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CONCUSSION IN MOTORSPORT

39 **Abstract**

40 **Objective:** To assess concussion experiences, knowledge and attitudes of
41 motorsport medical personnel and drivers, and to determine priority areas regarding
42 concussion within the sport.

43 **Design:** Sequential mixed-methods design. Part 1: Stakeholder interviews; Part 2:
44 Cross-sectional online survey.

45 **Setting:** United Kingdom.

46 **Participants:** Part 1: Key motorsport stakeholders ($N=8$); Part 2: Motorsport medical
47 personnel and drivers ($N=209$) representing amateur and/or professional 4-wheeled
48 motorsport.

49 **Main Outcome Measures:** Concussion experience, knowledge, attitudes and
50 perceived priority areas.

51 **Results:** Thirty-one percent of surveyed drivers (age = 37.91 ± 13.49 years: 89%
52 male) reported suffering from concussion in motorsport. Eighty-seven percent of
53 surveyed medical personnel (age = 48.60 ± 10.68 years: 74% male) reported
54 experience with concussed drivers and 34% reported feeling pressured to clear a
55 driver with concussion. Gaps in knowledge and misperceptions about concussion
56 were reported in both groups, and disparity between concussion attitudes emerged
57 between drivers and medical personnel. Application of assessment and
58 management procedures varied between medical personnel and there was evidence
59 motorsport policy and concussion guidelines may not be directly followed. According
60 to both medical personnel (77%) and drivers (85%), 'education and training' is the
61 top priority area for the sport.

62 **Conclusions:** There is clear evidence of concussions in motorsport, but accurate
63 knowledge about this injury is missing. Concussion education and training for all

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64 drivers and medical personnel is required. Additional investigations into concussion
65 attitudes are advised to complement and advance simple educational initiatives.
66 Further investigation is also required to determine how to best support motorsport
67 medical personnel, and general practitioners, who hold significant responsibility in
68 guiding drivers from diagnosis to return-to-racing, and to support the effective
69 implementation of policy.

70 **Key Words:** concussion, motor sports, motorsport, stakeholders, knowledge,
71 attitudes.

72 **Clinical Relevance:** Concussion in motorsport is a concern, and relevant
73 information, guidelines and policy may not be effectively reaching motorsport
74 medical personnel and drivers.

75 **INTRODUCTION**

76 Sport concussion is a current, high priority issue affecting millions of individuals
77 worldwide¹, including motorsport athletes (e.g., Formula-1, rally)². Drivers are
78 frequently subjected to demands that are rare in other sports (e.g., excessive
79 speeds, high G forces, large rotational mechanisms)^{2,3}. The risk and incidence of
80 concussion in motorsport have been reported as high, and rising^{2,4}.

81 However, published evidence of the experiences, knowledge and attitudes of key
82 motorsport stakeholders (e.g., medical personnel, drivers) is lacking, and there is a
83 significant knowledge gap regarding concussion in motorsport specifically⁵.

84 Motorsport has more than 80 million people involved worldwide⁶ and an
85 increasing number of younger participants entering the sport⁵. The exact number of
86 drivers is unknown, because unlicensed drivers may be three times the number of
87 licensed at any one time⁷. The UK alone reports approximately 30,000 licenced
88 drivers each year⁸. There are specific challenges within the context of motorsport
89 including that the sport can be highly independent, with many drivers traveling to and
90 from races alone, without a coach or family member. Furthermore, the availability of
91 on-site medical personnel and medical resources varies significantly across region,
92 race series and level, making standardised concussion management challenging. A
93 detailed description of the specific components of motorsport is beyond the scope of
94 this paper, however, relevant information can be found at www.msauk.org.

95 Recently there has been an increase in concern about concussion in
96 motorsport reflecting high profile incidences⁹, governing body policy¹⁰, media
97 publications¹¹⁻¹³ and developing research in other sports. Consequently, early stage
98 research into incidence and engineering perspectives have emerged^{2,5}.

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99 Research in other sports has identified gaps in athletes' knowledge, and
100 attitudes, towards concussion¹⁴⁻¹⁸. Similarly, medical professionals have
101 demonstrated substantial gaps in knowledge, and misperceptions¹⁹⁻²¹. Physician
102 knowledge about concussion is essential, particularly given they remain the primary
103 health care provider for concussion²². Limited evidence of knowledge towards
104 concussion exists in two-wheeled motorsport²³, but to date, there have been no
105 peer-reviewed studies of knowledge, or attitudes, towards concussion within four-
106 wheeled motorsport.

