

BMJ Open Active & Safe Central: using a mixed-methods design and the RE-AIM framework to evaluate a sport and recreational injury prevention resource for practitioners in Canada

Sarah A. Richmond ^{1,2} Samantha Bruin,³ Amanda M Black ^{4,5} Ian Pike,^{3,6} Shelina Babul^{3,6}

To cite: Richmond SA, Bruin S, Black AM, *et al*. Active & Safe Central: using a mixed-methods design and the RE-AIM framework to evaluate a sport and recreational injury prevention resource for practitioners in Canada. *BMJ Open* 2021;**11**:e039070. doi:10.1136/bmjopen-2020-039070

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-039070>).

Received 03 April 2020
Revised 07 November 2020
Accepted 03 December 2020



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Dr Sarah A. Richmond;
sarah.a.richmond@gmail.com

ABSTRACT

Objectives An online, evidence-based resource was created to support the development of sport and recreational injury prevention programmes. The resource, called Active & Safe Central (www.activesafe.ca), provides evidence-based information across the public health approach for a number of sport and recreational activities. The objective of this project was to evaluate the perceived usefulness of Active & Safe Central as an educational tool.

Design A mixed-methods study design, guided by the RE-AIM (reach, effectiveness, adoption, implementation and maintenance) framework, was used to evaluate Active & Safe Central.

Setting Data were collected using an online survey, available to all users of the site, and focus groups (n=2) that took place in Vancouver and Toronto, Canada.

Participants Survey respondents (n=87) were recruited online, including parents, coaches, youth and adult athletes, and teachers. Focus group participants (n=16) were key stakeholders and end users, recruited from academia, local health sectors, sport and recreational organisations, and not-for-profit injury prevention organisations.

Results Post launch, there were 1712 users visiting the website 2306 times (sessions), with the majority representing new users, over returning users (87.5% and 12.5%, respectively). There were 6340 page visits, with the most popular pages including soccer, playgrounds and ice hockey. Active & Safe Central was reported as a credible source of evidence-based sport and recreational information and that the site would be recommended to others. Information collected from focus group participants was used to inform necessary adaptations to the online platform, including critical navigation issues, visualisations and interactivity. The major themes that emerged from focus group and survey data included increased awareness of injury prevention recommendations and that the recommendations would be used in one's own sporting activity and/or practice.

Conclusions The results of the evaluation suggest the tool is a useful resource for sport and recreational injury information that has significant potential to impact prevention practice.

Strengths and limitations of this study

- The RE-AIM (reach, effectiveness, adoption, implementation and maintenance) framework, widely used in public health programme evaluation, was used to evaluate the impact and perceived usefulness of the Active & Safe Central sport injury prevention resource.
- Active & Safe Central was created using an integrated knowledge translation approach, involving end users and stakeholders throughout the research, development and dissemination process.
- Our study would have benefited from the opportunity to collect data on whether the prevention strategies suggested were implemented and how; however, given the specific aims of this study, future work in this area is warranted.
- The study has a small number of respondents to the online surveys; therefore, the results reported here may not truly represent all Active & Safe Central users, nor users of internet-based resources for sports and recreational information.

INTRODUCTION

In the area of sport and recreational activity, there is a breadth of literature that supports interventions that reduce the risk of injury. Neuromuscular training,^{1 2} body checking policy changes in ice hockey³⁻⁵ and bicycle helmets to reduce the risk of head injury⁶⁻⁸ are examples of interventions that are effective at decreasing the risk of sustaining a sport-related and/or recreation-related injury. Increasing the impact of these interventions; however, requires application at a population level. For example, implementing neuromuscular training programmes in physical education in schools has been shown to decrease all-sport injury rates.^{2 9} However, knowledge of and access to the information specific to what is effective, by sport or activity,

is often not available to those that work in community sport and recreation programmes, in schools or in public health practice.^{10 11} For example, a recent study reported both facilitators and barriers to implementing an evidence-based, neuromuscular training programme adapted for physical education classes in junior schools in Alberta, Canada.¹¹ The physical education teachers cited a significant facilitator to the process of implementing the programme was knowledge of the programme being evidence-based; however, barriers to the process included access to resources to support ongoing implementation efforts, in particular having access to tools to support implementing the programme as intended.¹¹ In addition, teachers cited this need for programme sustainability as well as to increase capacity at an individual level (eg, teachers themselves having the necessary skills and knowledge).¹¹ There is also literature documenting the lack of access to resources as a barrier to sport-specific intervention uptake. For example, the lack of preseason educational support was cited as a significant barrier for soccer coaches.¹² To increase the public health impact of interventions designed to reduce sport-related injury, access to translated evidence on effective interventions for those who treat, coach and parent both elite and recreational athletes is imperative.

