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To cite this article: Mike Weed (17 Jun 2024): Informing evidence-based policy for sport-related concussion: are the consensus statements of the concussion in sport group fit for this purpose?, Sport, Ethics and Philosophy, DOI: [10.1080/17511321.2024.2365401](https://doi.org/10.1080/17511321.2024.2365401)

To link to this article: <https://doi.org/10.1080/17511321.2024.2365401>



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Published online: 17 Jun 2024.



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Informing evidence-based policy for sport-related concussion: are the consensus statements of the concussion in sport group fit for this purpose?

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ABSTRACT

This essay explores how evidence-based policy can be developed for sport-related concussion (SRC), focusing particularly on the role and influence of the Consensus Statements of the Concussion in Sport Group (CiSG). Three credible policy purposes are suggested: (i) to mitigate acute health impacts of concussion events in sport; (ii) to reduce or eliminate the identified causes of SRC (direct blows to the head, neck, or body); and (iii) to improve long-term brain health outcomes for athletes. Eight of ten systematic reviews commissioned for the most recent Consensus Statement, and ten of its thirteen headings, address the first purpose. The primary influence of the CiSG Consensus Statements has been to improve SRC acute response practice and protocols in professional/elite sport, which has always been their primary policy purpose, although evidence of improvement is more limited in child/adolescent and recreational sport. But a primary focus on mitigating acute health impacts has crowded out other credible policy purposes of concern to stakeholder groups with whom evidence-based policy for SRC must be co-produced. No recommendations are made to improve long-term brain outcomes for athletes because concerns about imperfections in evidence are cited to question the link between such outcomes and SRC. Modifications to reduce or eliminate purposive blows to the head, neck, or body that are permitted as a structural part of the way some sports are played are given very limited attention, even when discussing prevention, where they are just one approach considered alongside protective equipment, neuromuscular strengthening, and concussion management strategies. The essay concludes that the CiSG should shift the primary policy purpose of its Consensus Statements to address the identified causes of SRC: purposive blows to the head, neck, or body. Reducing or removing causes of SRC both better safeguards children/adolescents and renders debates about the link between SRC and long-term brain health outcomes superfluous.

ARTICLE HISTORY

Received 3 June 2024
Accepted 4 June 2024

KEYWORDS

Concussion; policy; evidence; safeguarding; critical policy sciences

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The successive Consensus Statements of the Concussion in Sport Group (CiSG) have set out to summarise 'evidence-informed principles of concussion prevention, assessment and management' and explicitly state that their basis is 'science and expert consensus' (Patricios 2023, 695). However, it is important to distinguish the role of science, and science experts, in setting out a consensus of what the scientific evidence says, from the role of policy and policy experts, in considering whether and what kind of policy response is merited. This is particularly important in relation to an area such as sport-related concussion (SRC), which involves risks to human health, which may have long-term consequences, including among children. Consequently, the expectations of stakeholders, and the general public, might be that policy action is taken on the balance of risks indicated by the evidence, rather than only in areas in which the scientific consensus is that a proven effect has been definitively established in the scientific literature.

This essay draws on a critical policy sciences approach to the problem(s) of concussion in sport. The policy sciences originate in the work of Lasswell (1951), and are simultaneously concerned with evidence of *how and for what purpose* policy, and recommendations for policy, have been developed (evidence of policy), and with *what evidence* has been drawn upon to develop policy and recommendations for policy (evidence in policy) (Lewin and Shakun 1976; Sinclair 2006). In the case of responding to scientific consensus recommendations, these two elements of a critical policy sciences approach are almost inseparable. Questions of how and for what purpose policy recommendations have been developed are inextricably interlinked with questions of what evidence has (or has not) been assembled and how it has been interpreted. Thus, a critical policy sciences approach is not specifically concerned with a detailed analysis of the global evidence base in relation to SRC. Rather, it focuses its analysis on what aspects of that evidence base have been considered, how it has been interpreted as applicable to policy, for what purpose, for whom, and with what outcomes.

In considering evidence *of* policy, the essay will first explore whether the Consensus Statements of the CiSG set out clear and credible policy purposes, as well as what credible policy purposes for SRC might reasonably be expected to be. Secondly, in considering evidence *in* policy, the essay will explore the extent and nature of the efficacy and effectiveness evidence that supports the recommendations of the CiSG set out in the consensus statements, and whether the recommendations can achieve credible policy purposes for SRC by the means proposed, as well as whether there are other potential means to achieving those purposes. Finally, in returning to evidence *of* policy, the essay will explore how, and for whom, the CiSG recommendations have been developed, and in doing so, will consider how far they might be perceived to have legitimacy in the eyes of stakeholders and the general public.

