

# INFLUENCE OF PASSIVE SAFETY FACTORS IN PREGNANT WOMEN INJURY CAUSED BY TRAFFIC ACCIDENTS

## ВЛИЯНИЕ ФАКТОРОВ ПАСИВНОЙ БЕЗОПАСНОСТИ НА ТРАВМЫ БЕРЕМЕННЫХ ЖЕНЩИН В ДОРОЖНО-ТРАНСПОРТНЫХ ПРОИСШЕСТВИЯХ

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**Abstract:** Prevention of injuries in traffic accidents that contribute to passive safety factors have saved many lives but the inappropriate use caused the injury that might have been prevented. This is particularly evident in pregnant women and children younger than 12 years. Unprofessional use of seat belts during pregnancy can cause injury that can be fatal for the fetus even within low driving speed. This is supported by the fact of the NHTSA that the accidents are greatest cause of death for pregnant women and unborn children. In addition to seat belts, in the past ten year considerable research was carried out on the impact of airbags on pregnant women and the potential dangers that threaten them, so it was considered to deactivate the air bags when driving pregnant women. The paper presents statistical data and research that have been made in developed countries and the recommendations as well as possible measures for the prevention of injuries in pregnant women in traffic accident in Croatia.

**KEY WORDS:** TRAFFIC ACCIDENTS, PREGNANT WOMEN, SEAT BELT, AIR BAG

### 1. Introduction

Increasing the number of road vehicles and construction of road infrastructure in the past ten years, the need for stronger engagement in the prevention of traffic accidents raised. Safety of other traffic participants is improving with development of auto industry and the enhancement of active and passive factors of safety. Active safety factors are likely to reduce the possibility of traffic accidents, and passive vehicle safety factors have a role to mitigate the consequences of an accident. In the case of an accident, the passive safety factors have a function to prevent and mitigate injuries of driver and passengers in the vehicle. One of the most important passive security factor in the vehicle are seat belt, airbags and head restraints.

According to research by the National Highway Traffic Safety Administration (NHTSA), in America, passengers who use seat belts in the back seat of vehicles have 44% more chance to survive a traffic accident than those travelers who are not tied. According to the same source, in 2006. in the United States there were 81% of passengers in cars tied with safety belt, which according to their data saved 15,383 lives. However, research also shows that 37% of passengers died in traffic accidents, despite the fact that they were fastened by a safety belt. The reason for this is the inappropriate handling of safety belt, which can result in fatal consequences. This was in particular expressed by the least-protected groups in transport, namely children under 12 years of age and pregnant women. For these reason, by legal requirements was prescribed for children under 12 years the use of additional passive safety factors, ie car seat. Due that, in the final law on road traffic, safety requires that all children under 12 years must use a child safety seat adapted to their age, unless they are transported to a place where there is a zone in the two-point binding.

There is no legal framework for pregnant a woman that obliges them to undertake special measures when driving. The reason for this is the fact that there are no exact data in Croatia on the number of pregnant women involved in traffic accidents and therefore it is impossible to conduct a quality analysis based on data for the Republic of Croatia. For these reasons, in this study are used available data from other countries in order to enhance local services to increase involvement in the prevention of injuries for pregnant women that can result from traffic accidents.

### 2. The safety belt as a passive factor of safety for road vehicles

Using the seat belt prevents hitting the windshield with head and the chest cage in the steering wheel. When vehicles attacks a barrier

with the speed that is realistic in the road traffic, the vehicle in a short time will void its speed and untied traveler will continue to move in almost the same direction and speed, during the mentioned attack - inside the vehicle the serious or fatal injury can occur.

The safety belt is designed to keep the human body in the seat during the crash, meaning that it does not allows the body to struck in the inner parts of the vehicle or ejection of body from the vehicle under the influence of created forces.

Safety belts are most effective in frontal collisions, or when a vehicle attacks the barrier. Researchers have shown that under the crash speed of about 50 km/h, the front is shortening by 50 cm, and a significant part of the load is taken by seatbelts. In the sidelong collisions the safety belts are much less efficient, and such collision leads to injuries of head while hitting the side glass.

The disadvantages of using seat belts are most often related to injuries that it can cause during a collision. Previous researches [5] have shown that injuries caused by the seat belt are most likely as it follows:

- Abdominal organ damage
- Bowel rupture
- Abdominal wall injuries
- Ruptured liver
- Blood vessel trauma
- Chest trauma
- Fractured sternum
- Myocardial contusion
- Spine fractures

Injuries caused by safety belt due to traffic accidents are also called Seat-belt syndrome, and are most often for children younger than 12 years.

However, injuries caused by tightening the belt during the impact are negligible with regard to the consequences that the body could have if not been fastened by a safety belt.