To address an identified gap in access to synthesised evidence across the public health approach to sport-related and recreation-related injury prevention, an online, evidence-based resource for the prevention of sport and recreational injury was developed, called Active & Safe Central (www.activesafe.ca). The development of Active & Safe Central is published elsewhere¹³; however, in short, we used an integrated knowledge translation approach to scope and develop the site, completing a large-scale systematic review of over 50 sport and recreational activities across five outcomes: prevalence, risk factors, interventions, and implementation and evaluation of interventions to reduce injury. At all stages of development, project team members included coaches, parents, athletes, injury researchers, sport administrators and practitioners, as well as members of a digital design team, all of whom informed the research and dissemination process. This included forming the research question, data collection and translation of the evidence.¹³ This approach, widely considered the most effective way to increase relevance, use and sustainability of public health innovations,¹⁴ was integral to its development.

The aim of this project was to evaluate the impact and perceived usefulness of the Active & Safe Central platform. The specific objectives of this study were (1) to identify the demographics of end users of the site so as to better understand the target audience; and (2) to evaluate the impact and perceived usefulness of the site using the RE-AIM (reach, effectiveness, adoption, implementation and maintenance) framework as guidance: reach of the site, perceived usefulness of the injury prevention messaging, intentions of adopting use of the site and intentions of revisiting the site for more information.

METHODS

Study design and setting

We used a mixed-methods design to evaluate the perceived usefulness of the Active & Safe Central platform as an educational tool to increase knowledge around injuries related to sport and recreation and the adoption of prevention efforts at an individual level. The survey was linked to the Active & Safe Central tool itself, accessible to all users who visited the site. Further, we used focus groups, one at the start of the development of the website (n=9) and the other at mid-development (n=7), to assist in the design and revision of the tool so as to increase end user experience.¹³ The focus groups were completed, the first in Vancouver, Canada at the British Columbia Children's Hospital (focus group 1) and the second in Toronto, Canada at Parachute, the Canadian Injury Prevention Knowledge Mobilization Unit (focus group 2), with participation of a trained facilitator.

Data collection and participants

The evaluation of Active & Safe Central used an online survey (live from 10 May 2018 to 18 June 2018) that was embedded within the tool, use-metrics collected using Google Analytics as well as data collected from the two focus groups. The survey was available to all visitors using the site through a pop-up message. Further recruitment was advertised through Facebook, aimed at parents, coaches, youth and adult athletes, and teachers. Participants were incentivised to complete the evaluation by being entered into a draw for a prize. Questions in the survey included demographic information on the user, as well as questions to evaluate the reach, perceived usefulness, adoption and maintenance of participation on the Active & Safe Central site (see online supplemental table 1 for survey questions). The focus groups aimed to collect information on adaptations that could be made on the site prelaunch in order to increase the relevance and usefulness of the platform. Focus group participants were recruited via purposive sampling and included key stakeholders and end users from the Active & Safe Central project team, as well as the wider sport and recreational community. These included athletes and coaches as well as participants from academia, local health sectors, sport and recreational organisations, and not-for-profit injury prevention organisations, all potential users of the site. Questions included perceptions of the data visualisations and site interactivity, as well as perceived usefulness, site limitations and any other comments to increase the use of the site. Focus groups were conducted by a trained facilitator (focus group 1 in January 2018) and the first author (focus group 2 in April 2018), trained in facilitation and experienced in focus group data collection and analyses. Focus groups were both video-recorded and audio-recorded. In addition, information on the study objectives and research rationale was communicated with all participants, and during the data collection process the trained facilitator used a process of checking-in with participants to verify the information that was collected.

Throughout the evaluation process, participants were invited to provide feedback and to ask questions related to any aspect of the project. It was not necessary to repeat any of the data collection with respect to the focus groups.

Patient and public involvement

We used an integrated knowledge translation approach to the development, dissemination and evaluation of the Active & Safe Central project. Our key stakeholder and end user advisory group provided input and feedback throughout the development process. This included participation from this group on the research question development through to the evaluation of the platform.

