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Concussion Education: Is it time to give athletes a voice in the dissemination strategies of concussion-related information?

Examination of 2444 adolescent athletes

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Abstract

Background: Translating knowledge from clinical research into practice is a vital step in effectively educating athletes on sport-related concussion. Currently, no research has investigated the opinions of adolescent athletes on the content and delivery methods employed in concussion educational interventions.

Objectives: To screen male and female adolescent athletes on their concussion educational histories and future preferred future educational interests in terms of messenger, modality and concussion-related areas of interest.

Methods: A brief cross-sectional survey instrument was delivered to athletes in secondary schools (n = 10) and sports clubs (n = 31) under supervision of the principal investigator.

Results: 2444 adolescent athletes (male = 1854, female = 590) completed the survey. 19.7% (n = 482) of the sample received education in the last 12 months. Male athletes had a significantly higher rate of previous education than female athletes. The methods utilised in previous educational interventions are not matching the interests of the athletes. Gender played a significant role in the preferred educational methods with male and female athletes having significant differences in their choice of educational messenger, modality and areas of interest.

Conclusion: Male and female athletes differ significantly in their favoured educational methods and areas of interests. Future interventions may consider tailoring their knowledge translation strategies to match the specific needs of the stakeholder. As athletes' desire concussion education from a multitude of sources and individuals, it is imperative these sources of information and educational messengers are providing consistent and evidence-based information on sport-related concussion.

Introduction

Concussion has become a major public health priority in recent years resulting in an abundance of published research in the medical literature.[1] The substantial level of research in the area is predicated on sport-related concussion (SRC) being a significant threat to the quality of life of athletes of all ages, genders and levels of play.[2] Although, due to current scientific limitations, the understanding of this topic remains in its infancy. A universal standardised definition of SRC remains elusive.[3] The scientific community remain divided on several key aspects of SRC including; identification methods,[4] management and return-to-play protocols,[5] recovery diagnoses [6] and the potential links between repeated concussive and sub-concussive blows with the onset of early neurodegenerative diseases.[7] However, despite divergent opinions, there is an across-the-board acceptance of SRC being a dangerous brain injury and the need to reduce its prevalence and to manage the injury safely is indubitable.[8] A concussion can produce debilitating symptomatology which may affect an athlete for a number of weeks and may even remain to the fore over several months in the form of post-concussion syndrome.[9] Athletes may experience motor, cognitive, behavioural and sleep impairments which hinder everyday activities, academic and athletic performance, and can leave the athlete in a compromised emotional state.[8]

The prevalence of SRC is higher in contact or collision-based sports than non-contact sporting activities.[10] As youth athletes appear to be at a heightened risk of concussion and its associated negative effects, the prompt removal from play and management of the injury for athletes in such sports is crucial.[11] Currently, there is no objective diagnostical tool available for concussion and thus, many concussions are overlooked and untreated.[8] There is an onus on the individual athlete to honestly disclose the presence of any potential concussive symptoms to allow a medical assessment to be undertaken. Previous research on youth athletes has

emphasized several barriers which deter their honest disclosure of potential concussive events.[12–14]

Over the last decade, the education of important stakeholders such as athletes, parents, coaches and medical personnel on the dangers of SRC has become a topical area of research.[15] The effective transfer of information and guidelines from clinical research into everyday practice is a difficult task.[16,17] The efficacy of numerous educational strategies to effectively disseminate information have been investigated.[18] Unfortunately, many past interventions have methodological flaws that need to be taken into consideration when interpreting their findings. The long term impact of such interventions on athlete knowledge and behaviour remains unknown due to the lack of follow up investigations.[18] As an increase in knowledge does not equate to behaviour change, educational interventions aimed solely at increasing knowledge have been found ineffective at modifying concussion reporting behaviours in athletes.[19] To achieve desired results, educators must screen athletes on their underlying motivational beliefs which dictate their reporting of SRC. Generalised educational strategies may be ineffective methods of educating athletes about SRC and efforts to design interventions in a population appropriate manner should be explored.[20] Recently, researchers have experienced early success utilising behavioural models, such as the theory of planned behaviour, to understand and mitigate these negative reporting behaviours.[20,21] Although, a step forward in the right direction, these teaching techniques, used exclusively, may not reflect an athlete's educational desires. A screening of athlete interests should be undertaken to allow a tailored intervention to be developed.[22] If athletes are cognitively engaged throughout the knowledge translation process, they have a better chance of retaining a long-term knowledge of the material provided and adhering to the recommended safety guidelines.[23,24]

