

The effect of torso protectors during equestrian falls

Stephanie Bonin, Karin Brolin

I. INTRODUCTION

Falls during equestrian activities can result in torso injuries from striking the ground, a fence, or being stepped on by a horse. Torso protectors are designed to mitigate these injuries and come in two configurations: safety vests and air vests. Safety vests are made of foam, cover the entire torso, and are tested to ASTM F1937 or EN 13157. Air vests are tethered to the saddle and inflate bilateral air bladders along the chest and back as the rider separates from the saddle. Air vests can be tested to NF S72-800; however, no equestrian governing bodies currently require this certification. The use of torso protectors by riders varies widely. In the eventing discipline, safety vests are required during the cross-country phase and some riders choose to wear both a safety vest and an air vest. In other disciplines, such as hunter/jumper, torso protectors are not required, although some riders choose to wear one or both protectors. Prior studies have shown that safety vests and air vests either have a limited benefit on torso injuries or are associated with an increase in torso injuries [1-4]. Here, we sought to quantify the usage of torso protectors and their effect on rider torso injuries during eventing and hunter/jumper disciplines at competitions sanctioned by the United States Equestrian Federation (USEF). These results will help inform manufacturers, standards organisations, and governing equestrian organisations of the effectiveness of torso protective equipment.

II. METHODS

Anonymised data from 2020 through 2023 were obtained from the USEF. The data summarised standardised reports from licensed officials regarding injury-producing incidents that occurred during USEF competitions. We extracted data for two disciplines: eventing and hunter/jumper (comprised of hunter, jumper, hunter/jumper, hunter seat equitation, and medal classes). These two disciplines were chosen because riders may or may not use torso protectors despite similar exposure to jumping hazards. Based on the free-text descriptions in the reports, we classified all falls from a horse as either related or not related to jumping. We defined cases as torso injuries and controls as non-torso injuries [5]. Torso protector use was categorised as safety vest only, air vest only, both safety and air vest, or none. In eight eventing cases, where the fall happened on the cross-country course, the torso protector use was manually changed from “none” to “safety vest” because the USEF rules require all riders to wear a safety vest while riding cross-country. Injury severity was not coded in the data; therefore, we used treatment level (0 = no treatment, refused treatment or refused transport, 1 = on-site treatment, or 2 = transported by EMS or privately) as a surrogate for injury severity. Pairwise Chi-squared analyses were performed to determine if torso injuries were more common with torso protectors relative to the “none” condition. A binomial logistic regression analysis was performed to evaluate the effects of wearing a body protector (safety vest, air vest, both, or none) and jumping (yes or no) on torso injury severity (XLSTAT, v. 16.83, Paris, France). Treatment levels 0 (none/refused) and 1 (on-site) were combined for this latter analysis. P-values ≤ 0.05 were considered significant.

III. INITIAL FINDINGS

The database included 3,347 total entries, of which 2,345 (70%) involved injuries to eventing or hunter/jumper riders who fell from a horse. Within this subset, 87% (2,050/2,345) were hunter/jumper riders, 94% (2,198/2,345) were female, 59% (1,387/2,345) were ≥ 18 years old, and 82% (1,913/2,345) were related to a jump (i.e. before, during, or after a jump, as determined from the free-text descriptions). Proportionally more eventing riders than hunter/jumper riders wore a torso protector (Table I). Compared to the no-torso-protector condition, the odds of a torso injury with any of the three torso-protector conditions was <1 , but not significant (pairwise Chi-squared $p > 0.45$, Table II).

When categorised by treatment level, 1,424 riders (61%) were transported to medical care for their injuries (Fig. 1). Although most torso injuries at all treatment levels were sustained by riders who were not wearing a torso protector (Fig. 2), the logistic regression analysis showed that the odds of a rider needing to be transported for their torso injury were 2.05 (95th %ile confidence interval of 1.78–3.58) times higher for a safety vest compared to no vest, 4.43 (1.35–14.55) times higher for an air vest compared to no vest, and 2.60 (1.21–5.62) times higher

S. Bonin (e-mail: stephanie.bonin@meaforensic.com; tel: +1 949 855 4632) is a Senior Engineer at MEA Forensic Engineers & Scientists, Laguna Hills, CA, USA. K. Brolin is a consultant with Lightness by Design Stockholm, Sweden.

for both vests compared to no vest (all $p \leq 0.05$). A fall in proximity of a jump was not a significant factor in the regression ($p=0.225$).

TABLE I

Torso protector use for riders who fell from a horse.

Discipline	Guard	Air Vest	Both	None	Total
Eventing	136 (46%)	6 (2%)	105 (36%)	48 (16%)	295
Hunter/Jumper	72 (4%)	115 (6%)	110 (5%)	1753 (85%)	2050
Total	208	121	215	1801	2345

TABLE II

Contingency table for Chi-squared analysis.