Demographic information and RE-AIM evaluation

At the start of the survey, participants were asked to provide demographic information including type of user (eg, participant/athlete, coach, parent), sex (male/female/other/prefer not to answer), age (ie, <9, 10–14, 15–18, 19–24, 25–44, 45–64, 65–74, 75–84, 85+ years old), previous injury (ie, yes/no to previous 12-month sport or recreational injury severe enough to require medical attention), time loss from injury (ie, 1–12 weeks, 1–12 months, not yet recovered), injury type (eg, sprain, strains, concussion) and activity type (ie, sport played

while injured). User categories were informed by the focus groups, as well as previous literature including validated previous injury survey data collection measures.¹⁵

To better understand the perceived usefulness of Active & Safe Central in providing sport and recreational injury information across a range of outcomes (eg, prevalence, risk factors and effective interventions) and to increase the uptake of the recommended injury prevention strategies, we used the RE-AIM framework¹⁶ to develop and analyse responses to the questions used in both the online surveys and focus groups. We adapted each of the five constructs in RE-AIM (reach, effectiveness, adoption, implementation and maintenance) to assess the impact of Active & Safe Central (see [table 1](#) for operationalisation of each construct of the RE-AIM framework as applied to this project). For the online surveys, respondents were asked to indicate their level of agreement with each of a series of statements using a 4-point scale: strongly disagree, disagree, agree and strongly agree (online supplemental table 1).

Informed consent process

All participants provided informed consent to participate in the online survey and focus groups. For focus group

Table 1 Adaptation of the RE-AIM framework for use in the evaluation of Active & Safe Central

RE-AIM constructs	Definition	Operational definition
1. Reach	<ul style="list-style-type: none"> ▶ The number, proportion and representativeness of individuals who are willing to participate in the intervention. 	<ul style="list-style-type: none"> ▶ The number of users visiting the site (nationally and internationally). ▶ The number of page visits within the postlaunch period. ▶ The proportion of reported visits from website acquisition (ie, how users arrived at the site).
2. Effectiveness (perceived usefulness)	<ul style="list-style-type: none"> ▶ The impact that the intervention has on the outcomes, including potential negative effects. 	<ul style="list-style-type: none"> ▶ The number and proportion of respondents who reported that the site was a useful resource, that they learnt something new and that it increased awareness of injury prevention recommendations.
3. Adoption	<ul style="list-style-type: none"> ▶ The number, proportion and representativeness of the setting/organisational willingness to adopt the intervention. 	<ul style="list-style-type: none"> ▶ The number and proportion of respondents to the survey who report intention to use the platform in their sport and/or recreation practices.
4. Implementation	<ul style="list-style-type: none"> ▶ The fidelity and consistency to the interventions protocol. 	<ul style="list-style-type: none"> ▶ The extent to which the site was developed and launched as intended (predevelopment and mid-development adaptations of the site).
5. Maintenance	<ul style="list-style-type: none"> ▶ The long-term effects of the intervention at both an individual and organisational level. 	<ul style="list-style-type: none"> ▶ How the site was adapted in its maintenance phase. ▶ The number of users to the site (nationally and internationally) measured at 1 year. ▶ The number of page visits measured at 1 year. ▶ How information from the site is being used in practice (open-ended question).

participants, the consent form outlined the process for individuals to request copies of the focus group data transcripts as well as the mechanisms for feedback and questions.

Data analysis

Thematic analyses were used to evaluate Active & Safe Central using data from the online surveys, presented as frequencies and proportions. Google Analytics data were accessed in order to track the number and extent of website visits and engagement, analysed using descriptive statistics and also presented as frequencies and proportions. One reviewer analysed the open-ended text that was derived from the online survey as well as data from the focus groups, using word processing software. This reviewer (SR) is experienced in qualitative analyses, specifically using thematic analyses.^{10 11 17 18} Focus group data were collected, analysed and shared with the stakeholder team concurrently in the build stages of the site, creating space for reviewer reflection of the data collection and data saturation. A coding scheme that included the development of major and minor codes, categorised from themes identified in the data, was used. All codes were used to identify specific build concepts for the site that would increase the perceived usefulness, adoption, implementation and maintenance of the site. After codes were developed, data were provided to the stakeholder team to collect feedback and confirmation of the themes identified. Minor codes that were identified were discussed in the context of the relevance and significance for implementation of the platform. Any data identified from minor codes that received consensus from the stakeholder team were integrated into future iterations of the platform. On consensus from the stakeholder team of a good understanding of the necessary changes to be made, data collection was considered complete. Any information gathered that was considered missing from previous data collection periods was added. None of the recruited focus group participants refused to participate, nor were additional focus groups necessary. Finally, we used the Consolidated criteria for Reporting Qualitative research checklist (COREQ)¹⁹ as guidance for reporting these data (see online supplemental table 2 for the COREQ checklist criteria).

