can pull the placenta away from the uterine wall.[19,20]

Internal force is also generated by the pregnant occupant's upper body. In a collision the upper body will deflect forward. The forward motion of the torso increases pressure in the chest and abdomen. This pressure can create a blunt force against the uterus and cause abruption without an external force acting on the abdomen.[19]

Direct fetal injury is often a primary concern of pregnant drivers and passengers. However, it comprises a relatively small number of fatalities, occurring in less than ten percent of fetal losses.[21] Even when a direct fetal injury does occur it may be the result of contact with internal structures like the pelvis and not necessarily an external object.[22]

Uterine rupture is even less common, occurring in less than one percent of fetal losses. [21] There are some case studies where uterine rupture led to fetal loss.[23,24] While it is possible, these cases often involve extraordinary circumstances or seat belt misuse. They become case studies because of how notable the rare cases of MVC-related uterine rupture are.

Maternal shock is the most significant risk to consider for pregnant and fetal vehicle occupants other than placental abruption. Hypovolemia, or insufficient blood flow due to blood loss, is a particular risk for pregnant and fetal patients. When a pregnant patient goes into shock, the body will shunt blood flow away from the uterus to preserve the functions of the pregnant patient's body.

The treatment of shock for pregnant patients is complicated by the fact that recognition of the condition is more difficult during pregnancy. A pregnant patient can lose as much and one and a half liters of blood before they begin displaying clinical signs of shock.[25]

The liver, spleen, and kidneys are organs that have extensive blood flow and lead to significant blood loss when injured. Blood loss from organ injuries due to MVC have been observed in pregnant patients and can be catastrophic.[26]

The liver and spleen 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.[27] Additionally, there is potential for greater internal force on the liver and spleen. As previously discussed, there is an increase in intrathoracic and intra-abdominal pressure during an MVC. In a pregnant occupant this force is pressing organs into a cavity that is already crowded by the expanded uterus.

Common vehicle safety features including seat belts and airbags have been proven to reduce placental abruption, direct fetal injury, uterine rupture, maternal shock, and maternal death. However, these safety features must be used correctly and effectively.

Seat Belts

The most common style of seat belt found in passenger vehicles is a 3-point lap and shoulder belt. A 3-point belt rests low across the lap, contacting the hips, then crosses the chest and collar bone. Seat belts keep the occupant inside the vehicle, position the occupant in the seat, direct crash force to stronger body structures, and distribute crash force across a larger surface area.

There is abundant evidence to demonstrate that wearing a 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.[28]
- A series of crash tests specifically designed to look at the area of placental abruption found that negative fetal outcome was not likely with a correctly positioned seat belt.[29]
- 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.[7]
- 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.[30]
- The same study also concluded that pregnant vehicle occupants who were wearing a seat belt did not have a significantly higher risk of an adverse fetal outcome than a pregnant person who was not in a crash at all during their pregnancy. [30]
- 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.[31]

- 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. [32]
- 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. [33]
- A series of crash simulations comparing unbelted, lap belt only, and lap and shoulder belt concluded that the lap and shoulder belt provided the greatest protection. [34]
- The first crash tests completed with a specially designed pregnant crash test dummy recorded the lowest force and acceleration readings when the seat belt was worn in the recommended manner.[35]
- A review of 188 pregnant trauma patients at a level 1 trauma center found that every one of the maternal fatalities in the hospital's records were not wearing a seat belt at the time of the collision.[36]
- Crash simulations using a highly detailed representation of a pregnant occupant and fetus to compare belted and unbelted occupants found that an unrestrained pregnant occupant had the highest uterine strain and risk of adverse fetal outcome. [37]
- An extremely detailed review of 120 MVCs involving pregnant occupants found that almost all cases of direct fetal injury, uterine injury, or maternal death were not wearing a seat belt. [21]
- A different review of case studies concluded that improperly restrained pregnant occupants have an increased risk of adverse fetal outcomes, even in low severity crashes.[38]
- Using national data of pregnant occupants in MVCs, it was noted that 96.7% of seat belt-related injuries were categorized as minor injuries. [39]

There is no doubt from a research perspective that seat belts improve patient outcomes. However, up to 40% of pregnant vehicle occupants are still unsure if the seat belt would help their baby in a crash or think the seat belt could cause harm.[40,41,42]

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%.[7]

Another case study of a pregnant vehicle occupant 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.[27]