Evidence Of Policy I: Do the CiSG Consensus Statements Set Out Clear and Credible Policy Purposes for SRC?

The first Consensus Statement of the CiSG (Aubry 2002) is clear that its aim was 'to provide recommendations for the improvement of safety and health of athletes who suffer concussive injuries', and is intended 'for use by doctors, therapists, health professionals, coaches, and other people involved in the care of injured athletes, whether at the recreational, elite, or professional level' (6). In doing so, it considered the 'signs and

symptoms of acute concussion' (7) and the 'acute response' (8) for management and rehabilitation. This, thus, sets the purpose for the first Consensus Statement, and the ongoing primary purpose for those that followed, to mitigate the acute health impact of concussion events in sport once they occur through establishing a protocol for the recognition and treatment of acute symptoms, as well as identifying those who should contribute to this.

SRC is defined in the most recent Consensus Statement (Patricios 2023, 697) as a 'traumatic brain injury caused by a direct blow to the head, neck or body'. Given that this definition identifies a clear cause of SRC, it is problematic to limit the purpose of recommendations developed by Consensus Statements to recognising and treating the acute symptoms of SRC (i.e. the acute health impacts), when there already exists a clear opportunity to reduce or eliminate the identified cause: i.e. direct blows to the head, neck or body. This is particularly problematic when, in some sports, the cause—direct blows to the head, neck, or body—is permitted and purposive within the constitutive rules of the sport, as opposed to blows that are not permitted or that are accidental.¹ The first Consensus Statement did implicitly acknowledge the opportunity to address the cause of SRC, as it included a section on prevention which noted that '[r]ule changes and rule enforcement play a key role in reducing and preventing concussions' (Aubry 2002, 9). However, while subsequent Consensus Statements discussed the use of protective equipment and the implementation of rule changes (and better rule enforcement), no specific recommendations for prevention and risk reduction strategies were made until the publication of the fifth statement (McCrorry 2017), which was informed by a commissioned systematic review on risk reduction (Emery et al. 2017). Even then, recommendations were limited to helmet use in skiing and snowboarding, and stricter rule enforcement relating to high elbows in soccer (McCrorry 2017, 845). But protective equipment mitigates rather than reduces or eliminates the causes of SRC, while recommendations for stricter rule enforcement address only accidental causes of SRC, or those that contravene the constitutive rules. Therefore, despite rule changes being identified as a strategy to reduce and prevent SRC in the first Consensus Statement (Aubry 2002), fifteen years later, successive Consensus Statements had still not made any recommendations to address the purposive and constitutive causes of SRC.

The latest Consensus Statement (Patricios 2023, 695) does set out a broader purpose than the first; namely, to support 'the care of athletes at risk of SRC or who have sustained a suspected SRC at any level of sport (ie, recreational to professional)'. Given that blows to the head, neck, or body, be they accidental or purposive, are to some extent a risk for virtually every athlete in virtually every sport (including non-contact sports such as alpine skiing), the most recent statement might reasonably be interpreted as committing to provide recommendations that address the causes and symptoms of SRC for all athletes at all levels of sport.

So far, in this section, the discussion relating to the symptoms of SRC has focused on acute symptoms: those experienced in the more immediate aftermath of SRC. However, in committing to 'the care of athletes ... who have sustained a suspected SRC', it is not justifiable for such care to be limited to acute symptoms. Rather, the commitment must extend to a care *and concern* for symptoms that might be experienced in the longer term.

Although the first Consensus Statement (Aubry 2002) acknowledged that efforts to evaluate long-term brain health outcomes and functional deficits should guide

continuing investigation of SRC, a specific discussion of 'chronic concussion-related changes' did not appear until the publication of the fourth Consensus Statement more than a decade later (McCrary 2013).² This discussion emphasised the unknown incidence of long-term effects on brain health (specifically, chronic traumatic encephalopathy [CTE]) in athletic populations, and that, in any case, a causal link between SRC and CTE had 'not as yet been demonstrated' (254). The only action suggested in relation to long-term brain health was that 'it is important to address the fears of parents/athletes from media pressure related to the possibility of CTE' (254). Therefore, despite acknowledging that there had been an 'interpretation of causation in modern CTE case studies' (254), because the CiSG concluded that causation had 'not as yet been demonstrated' (254), their greatest concern in the third Consensus Statement was, rather oddly, to 'address fears' about the possibility of CTE. This seems to fall seriously short of the stated aim to support the 'care of injured athletes, whether at the recreational, elite or professional level' (McCrary 2013, 250).