107 Stakeholder involvement develops local relevance²⁴, improves research
108 uptake²⁵ and is a valuable component of the processes leading to effective
109 interventions²⁶. Involving stakeholders in helping to identify research priorities has
110 proven effective in other areas of medicine and sport, such as nursing²⁷,
111 paediatrics²⁸, health promotion, and sport injury prevention^{29,30}. To our knowledge,
112 stakeholders', in this case motorsport drivers and medical personnel, perceived
113 priority areas regarding concussion remain largely unaddressed, meaning
114 contextualised perspective on this issue is lacking.

115 The aim of this research was to assess context and establish research
116 feasibility and direction, followed by further assessment of concussion experiences,
117 knowledge, attitudes and perceived priority areas for development in motorsport.

118 **METHODS**

119 A sequential mixed-methods design³¹ was used. Qualitative interviews (Part
120 1) explored stakeholders' views and experiences. This informed a survey (Part 2)
121 developed to assess experiences, knowledge, attitudes, and perceived priority
122 areas. Research was approved by the relevant institutional ethics committee.

123 **Part 1**

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124 Eight experienced stakeholders (4 medical personnel (*MED*), 4 drivers
125 (*DRIV*); aged 18+ years, $M=40$), with a mean 18 years of experience (range = 5 - 28
126 years), gave informed consent to be interviewed. Stakeholders were purposively
127 sampled to be representative of different disciplines, roles and levels of motorsport
128 (see Table, Supplemental Digital Content), and included highly accredited medical
129 personnel and drivers at the professional level of the sport.

130 A semi-structured interview guide was developed through an iterative process
131 of revision and piloting, using an expert panel ($N=4$) including qualitative researchers
132 and a former international motorsport driver. Individual interviews ($M= 30$ minutes)
133 were recorded and transcribed using unique pseudonyms, and member checking³²
134 was used to improve confidence in quality of data. Thematic analysis was
135 conducted³³ and consensus validation³⁴ was used to establish validity and
136 trustworthiness, achieving 86% initial agreement prior to researcher discussions
137 which resolved any discrepancies.

138 **Part 2**

139 An online cross-sectional survey was disseminated using Bristol Online
140 Survey (BOS; <https://www.onlinesurveys.ac.uk/>). Prior to launching, the survey went
141 through multiple stages of revision and piloting. Content and face validity were
142 checked by motorsport medical experts and professional motorsport drivers. The
143 survey was disseminated UK-wide via national governing body mailing lists,
144 newsletters, websites and postings on social media. Inclusion criteria included being
145 16+ years of age, and either a racing licenced UK driver or medical personnel
146 (including UK certified doctors, surgeons, paramedics) from 4-wheeled motorsport.

147 Surveys contained a 24-item sign/symptom checklist (including distractors)
148 and 18 statements, to assess concussion knowledge and opinions, adapted from a

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149 previous survey³⁵. Checklist items reflected all different categories of
150 signs/symptoms (i.e., physical, cognitive, emotional and sleep)³⁶. Attitudes towards
151 concussion were assessed using scenario-based questions from the Rosenbaum
152 Concussion Knowledge and Attitude Survey (RoCKAS)³⁷, which were adapted to suit
153 motorsport context. Scoring and interpretation of these sections followed guidance
154 from previous publications^{35,37}.

155 Medical personnel completed open-ended questions about concussion
156 assessment and management practices (e.g., “How would you assess someone with
157 a suspected concussion?”), adapted from the literature³⁸. Additionally, all
158 participants were instructed to describe two perceived priority areas regarding
159 concussion in motorsport.

160 Quantitative analyses were performed using SPSS Statistics version 22.0
161 (SPSS, Inc.), with an a priori significance level of $p < 0.05$. Normality and equality of
162 variance assumptions (Shapiro-Wilk’s and Levene’s tests respectively) were met for
163 general knowledge statements as well as the attitude scenarios. T-tests were
164 therefore used to assess differences in general knowledge, and attitude scenarios,
165 between groups (MED, DRIV). Sign/symptom data did not meet normality
166 assumptions, and so a Mann-Whitney U test was used to assess sign/symptom
167 knowledge between groups. Qualitative survey questions were analysed using
168 thematic analysis^{33,34}.