Airbags

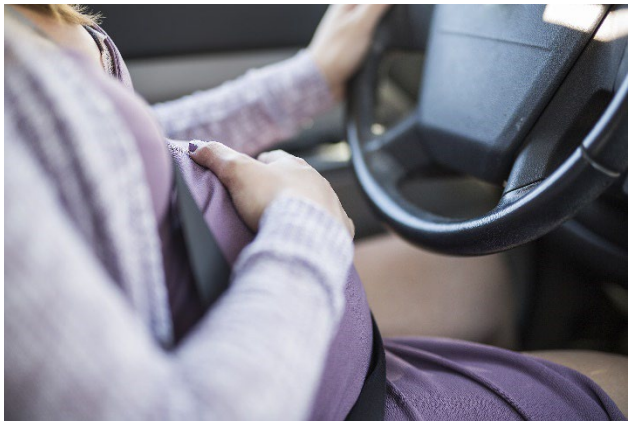
Since their advent airbags in passenger vehicles have reduced injuries and saved lives. Over the years the designs have been refined and improved. While there is less research information available for airbags, the evidence shows that airbags are effective in reducing injury for pregnant vehicle occupants.

- In a series of 30 cases at two major hospitals where a pregnant vehicle occupant was involved in an MVC with airbag deployment only one of the 30 patients experienced a fetal loss.[43]
- Another set of cases from a different hospital found that airbag deployment did not appear to increase risk to pregnancy. [44]
- A series of crash tests using dummies designed to simulate a pregnant occupant found that a three-point seat belt coupled with an airbag provided superior protection to the three-point belt alone.[37]
- A follow-up series of crash tests using computer simulations designed to recreate a pregnant occupant confirmed that a three-point seat belt paired with an airbag led to the lowest amounts of uterine strain recoded in the testing.[37]
- A study of 25,168 pregnant drivers involved in MVCs in North Carolina found that pregnant occupants in vehicles without airbags

experienced higher rates of placental abruption and preterm birth than pregnant occupants in vehicles equipped with airbags.[28]

- Using national data of pregnant occupants in MVCs, it was noted that 98.9% of seat belt-related injuries were categorized as minor injuries. Additionally, 58.1% of the pregnant occupants who were injured by the airbag were unbelted at the time of the collision.[39]

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. Some studies have 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.[32,45]



It is also important to note that seat belts and airbags are a team. Crash tests have shown that seat belts are most effective when paired with airbags.[37] Data from MVCs has shown that airbags alone decreased fatal injury by 13%, but an airbag with a three-point seat belt reduced fatality by 50%.[46]

Incorrect Use Can Be Dangerous

While seat belts and airbags have clearly reduced rates of severe injury and fatality, there is evidence that an improperly used seat belt can have serious consequences for pregnant and fetal vehicle occupants.

- A review of patients from a level 1 trauma center found that patients who had seat belt marks across their abdomen, indicating the lap belt was higher on their belly than the recommended use, were 50 times more likely to experience placental abruption.[47]
- A series of crash tests that calculated the area of placental abruption with various lap belt placements corroborated these results. Testing found that the abruption area increased considerably when the lap belt was positioned incorrectly.[29]
- A detailed study of cases involving a pregnant occupant in an MVC noted that 50% of the cases with confirmed improper seat belt use experienced adverse fetal outcomes.[7]
- Another expansive case series observed uterine injury in every case where improper seat belt use was confirmed. [21]
- Further crash tests measured increased strain on the uterus as lap belt height on the abdomen was increased.[5]
- Another set of crash tests put a number to this increase and published results stating that the force transmitted to the uterus increased three to four times at all speeds tested when the lap belt was over the uterus. [35]
- Seven separate case studies confirm all of the results above. Each of these seven cases resulted in fetal death and in each of the cases improper seat belt use was confirmed.[18,23,24,36,48,49,50]

This evidence is concerning. While it is well proven that seat belts and airbags are helpful, it is of the utmost importance that these devices are used correctly to prevent injury.

If proper seat belt use is this imperative, then how many pregnant vehicle occupants are utilizing their seat belt correctly? Results from a pilot prenatal seat belt check program have found that only 17% of pregnant vehicle occupants checked were wearing their seat belt correctly. Other studies have found correct use rates as low as 3.5% and rates of pregnant occupants placing their lap belt over their belly as high as 22%.[51,52]

Education

Immediate action must be taken to increase the rate of correct seat belt use by pregnant vehicle occupants. Effective education on seat belt use during pregnancy is needed.

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.[11] 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.

In-person seat belt education can be given by anyone who interacts with pregnant vehicle occupants including providers, prenatal educators, public safety professionals, and many more. In-person education can also be delivered individually or in a group setting.

High quality visual aids and teaching tools have proven to increase proper seat belt use even more than general education without an aid. There are a number of flyers, teaching tools, training dolls, and training seat belts available for assist professionals with providing seat belt education.

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 participants 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 provide recommendations regarding any misuses that were identified. The process takes approximately five to ten minutes.