Four years later, the fifth Consensus Statement reiterated that a link between SRC and CTE had not yet been demonstrated and that the literature on the long-term brain health consequences of SRC was inconsistent (McCrary 2017, 844). However, the commissioned systematic review that informed these conclusions noted that 'some former athletes suffer from depression and cognitive deficits later in life', and that 'there is an association between these deficits and a history of multiple concussions' (Manley et al. 2017, 976).

The most recent Consensus Statement (Patricios 2023), underpinned by a further systematic review (Iverson et al. 2023), is more expansive in its discussion and exploration of long-term brain health outcomes, and these are discussed later in this essay. Nevertheless, a primary theme of both the Consensus Statement and the linked systematic review remained raising questions concerning the quality of studies that suggest causal links between SRC and long-term brain health, as well as suggesting that such studies did not account for other factors that could also impact brain health, such as education, socio-economic status, smoking, diet, and exercise.

A Consensus Statement that might reasonably be interpreted to have committed to provide recommendations that address the causes and symptoms of SRC for all athletes at all levels of sport implies three policy purposes:

- (1) *To mitigate the acute health impact of concussion events in sport.* This has been a clear and unambiguous purpose of the Consensus Statements from the start, and clearly remains the primary purpose of the most recent statement, in which ten of the thirteen headings, and their associated recommendations, address recognition and treatment of acute symptoms.
- (2) *To reduce or eliminate the identified cause of SRC: direct blows to the head, neck, or body,* particularly where these are permitted and purposive within the constitutive rules of the sport. While this is an implied purpose of the most recent Consensus Statement, it does not appear to be clearly or extensively enacted, given that it comprises only one of thirteen headings, within which the recommendations proposed mostly focus on mitigation rather than prevention.
- (3) *To improve long-term brain health outcomes for athletes.* A primary theme of successive Consensus Statements has been to highlight that a causal link between SRC and long-term symptoms/effects is unproven, despite associations between

them being shown. Consequently, it is not at all clear that the CiSG regards one of the purposes of the recommendations of its Consensus Statements to be to improve long-term brain health outcomes for athletes.

The above policy purposes are credible, and are also those that might reasonably be expected of an international group of scientific experts (the CiSG) producing a consensus statement on SRC. However, it is not clear that reducing or eliminating the identified causes of SRC (direct blows to the head, neck, or body) is meaningfully enacted as a purpose in the CiSG consensus statements. Nor is it clear that the development of recommendations to improve long-term brain health outcomes for athletes is regarded as a purpose of the Consensus Statements by the CiSG, despite long-term effects being considered. This leaves mitigation of the acute health impacts of concussion events in sport as the only clearly stated and enacted purpose of the consensus statements.

Evidence In Policy: What Evidence Is Presented That the CiSG Consensus Statements Can Achieve Credible Policy Purposes for SRC?

Three credible policy purposes have been established for a Consensus Statement for SRC that might reasonably be interpreted to have committed to provide recommendations that address the causes and symptoms of SRC for all athletes at all levels of sport. The discussion that follows will explore what efficacy and effectiveness evidence is presented that the recommendations of the Consensus Statements can achieve each of the policy purposes for SRC by the means proposed. It will also explore whether the evidence suggests that there are other potential means to achieving those purposes.

The latest Consensus Statement (Patricios 2023) is underpinned by evidence from ten specifically commissioned systematic reviews (Echemendia et al. 2023; Eliason et al. 2023; Iverson et al. 2023; Leddy et al. 2023; Makdissi et al. 2023; Patricios et al. 2023; Putukian et al. 2023; Schneider et al. 2023; Tabor et al. 2023; Yeats et al. 2023), as well as other extant reviews and evaluation studies, and the outcomes of a ‘scientific consensus process’ (Schneider 2023). These reviews, studies and the consensus process variously provide evidence of efficacy (what works in ideal controlled conditions) and of post-implementation effectiveness (what works in the real world) (Weed 2016). In addition, some evidence is of assumptive efficacy (what *should* work in specific controlled conditions based on efficacy of similar processes), and of assumptive effectiveness (what *should* work in the real world based on post-implementation effectiveness evidence from very similar contexts).

Mitigating the Acute Health Impacts of Concussion Events in Sport

Evidence to support recommendations to mitigate the acute health impacts of concussion events in sport is the most extensive and the most well-established within the Consensus Statements, as this has been their primary purpose since the publication of the first statement in 2002 (Aubry 2002). Eight of the ten systematic reviews commissioned for the latest Consensus Statement address areas relating to the mitigation of acute health impacts, and this is supported by specific evaluations that provide evidence for the effectiveness of many of the tools developed and evolved from previous consensus statements, such as the Sport Concussion

Assessment Tool (SCAT) (e.g. Echemendia et al. 2017). The evidence base for the use of such tools has evolved over 20 years from assumptive efficacy evidence for a hypothetical SCAT (that a potential tool *should* work if designed and implemented as intended), such as that discussed by Aubry (2002, 7), to post-implementation effectiveness evidence that the 6th iteration of the tool works in real-world contexts (Echemendia et al. 2023). This evidence has improved practice and protocols for acute responses to SRC in professional and elite sport, and has been the primary success of the CiSG Consensus Statements in informing policy for SRC.