To date, only two studies have investigated the concussion educational interests of their target stakeholder. Using an online survey, Kroshus et al.[22] and Sullivan et al.[25] screened US

collegiate athletes and Irish GAA (Gaelic Athletic Association) coaches, respectively. No research has been carried out on high school athletes. Therefore, the aim of this study was to screen male and female high school athletes on their concussion educational histories and preferred future educational interests. The study aimed to 1) assess the difference in previous concussion education rates between male and female athletes, 2) examine the impact of gender on educational desires and 3) to test whether methods utilised in previous educational interventions are matching the interests of the athletes in terms of messenger, modality and content.

Methods

Sample

Irish secondary schools (n = 45) and sports clubs (n = 78) were invited, via email to participate in the study between January 2016 and September 2017. Ten secondary schools (22.2%) and thirty-one sports clubs (39.7%) agreed to allow their athletes to take part in the research. Athletes were eligible to participate if they were aged 12 to 18 years and currently played a contact or collision-based team sport at an amateur level at the time of testing. The sample was sub-categorised according to the gender of the participants. Prior to testing, the principal investigator visited each school and club to outline the design and purpose of the research. The respective parents or guardians were also informed of the study via letter and email. Participation was voluntary, and the anonymity of the athletes was preserved. No parent or athlete objected to the study and the research was permitted by the Institute of Technology, Tallaght, Dublin's Research and Ethics Committee.

Instrumentation

A brief cross-sectional survey instrument consisting of a mixture of dichotomous and multiple choice styled questions (9 questions) was administered to the athletes (Supplementary File 1).

Prior to testing, the survey instrument was reviewed by a panel of three experts to determine content validity. Each question was evaluated for relevancy and needed unanimous approval by the expert panel to be included in the survey. Each question was determined as relevant, yet, the terminology employed in two of the questions was simplified to ensure there was no misunderstanding or confusion among the students. A pilot test was carried out using a randomised sample of fifty athletes (n = 29 male, n = 21 female) across three and seven of the participating schools and clubs, respectively. To assess for internal consistency reliability, the pilot sample completed the survey on two occasions with a seven-day period between the first and second round of testing. The survey recorded a Cronbach alpha score of 0.91 and thus, was deemed a reliable measure of an athlete's concussion educational history and future educational desires.

The survey comprised of two sections and took approximately ten minutes to complete. The first section examined the athletes' demographic information. The second section questioned athletes on their concussion educational history and their favoured methods of future SRC education. This section was split into three categories; 1) educational messenger, 2) modality and 3) areas of concussion-related interest.

Procedure

Under supervision of the principal investigator, one paper survey was administered per athlete in an exam environment. Testing was carried out in groups ranging from 10 to 50 students at the premises of the participating schools and clubs between March 2016 and September 2017. All participating athletes within the same school or club were tested on the same day to limit athlete interaction.

Statistical analysis

Descriptive statistics were used to calculate the athlete frequency responses in each category of the survey (messenger, modality and areas of interest). The data for each category was split according to gender and educational history, and was examined using separate contingency tables. A Pearson chi-squared test of association was used to compare the proportion of responses for each above variable. An alpha priori level of 0.05 was chosen for the study and all descriptive and inferential statistical analyses were performed using SPSS statistical software version 24 (IBM Corporation, Armonk, NY).