From January 15, 2022 to April 3, 2024:

- 2,336 Seat belt checks performed
- 1,553 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	7.10%
Informational Materials Only	16.87%
In-Person Seat Belt Education	47.20%
Education with Visual Aid	74.00%
Vehicle-Side Seat Belt Check*	94.01%

*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.

Additional studies on seat belt education and proper seat belt use corroborate these results that increased education leads to increase proper use.[53,54]

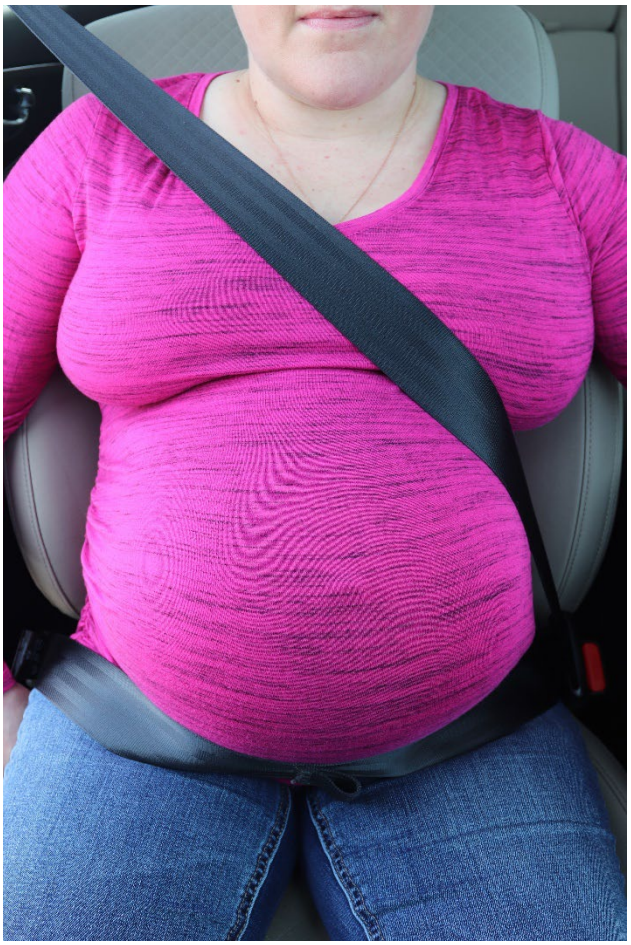
Unfortunately, most pregnant people do not receive counseling on their seat belt use. Out of 1,447 pregnant vehicle occupants surveyed by UCHealth only 19.63% reported receiving in-person seat belt education. Other studies have found similarly low rates of seat belt education.[4,40,41]

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.[55,56]

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.

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.
  - Move vehicle seat forward.
- 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.

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.

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. 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 pregnant 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.

Acknowledgements

The report author would like to thank the UCHealth EMS management and staff for supporting this project and other community outreach efforts.

The author would also like to thank the very generous volunteer who sat for the photographs used in this report and accompanying educational materials.

Contact Information

Gregory Colton
Community Outreach Captain, UCHealth EMS
Gregory.Colton@uchealth.org