Across the ten headings relating to mitigating acute health impacts, there is good effectiveness evidence that this policy purpose can be, and has been, achieved to varying extents by the means proposed in professional and elite athlete populations. However, in child/adolescent and recreational athlete populations, the evidence base has not yet fully evolved from demonstrating efficacy (what works in ideal controlled conditions) to demonstrating effectiveness. This is because the knowledge and resources available to support effective local implementation in child/adolescent and recreational athlete sport settings of recommendations that have been shown to be efficacious in ideal conditions are limited (Iverson et al. 2023). As such, there is not yet comprehensive post-implementation effectiveness evidence that the Consensus Statement recommendations can achieve the policy purpose of mitigating the acute health impacts of SRC *in child/adolescent and recreational athlete populations* by the means proposed.

One rather obvious omission from the Consensus Statements is a consideration of whether treatment of the immediate symptoms of concussion events in sport to mitigate acute health impacts is associated with an improvement in long-term brain health outcomes for athletes. Did, for example, athletes that adhered to the return to play protocols recommended more than twenty years ago by Aubry (2002, 9) have better long-term brain health outcomes than those in previous generations that did not. While this is a very difficult area to evidence, likely requiring painstakingly constructed retrospective case-control designs, it seems a highly important area to understand, because if treating the acute symptoms of concussive events in sport has no positive impact on long-term brain health outcomes, then this places even more significance and importance on reducing or eliminating from sport the identified causes of SRC: direct blows to the head, neck or body.

Reducing or Eliminating the Identified Causes of SRC: Direct Blows to the Head, Neck, or Body

Undoubtedly, the clearest way to address SRC is to reduce or eliminate from sport the identified causes of SRC, which are direct blows to the head, neck, or body. If the purposive causes of SRC are minimised or eliminated from sport, then policy purposes to recognise and treat or mitigate both the acute and long-term symptoms of SRC are limited to the consequences of accidental blows, and those that contravene the constitutive rules. Furthermore, it has long been known that the acute health impacts of SRC are magnified with each repeated concussion (Guskiewicz et al. 2003), and the concern for long-term brain health outcomes in athletes is related to *repetitive* head impacts (RHI) (Iverson et al. 2023). Consequently, the primary concern of a policy purpose to reduce or eliminate the identified cause of SRC should not be isolated or accidental SRC, but rather

the purposive direct blows to the head, neck, or body, which are a regular result of the constitutive rules of the sport.

However, the section on prevention of concussion, which is only one of thirteen sections in the most recent Consensus Statement (Patricios 2023, 699), outlines four strategies, only one of which aims to reduce or eliminate purposive direct blows to the head, neck or body, which are identified by that same Consensus Statement as the cause of SRC (Patricios 2023, 697). The other three strategies, relating to personal protective equipment, neuromuscular training, and concussion management strategies, are concerned only with *mitigating* the impact of direct blows to the head, neck, or body.

Post-implementation effectiveness evidence is presented that disallowing body-checking in child and adolescent ice hockey reduced in-game concussions by 58% and that restricting collision time in training and practice in American Football across all age groups reduced concussions in training and practice by 64% (Eliason et al. 2023, 749). However, this evidence led only to recommendations that body checking should be disallowed at all levels of child ice hockey, and most levels of adolescent ice hockey, and that only training and practice involving contact should be limited at all levels of American Football. This is a little perplexing because post-implementation effectiveness evidence that limiting body checking in child/adolescent ice hockey reduces incidences of SRC by significantly more than half is also assumptive effectiveness evidence that limiting body checking in *all* ice hockey would significantly reduce incidences of concussion in *all* ice hockey. Similarly, if post-implementation effectiveness evidence shows reducing contact in American Football training and practice reduces incidences of SRC by almost two-thirds, then this represents assumptive effectiveness evidence that limiting contact in American Football matches would also similarly reduce incidences of SRC. As such, it is not at all clear why the CiSG did not make recommendations in their most recent Consensus Statement (Patricios 2023) to limit body-checking in *all* ice hockey, to limit contact in *all* American Football, and even to extend this to all contexts and all age groups across other similar contact sports such as Rugby Union. Unless, of course, and issues of consent notwithstanding, the CiSG believes that SRC is not acceptable in some circumstances (child/adolescent sport; training and practice) but that it is acceptable in others (adult sport; competitive matches). This effectiveness evidence shows, quite simply, that limiting the volume of purposive constitutive contact in sport reduces incidences of SRC by between half and two-thirds. Thus, unsurprisingly, the more purposive contact is limited, the fewer incidences of SRC there are, and this is further evidenced by wider similar evidence across other sports collated by the related commissioned systematic review (Eliason et al. 2023, 753–4). Consequently, if the policy purpose is to reduce or eliminate the identified causes of SRC, there appears to be no reasonable rationale to explain why this evidence, which represents assumptive effectiveness evidence across all contact sports, has not been used by the CiSG to make much broader and expansive recommendations about reducing purposive constitutive blows to the head, neck or body in all sports.

