

USER PREFERENCES ON WIRS

USER PREFERENCES ON WHEELCHAIR INTEGRATED RESTRAINT DESIGN

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ABSTRACT

Many wheelchair users find that wheelchair occupant restraint systems (WORS) are difficult to use, provide poor belt fit, and are therefore uncomfortable to wear, often resulting in low upper torso restraint system usage. A survey and focus group were conducted to obtain qualitative and quantitative feedback on occupant restraint design and deficiencies. These tools were also used to determine user preferences and desired features of a wheelchair integrated occupant restraint system (WIRS) for children and adults. Preliminary results show that a WIRS may benefit those with a higher level of disability, both pediatric and adult, but to a lesser extent adults who use manual wheelchairs. The results from this study will help to develop design guidelines for innovative wheelchair occupant restraint designs.

BACKGROUND

In 1994, a group of 154 wheelchair users with spinal cord injuries responded to survey questions concerning the use of safety equipment such as wheelchair tiedowns and occupant restraints [1]. The study found that 70% of the wheelchair occupants riding in a privately owned van used wheelchair tiedown systems, but only 50% of the individuals used occupant restraints. Conclusions drawn from this study suggested that improved education and equipment design should solve 'lack of occupant restraint use'. A recent study conducted at the University of Pittsburgh reported deficiencies in currently used fixed vehicle-mounted occupant restraint systems [2, 3]. These systems were found to be difficult to adjust and uncomfortable, and many types of equipment mounted on wheelchairs interfered with the belts' ability to contact the body thereby decreasing occupant protection.

One way to improve wheelchair occupant restraint system (WORS) safety, usability, satisfaction, comfort, and fit, is to integrate the upper torso and pelvic restraint into the wheelchair. Considerable research on integrated restraint technology has been done in the automotive industry. Improved occupant protection was found when using integrated seat belt systems in commercial vehicles [4-6]. Feasibility of seat integrated restraint technology on wheelchairs (WIRS) was shown in a study conducted at the University of Pittsburgh [7]. A wheelchair was equipped with a WIRS structure and evaluated during a 20g/30mph frontal sled impact. This type of occupant restraint showed adequate injury protection of a 50th percentile Hybrid III ATD during frontal impact.

The ANSI/RESNA WC-19 Standard for wheelchairs used as seats in motor vehicles, require an integrated pelvic belt on wheelchairs [8]. The current study will provide the necessary ground work to take the next step: a completely integrated upper torso and pelvic restraint (Figure 1).

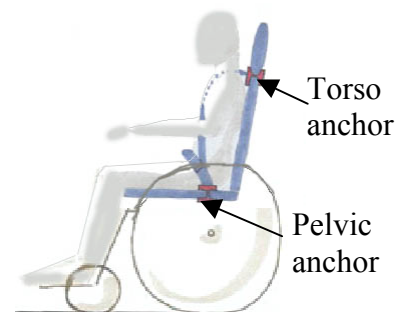


Figure 1: Wheelchair Integrated Occupant Restraint System (WIRS)

OBJECTIVES

The first objective of this study was to develop and conduct a qualitative survey among adult and pediatric wheelchair users to gather information about WORS usage patterns, restraint deficiencies, and user characteristics. Another objective was to conduct a focus group among

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wheelchair users, their caregivers, therapists, and occupant restraint, wheelchair and seating manufacturers to obtain qualitative feedback on proposed conceptual innovative WORS designs. These methods were also used to expand on technical requirements and user needs.

METHOD

Surveys were mailed to pediatric and adult wheelchair users and their caregivers. Potential subjects were located through organizations that serve wheelchair users. When this paper was written, a total of thirty-six subjects, fifteen children and twenty-one adults, had returned completed surveys. Of these respondents, fourteen children and eight adults use manual chairs, and one child and thirteen adults use power chairs. The survey consists of thirty-eight multiple choice and open-ended questions. Each subject was asked to provide information about the wheelchair user, his/her wheelchair, attitudes and behaviors regarding travel in motor vehicles while seated in a wheelchair, and preferences for the design of wheelchair integrated restraint systems. In addition to the survey, a focus group was held. Focus group participants included manufacturers, researchers, transit providers, as well as two power wheelchair users. Focus group participants were asked to provide their input on issues and benefits related to a WIRS. Their input was also used to develop a list of technical requirements, and to provide the researchers with information on user needs and populations that would benefit most from using a WIRS.

RESULTS AND DISCUSSION

Results from the survey were compiled and compared to focus group comments. Focus group participants believed that the population most likely to benefit from using a WIRS is comprised of more severely involved pediatric and adult wheelchair users as well as wheelchair users who are not very active. Wheelchair manufacturers felt that active manual wheelchair users would not be good candidates for a WIRS because it may add significant weight to the wheelchair and necessitates raising the wheelchair backrest height. These changes may impair the mobility of active manual wheelchair users. However, survey results show that most users of both manual and power wheelchairs place safety as a higher priority than light weight and low backrest height. Only 20% of children and 42% of adults felt that added weight was a concern. Additionally, only 27% of children and 33% of adults felt that added backrest height was a concern.

Many respondents provided comments indicating that if a WIRS were proven to be safer than the traditional vehicle-mounted restraint systems, the added backrest height and wheelchair weight would be a small price to pay. However, more adults who use manual wheelchairs, 56%, would definitely prefer a vehicle-mounted restraint system, as opposed to only 33% of power chair users. In addition, 42% of power wheelchair users were unsure about whether or not they would prefer a WIRS, expressing concerns over the safety of WIRS and the annoyance of added weight.

Wheelchair manufacturers from the focus group felt that caregivers of children may strongly object to added weight and backrest height in their children's wheelchairs. But as is made clear by the percentages shown above, more adults than children found added weight and backrest height to be a concern. One of the limitations of the study is that the children's caregivers, not the children themselves, responded to this survey, and their priorities for safety versus lightweight and low backrest height may be different than those of the children in their care.

Focus group participants saw many benefits of using WIRSs as opposed to vehicle-mounted restraint systems. WIRSs fit better because they can be custom-designed, so they are more comfortable, increase compliance/usage, and provide better occupant protection for most users than vehicle-mounted restraints. WIRSs allow more users to restrain themselves independently, decreasing the necessity for transit operators to assist in this process. However, the wheelchair manufacturers in the focus group emphasized that current wheelchair designs would need to be

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significantly altered in order to accommodate WIRSs. Frames and seating systems would need to be stronger. Wheelchairs would be difficult to fold if a WIRS were built in. Wheelchairs designed to have a low backrest and be lightweight could not easily accommodate a WIRS. Adding a WIRS to a wheelchair would also increase wheelchair cost.

More research needs to be conducted to determine the optimal location for installing a WIRS, as well as how WIRSs can be stowed when not in use.

Ideal WIRSs would be durable, easy to use, adjustable, comfortable, easy to clean, low cost, aesthetically pleasing, lightweight, and easy to stow. They should provide occupant protection, serve the dual function of a postural support, allow for freedom of movement and quick release, not interfere with seating configurations, have the ability to be added onto the wheelchair frame, and not increase wheelchair length.

CONCLUSIONS

Our findings suggest that WIRSs may offer a trade-off and may not be appropriate for all wheelchair users in all environments. However, the survey results indicate that a substantial portion of pediatric and adult wheelchair users are interested in using wheelchair integrated restraint technology, even if it means increasing wheelchair weight and backrest height. Safety is a high priority for this population. The focus group participants and survey respondents helped to generate a defined set of ideal WIRS design characteristics that will be used to take WIRS development to the next stage, a fully integrated upper torso and pelvic restraint system.

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