169 **RESULTS**

170 **Part 1**

171 The following themes describe the current state of concussion in motorsport:

172 *Concussions occurrence*

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173 All MED reported working with concussion in motorsport. One MED also
174 described working with drivers with on-going symptoms and related-challenges:

175 "...seen drivers as a clinical follow-up who have been concussed, with on-
176 going symptoms and issues with decision-making etc" (MED3).

177 Two of four drivers described personal experiences of concussion and three
178 described indirect experiences through teammates or friends (Table 1).

179 *Potential underdiagnoses/underreporting*

180 Participants described signs of concussion including periods of transient
181 dysfunction following accidents, and feelings of the brain being "shaken". One driver
182 indicated they might delay symptom reporting, or not seek medical help at all (Table
183 1). Additionally, MED articulated concerns about the consequences associated with
184 underdiagnosis or underreporting:

185 "my fear is you have somebody who is not really in control of their faculties...
186 they're drowsy, not able to think clearly... if they go back in that car, they're
187 potentially going to kill themselves or kill somebody else" (MED1).

188 They also noted that concussion is likely under-recognised in general, and from a
189 media perspective:

190 "it's perhaps not as well-known from the public's point of view, it's not seen
191 on camera as much as it is in rugby, American football... on a track if there's
192 something really big they just turn the camera away..." (MED4).

193 *Challenges & variation in diagnosis, assessment and management*

194 Reported concussion assessment and management practice differed
195 according to motorsport series and/or level (Table 1). In addition, two MED (who
196 regularly work in general practice) were concerned about general practitioners'

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197 (GPs) “lack of concussion knowledge”, particularly given recent UK motorsport
198 policy¹⁰ that requires concussed drivers to seek GP clearance before returning to
199 competition:

200 “unreasonable to ask [GPs] to write a letter to say this guy’s better from this
201 concussion... GPs haven’t got a clue we don’t see concussion in general
202 practice” (Med1).

203

204 [Table 1]

205

206

207

208 The following themes reflect recommended future directions and requirements:

209 *Role of governing bodies*

210 All participants advocated for governing bodies to be heavily involved in
211 supporting and actively implementing research findings (Table 2).

212 *Education and training*

213 All DRIV, and two MED, emphasised a need to disseminate concussion-
214 related information and/or education, and mandatory education was also suggested
215 (Table 2).

216 *Motorsport-specific research*

217 Two drivers emphasised pushing for more sport-specific research, as they
218 believed it is currently lacking:

219 “so far things with concussion are not as researched and understood [in
220 motorsport]” (DRIV2).

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221 This was echoed by medical personnel. Specifically, they felt data is needed to
222 enhance diagnosis, assessment and management procedures (Table 2).

223 *Engineering and technology*

224 Two drivers prioritised focusing on safety technology (e.g., helmets) and one
225 MED prioritised continued improvements to track-design and safety equipment
226 (Table 2).

227 **Part 1 summary**

228 Motorsport experts have significant experience with concussion and the injury may
229 be underdiagnosed. Motorsport MED (and GPs in general) may be behind other
230 sports in terms of assessment and management practices, and implementing recent
231 policy¹⁰. In general, the sport may have limited information and knowledge about
232 concussion. Top perceived priority areas include education and training, acquiring
233 motor-sport specific data and focusing on collective action between researchers,
234 medical professionals and governing bodies.

235

236 [Table 2]

237

238 **Part 2**

239 Two hundred and nine respondents (90 MED, 119 DRIV) completed the survey. One
240 MED and 18 DRIV did not meet inclusion criteria, thus their data was excluded from
241 analyses. The majority of participants were male (74% MED, 89% DRIV). Forty-eight
242 percent of MED were qualified medical doctors. Seventy-five percent of drivers were
243 amateur level, and 78.7% of MED worked both amateur and professional level
244 events. Respondents represented multiple types of motorsport, 'Circuit racing'

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245 (65.2% MED, 25.7% DRIV) and 'Rallying' (27.0% MED, 42.6% DRIV) were the most
246 common (see Tables, Supplemental Digital Content).

247 Thirty-one percent of drivers reported concussion during motorsport. Eighty-
248 seven percent of MED reported working with concussed drivers. Thirty-four percent
249 of MED have felt pressured to clear a concussed driver.