RESULTS

Demographic information of survey respondents and focus group participants

The results of this project are presented from 87 completed surveys and 2306 site sessions, post launch of the Active & Safe Central site. The majority of users who completed the survey (n=87) indicated that they participated in sport and recreational activity as a participant/athlete (62%) and 31% indicated that they were a parent of a participant/athlete. Nearly two-thirds (62%) of users self-identified as female and just over one-third (36%) self-identified as male. The majority reported being

between the ages of 25 and 44 years (38%), 23% reported being between 45 and 64 years of age, and 16% between 19 and 24 years. For children and youth, 14% reported being between 15 and 18 years of age and fewer than five respondents were ages 10–14 years.

Of the users who completed the survey, 30% (n=26/87) reported suffering a medically treated injury in the previous 12 months; of these, 38% experienced a recovery period of 1–12 weeks, 38% experienced a recovery period of 1–12 months, and 23% were still in the recovery period. When stratified by age, the proportion of children and youth (under the age of 19) reporting a sport-related injury in the previous 12 months was 40%. The most common injuries included sprained ankles and concussion; other injuries included anterior cruciate ligament tears, hip flexor, shoulder and knee-related musculoskeletal injuries, and fractures. The most common sport and recreational activities engaged in at the time of the injury included soccer, basketball and running.

Focus group participants were key stakeholders and end users, and included athletes, coaches and practitioners from academia, local health sectors, sport and recreational organisations, and not-for-profit injury prevention organisations. Sixteen individuals in total participated in two, 1-hour focus groups (n=9 and n=7, respectively). Participant characteristics can be found in [table 2](#). Overall, participants were potential users of the site and informed the development of the site at two critical stages of development.

Reach

Reach, as an individual measure in this study, was determined using the number of users visiting the site, in the 40 days post launch. There were 1712 users visiting the website 2306 times (sessions), with the majority representing new users, over returning users (87.5% and 12.5%, respectively). Most visitors accessed the website from Canada (80.8%, n=1387); 76.1% (n=1066) were from British Columbia, 10.4% (n=145) from Alberta and 8.3% (n=116) from Ontario. Active & Safe Central gained the interest of non-Canadians, with the remaining 19.2% of all users accessing the resource from countries including the USA (n=122), Peru (n=62) and Australia (n=18) ([figure 1](#)). There were 6340 page visits in the 40-day postlaunch period, with the most popular pages including soccer, playgrounds and ice hockey. For website acquisition, the majority of users (35%) accessed the website through direct means (ie, clicking on, or typing in, [activesafe.ca](#)), while others accessed the site through social media platforms, such as Facebook and Twitter.

Perceived usefulness

The perceived usefulness of the site was determined using data from both the online survey and focus groups. Of the 87 survey respondents, over 90% reported agreeing or strongly agreeing that Active & Safe Central is a useful resource and is easy to use, and that they learnt something new while reviewing the site. Further, over 90% agreed

Table 2 Survey and focus group participant characteristics

Survey participants	n
Persona identified/sector*	
Participant/athlete	54
Parent of participant/athlete	27
Health professional	20
Coach	17
Club/activity administrator	15
Teacher/school administrator	6
Other	9
Sex	
Male	33
Female	54
Age group (years)	
10–14	<5
15–18	14
19–24	14
25–44	32
45–64	20
65–74	<5
75+	<5
Previous sport-related injury	
Yes	26
No	61
Focus groups	
Persona identified/sector	
Not-for-profit organisation, injury prevention	4
Academia	4
Sport and recreational organisations	2
Coach/athlete/parent of athlete	<5
Local health sector	4
Other	<5
Sex	
Male	<5
Female	15

*Survey participants' responses included all that applied.

that the site increased their awareness of injury prevention recommendations. From the open-ended questions, major themes that emerged from the data included report of increased knowledge from using the site and the site as a credible source of evidence-based information for sport and recreation. Several respondents expressed gratitude to the existence of the platform, citing its usefulness, ease in use and accessibility:

This is an amazing website and an amazing resource! It is easy-to-use and empirically-based, and I like the fact you have made it easy for users to find the actual research papers you have utilized.