To protect against injury in traffic accidents, safety belt must be used in accordance with the instructions that travelers often ignore. In particular, this applies to traffic accidents in which drivers or as passengers participating are pregnant women. Pregnant women, due to poor methods of bonding seat belt, are endangering the fetus because when braking, at low speeds as well, injuries caused by tightening the belt can have fatal consequences for the fetus.

Because of that, there are contrary opinions on the use of seat belts. Most experts agree that the use of seat belts during pregnancy is beneficial, under condition that it is used in a prescribed manner. However, there are countries like Japan where the pregnant woman while driving are exempt of use of the belt [3] due to possibility of fetal injury during sudden braking

### 3. The airbag as a passive factor of safety of road vehicles

The airbag is passive safety system of vehicles, which is nowadays more and more found in standard equipment of vehicles. In a crash, the airbag is opened by means of sensors within 30-50 milliseconds and is rapidly filled with gas, usually nitrogen, to softly await the body of passengers, and in that way to absorb inertial force of the body. Airbag for driver and passenger should protect against head injuries and chest in the frontal crash. Its full effect, airbags have in combination with safety belts that are tied at three points. In the collision of the head and upper body, the airbag must not constitute a strong barrier to maintain constant pressure. The body hitting the bag pushes gas filling through the exhaust openings from the air bag.

The basic elements of the air bag are:

- Bag of multi-layered composites based on polyamide
- Gas generator
- Contact board with an initiative capsule
- The electronic control unit with a sensor system

To ensure active filling of the air bag, the two sensors are mainly built in a vehicle, in a bumper and in the divider between the engine parts and space for passengers. Sensor system, a few milliseconds after impact, transmits an electronic signal that activates the initial capsule with approximately eight grams of plastic explosives. The explosion lit the initial mixture in the generator gas, whose combustion releases nitrogen to fill the airbag. The airbag is, after inflated and depreciated the impact of driver, blow out, and the whole cycle takes about 150 ms. Due to the cases when the electronic trigger did not worked at the time of the accident, the mechanical activation of the air bag has been introduced.

The negative effect of opening the air bag and a loud burst with strength of 140-160 decibels, should not pose a threat to human hearing because the impact of vehicle alone into another vehicle, or object creates a louder noise.

The biggest imperfection of airbags is their ability to activate when they are simply not expected. Except, with failure in the system that may cause the opening of the air bag, there is a risk that the airbag opens in collisions when a vehicle has low speed and airbag is not needed to absorb the body impact to the steering wheel. In such cases, due to low speed, the body does not come into contact with the interior of the vehicle because of its small inertia forces, but it reinforces the seat belt in the vehicle seat. If the airbag is activated, in such cases can cause head and chest injury, which would not emerged that the air bag not activated.

Such injuries are especially dangerous for pregnant women because they can cause death of the fetus. Such phenomena are trying to be solved in a way that air bags do not open up to a certain vehicle speed or up to specific vehicle body deformation.

In the European cars are built in two types of airbags:

- o 35 liter "eurobag"
- o 67 liter „bull size“

Although the 'euro' air bag adds significantly to the safety, measurement results conducted on the dummies in "crash tests" showed significantly less stress in the critical part of the cervical vertebrae and smaller injuries when using a large "bull-size" air bag. Newer-generation airbags like the French SRP system (System de Retenue Programme) function in a way that they are programmed to strain safety belts with pyrotechnic strainer that work in combination with the new generation of airbags.

These bags can bend from top to bottom and sideways, which allows regular distribution of tensions in the chest, and have specially calibrated valve that regulates the throughout power and exhaust of gas. Such combined protection proved to be much more successful than previous ways of functioning, so chest injuries are for 70% less.

### 4. Research analysis

#### 4.1. Influence of seat belts in pregnancy

Every year in the United States in traffic accidents are involved 32,800 pregnant women [1]. Previous studies [2], shown in Table 1, which were conducted in the period 1989 - 2001. in the State of Washington, have shown that pregnant women who were not tied with a seat belt, have 3 times bigger possibility of infant death and it is 2 times more likely to have complications during pregnancy than women who were tied at the time of accident.

Injury classification	% Non severe injury (n=309)	% Severe injury (n=84)
Fractures, dislocations, sprains	53,4	81,0
Intracranial injuries	9,7	25,0
Internal injury of chest	0	26,2
Internal injury of abdomen	2,9	20,2
Internal injury of pelvis	1,0	2,4
Open wound	17,5	41,7
Blood vessel injury	0,3	3,6
Superficial, contusion, crushing injury	53,4	26,2
Nerve and spinal cord injuries	0,3	1,2

Table 1. Research [2], Types of injuries, by women hospitalized for a motor vehicle crash in Washington State, 1989–2001