Improving Long-Term Brain Health Outcomes for Athletes

A primary theme of sections considering long-term brain health outcomes for athletes in successive Consensus Statements has been to question the quality of studies that suggest or infer a causal link to SRC. The latest Consensus Statement (Patricios 2023) went one

step further, as the CiSG commissioned an underpinning systematic review that, by design, precluded such studies by limiting the review to cohort and case-control studies, and excluding case series and cross-sectional studies, which thus excluded all of the post-mortem evidence of the existence of chronic traumatic encephalopathy (CTE) in former athletes (Schneider 2022). The commissioned review (Iverson et al. 2023, 811) acknowledges that:

There is a large and steadily growing body of cross-sectional studies on problems with brain health, broadly defined, in former amateur and professional athletes, and these studies have been the focus of multiple past narrative and systematic reviews.

The commissioned review cites 28 such previous reviews (compared to the 28 single studies, four of which use the same cohort, that are included in the systematic review), noting that they 'are important because they illustrate how common it is for a group to have certain health problems ... and they can describe factors associated with those health problems' (Iverson et al. 2023, 811). But they are excluded from the systematic review itself on the basis that 'they are only a snapshot in time and include only prevalent cases' (Iverson et al. 2023, 811–2). The exclusion of these studies from the systematic review resulted in there being no discussion of this significant volume of evidence in the most recent Consensus Statement (Patricios 2023).

The exclusion of this significant volume of broader evidence led the CiSG to go beyond the conclusion that there is no evidence of a link between SRC and mental health outcomes in populations of former amateur and former professional athletes. The latest Consensus Statement more definitively concludes that these populations are 'not at increased risk' (Patricios 2023, 704) of a range of adverse mental health outcomes, although it does concede a link between some populations of professional athletes and mortality rates linked to neurological and neurodegenerative conditions, such as dementia (Patricios 2023, 704). However, as with previous Consensus Statements, the emphasis remained on methodological limitations of the evidence, such as not adjusting for other factors that can be associated with mental health or neurological outcomes, such as education, socio-economic status, smoking, diet, and physical activity (Patricios 2023, 705). These limitations were perceived to be important enough for the CiSG to make no recommendations in its latest Consensus Statement that seek to improve long-term brain health outcomes for athletes, only to call for better quality evidence and to suggest the establishment of a working group to guide such research.

Other reviews, including those cited in the commissioned systematic review, have reached different conclusions. One such review cited in Iverson et al. (2023), using the long-established Bradford-Hill criteria for causation (Bradford-Hill 1965), which assessed a broader body of evidence relating to SRC and CTE for both its strength and its quality, concluded that, '[although] the evidence is imperfect, and like all similar research, it will remain imperfect in perpetuity ... we have the highest confidence in the conclusion that RHI [repetitive head impacts] cause CTE' (Nowinski et al. 2022, 14). Consequently, Nowinski et al. (2022, 14) recommended that 'the medical, scientific and public health communities [should] act now under the premise of a causal relationship and take immediate action to prevent CTE'.

Nowinski et al. (2022), like the CiSG (Patricios 2023) and its commissioned systematic review (Iverson et al. 2023), do call for further research to understand mechanisms of causation, but they also note that:

... while we call for more research, we also believe that the strength of the current evidence compels us to move past a scientific discussion focused solely on filling gaps in the evidence to focus on immediately implementing aggressive CTE mitigation programs, especially for children. We support measures to minimize and eliminate RHI [repetitive head impacts] as the best action for preventing CTE. We encourage awareness efforts so parents, athletes and policymakers can better understand the risks associated with RHI, and change how games are played to reduce or eliminate RHI. (Nowinski et al. 2022, 14)