Results

In total, 2502 athletes undertook the survey instrument, however, 58 athletes failed to complete the survey. Thus, their responses were discarded from the findings leaving 2444 athlete responses (1854 = male; female = 590) eligible for review. The sample consisted predominantly of rugby players (44.9%, n = 1097), followed by soccer (32.7%. n = 800) and GAA (22.4%, n = 547) players (Gaelic football, hurling and camogie). 35.2% (n = 860) reported receiving previous education on SRC with 19.7% (n = 482) of athletes receiving some education in the last 12 months. The concussion educational histories of the sample are sub-categorised by gender in Table 1. A comparison between past methods of concussion education received by the athletes and their favoured future methods is displayed in Figure 1 and 2. Male adolescent athletes have received significantly more previous education on SRC than female athletes (41% vs 17%; $\chi 2 = 73.5$, $p < 0.001$).

Insert Table 1 near here

Insert Table 2 near here

Gender also played a significant role in the preferred educational methods within the sample ($\chi 2 \geq 546$, $p < 0.001$). With regards to modality, male athletes were significantly more inclined to opt for an "*interactive*" (46% vs 12%: $\chi 2 = 13.7$, $p < 0.001$) or "*on-field demonstration*"

(42% vs 16%; $\chi 2 = 84.3$, $p < 0.001$) compared with female athlete who had a greater desire for an "*informational handout/poster*" (8% vs 40%; $\chi 2 = 289.2$, $p < 0.001$) than males. With reference to educational messenger, male athletes were more likely to choose a "*professional/famed coach*" (71% vs 30%; $\chi 2 = 254.4$, $p < 0.001$) or "*professional/famed player*" (69% vs 35%; $\chi 2 = 82.5$, $p < 0.001$) than females. Both male (45%) and female (67%) athlete sought their coach to be involved in their concussion education. In terms of areas of future learning, female athletes had a considerably greater interest in the potential "*long-term complications*" (38% vs 57%; $\chi 2 = 37.4$, $p < 0.001$) of SRC and "*impact on academics*" (20% vs 63%; $\chi 2 = 258.7$, $p < 0.001$) whereas male athletes had considerable more eagerness to understand the "*short-term complications*" (79% vs 62%; $\chi 2 = 17.1$, $p < 0.001$) of SRC and the "*impact on athletic performance*" (71% vs 33%; $\chi 2 = 102$, $p < 0.001$) (Table 2).

Insert Figure 1 near here

Insert Figure 2 near here

Discussion

This study sought to examine the concussion educational histories, preferred future educational methods and concussion-related areas of interest in a large cohort of high school athletes. As education is a vital step in improving athlete reporting behaviours, sporting, medical and government bodies are tasked with disseminating information to their respective sporting populations. In the United States for example, education on SRC is mandated for youth athletes under new government legislation and for collegiate athletes through NCAA policy.[26] It is imperative that the education being delivered to athletes, coaches and parents is matching the specific need of each stakeholder.[17]

Previous education on SRC

Despite increased emphasis placed on the issue of SRC by sporting organisations and improved media attention, there is still a worrying lack of concussion education in adolescent athletes. High school athletes are more susceptible to SRC and carry an increased risk of a debilitating symptomology than older athletes.[27] Given that female athletes may be at an even higher risk of suffering a concussion and its associated negative effects,[28] their significantly lower rate of previous education than their male counterparts (17% vs 41%) is troubling and requires urgent intervention by their parents, clubs and schools. Over 80% of the sample did not receive any education on SRC in the last 12 months indicating the urgent need of sporting organisations, schools and medical bodies to explore effective knowledge translation strategies to disseminate concussion-related education to athletes on a nationwide scale.