250 Medical personnel demonstrated significantly greater sign/symptom
251 knowledge ($M=20.27$, $SD=2.14$; $U=2,077.0$, $p<0.001$, $r=0.48$) compared to drivers
252 ($M=16.76$, $SD=4.04$). Inspection of individual checklist items revealed knowledge
253 gaps. For example, few DRIV correctly identified 'sadness' (35.6%), 'trouble falling
254 asleep' (41.6%) and 'feeling more emotional' (47.5%). Overall, both groups identified
255 fewer 'emotional/sleep' items. Furthermore, 'shortness of breath' (20.2% MED, 18%
256 DRIV) and 'ear discharge' (32.6% MED, 36% DRIV) were incorrectly thought to be
257 signs of concussion (Figure 1).

258 Medical personnel demonstrated significantly greater general concussion
259 knowledge ($M=72.87$, $SD=6.06$; $t(187)=9.03$, $p<0.001$, $d=1.32$) compared to drivers
260 ($M=64.80$, $SD=6.19$). However, both groups indicated several misperceptions. The
261 most common were uncertainty about the recovery time for younger drivers (37.1%
262 MED, 52.0% DRIV) and uncertainty whether prior concussion increases the risk of
263 another concussion (37.1% MED, 35.6% DRIV). Furthermore, DRIV incorrectly
264 agreed protective equipment (e.g., helmet) prevents concussion and that standard
265 brain imaging (e.g., CT scan) shows concussion damage (26.7% and 23.8%,
266 respectively). DRIV (50.5%) and MED (42.7%) incorrectly agreed drivers can start
267 normal training when they are symptom free (Table 3). Furthermore, few participants
268 (67.4% MED, 23.8% DRIV) 'strongly disagreed' that concussion can only occur from
269 a direct blow to the head. Finally, 50.5% of DRIV and 42.7% of MED incorrectly

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270 believed drivers can start normal training as soon as they are symptom free (Table
271 3).

272

273 [Figure 1]

274

275

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Analysis of the adapted RoCKAS scenarios revealed no significant group
278 differences in mean attitude scores ($t(185)=1.31$, $p=0.19$, $d=0.19$; DRIV: $M=40.56$,
279 $SD=4.61$, MED: $M=39.67$, $SD=4.61$). When participants responded about their own
280 attitudes, both groups demonstrated moderately safe attitudes towards concussion.
281 However, variation was introduced when MED were asked to comment on what
282 'most drivers would feel' (Table 4 & see Table, Supplemental Digital Content).

283

284

[Table 3]

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[Table 4]

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295

Medical Personnel (76%) reported using subjective and objective assessment
approaches (24% of whom reported using a combination of both). Few MED

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296 acknowledged following concussion policy and two MED reported adopting the
297 World Rugby guidelines while working in motorsports. A number of findings highlight
298 violation of recent consensus guideline³⁹ and UK motorsport policy¹⁰. For example,
299 few MED (8%) reported recommending drivers follow a graduated return-to-sport
300 protocol. Additionally, few MED reported telling drivers they should see their GP, or
301 ensuring drivers are removed from competition until recovered and/or having the
302 driver's licence temporarily suspended (12% and 28%, respectively) (Table 5).

303

304 [Table 5]

305

306 Thematic analysis revealed that the top three priority areas surrounding
307 concussion in motorsport included: (1) 'Education/training' (MED=77%, DRIV=85%);
308 (2) 'Clearer concussion policy/procedures' (MED=30%, DRIV=24%); (3) 'Improving
309 assessment procedures' (MED=28%, DRIV=10%).

310 **Part 2 summary**

311 Eighty-seven percent of surveyed MED and 32% of DRIV reported concussion
312 experiences, and 34% of MED reported feeling pressured to clear a concussed
313 driver to return-to-sport. MED outperformed drivers (as expected) on both
314 sign/symptom identification and general knowledge statements. However, both
315 groups showed knowledge gaps. Although no significant group differences existed in
316 regards to participants' attitudes towards concussion, MED indicated negative
317 expectations of drivers' intentions. Medical personnel may benefit from support to
318 improve adherence to motorsport concussion policy. 'Education/training' was the
319 most highly reported priority within the sport.

320 **DISCUSSION**

321 This mixed-methods study represents the first examination of concussion knowledge
322 and experiences within (four-wheeled) UK motorsport. It is also the first assessment
323 of concussion attitudes across motorsport, and, is believed to be the first to conduct
324 stakeholder interviews to help direct a sport-specific research agenda on concussion
325 and to build justification for subsequent survey investigation.

326 Concussion in motorsport may be more common than expected. A third of
327 surveyed drivers and 87% of medical personnel reported concussion experiences.