It is noteworthy that the Nowinski et al. (2022) recommendation that the best means to achieve the policy purpose of improving long-term brain outcomes for athletes is to ‘change how games are played to reduce or eliminate RHI’ (14) is almost identical to the conclusion of the first CiSG Consensus Statement twenty years earlier that ‘there are relatively few methods by which concussive brain injury may be minimised in sport ... Rule changes and rule enforcement play a key role in reducing and preventing concussions’ (Aubry 2002, 9). Furthermore, as discussed previously, effectiveness evidence from the CiSG’s most recent commissioned systematic review in this area (Eliason et al. 2023, 753–4) shows that limiting the volume of purposive constitutive contact in sport reduces incidences of SRC by between half and two-thirds. Consequently, regardless of debates about the quality or strength of evidence, or about causal versus associative links between SRC and long-term brain health outcomes for athletes, a ‘change to how games are played’ (Eliason et al. 2023, 753–4) clearly remains one of the ‘few methods by which concussive brain injury may be minimised in sport’ (Eliason et al. 2023, 753–4).

Evidence Of Policy II: How and for Whom Have the CiSG Consensus Statements Been Developed, and Are They Perceived to Be Legitimate?

Public and policy interest in the consequences of SRC, particularly in relation to long-term effects, is growing considerably. Data on incidence suggests that, while globally there is a one in five-lifetime risk of concussion and annually an estimated 3 million people, half of whom are children and adolescents, sustain a concussion in North America (Centers for Disease Control and Prevention CDC 2015), SRC is estimated to account for 36%-60% of concussions in children and adolescents (Eapen et al. 2019; Rajabali 2013). The most recent Consensus Statement (Patricios 2023) notes that there is ‘increasing societal concern about possible problems with later-in-life brain health in former athletes’ (704) and that ‘the potential long-term effects of SRC and repetitive head impacts are areas of ongoing public health interest and concern among both healthcare professionals and the general public’ (696). Consequently, the audiences, and indeed the ‘clients’, for the CiSG’s Consensus Statements are not limited to the scientific community, or to sport, but extend to concerned parents, health practitioners, policy-makers, politicians, and the general public, as well as the athletes themselves.

The perceived legitimacy of the CiSG Consensus Statements among their wide-ranging stakeholders will be related to how the statements have been developed, what questions they have asked, and how they have sought to answer them (Heazle and Kane 2016).

Credible policy purposes for the Consensus Statements have been discussed earlier, but only one of these, mitigation of the acute health impacts of concussion events in sport, could reasonably be considered to be a clear and primary purpose of the most recent Concussion Statement (Patricios 2023).

A survey of 342 participants in the most recent consensus process ranked long-term effects (1st) and prevention (2nd) as the top two priorities for future research (Patricios 2023, 707). Clearly, long-term brain health outcomes is the area of greatest concern among all stakeholders, and the earlier discussion of evidence *in* policy showed that the clearest means to improve long-term brain health outcomes for athletes is to prevent SRC by acting on effectiveness evidence that rule changes will reduce or eliminate purposive blows to the head, neck or body that are a constitutive part of the way sport is played.

However, the CiSG has been reluctant to make recommendations to address long-term brain health outcomes for athletes by these means. Its most recent Consensus Statement (Patricios 2023) does not consider the question of whether treatment of the acute symptoms of concussive events in sport has any impact on long-term brain outcomes; it does not make any recommendations relating to improving long-term brain outcomes linked to SRC because of concerns about imperfections in the evidence; and it has made only limited recommendations to prevent SRC by eliminating purposive constitutive blows to the head, neck or body because it interprets effectiveness evidence as only having meaning and value in the immediate and narrow contexts in which it has been collected. In short, the CiSG has been concerned with strict standards of proof in science, rather than with the concerns of stakeholder groups for SRC policy.

The most recent Consensus Statement notes that there are 'ethical and scientific challenges related to the issue of potential long-term effects of concussion' (Patricios 2023, 707). Yet the ethics and science of SRC are significantly different domains. The CiSG highlights the *scientific challenge* as being the extent to which definitive conclusions can be drawn about a causal link between SRC and long-term brain outcomes due to gaps and imperfections in the evidence, and it limits its recommendations because of this. However, the *ethical challenge* is whether evidence of a clearly identified *potential risk* of poorer long-term brain health outcomes for athletes (including early mortality) (Iverson et al. 2023; Nowinski et al. 2022) from SRC and RHI (repetitive head impacts), particularly where those are purposive and constitutive parts of the sport being played, requires a policy intervention.