Athlete interests in concussion education

As illustrated in Figure 1, there is a large disconnect between the past methods of concussion education athletes have received and their preferred future methods of education. Most athletes recalled receiving an "*informational handout/poster*" (50%) and/or a "*general conversation*" (51%) in their previous SRC education despite only a small proportion of the overall sample favouring these modalities. The use of a handout or poster has become common practice in the concussion education of athletes.[29] However, the efficacy of these passive approaches in modifying behaviour has been questioned.[22] Currently, the usage of online platforms for concussion education is failing to match the needs of the athletes (Table 2). With the emergence of readily accessible smartphones, 92% of adolescents' report being online daily with 71% using more than one social media application.[30] Research into internet-based applications such as Facebook [31] and Twitter [32] have highlighted their potential ability to educate a wide range of adolescent athletes on SRC. To date, many sporting organisations are failing to provide transparent, informative and consistent information on SRC on their respective websites.[33] A recent review of concussion related websites also found varying standards of content, delivery

and readability of information.[34] Future research into the knowledge transfer of concussion-related information using social media and other online platforms is warranted.[35]

Gender differences

Previous research has proposed tailoring concussion education for differing members within a sample population according to certain concussion modifiers including age,[36] concussion history,[33] and sport[10]. Within the sample, the preferred educational interests of male athletes differ significantly from female athletes. Therefore, it may also be advantageous to modify future interventions according to the gender of the athletes. As displayed in Table 2, male athletes were significantly more likely to choose an "*interactive demonstration*" (46% vs 12%) and/or an "*on-field demonstration*" (42% vs 16%) as their modality of choice than female athletes. It may be postulated that female athletes may not be as comfortable learning in an active sporting atmosphere or engaging in an open dialogue about SRC with an educational messenger.

"On field" learning approach

Chinn & Porter[37] emphasised the potential efficacy of a procedural learning approach to concussion education by educating athletes in a setting representative of a game-day environment. If athletes are taught in a slow-paced environment through a lecture or video for example, their cognitive processes may be ill equipped to access this information during the contrasting demands of a hectic and adrenaline filled game scenario.[37] "*On-field*" educational strategies may be an effective, yet vastly underutilised method of educating athletes on SRC (Table 1) and should be explored further in future research. However, if educators seek to use these interactive methods appropriately, on female athletes especially, they must cultivate an inclusive learning atmosphere to allow the athletes to feel comfortable to actively participate during the intervention.

Educational messenger

Most female athletes (70%) seek a "*medical professional*" as their concussion educational messenger (Table 2). With recent legislature in youth sport, medical professionals have an increased responsibility in the identification and management of SRC. [26] For instance, state-wide US legislation mandates a clinical diagnosis of the injury and written clearance from a medical professional prior to returning to play.[38] As female athletes also seek medical personnel in their concussion education, it is imperative these personnel, have up-to-date knowledge of SRC, have the confidence to educate athletes and can effectively distribute concussion-related medical information to their lay audience.[39]

In contrast, male athletes are keen to have a "*professional/famed player*" (71%) or "*professional/famed coach*" (69%) in the educational process (Table 2). The novelty of having an inspirational figure leading their concussion education seems important within the male sample. If these famed figures provide their own insight into the negative complications of underreporting and encourage honest disclosure of concussive symptoms, it may resonate with athletes and facilitate a positive behaviour change. In alignment with previous research on collegiate athletes,[22] 50% of the sample wish for their own coach to be a part of their future concussion education (Table 2). Previous research has also highlighted the influence of the coaches' approval on their athletes' decision-making processes.[14,40] As coaches have a considerable impact on their players, they have an obligation to promote a positive reporting culture where athletes will not be punished for openly disclosing their injury.[41,42] Annual educational strategies to improve coach knowledge, attitude and compliance to SRC management guidelines are warranted.