Further:

This is a very useful resource, both for those working in injury prevention and for parents.

I have the opportunity to coach sports such as basketball, volleyball, soccer, and flag football. I also have the opportunity to run summer day camps. I will use this information to prevent injuries and inform staff and young athletes.

Athletes themselves identified taking the information gained into their own practices:

I would use what I have learned as I am a participant in many athletic sports and I feel that these tips on how to improve my safety will benefit me in the future.

The majority of participants from both the survey and focus groups reported how decisions made in practice need to be evidence-based, from a reliable source, and that the platform provided a mechanism in which to access information necessary to guide their programming, as demonstrated here:

This site helps me to have access to valid information to share with (staff) from a legitimate source.

Adoption

For adoption, data from the survey suggested that the vast majority of users (87%) would use the platform in their practice and the recommendations in their own sporting activity and/or practice (eg, coaching, teaching, public health). For example, one participant described:

I will use it to promote the importance of athletes participating in a proper warm up and encourage coaches to coach their athletes to play the sport safely.

Several others described the increased awareness of injury prevention information provided on the platform to be used in practice:

...Making me aware of common injuries, I can employ the preventable measures.

Furthermore, over 85% of respondents agreed or strongly agreed that they will share the information learnt on the site with others, and over 90% reported intention to recommend the website to others, as demonstrated by one participant:

I think this is a really great resource that I will share with parents and coaches.

Implementation

The information collected through the focus groups was used to inform the initial development of the platform and in adaptations made mid-development. We defined implementation as the extent to which the site was developed and launched as intended (predevelopment and mid-development adaptations of the site). Participants in the focus groups were a selection of users that included

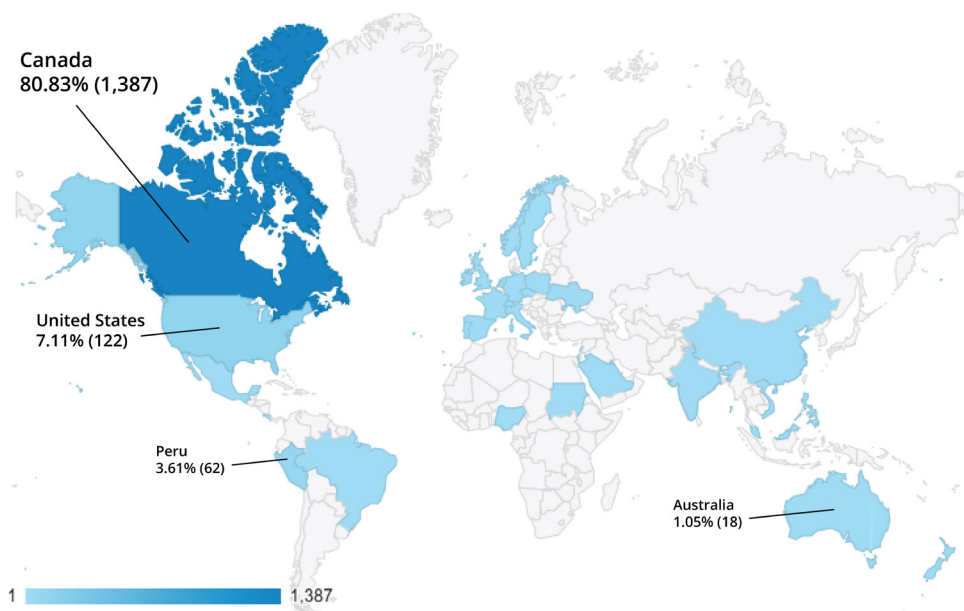


Figure 1 Proportion and number of Active & Safe Central users, by location, 30 days post launch.

areas of practice in sport and recreational injury prevention as well as end users. These included coaches, practitioners, academics as well as athletes. We collected participant perceptions of site accessibility and functionality, formatting and visual appeal, in addition to any other information participants were willing to offer that would increase the user ability of the site. The focus group data suggested that the information was best filtered first by sport, and then by user (ie, participant/parent, coach/teacher, official/administrator/health professional), allowing participants to choose an identity to receive tailored information. One participant described how the site would increase in ease of use in this way:

This is an awesome resource that I can utilize in the classroom, in the gym, and when I teach others...this resource has a lot of potential, (especially) as (the information) is tailored...

All focus group participants agreed that data visualisations, including a combination of infographics, videos and data tables, were the preferred presentation format, as demonstrated here:

The links were helpful, however, embedded videos may engage younger athletes for a longer, more effective time.