Expectations of stakeholder groups are different from expectations of scientists, and scientists should consider this in their work if they wish their work to be perceived as legitimate by such stakeholder groups. In this respect, successful evidence-based policy-making must combine scientific evidence with governance principles, which involves policy co-production³ with stakeholders such as public bodies, interest groups, and service users based on the values and concerns of those stakeholders (Cairney and Oliver 2017). Stakeholder groups for SRC policy are clearly concerned about poor long-term brain health outcomes for athletes, particularly where these might be preventable. But the expectations of stakeholder groups about when evidence merits action are likely to be based on societal values and perceptions of acceptable and unacceptable risks, rather than scientific standards of proof. Consequently, if stakeholder groups are told that athletes 'are not at increased risk' (Patricios 2023, 704) of a range of adverse mental health

outcomes, then they might reasonably interpret that to mean that a broad range of evidence has been considered and that it is conclusive. However, stakeholders might form an entirely different view of the risks involved if they were to read either of the following statements, one from the most recent Consensus Statement, and one from its commissioned review on later-in-life health risks associated with SRC, neither of which are part of the headlines or summaries of these documents:

It is reasonable to consider extensive exposure to repetitive head impacts, such as that experienced by some professional athletes, as potentially associated with the development of the specific neuropathology described as CTE-NC. (Patricios 2023, 705)

Although the studies with former amateur athletes all yielded negative findings, that does not mean that there are no possible later-in-life adverse health effects associated with participation in amateur sports (Iverson et al. 2023, 818)

It has long been understood to be an inherent feature of the policy process that stakeholder groups will allocate social values and relative weights to multiple concerns (Easton 1971), and that the quality and, indeed, the strength, of evidence will be but one such concern. Scientists must both understand and be open to this as part of the process of co-production of evidence-based policymaking with stakeholders. They should not try to shut it down by inappropriately singularly summative statements such as that of the most recent Consensus Statement (Patricios 2023, 704) that athletes ‘are not at increased risk’ of adverse mental health outcomes, or that of the authors using the Bradford-Hill criteria (Nowinski et al. 2022, 14) that stakeholders must ‘act now under the premise of a causal relationship’ between RHI and CTE. As contributions to the co-production of evidence-based policy, both statements are flawed: the former asserts no increased risk based on partial evidence collated utilising exacting methodological criteria that would not be universally accepted as definitive; the latter includes broader evidence based on less exacting criteria to assert the premise of a causal relationship that would also not be universally accepted as definitive. Neither fully acknowledge nor understand that there will be multiple wider stakeholder concerns and values that will influence policy, and thus that ‘good evidence for policy [is] that which best serves public health needs, not that which best fits any single methodological criteria’ (Parkhurst and Abeyasinghe 2014, 47). In short, the collation, analysis, and summative interpretation of scientific evidence is not the outcome of evidence-based policymaking, rather it is one of multiple inputs to the process.

Conclusion: Can the Recommendations of CiSG Consensus Statements Be Credible, Legitimate, and Effective?

A reasonable interpretation of the stated purpose of the latest Consensus Statement of the CiSG, which is to support ‘the care of athletes at risk of SRC or who have sustained a suspected SRC at any level of sport (i.e. recreational to professional)’ (Patricios 2023, 695), is that it commits to provide recommendations that address the causes and symptoms of SRC for all athletes at all levels of sport. This implies three credible policy purposes: (i) to mitigate the acute health impact of concussion events in sport; (ii) to reduce or eliminate the identified causes of SRC, which are direct blows to the head, neck, or body; and (iii) to improve long-term brain health outcomes for athletes.

However, while the wide range of stakeholder groups for SRC policy—concerned parents, practitioners, policy-makers, politicians, and the general public, as well as the athletes themselves—have expectations that all three policy purposes will be addressed, only one of these, mitigation of the acute health impacts, could reasonably be considered to be a clear and primary purpose of the most recent Consensus Statement.

The CiSG's recommendations for recognition and treatment of the symptoms of the acute impacts of SRC among elite and professional athlete populations in the most recent Consensus Statement (Patricios 2023) are well served by post-implementation effectiveness evidence, as well as by well-evidenced tools for the detection and assessment of SRC. However, there is a widespread lack of local resources (including localised knowledge) to robustly and extensively implement these recommendations and tools in child/adolescent and recreational sport settings. Consequently, despite such recommendations and tools being supported by efficacy evidence, post-implementation evidence for their effectiveness among child/adolescent and recreational athlete populations is lacking.

Conversely, the most recent Consensus Statement makes no recommendations for treating symptoms of SRC associated with long-term brain health outcomes. This is because, like previous Consensus Statements, discussions focus on forefronting problems with the quality of the evidence that such symptoms are associated with SRC. Nevertheless, the systematic review (Manley et al. 2017, 976) underpinning the fifth Consensus Statement (McCrory 2017), which considered a broader range of evidence than the systematic review (Iverson et al. 2023) underpinning the most recent statement (Patricios 2023), highlights an association between athletes suffering depression and cognitive deficits later in life and a history of multiple concussions. The most recent statement notes a link between mortality rates linked to neurological and neurodegenerative conditions and some populations of professional athletes (Patricios 2023, 704), as well as noting that it is reasonable to consider extensive exposure to RHI among some professional athletes as potentially associated with the development of CTE (705). Additionally, the underpinning systematic review (Iverson et al. 2023, 818) notes that negative findings from the studies it included do not mean that there are no possible later-in-life adverse health effects associated with participation in amateur sports.