Adolescent athletes are receiving and requesting concussion-related education from multiple sources (Figure 1). It is imperative these sources are disseminating an evidence-based uniform

message on SRC. The establishment of a state or national taskforce dedicated to concussion education, management and prevention may be necessary to ensure all educational messengers have competent knowledge and are providing a consistent and singular message on SRC to their athletes.[33] Screening athletes on their knowledge and reporting behaviours using behavioural models are effective methods in tailoring educational interventions for a specific target audience.[20,21] To achieve enhanced improvements in reporting behaviour however, it may be necessary to also include the athletes' educational desires to guide the implementation and dissemination strategies of a personalised intervention..

Study limitations

The study employed a single methodological approach utilising a quantitative questionnaire. Future qualitative research of a target population may be used to delve deeper into their rationale and motivation behind their educational interests prior to designing an appropriate intervention. As this was the first study to investigate the concussion educational interests of high school athletes, the application of the findings in future interventions is unclear. Future research evaluating the inclusion of athlete interests in the knowledge translational strategies of concussion interventions is needed.

Conclusion

When establishing suitable concussion educational interventions, allowing athletes to voice their opinion on which information is disseminated, who delivers it and how they deliver it, may be a simple approach to retain athlete cognitions throughout the educational process. There is a disconnect between previous concussion education received and future education desired amongst high school athletes. Male and female athletes seek further education on SRC however, there is a significant difference in their preferred methods of future education.

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Competing Interests: None

What is already known about the topic?

- Adolescent athletes who participate in contact or collision-based sport are at a heightened risk of suffering a concussion and its negative associative effects.
- Effective knowledge translation strategies are needed to complement existing evidence-based concussion guidelines to enable athletes to uptake information and modify behaviour.

What does this study add?

- There is a large discrepancy between the previous methods of education athletes have received on sport-related concussion and their preferred future methods of education.
- Male and female athlete differ significantly on their educational desires.
- Prior to designing an intervention, the target audience should be allowed voice their opinion on the knowledge translation strategies to ensure the methods incorporated are matching their interests.

Tables and Figures

Table 1. Athlete Demographics and Educational History

Table 2. Preferred Methods of For Future Concussion Education

Figure 1. Modality used in Previous Intervention versus Desired Future Modality

Figure 1 Caption: † Significant difference between previous modality received and future modality desired within the sample ($P < 0.05$).

Figure 2. Messenger used in Previous Intervention versus Desired Future Messenger

Figure 2 Caption: † Significant difference between previous messenger received and future messenger desired within the sample ($P < 0.05$).

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Table 1. Athlete Demographics and Educational History

Sport	Male	Female	Total (n)
Rugby	866	231	1097
Soccer	587	213	800
GAA*	401	146	547
Total	1854	590	2444

Concussion Educational Histories of Male and Female Athletes

	Male n = 760 (41%)	Female n = 100 (16.9%)	Total n = 860 (35.2%)
Modality			
Handout/poster	374 (49.2%)	52 (52%)	426 (49.5%)
Website/social media	188 (24.7%)	27 (27%)	215 (25%)
Educational video	80 (10.5%)	5 (5%)	85 (9.9%)
PC/Video game	7 (0.9%)	-	7 (0.8%)
Presentation	149 (19.6%)	15 (15%)	164 (19.1%)
General conversation	388 (51.1%)	54 (54%)	442 (51.4%)
Interactive demonstration	9 (1.2%)	-	9 (1%)
On-field demonstration	11 (1.4%)	-	11 (1.3%)
Other	14 (1.8%)	4 (4%)	18 (2.1%)
Messenger			
Parents	212 (27.9%)	35 (35%)	247 (28.7%)
Coach	225 (29.6%)	21 (21%)	246 (28.6%)
Teacher	109 (14.3%)	7 (7%)	116 (13.5%)
Physio	35 (4.6%)	5 (5%)	40 (4.7%)
Guest speaker/specialist	78 (10.3%)	-	78 (9.1%)
Fellow player	47 (6.4%)	8 (8%)	57 (6.6%)
Medical professional	141 (18.6%)	12 (12%)	153 (17.8%)
Professional/famed player	29 (3.8%)	2 (2%)	31 (3.6%)
Professional coach	10 (1.3%)	-	10 (1.2%)
Other	6 (0.8%)	3 (3%)	9 (1%)

