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Evolution of safety in Motorsport

Academic Skills

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1 Introduction

The purpose of this paper is to look at how motorsport competitions began in terms of safety, the development of features surrounding safety. From the design and implication of the Halo (Demirel, Jennings, and Srinivasan, 2022) to the wider run off/deceleration areas (Metz, 2002), and many more to be discussed.

1.1 Justification

The reason for this paper is to discover if the safety advancements have evolved and is there more to be researched and developed.

1.1.1 Aims

The aim of this paper is to find research that shows how much its evolved over the years and to investigate if the outcome is positive or negative.

1.1.1.1 Objectives

The objectives are to analyse all safety devices that made a difference since their introduction and to investigate which ones could have been implemented sooner or if they need to be improved in any way.

2 Background

Many safety features have been added throughout the history of motorsport, some of which have been recent (Duxbury, 2022). Devices, like the HANS device, which was implemented in the early 2000s (F1technical, 2006), the Halo which has saved many lives since its introduction into F1 in 2018 (FIA, 2021), and the well-placed barriers surrounding each track which have proven they need some work to improve the design due to Grosjean's crash at Bahrain in 2020 (Howson, 2023).

3 Discussion

3.1 HANS Devices

HANS (Head and neck support) is a combination of straps around the driver's body that keeps a rigid collar in place which gives a load path using flexible tethers from the helmet to the shoulders. These are worn by drivers during Motorsports competitions. When a driver is involved in an impact on track, the HANS device aids in the reduction of injuries related to the head and neck and lowers the probability of fatality. Specifically, it has almost eliminated all examples of fatal injuries that occur to the craniovertebral junction (CVJ) which in the past has been known as a common cause of death in motorsport competition. The HANS system works by restricting the forward and backward movement of the head under crash conditions. The HANS device was engineered by Dr. Robert Hubbard (FIA, 2019). Hubbard worked with Mercedes-Benz in 1997, to develop and assess HANS prototypes, with the help of a single-seater monocoque fitted to a High-impact test sled, with a crash-test dummy sat inside. After years of tests, they found a design that appealed to everyone including the FIA, which made the device necessary for all Formula 1 (F1) drivers at the beginning of the season in 2003 (F1technical, 2006).

While using the HANS device, the restraint it provided helped reduce neck tension by 81%, Shear by 72%, and overall neck load by 78% a human head can experience an acceptable 62g because the movement of the driver's neck and torso are now in sync, the g-forces in the chest area rise but the chest compression experiences a reduction in pressure (Sherman, 2012).

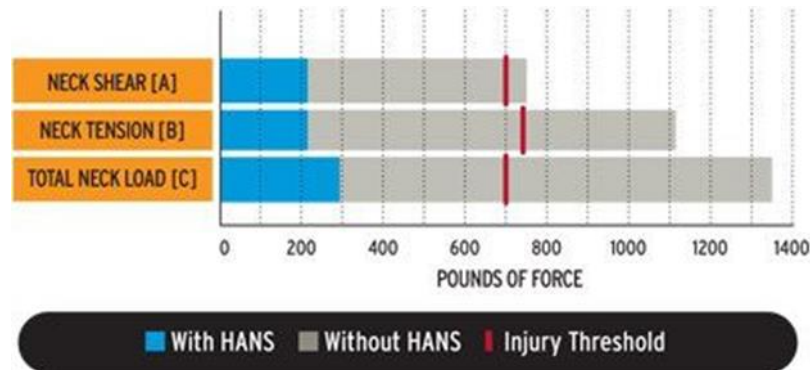


Figure 3-1 This graph shows the result of injury threshold with and without the use of the HANS device.

The device was created after Hubbard's race car-driving brother-in-law, Jim Downing, came to him with the idea of the HANS device after one of his friends died of a head injury while competing in an American Le Mans sportscar race. Downing thought that protection was essential for drivers when they must get on the brakes suddenly and that would cause their head to accelerate forward and potentially cause injury from whiplash which could lead onto causing basilar skull fractures (FIA, 2019).

3.2 The Halo

The first version of the Halo device was designed by the Mercedes-Benz F1 team in 2015 after the rest of the teams had to design their own iterations, the FIA then wanted on-track testing to commence during the 2016 and 2017 seasons as well as further testing off the track (Evans, 2023). The Halo is constructed of a wishbone titanium bar, covered in carbon fibre, that wraps around the cockpit of the car and is expected to withstand around twelve tonnes of weight despite only weighing 7KG itself (Poidevin, 2022).