328 These findings are consistent with recent literature², including a pilot survey that
329 found 90% of medical staff (31 countries) reported concussion experiences¹¹.

330 Stakeholders indicated that motorsport may be experiencing underreporting and
331 underdiagnosis similar to other sports¹ (see Table 1). Behaviours and processes for
332 reporting, and non-reporting, in motorsport should be investigated further.

333 Attitudes have a significant role in guiding behaviours⁴⁰, and whilst
334 participants demonstrated relatively safe attitudes towards concussion, on average,
335 medical personnel showed evidence they did not believe most drivers always
336 respond in the safest manner. In contrast, drivers generally thought they, and other
337 drivers, would respond safely to concussion. It could be that drivers responded in a
338 socially desirable manner. Previous research found athletes demonstrated safe
339 concussion attitudes when assessed using questionnaires but revealed unsafe
340 behaviours during follow-up interviews¹⁶. These findings have implications for how
341 concussion attitudes are assessed, and prompts further questions around the
342 medical personnel and athlete relationship. Additional investigation is warranted and
343 alternative methods of assessing attitudes, such as through implicit measures⁴¹,
344 would significantly enhance quality of evidence.

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345 Drivers demonstrated worse sign/symptom knowledge compared to MED and
346 performed up to 22% worse compared to other surveyed athlete groups^{14-17,23}. Both
347 groups identified fewer 'emotional-sleep' signs/symptoms of concussion compared to
348 'cognitive' or 'physical' items, consistent with previous surveys^{14,35,38,42}. Interestingly,
349 more drivers correctly identified the 'red flag' signs of concussion (seizure or
350 convulsion, neck pain) than MED⁴³. There is a need to improve sign/symptom
351 identification within motorsport and such knowledge gaps should feature in
352 interventions.

353 Participants reported misperceptions consistent with earlier literature in other
354 sports³⁵. For example, a number of respondents incorrectly believed scans (e.g., X-
355 ray) show concussion-induced damage to the brain and that protective equipment
356 (e.g., helmet) prevents concussion. In fact, some participants regarded personal
357 protective equipment as a priority in addressing concussion in motorsport,
358 demonstrating lack of awareness that items like helmets may not reduce concussion
359 incidence or severity^{36,44}. Additionally, few participants understood that younger
360 individuals (under 18 years) typically take longer than adults to recover from
361 concussion. Drivers incorrectly agreed that concussions only occur from a direct
362 blow to the head and that drivers have to lose consciousness to be diagnosed with
363 concussion. In motorsport specifically, significant rotational forces (which can lead to
364 concussion) are common even without direct impact or loss of consciousness².

365 Medical personnel, GPs in particular, are the gatekeepers between drivers
366 and their return to racing. However, present findings suggest recent policy^{10,39} may
367 not be reaching medical personnel. Few MED discussed the importance of a return-
368 to-sport protocol, ensuring drivers are removed from competition with a temporarily

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369 suspended licence or that drivers follow-up with a GP, which are all key points of UK
370 motorsport concussion policy¹⁰ and consensus guidelines³⁹.

371 Furthermore, the current guidance to see a general practitioner, and the
372 finding that 40% of MED in the current study immediately refer patients to hospital for
373 concussion, may be a concern. Studies suggest UK emergency department
374 physicians lack concussion knowledge⁴⁵ and that general practitioners show
375 inadequacies in concussion-related knowledge and practice^{19,21,22,46} despite being
376 the primary health resource for concussed individuals²¹. To alleviate this concern,
377 and the burden placed on general practice and emergency departments, the UK may
378 benefit from adopting the North American practice of sport concussion clinics, where
379 highly trained multidisciplinary teams specialise in dealing with concussion cases.

380 Thirty percent of MED in the current study reported zero training or education
381 on concussion, which may help to explain the limited adherence to concussion
382 policy. A 2012 Canadian study found only 29% of its medical programmes provided
383 any form of concussion education and that medical students lacked concussion
384 knowledge⁴⁶, similar to the current findings. Further work is needed to support
385 motorsport medical personnel, and possibly GPs in general. Concussion education
386 has now been successfully integrated into medical curricula in other countries¹⁹ and
387 may be needed in UK programmes. Ensuring MED are educated about concussion
388 (and updated as things progress) will likely improve concussion-related care²¹,
389 simultaneously addressing other top priorities from the current survey (i.e.,
390 'assessment practices', 'clear concussions policy/procedures').