Table 2. Preferred Methods for Future Concussion Education

	Total		Total (n)
	Male	Female	
(n) of athletes seeking further education on SRC	1758 (94.8%) n = 1758	570 (96.6%) n = 570	2328 (95.3%) n = 2328
Modality			
Handout/Poster*†	132 (7.5%)	226 (39.6%)	348 (14.9%)
Website/Social media/Mobile App*†	963 (54.8%)	239 (41.9%)	1202 (51.6%)
Educational video*†	241 (13.7%)	125 (21.9%)	366 (15.7%)
PC/Video game*†	255 (14.5%)	28 (4.9%)	283 (12.2%)
Presentation*†	127 (7.2%)	88 (15.4%)	215 (9.2%)
General conversation*†	133 (7.6%)	74 (13%)	207 (8.9%)
Interactive demonstration*†	802 (45.6%)	68 (11.9%)	870 (37.4%)
On-field demonstration*†	743 (42.3%)	90 (15.8%)	833 (35.8%)
Areas of Interest			
Signs & Symptoms	1465 (83.3%)	503 (88.2%)	1968 (84.5%)
Incidence	619 (35.2%)	194 (34%)	813 (34.9%)
Short-term complications*	1389 (79%)	352 (61.8%)	1741 (74.8%)
Long-term complications*	662 (37.7%)	324 (56.8%)	986 (42.4%)
Importance of self-reporting	498 (28.3%)	133 (23.3%)	631 (27.1%)
Impact on athletic performance*	1253 (71.3%)	188 (33%)	1461 (62.8%)
Impact on academic performance*	355 (20.2%)	360 (63.2%)	715 (30.7%)
Prevention	1133 (64.4%)	367 (64.4%)	1500 (64.4%)
Educational strategies	124 (7.1%)	29 (5.1%)	153 (6.6%)
Management/RTP	1201 (68.3%)	403 (70.7%)	1604 (68.9%)
Current/future technologies*	532 (30.3%)	103 (18.1%)	635 (27.3%)
Legislation	134 (7.6%)	49 (8.6%)	183 (7.9%)
Misconceptions/Media*	359 (20.4%)	193 (33.9%)	552 (23.7%)
Safety equipment*	385 (21.9%)	287 (50.4%)	672 (28.9%)
High profile cases	656 (37.3%)	187 (32.8%)	843 (36.2%)
Messenger			
Parents*†	137 (7.8%)	72 (12.6%)	209 (9%)
Coach*†	784 (44.6%)	379 (66.5%)	1163 (50%)
Teacher*†	138 (7.8%)	73 (12.8%)	211 (9.1%)
Physio*	86 (4.9%)	48 (8.4%)	134 (5.8%)
Guest speaker/specialist*†	664 (37.8%)	311 (54.6%)	975 (41.9%)
Fellow rugby player*	94 (5.3%)	86 (15.1%)	180 (7.7%)
Medical professional*†	451 (25.7%)	399 (70%)	850 (36.5%)
Professional player*†	1246 (70.9%)	169 (29.6%)	1415 (60.8%)
Professional coach*†	1205 (68.5%)	197 (34.6%)	1402 (60.2%)

* Significant difference in preferred method of education between male and female athletes ($p < 0.05$).

† Significant difference between previous education received and future education desired within the sample ($P < 0.05$).