The Halo has saved many lives since its introduction to F1 in 2018. The most memorable example of this statement is when Romain Grosjean had his crash at the Bahrain Grand Prix in 2020. His car hit the barriers at around 192 km/h and at an estimated force peak of 67G, the survival cell pierced the barrier and was stopped by the primary roll structure on the other side. The Halo lived up to expectations and protected Grosjean through the entire ordeal, leaving him with only a few minor burns from the flames of the fuel igniting (FIA, 2021).

However, the use of the Halo could have prevented many injuries prior to 2018. For example, the Felipe Massa incident during qualifying at the Hungarian Grand Prix in 2009, where a loose spring from Rubens Barichello's Brawn was ejected across the track and struck Massa in the head, causing him to fall unconscious and make contact with the barriers at around 250 km/h. The impact caused him to undergo intense surgery where the doctors inserted a metal plate to the surrounds of his left eye (Bradley, 2020). These injuries could have been avoided if the infamous Halo had been invented and introduced much earlier.

3.3 Protective clothing

In the early days of F1, around the 1950's, there was no such thing as fire resistant race suits. Instead, drivers wore casual items such as polo shirts and work jackets. They could wear whatever they preferred but, as time progressed into the 1960's, the FIA introduced the first rules regarding fireproof suits with a material called Nomex, which is flame resistant. In the 1970's, the FIA released official standards for fire rated safety equipment but, a crash involving Nikki Lauda at the 1976 Nürburgring Grand Prix, proved that the suits were still not advanced enough as he was engulfed in flames and was almost killed. In 1979, driver's began wearing NASA rated suits which brought them some discomfort as the suits were made of 5 layers of fire-resistant materials, the same materials used to make astronauts suits. Until 2018, there were little to no advancements made in race suit technology. The suits had been replaced with more lightweight fibres and layers of Nomex which were breathable. These suits go through a specific testing, washing and drying process to ensure they withstand the temperatures of 600-800 degrees Celsius. From the gloves they wear to the socks, everything must now be able to survive the same testing procedure (Parkin, 2018).

Modern helmets have also come a long way; these days they are full-face with small visors just about big enough to see out of and have the same Nomex materials within them. As well as being lightweight with a carbon fibre shell lined with Kevlar, they can be described as "bulletproof". Before this technical marvel, drivers in the pre-world-war one era wore cloth caps and goggles to prevent dust and debris from hitting their eyes. Only in 1954 did the world see the introduction of the first purpose made racing helmet made by Bell. It was an open face design made of glass fibre-laminate and was the most effective helmet at the time. The 1970's is where drivers saw the full-face helmets that the world knows today come into effect but, there were concerns of drivers not having full visibility due to condensation fogging up the visor. As well as a lack of ventilation to keep them cool at hot tracks, now the helmets of today's generation include lots of vents to combat these issues (Magneto, 2022).

3.4 Track safety and Barriers

Since the beginning of motorsport, speed has been more important than safety. Drivers had an understanding that a crash in the car may one day kill them. From no seatbelts and leather helmets (Ellis, 2021), to the hay bale barriers surrounding the track, motorsport

has seen a well-needed upgrade in terms of driver and spectator safety, with the introduction of Armco barriers, Techpro barriers and wider run-off areas with added gravel traps (Duxbury, 2022).

Armco barriers are steel structures customised to each racetrack by the FIA's own software to determine the right construction to be effective. They were introduced to F1 between the 1960s and '70s to replace the dangerous barriers in place currently, which were constructed of hay bales and concrete. The Armco is designed to dissipate the impact of a car contacting it and can withstand high-speed impacts and still stay in one piece. The barriers were put in place and proved to protect spectators from cars coming off track, as well as to prevent drivers from being killed during races. Romain Grosjean encountered one of these barriers at the Bahrain Grand Prix in 2020. His car sliced through the barrier that was meant to stop him from potentially hitting the marshals behind it, proving that yes, they are safer than what used to be in place but, there is still work to be done to prevent this from repeating (Howson, 2023).

Techpro barriers are a contact wall constructed of polyethylene which is hollowed inside. They work in the same way as Armco; they are in place to protect drivers and spectators but, they carry this out in a more effective way as the barriers once hit can be replaced in a matter of minutes due to their modular design, saving time during red flags at races. Tracks can also be reshaped within a day if there needs to be changes due to track limits or run-off areas. They have been proven to be very effective, hence why you will see them at almost every racetrack in the world (FKP, 2023).

4 Conclusion

Despite all the information that has been presented in this paper, there is still a need for further studies in relation to injury prevention and safety in motorsports. On the other hand, there has already been a huge amount implemented over the years to improve the safety in motorsport, as shown in this report. Many advancements have been mentioned above from having no protection for the drivers to having full fireproof suits and carbon Kevlar helmets. Also, no barriers evolved to advanced module barriers designed to protect the drivers and spectators.

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