Maintenance

Key to the success of the Active & Safe Central site was adaptation (ie, addition) of content in the maintenance phase. Post launch of the site, information was collected on emerging content in sport injury, relevant to our stakeholders. It was determined through stakeholder engagement that support was needed towards increasing awareness for specialised topics in sport injury prevention.

These included training load and sleep as risk factors for injury, the role of physical literacy in sport and recreation injury, and neuromuscular training for overhead sporting activities, such as volleyball. In response to the expressed need, the project team consulted stakeholders on the ways in which this additional information could be shared with users of the site, and the result was the development of educational videos for each of the topic areas. The video content was developed with the entire project team and leading experts in each area, in addition to the development of translation and dissemination strategies.

As a proxy for sustained use of the site, we measured the number of users at the same time point 1 year later (from 10 May to 18 June 2019). There were a total of 1543 users that visited Active & Safe Central with 1785 total sessions. This represents a slight decrease of 10% in users from 2018. There was a larger diversity of users visiting the website from different countries in 2019 compared with 2018. In 2018, 80.8% (n=1387) of users were from Canada; in 2019, only 30.6% (n=474) of users were from Canada, 26.9% (n=416) were from the USA, and the remaining 42.5% (n=653) were from countries including Australia, UK, India, Japan, Philippines, the Netherlands, Malaysia and South Africa. Regarding website acquisition, most users arrived at Active & Safe Central through organic search (81.5%), 15.6% arrived through direct means, 2.2% arrived via referral from another website, and 0.7% arrived from clicking a link on social media.

From the open-ended questions, the major theme that emerged from the data included using the information from the site in practice. Specifically, respondents indicated that they would use information found on the site to help inform training methods, particularly incorporating the recommended neuromuscular training exercises

into sport-specific skill development programmes. As well, participants described the usefulness of the site in reviewing their current practice, as demonstrated here:

(I will use the information to) Improv(e) the participants' pre-ride warm-up (by) reviewing our current practices to ensure they fit (the) current information.

Other respondents reported using the intervention recommendations in staff training and community engagement events, as demonstrated by one participant here:

I would share the knowledge gained with (my) community in the form of workshops and also get volunteers to read the page to gain understanding.

DISCUSSION

The aim of this project was to evaluate a sport and recreational injury prevention resource that addressed a specific gap in access to synthesised evidence. Active & Safe Central makes information available to those who work in sport and recreational injury prevention who require up-to-date, evidence-based information to be used in practice. Despite the relatively small sample of participants in this study, overall, there was significant reported use and relevance of the tool, in addition to positive feedback on its sustainability. The major themes that emerged from the data included increased awareness of injury prevention recommendations and that the recommendations provided would be used in individual sporting activity and/or practice. Active & Safe Central was reported as a credible source of evidence-based information for sport and recreation and the site would be recommended to others. The focus group data proved invaluable in adapting early iterations of the resource, including the preference for data visualisations and the ability to choose the sport and user when interacting with the site.

Although the number of respondents from the online surveys was relatively small, we were able to use this information to better understand the demographics of our users not captured by traditional website tracking measures, such as Google Analytics. Most users of the site were female athletes, ages 25–44, with 30% reporting a previous sport-related injury in the past 12 months. When stratified by age, 40% of children and youth under the age of 19 years reported a previous injury, with the majority of injuries reported in male respondents. The majority of respondents from this age group were 15–18 years. This is similar to previous literature in this area that reports previous 12-month injury occurrence in children and youth from Calgary, Alberta, Canada.^{20 21} In a survey of high school students (ages 15–19 years), previous 12-month medically treated injury was reported in 40% of respondents. In addition, the reported sport where the injury occurred was similar to other studies; soccer, basketball and running were the most commonly

reported sports from the majority of respondents, similar to basketball, hockey, soccer and snowboarding reported in the study by Emery *et al.*²¹

Previous work has indicated that a barrier to the successful implementation of sport and recreation injury prevention programmes was access to and use of evidence-based interventions.^{10 11 22} Drawing from the example used in the introduction, the implementation of a sport prevention programme in physical education classes was hindered by access to resources, specifically those that can increase individual capacity in programme delivery. In addition, participants described self-efficacy as both a barrier and facilitator to the process of implementation. This concept, one that describes a person's perception of their ability to implement the programme as intended, was high in several teachers who delivered the programme and was quite low in others. Participants with high self-efficacy described how previous knowledge of and experience with the components of the programme were drivers of self-efficacy. Others described their lack of knowledge and experience contributed significantly to their lack of confidence, and that having access to resources and tools to support increasing knowledge of the programme and its components would contribute to its success. In addition, a significant facilitator to the implementation of the programme was knowing that the programme was evidence-based and from a reliable source (an academic institution).¹¹ This was also reported by the end users of Active & Safe Central, where several participants cited the success of the site due to its foundation in scientific evidence. This was in addition to the resource being accessible. Not requiring academic institution access for prevention information to be used in practice increases the ability for evidence-based practice at a local level.

