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- LU – Loughborough University, GB
- Humanetics Europe GmbH, DEU
- UdS – University of Strasbourg, FRA
- Volvo Cars, SWE
- VTI – Swedish National Road and Transport Research Institute, SWE (project leader)

WWW.ADSEAT.EU

More news on ADSEAT can be found on our website www.adseat.eu. It features information on the project and links to project partners. You can also find abstracts and publications for downloading.

The ADSEAT project

ADSEAT, short for Adaptive Seat to Reduce Neck Injuries for Female and Male Occupants, is an EU Commission funded project within the 7th Frame-work programme. The major focus is on whiplash injuries. Our vision is to improve safety for vehicle occupants by making recommendations for future evaluation of the effectiveness of anti-whiplash systems.

BACKGROUND

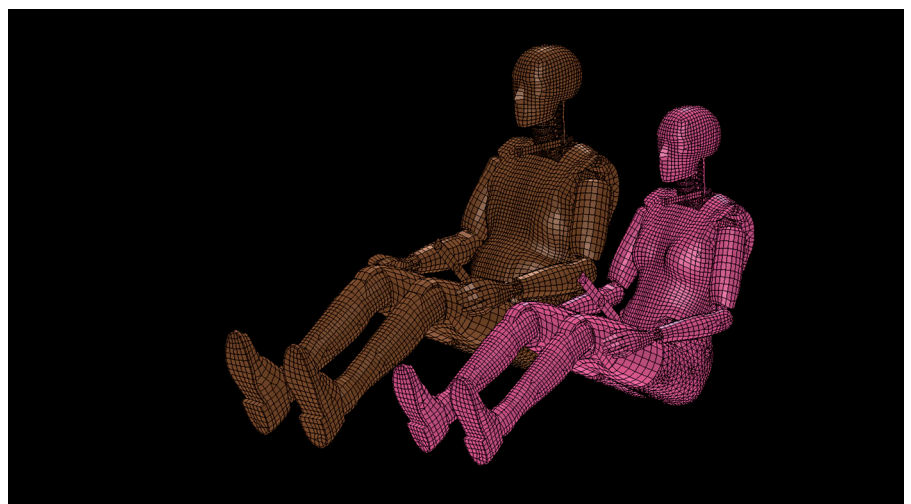
Whiplash injuries put a significant social and financial burden on the European society. For the insurance companies whiplash injuries account for approximately 70 % of the cost of all injuries leading to permanent medical impairment following a collision. Females have a higher risk of sustaining whiplash injuries in vehicle crashes than males.

Anti-whiplash systems for passenger vehicles on the market today can reduce the injury risk, however recent evaluation has shown that males, more so than females, benefit

from the recently developed protective performance of the seats. Current commercially available crash test dummies for rear impact testing represents an average male.

OBJECTIVES

The overall objective of the ADSEAT project is to provide guidance on how to evaluate the protective performance of vehicle seat designs, aiming to reduce whiplash injuries for female as well as male motor vehicle occupants. We will develop a finite dummy model.





ADSEAT: what has been and will be done?

The ADSEAT project is divided into seven work packages (WP), including management and dissemination (WP 6–7). Following a description of what work has been done and will be done in the five technical work packages:

WP1 aim: to analyze real world data

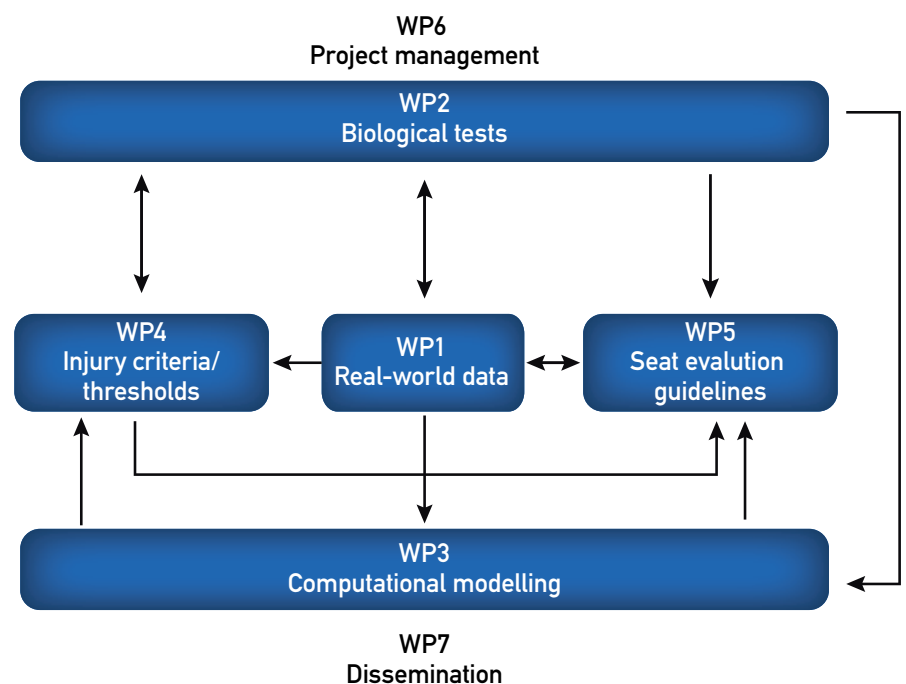
An extensive literature review and analysis of databases was carried out. Real world data analysis shows that existing whiplash protection concepts are more effective for males than females, with a 45 % risk reduction in permanent medical impairment for females and 60 % for males.