391 Education and training are clearly top priorities for motorsport. Concussion
392 education is advocated as a highly effective part of addressing the problem of sports
393 concussion and has shown improvements in other sports⁴⁷. Interviewed stakeholders

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394 in the current study also perceived developing safety equipment and technology as
395 key priorities. However, new developments take significant resources, and years,
396 before implementation even at the top levels of motorsport (e.g., the 'Halo' system
397 designed to guard drivers against airborne debris⁴⁸). More specifically,
398 advancements in engineering may not be effective, or plausible in cost or time to
399 efficiently address concussion issues. Consequently education and training, which
400 could be quickly made available to all levels of the sport, should be prioritised.

401 The survey was widely distributed across the UK however there may be a
402 self-selection bias; people who already knew, or held personal interest, about
403 concussion may have been more likely to respond. Additionally, accurate response
404 rates could not be quantified given the described recruitment methods. Participants'
405 reported concussion history could not be validated using medical records. Finally,
406 the research was specific to the UK and therefore should not be generalised to other
407 countries or two-wheeled motorsports.

408 In summary, this research helps to address the existing knowledge gap for
409 concussion in motorsport specifically, and highlights several concussion issues in the
410 sport including misperceptions and gaps in knowledge, and limited adherence to
411 concussion policy and guidelines. Education and training for drivers (currently
412 underway) and medical personnel is needed. Findings also extend beyond
413 motorsport, indicating a potential need to review current medical programmes to
414 ensure structured training and continued educational opportunities on sports
415 concussion as well as further consideration of the role for UK sports concussion
416 clinics.

417

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555 **Figure legends:**

556 **FIGURE 1.** Percentage of Correctly Identified Concussion Signs and Symptoms by

557 Motorsport Medical Personnel (MED; $N=89$) and Drivers (DRIV; $N=101$).

558

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559 **Table legends:**

560 ***Please also see separate Table file.**

561

562 *Table title:* **TABLE 1.** Current State of Concussion in Motorsport

563 *Appropriate column heads:* **Main theme; Sub-theme with sample quotes; No. of**
564 **participants who endorsed this**

565 *Explanatory legends: Note.* N=8, MED=Medical personnel, DRIV=Drivers.

566

567 *Table title:* **TABLE 2.** Future Directions and Requirements in Motorsport

568 *Appropriate column heads:* **Key theme; Sub-theme with sample quotes; No. of**
569 **participants who endorsed this**

570 *Explanatory legends: Note.* N=8, MED=Medical personnel, DRIV=Drivers.

571

572 *Table title:* **TABLE 3.** General Gaps in Knowledge and Opinion Identified in

573 Motorsport Medical Personnel (MED; N=89) and Drivers (DRIV; N=101)

574 *Appropriate column heads:* **Statement; Responses (%), Strongly disagree,**
575 **Disagree, Neutral, Agree, Strongly Agree**

576 *Explanatory legends: Note.* Key knowledge gaps are in bold. Items 8-14, 16-17 are

577 reverse scored. Distractor items not presented. MED=Medical personnel,

578 DRIV=Drivers.

579

580 *Table title:* **TABLE 4.** Concussion Attitudes According to Scenario-Based Questions

581 *Appropriate column heads:* **Statement; Responses (%), Strongly disagree,**
582 **Disagree, Neutral, Agree, Strongly Agree**

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583 *Explanatory legends: Note.* Responses (%) = percentage of MED/DRIV who rated
584 each particular item as such, MED=Medical personnel, DRIV=Drivers. See
585 Supplemental Digital Content for full scenarios. Safer attitudes are in bold. Scenario
586 **2** is reverse scored. Participants received 1-5 points for each item, 5 points
587 representing safest possible answer and 1 point representing least safe answer.
588 Possible scores ranged from 10-50, higher scores representing safer attitudes
589 towards concussion.

590

591 *Table title:* **TABLE 5.** Concussion Assessment & Management Practices Amongst
592 Motorsport Medical Personnel

593 *Appropriate column heads:* **Assessment approach; No. (%) of respondents;**
594 **Management approach; No. (%) of respondents**

595 *Explanatory legends: Note.* No. (%) of respondents=number of medical personnel
596 who endorsed the item. Analysis based on responses from *N*=68 doctors. Multiple
597 items sometimes suggested by respondent, thus % exceeds 100 and No. exceeds
598 *N*.

599

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600 **Supplemental Digital Content:**

601 Supplemental Digital Content 1_Adams et al._Concussion in motorsport.pdf