	Guard	Air Vest	Both	None	Total
Torso Injuries	34	18	36	316	404
Non-torso Injuries	175	103	179	1484	1941
Total	209	121	215	1800	2345

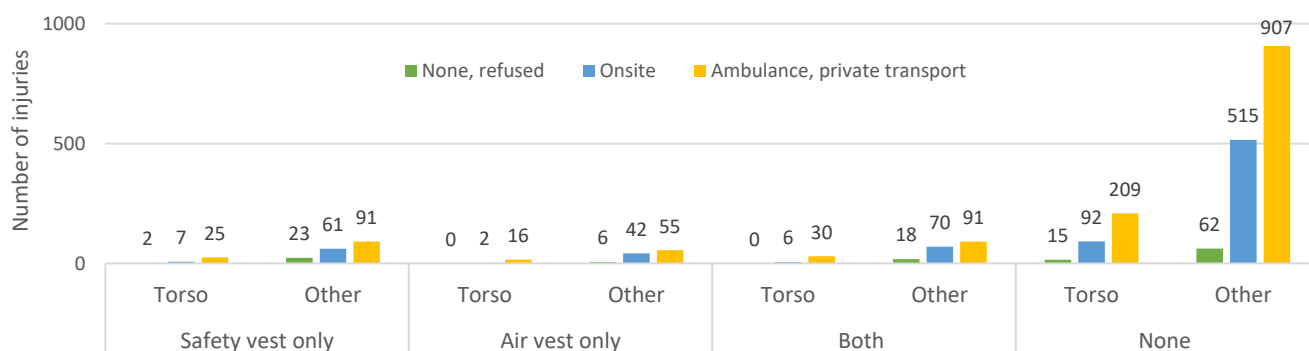


Fig. 1. Number of torso injuries (Torso) and non-torso injuries (Other) according to torso protector type and treatment category.

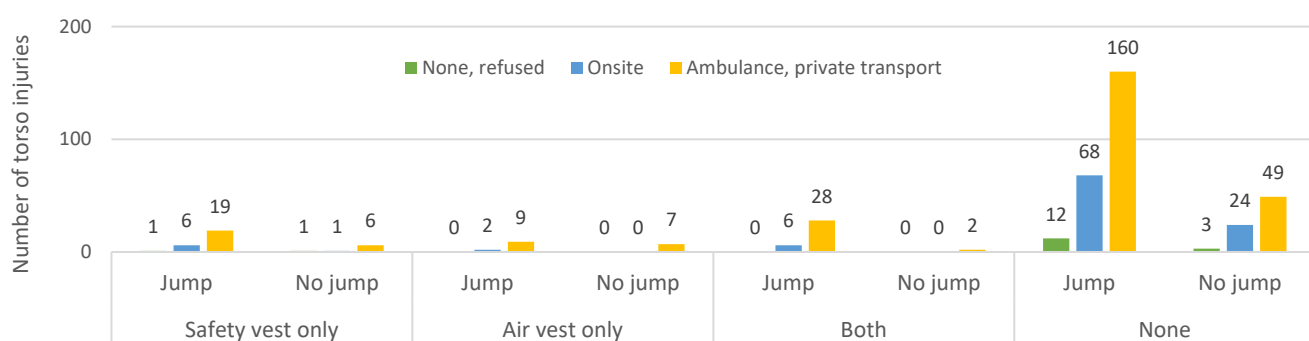


Fig. 2. Number of torso injuries according to torso protector type, treatment category, and proximity to a jump.

IV. DISCUSSION

We quantified the use and effectiveness of torso protectors based on recent USEF injury data. Overall, we found that the proportions of torso and non-torso injuries with any combination of torso protector were not significantly different compared to the proportions when not wearing a torso protector. When we further considered treatment level as a surrogate for injury severity, we found higher odds of torso injury when wearing a torso protector compared to not wearing a torso protector. These counterintuitive findings are similar to those reported in prior studies [1-4] despite one study not distinguishing between torso and non-torso injuries [1] and two other studies defining torso injuries differently [2][4]. Nevertheless, the similar findings across all five studies (including our study) suggest that: (i) torso protectors are associated with more severe injuries; (ii) torso protectors are effective at reducing all but the more severe injuries; (iii) the data available to assess torso-protector effectiveness are incomplete. With respect to this latter explanation, the current methods for acquiring injuries data do not quantify impact severity (e.g. through video analysis) or injury severity, do not contain actual injury diagnoses, and do not capture incidents in which no injury occurred. These latter missing data, i.e. incidents with uninjured riders, are important control data to show whether torso protectors are effective at preventing injuries. Thus, our study highlights that currently available data and studies are inadequate to say how effective safety and air vests are and that further research that accounts for cases where injuries were prevented from torso protector use, is warranted.

V. REFERENCES

- [1] Nylund, *J Sci Med in Sport*, 2019. [2] Andres, BOSEM, 2018. [3] Foote, *Aust Rural Ind R&D*, 2014.
 [4] Hessler, *Klinische Padiatrie*, 2012. [5] Graves, *Injury*, 2015.