The RE-AIM framework was used to guide the evaluation using both online survey and focus groups. A number of frameworks support the evaluation of interventions to determine effective outcomes; however, little attention is paid to other important factors of intervention development, such as implementation and maintenance. The RE-AIM framework helps to determine not only the perceived usefulness of Active & Safe Central in providing accessible sport injury information to practitioners, but key factors that influenced final product delivery to the end users. Further, RE-AIM is a widely used framework to 'understand the relative strengths and weaknesses of different approaches to health promotion and chronic disease self-management-such as in-person counseling, group education classes, telephone counseling, and internet resources'.²³ The information we collected was also used to determine the sustained investment on the site, as well as for use in increasing its reach. From both surveys, participants expressed the need for additional information in future iterations of the site. For example, there was a need for the site to include more videos and GIFs (graphics interchange format) for more interactive content. In addition, there was a need for sport



pages to include information on athletes of all abilities. To respond to these needs, we have created additional postlaunch content that includes a number of videos addressing emerging injury topics such as sleep, training load, physical literacy and neuromuscular training for volleyball athletes. We are also in the process of developing a funding proposal to complete a review of the literature for the adapted sport context.

Strengths and limitations

There are several strengths to this work. First, we used the RE-AIM framework to guide the evaluation, which increases our ability to understand both the perceived usefulness of Active & Safe Central as well as constructs that better determine its use and impact as an educational resource. RE-AIM is a framework widely used in public health programme evaluation and is effective at assessing the overall public health impact of an intervention.²³ In addition, the site was created using an integrated knowledge translation approach, involving end users and stakeholders throughout the research, development and dissemination process.¹³

There are limitations to this study. First, we were unable to provide a valid denominator for the calculation of reach. The ability to calculate the number of individuals who would be eligible and willing to use the site would be the best representation of the reach in this case. Further, we did not evaluate the effectiveness of the site as defined by the RE-AIM framework, but its perceived usefulness. The development of the site was driven by addressing an identified gap in the availability of synthesised information for sport and recreational injury prevention practice. We operationalised the definition of effectiveness in this case to indicate the perceived usefulness of the site, over the effectiveness of an intervention to reduce sport injury. The study has a small number of respondents to the online surveys (n=87); therefore, the results reported here may not truly represent all Active & Safe Central users, nor users of internet-based resources for sport and recreational information. Our study would have also benefited from the opportunity to collect data on whether the prevention strategies suggested were implemented and how; however, given the specific aims of this study, future work in this area is warranted. The number of return visitors to the site decreased slightly (10% decrease in users from 2018); however, it should be noted that we used paid advertisements for use of the site in 2018, and not at any time point in 2019. We did not include a formal process of validating the data with the participants. This would increase the trustworthiness of the data, in addition to providing a process of validating the themes that were identified. Our trained facilitator; however, used a process of checking the data with participants to verify the information that was heard during data collection.

Implications for practice

The results of this study suggest that Active & Safe Central is a useful tool for accessing evidence-based sport and

recreational injury information, relevant to athletes, parents and practitioners. This has several implications for practice, including increasing the capacity of practitioners in sport and recreation, which in turn can reduce the burden of sport injury when applied in practice. Several respondents reported that the tool provided new knowledge on sport and recreational injury and that they would share this information to educate others. Using the tool to increase knowledge on sport-specific injury rates, risk factors and effective prevention programming can impact practice at an individual level; translating that information to others, particularly those at the organisational or policy level, can impact change at a population level. The greatest impact would be seen when practice shifts from standard of care towards practice that is evidence-based. This requires capacity-building support that includes providing accessible summaries of scientific evidence.^{17 18 22 24–26} The accessibility of the site provides opportunities to use the information and resources provided in daily practice. For example, coaches can access the latest evidence on effective exercises that can be added to neuromuscular training programmes to reduce the risk of injury. Physical education teachers can use the videos provided to not only teach how to complete an exercise using proper form, but as warm-up to their physical education class.