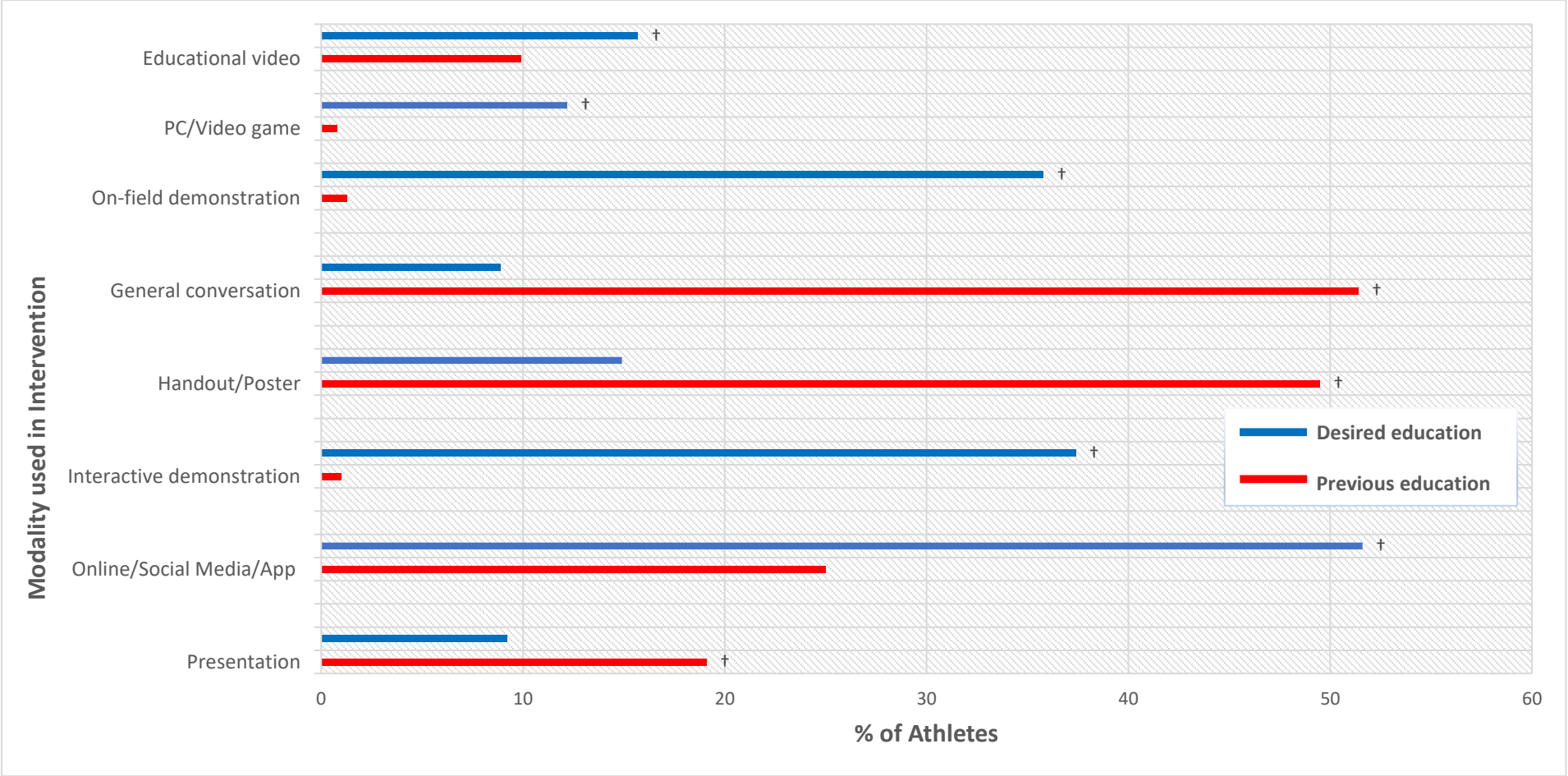

Figure 1. Modality used in Previous Intervention versus Desired Future Modality