Consequently, the Consensus Statement is only able to present robust post-implementation effectiveness evidence for recommendations relating to the recognition and treatment of the acute symptoms of SRC in elite and professional athlete populations. No such evidence is available for recommendations for acute recognition and treatment in child/adolescent and recreational settings, nor are any recommendations made for the treatment of long-term brain health outcomes in athletes. Furthermore, the Consensus Statement does not consider whether treatment of the acute symptoms of SRC has any impact on long-term brain health outcomes. As such, although a primary policy purpose to recognise and treat the symptoms of SRC dominates the Consensus Statement (comprising ten of thirteen headings), and thus arguably crowds out other credible policy purposes, it appears to be empirically flawed because post-implementation effectiveness evidence is available only for the recognition and treatment of acute symptoms, and even then only among elite and professional athlete populations. This suggests a need to more extensively engage with other credible policy purposes and, specifically, to consider whether a more appropriate *primary* policy purpose for a Consensus Statement that

seeks to address SRC would be to provide recommendations to remove the cause rather than treat the symptoms.

Only one of the thirteen headings in the latest Consensus Statement (Patricios 2023) focuses on prevention, and even within that heading, three of the four sub-headings regard prevention as mitigating rather than reducing or removing the identified causes of concussion. However, the one remaining sub-heading does address the identified cause of SRC by providing effectiveness evidence from the commissioned systematic review (Eliason et al. 2023, 749) that reducing the constitutive parts of sport that involve purposive blows to the head, neck, or body reduce incidences of SRC by between half and two-thirds.

To deliver the stated goal of ‘care for athletes at risk of SRC’ (Patricios 2023, 695), the CiSG must consider how its work can effectively support the co-production of evidence-based policy for SRC that meets the concerns of stakeholder groups (concerned parents, practitioners, policy-makers, politicians and the general public, as well as the athletes themselves). These concerns are not reflected in the primary policy purpose of the latest and all previous Consensus Statements, which is to support the acute treatment of concussion events in sport once they occur. Rather, it is ‘the potential long-term effects of SRC and repetitive head impacts [that] are [the] areas of ongoing public health interest and concern among both healthcare professionals and the general public’ (Patricios 2023, 696). Consequently, the CiSG should actively consider a shift in the primary policy purpose for its Consensus Statements. More than twenty years ago, the very first Consensus Statement of the CiSG (Aubry 2002) observed that ‘there are relatively few methods by which concussive brain injury may be minimised in sport’ and recognised that ‘[r]ule changes and rule enforcement play a key role in reducing and preventing concussions’ (9). The most recent Consensus Statement (Patricios 2023, 697) notes that SRC is a ‘traumatic brain injury caused by a direct blow to the head, neck or body’. This suggests that the concerns of stakeholder groups for SRC policy would be best served by a primary policy purpose for the CiSG Consensus Statements that addresses the identified cause of SRC by the demonstrably effective means of rule changes that reduce or remove the constitutive parts of sport that involve purposive blows to the head, neck, or body. Shifting the primary policy purpose of the Consensus Statements in this way would better safeguard athletes in child/adolescent and recreational sport settings, where a lack of resources and knowledge acts against effective recognition and treatment of the acute symptoms of SRC. Importantly, it would also result in debates about the strength and quality of evidence for a relationship between SRC and RHI and long-term brain health outcomes, being rendered largely superfluous.

Notes

1. *Constitutive rules* of sport are those that define the activity (the sport), the way the sport can be played, and the permitted means by which the goal or goals of the sport can be achieved (Suits 2014). In this essay, blows to the head, neck, or body are termed purposive blows if they have a purpose within the constitutive rules of the sport and they are permitted by those rules (e.g. punching in boxing, tackling in rugby, blocking in American football). This is as opposed to blows that are or may be accidental (eg, falls in alpine skiing, arm contact with the head in soccer,) or that are not permitted by the constitutive rules (eg, body checking in basketball).

2. Although the third Consensus Statement (McCrory 2009) included a note that ‘Panel discussion was held, and no consensus was reached’ (148) on long-term effects, no discussion of the evidence was included in the third Consensus Statement.
3. Note that co-production refers to integrating the values and concerns of stakeholders into the policy response to the evidence. It should not be taken to mean that the values and concerns of stakeholders should influence or co-produce the evidence itself, as this would represent a significant conflict of interest.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

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