Research [2], have shown that pregnant women who participated in traffic accidents, regardless of the severity of injury, have an increased risk of adverse pregnancy outcome. Injuries that have occurred in these cases are usually separation of the placenta which can cause death to the fetus. Research [2], is based on a comparison of data for 625 pregnant women who participated in traffic accidents and were then hospitalized, with data of pregnant women that have not participated in a car accident. Of those 625 women, one third had no injuries, half had minor injuries, and every seventh was seriously injured. Pregnant women involved in traffic accidents were compared with a randomly selected group of women who had given birth in the same period, or the child died during childbirth and who were hospitalized for injuries associated with collisions. Most pregnant women who participated in traffic accidents were in the third trimester of pregnancy while the smallest number of pregnant women was in the first quarter. Injuries of the pregnant women suffered in traffic accidents are shown in Table 1, and the injured pregnant women were divided into two groups. The first group of pregnant women are those with serious injuries, while in the second category are pregnant women with minor injuries. From the available data presented in table 2, it is visible that the most common injuries in traffic accidents of pregnant women are fractures and sprains. In the group of serious injured pregnant women, 26.2% of them had internal injuries of the chest which is the most common injury that causes the seat belt. Pregnant women involved in the collision, but had no reported injuries, was found highly elevated risk of preterm labor and the separation of the placenta, and their children were at increased risk of premature birth and low birth weight, compared with women who did not crash.

#### 4.2. Influence of the air bag on pregnant women

The latest research [1] also conducted in Washington State between 2002. and 2005. concluded that traffic accidents cause the most deaths of pregnant women and unborn children.

The airbag as a passive factor in traffic safety can cause injury by activating and cause premature childbirth or endanger the fetus. However, activation of the airbag can absorb the impact of pregnant women in the car's interior and in that way reduce injuries in pregnant women and their fetus.

	<b>PREGNANT WOMEN WITH AIR-BAG (%) n=198</b>	<b>PREGNANT WOMEN WITHOUT AIR- BAG (%) n=622</b>
<b>MATERNAL OUTCOME</b>		
Preterm labor	15,7	10,3
Placental abruption	2	1,6
Cesarean delivery	31,9	29,6
Cesarean delivery	26,8	24,1
<b>PERINATAL OUTCOME</b>		
Gestational age less than 37 week	11,1	10,0
Birth weight less than 2500	8,7	8,2
Smal for gestational age	11,6	9,8
Meconium at delivery	6,5	5,7
Fetal distress	5,6	6,0
Respiratory distress syndrome	2,5	1,6
Fetal death	1,0	0,3

Table 2. Research [1] Obstetrics & Gynecology Washington State: 2002-2005: Maternal and Perinatal Outcomes Associated With Air Bag Deployment among Pregnant Women in a Motor Vehicle Crash

By analyzing the available researches [1] shown in Table 2 it is visible that pregnant women who participated in traffic accidents, and airbag was activated, there is a higher percentage of those who have had preterm childbirth. Also, the percentage of fetal mortality is higher in cases when the airbag was activated.

These results indicate that the airbag negatively affect pregnant women during traffic accidents, but because of the large differences in the number of pregnant women (three times more when an air bag was not activated then it was), which were included by research, possibility of certain deviation are included which reduce differences in the impact of air-bag to pregnant women.

If we take into account variations during conducted research, it is possible to conclude that the air bag has no negative impact on pregnant women during traffic accidents. It should be noted that in this analysis were not available data how many of the pregnant women involved in traffic accidents were tied with the safety belt.

#### 5. Conclusion

As in Croatia there are no exact data on the number of pregnant women who participated in traffic accidents, it is not possible to implement any quality analysis on the influence of passive factors for that population in Croatia. For these reasons, in this study were used available data from other countries which are more developed than Croatia.

Some studies have shown that certain factors of passive safety such as seat belts and air bags can negatively affect pregnancy and cause fatal injury to the fetus. The analyzed data showed that safety belt reduces the chance of injuries under condition that it is used in a prescribed manner. Comparing the pregnant women for which the airbag activated and those whom the airbag did not activated, it is evident that the injury occurred in the accident are similar in both categories and there are no significant differences.

From the analyzed data it is possible to conclude that it is recommended for pregnant women to use seat belts and airbags, but in the prescribed manner. It is necessary to use a seat belt with binding in three points and it should be set optimally between the chest and abdomen. Lower part of the belt should be set between the abdomen and thighs, under the belly. On the market there are approved pads (which are subsequently bought in special stores) which serve to keep the lower part of the belt-low under the belly. The safety belt should never be linked through the stomach.

For vehicles that have airbags (mainly the front seats), in order to absorb the shock of activating the air bag in the body of pregnant women, the seat should be set back as much as possible, preferably a seat can be partially lowered.

For these reasons, it is necessary to strengthen community awareness and information on the use of belts among pregnant women. It is necessary to continuously educate pregnant women about the proper use of seat belts and air bag in order to minimize injury of pregnant women which may arise from the use of passive factors of safety.

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