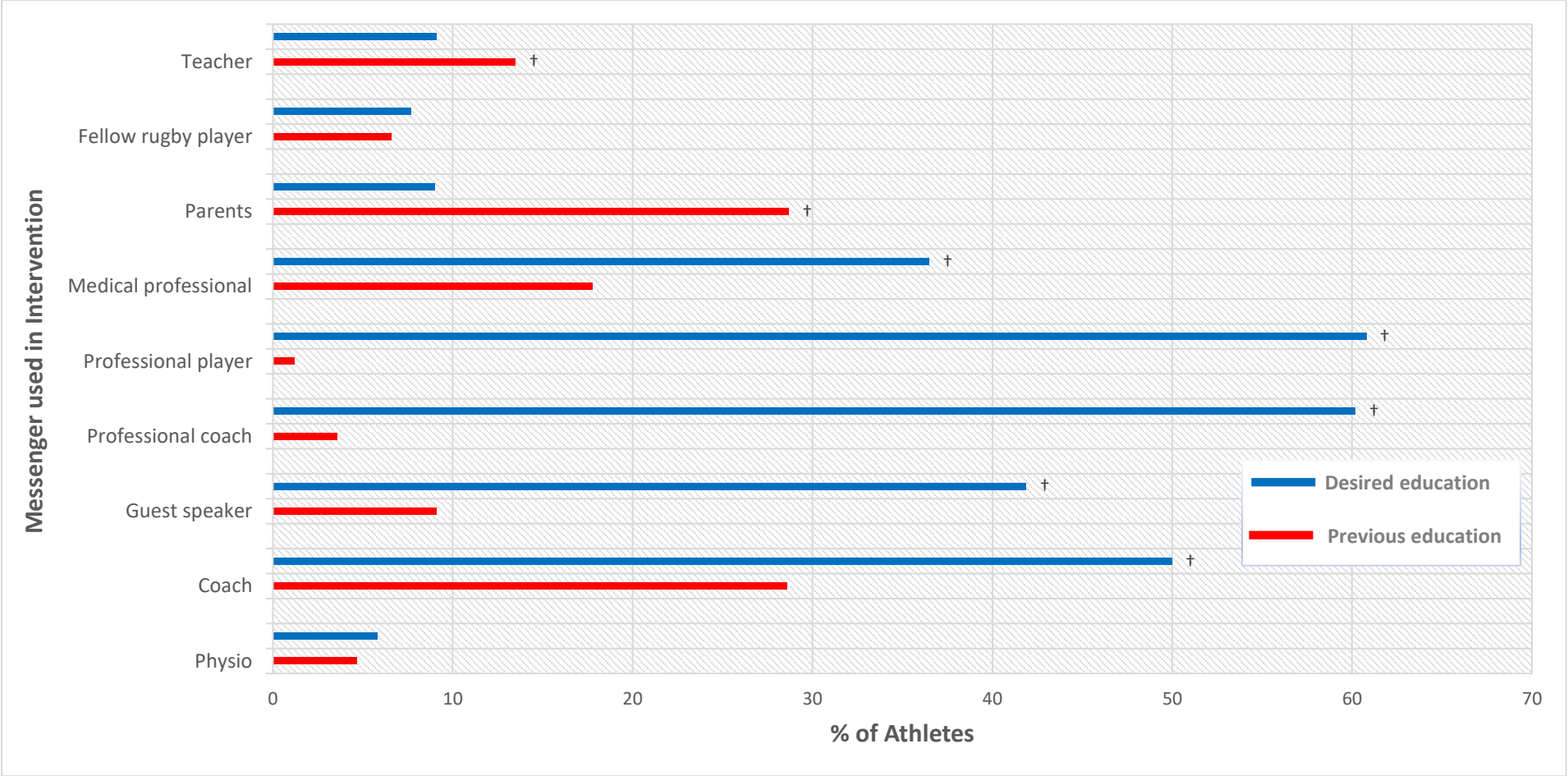

Figure 2. Messenger used in Previous Intervention versus Desired Future Messenger