Hudson Center for Prenatal Vehicle Safety QR Code

References

1. Management of Placental Abruption Following Blunt Abdominal Trauma (2020)
2. Comparison of Motor Vehicle Collision Injuries Between Pregnant and Non-Pregnant Women: A Nationwide Collision Data-Based Study (2021)
3. Comparison of the Injury Mechanism Between Pregnant and Non-Pregnant Women Vehicle Passengers Using Car Crash Test Dummies (2022)
4. Education for Appropriate Seatbelt Use Required for Early-Phase Pregnant Women Drivers (2020)
5. Evaluating Pregnant Occupant Restraints: The Effect of Local Uterine Compression on the Risk of Fetal Injury (2004)
6. Factors Affecting the Severity of Placental Abruption in Pregnant Vehicle Drivers: Analysis with a Novel Finite Element Model (2021)
7. Fetal Outcome in Motor Vehicle Crashes: Effects of Crash Characteristics and Maternal Restraint (2008)
8. Traffic Deaths Before and After Birth (2015)
9. Traffic Injuries of the Pregnant Woman and Fetal or Neonatal Outcomes (2005)
10. Trauma in Pregnancy: An Updated Systematic Review (2013)
11. National Highway Traffic Safety Administration Fatality and Injury Reporting System
12. Trauma in Pregnancy: An Analysis of the Adverse Perinatal Outcomes and the Injury Severity Score (2023)
13. Motor Vehicle Crashes During Pregnancy and Cerebral Palsy During Infancy: A Longitudinal Cohort Analysis (2016)
14. Factors Influencing Pregnant Women's Injuries and Fetal Loss Due to Motor Vehicle Collisions: A National Crash Data-Based Study (2021)
15. Motor Vehicle Crashes in Pregnancy: Maternal and Fetal Outcomes (2021)
16. Does Placenta Position Modify the Risk of Placental Abruption in Car Crashes (2009)
17. Trauma During Pregnancy: Outcomes and Clinical Management (2008)
18. Intrauterine Fetal Death Caused by Seatbelt Injury (2016)
19. Chest Compression of a Pregnant Woman by a Seatbelt Might Affect Fetal Outcome, Even in Minor to Moderate Frontal Vehicle Collisions (2019)
20. Comprehensive Program to Improve Safety for Pregnant Women and Fetuses in Motor Vehicle Crashes: A Preliminary Report (2000)
21. Injuries to Pregnant Occupants in Automotive Crashes (1998)
22. Pregnant Woman and Road Safety: Experimental Crash Test with Postmortem Human Subject (2008)
23. Seat Belt Placement Resulting in Uterine Rupture (1997)
24. Uterine Rupture: A Seat Belt Hazard (1994)
25. Trauma During Pregnancy (2020)
26. Multidisciplinary Approach to Rescue a Full-Term Pregnant and Her Fetus After Blunt Abdominal Trauma: A Case Report and Literature Review (2022)
27. Motor Vehicle Accident During Pregnancy with Two Lives at Risk: A Case Report (2021)
28. Adverse Pregnancy Outcomes Following Motor Vehicle Crashes (2013)
29. Severity of Placental Abruption in Restrained Pregnant Vehicle Drivers: Correct Seat Belt Use Confirmed by Finite Element Model Analysis (2022)
30. Effect of Motor Vehicle Crashes on Adverse Fetal Outcomes. (2003)
31. Effects of Seat Belts Worn by Pregnant Drivers During Low-Impact Collisions (2010)
32. Perinatal Implications of Motor Vehicle Accident Trauma During Pregnancy: Identifying Populations at Risk (2013)
33. Impact of Seat Belt Use in Pregnancy on Injuries and Outcomes After Motor Vehicle Collisions (2020)

34. Analysis of Pregnant Occupant Crash Exposure and the Potential Effectiveness of Four-Point Seatbelts in Far Side Crashes (2006)
35. Automobile Crash Simulation with the First Pregnant Crash Test Dummy (1996)
36. Consequences of High-Risk Behaviors: Trauma During Pregnancy (2006)
37. Computational Model of the Pregnant Occupant: Predicting the Risk of Injury in Automobile Crashes (2003)
38. Investigations of Crashes Involving Pregnant Occupants (2000)
39. Comparison of Pregnant and Non-Pregnant Occupant Crash and Injury Characteristics Based on National Crash Data (2014)
40. Awareness of Correct Use of a Seatbelt Among Pregnant Women and Health Professionals: A Multicentric Survey (2009)
41. Knowledge, Beliefs, and Practices Concerning Seat Belt Use During Pregnancy (2002)
42. Pregnant Women in Vehicles: Driving Habits, Position and Risk of Injury (2016)
43. Uterine Trauma in Pregnancy After Motor Vehicle Crashes with Airbag Deployment: A 30 Case Series (2006)
44. Airbag Deployment Following a Motor Vehicle Accident in Pregnancy (1996)
45. Orthopedic Trauma During Pregnancy: A Narrative Review (2022)
46. Changing Paradigms of Seat Belt and Air Bag Injuries: What We Have Learned in the Past 3 Decades (2010)
47. Seat Belt Sign as a Predictor of Placental Abruption (2017)
48. Fetal Death from Abruptio Placentae Associate with Incorrect Use of a Seatbelt (2000)
49. Seat Belt Injury: Case of Complete Transection of Pregnant Uterus (1968)
50. Uterine Trauma and Intrauterine Fetal Death Caused by Seatbelt Injury (2019)
51. Correct Use of Three-Point Seatbelt by Pregnant Occupants (2018)
52. Car Seatbelts in Pregnancy: The Practice and Knowledge of Pregnant Women Remain Causes for Concern (2000)
53. Effect of an Educational Leaflet on the Frequency of Seat Belt Use and the Rate of Motor Vehicle Accidents During Pregnancy in Japan in 2018: A Prospective, Non-Randomized Control Trial With a Questionnaire Survey (2019)
54. Focused Educational Intervention Can Promote the Proper Application of Seat Belts During Pregnancy (2004)
55. National Highway Traffic Safety Administration *If You're Pregnant: Seat Belt Recommendations for Drivers and Passengers.*
56. The American College of Obstetricians and Gynecologists *Car Safety for Pregnant Women, Babies, and Children.*

Links to all articles cited are available at:

www.hcpvs.org/research-articles