WP2 aim: biological tests, to establish biological data of females

Test data from volunteer tests using males and female volunteers in identical conditions were collected and analysed. Two test rigs for whiplash exposure have been manufactured and tested. A new acceleration sled test set-up with a high speed X-ray movie recording unit has been installed for testing.

WP3 aim: computational modelling, to develop an element dummy model

A first model of a finite element dummy model of an average female, called EvaRID, has been developed. A detailed evaluation against bio-mechanical requirement was made. The first evaluation showed that the model response correlates reasonably well with the test data, but further model refinement is needed.

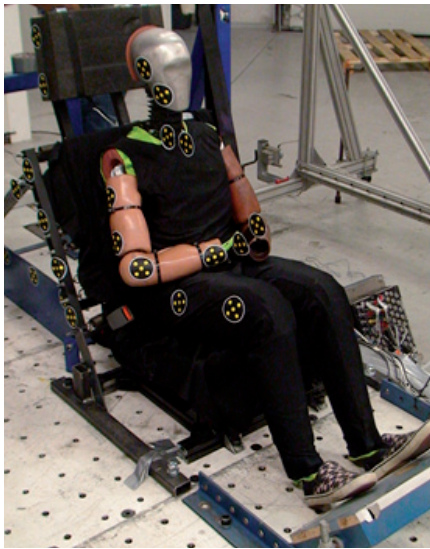


WP4 aim: to establish injury criteria/thresholds for females

Within WP4 we will analyze injury risk, assessing the usefulness of currently used neck injury criteria and comparing injury predictors for males and females based on computer simulations and sled tests. Theoretical suggestions were developed, sled testing was started and will be followed by computer simulations to investigate their practical applicability.

WP5 aim: to develop seat evaluation guidelines

We will provide guidance on how to evaluate the protective performance of vehicle seat designs with female as well as male motor vehicle occupants in mind. The findings in WP5 will constitute a component of the final outcome of the ADSEAT project.



When are females at risk of sustaining soft tissue neck injury?

So-called injury criteria are used to assess the injury risk. Such an injury criterion can be determined experimentally, for instance, when performing tests with crash test dummies. A crash test dummy measures the mechanical loading that is experienced during an impact. The acceleration of the head or the forces acting on the neck of the dummy can be recorded. These recordings are then used to determine injury criteria like the commonly used NIC (neck injury criterion). This criterion considers, for example, the acceleration of the head relative to the torso and represents thus a measure for the relative movement of these body parts during impact.

Based on biomechanical experiments and accident statistics the values of injury criteria are meant to be linked to the real-life injury risk. This allows estimating whether the value of an injury criterion as derived in a crash test is above or below a certain threshold which is thought to be injurious.

To date there are several injury criteria proposed with regard to soft tissue neck injury. However, these criteria were developed focusing on male vehicle occupants.

Can we nonetheless use them to assess the injury risk for females? Or do we need other criteria for females? The ADSEAT project addresses these questions. Based on studies published in the literature, based on accident statistics of real-world crashes and based on results

from volunteer experiments, it was analyzed which measures seem to be the most important when addressing the female injury risk. Afterwards first suggestions were developed how current criteria could be modified to take into account a female occupant. This assumes that the injury mechanism is most likely very similar for males and females, but differences in the anatomy (e.g. with respect to neck muscles) or the motion during an impact (as related to different size and posture of a female compared to a male) need being considered.

To investigate whether those first ideas are reasonable, a series of sled tests was performed. Recent vehicle seats were mounted on a sled which was moved in a similar way as in a rear-end collision. Since there is also no suitable female crash test dummy

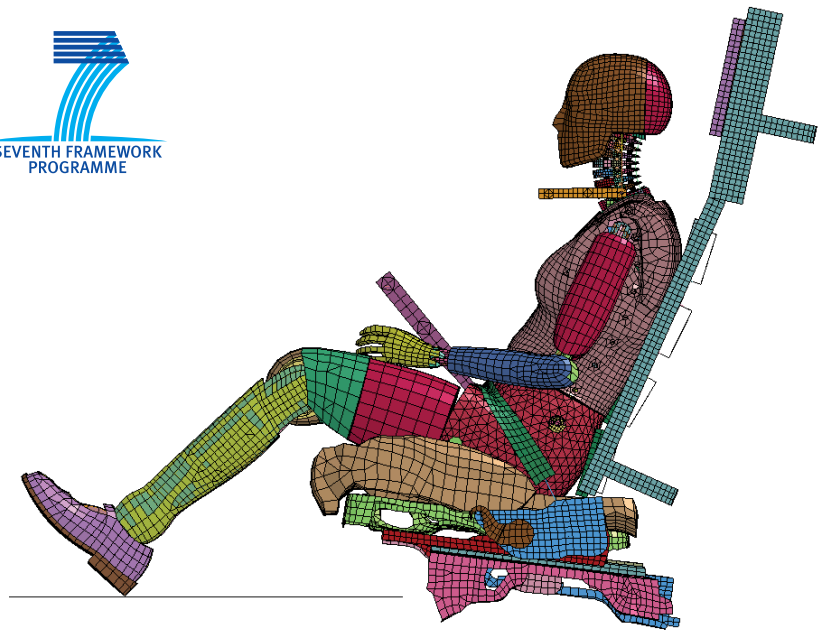
available (there is only a male model), an own dummy device was developed. This dummy (see picture) approximates a female anthropometry. The results obtained from this test series were the first of its kind. So ADSEAT is pioneering into a new area of exciting research.

As a next step also computer simulations will be conducted. On the one hand simulations using a female crash test dummy will be performed and on the other hand more detailed human body models will be used. Based on the sled tests and the computer simulations first suggestions on how to assess the female injury risk will then be finalized and released. ADSEAT thus contributes a first step towards optimizing the protective potential of vehicle seats also with regard to female occupants.



Sled test analysis completed

Sled tests were performed to investigate the predictive power of different injury criteria for female passengers. Based on currently used criteria such as NIC and Nkm as well as based on a theoretical approach taking into account different injury risk curves for males and females, suggestions for injury criteria specifically addressing a female were developed. These suggestions were evaluated by conducting sled test with different seats. As a test dummy a modified BioRID – called BioRID50F – was used. This dummy takes into account the anthropometry of a female. The series of sled tests is now completed. The results were compared with available data of sled tests using a BioRID. In a further step computer simulations will be performed to complement the sled tests and give additional insights with respect to the applicability of injury criteria for females.



EvaRID: Female Rear Impact Dummy

The ADSEAT project has developed an initial version of a finite element dummy model of an average female, which has been named EvaRID (Eva – female/RID – Rear Impact Dummy). EvaRID is based on the same design concept as the 50th percentile male rear impact dummy, the BioRID II

(Biofidelic Rear Impact Dummy) which was developed in the 1990ies. The first version, EvaRID V1.0, is developed in LS-Dyna. The model is described in “EvaRID a dummy model representing females in rear end impacts” presented at the 2010 Whiplash conference, Munich.

List of papers published

Carlsson A, Siegmund G P, Linder A, Svensson M (Sep 2010) Motion of the Head and Neck of Females and Male Volunteers in Rear Impact Car-to-car Tests at 4 and 8 km/h, Int. IRCOBI Conf. on the Biomechanics of Injury, Hannover, Germany.

Kullgren, A, Krafft, M (Sep 2010) Gender Analysis on Whiplash Seat Effectiveness: Results from Real-world Crashes, Int. IRCOBI Conf. on the Biomechanics of Injury, Hannover, Germany.

Schick S, Kullgren A, Tomasch E, Jakobsson L, Linder A, Gales N, Hell W, Schmitt K-U (Sep 2010) Basics for Developing a Female Occupant Model for Investigating Cervical Spine Distortion injury (CSD), ESAR conference, Hannover, Germany.

Chang F, Carlsson A, Lemmen P, Svensson M, Davidsson J, Schmitt K-U, Zhu F, Linder A (Nov 2010) EvaRID, A dummy model representing females in rear end impacts, Whiplash 2010 Neck Pain in Car Crashes, 3rd International Conference, Munich, Germany.

Linder A, Svensson M, Carlsson A, Lemmen P, Chang F, Schmitt K-U, Kullgren A (2011) EvaRID - Anthropometric and biomechanical specification of a finite element dummy model of an average female for rear impact testing. (Full published paper Number 11-0374)

Carlsson A, Linder A, Davidsson J, Hell W, Schick S, Svensson M Y (Sep 2011) Dynamic Kinematic Responses of Female Volunteers in Rear Impacts and Comparison to Previous Male Volunteer Tests

Svensson M (Oct 2011) Whiplash injury research at Chalmers – A review including the latest developments in the EU-ADSEAT project.

Coming events in the traffic safety area

9th International Conference Protection of Children in Cars
December 1–2, 2011:
Munich, Germany
[www.tuev-sued.de]

Transportation Research Board 91st Annual Meeting
January 22–26, 2012:
Washington, DC, USA
[www.trb.org]

SAE 2012 Government/Industry Meeting
January 25–27, 2012:
Washington, DC, USA
[www.sae.org/events/gim]

IRCOBI Conference 2012
September 12–14 2012:
Dublin, Ireland
[www.ircobi.org/conference.php]