Future work

We aim to develop opportunities to further address the needs expressed by users of Active & Safe Central, including updating the information on the site to include effective interventions for adapted sport contexts, as well as risk and protective factors for sport injury among athletes with disabilities. We will continue to update the site and provide summaries of evidence in emerging sport injury topics. This will include support from all of our project partners and those with research and content expertise across sporting activities.

Author affiliations

¹Health Promotion, Chronic Disease and Injury Prevention, Public Health Ontario, Toronto, Ontario, Canada

²Division of Epidemiology, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

³British Columbia Injury Research and Prevention Unit, BC Children's Hospital, Vancouver, British Columbia, Canada

⁴Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada

⁵Alberta Children's Hospital Research Institute, University of Calgary, Calgary, Alberta, Canada

⁶Pediatrics, The University of British Columbia, Vancouver, British Columbia, Canada

Twitter Sarah A. Richmond @S_A_Richmond and Amanda M Black @academic

Acknowledgements The authors would like to sincerely thank all of the participants of the online surveys and the focus groups. The authors would also like to thank John Jacob, Head and Research Lead, and the staff at the Digital Lab at BC Children's Hospital.

Contributors SR contributed to the concept, design, acquisition of data and analysis, and wrote the manuscript. SaB contributed to the acquisition of data and analysis, and to writing and editing of the manuscript. AMB, IP and ShB contributed to the concept, design and interpretation of data, and provided revisions to the manuscript.

Funding Funding for this work was provided by the British Columbia Physical Activity Strategy (REG10802387), which is co-led through a partnership between the Government of British Columbia and the BC Alliance for Healthy Living.

Map disclaimer The depiction of boundaries on this map does not imply the expression of any opinion whatsoever on the part of BMJ (or any member of its group) concerning the legal status of any country, territory, jurisdiction or area or of its authorities. This map is provided without any warranty of any kind, either express or implied.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethics approval for this project was provided by the Research Ethics Review Committee at the University of British Columbia (H17-02802).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Sarah A. Richmond <http://orcid.org/0000-0003-3632-5037>

Amanda M Black <http://orcid.org/0000-0001-5668-9706>

REFERENCES

- Emery CA, Roy T-O, Whittaker JL, *et al*. Neuromuscular training injury prevention strategies in youth sport: a systematic review and meta-analysis. *Br J Sports Med* 2015;49:865–70.
- Richmond SA, Kang J, Doyle-Baker PK, *et al*. A school-based injury prevention program to reduce sport injury risk and improve healthy outcomes in youth: a pilot cluster-randomized controlled trial. *Clin J Sport Med* 2016;26:291–8.
- Black AM, Hagel BE, Palacios-Derflingher L, *et al*. The risk of injury associated with body checking among Pee Wee ice hockey players: an evaluation of hockey Canada's national body checking policy change. *Br J Sports Med* 2017;51:1767–72.
- Black AM, Macpherson AK, Hagel BE, *et al*. Policy change eliminating body checking in non-elite ice hockey leads to a threefold reduction in injury and concussion risk in 11- and 12-year-old players. *Br J Sports Med* 2016;50:55–61.
- Emery C, Palacios-Derflingher L, Black AM, *et al*. Does disallowing body checking in non-elite 13- to 14-year-old ice hockey leagues reduce rates of injury and concussion? a cohort study in two Canadian provinces. *Br J Sports Med* 2020;54:414–20.
- Attewell RG, Glase K, McFadden M. Bicycle helmet efficacy: a meta-analysis. *Accid Anal Prev* 2001;33:345–52.
- Macpherson A, Spinks A. Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries. *Cochrane Database Syst Rev* 2008;3:CD005401. doi:10.1002/14651858.CD005401.pub3
- Thompson DC, Rivara FP, Thompson R. Helmets for preventing head and facial injuries in bicyclists. *Cochrane Database Syst Rev* 2000;2:CD001855.
- Emery CA, van den Berg C, Richmond SA, *et al*. Implementing a junior high school-based programme to reduce sports injuries through neuromuscular training (iSPRINT): a cluster randomised controlled trial (RCT). *Br J Sports Med* 2020;54:913–9.
- Richmond SA, Carsley S, Prowse R, *et al*. How can we support best practice? A situational assessment of injury prevention practice in public health. *BMC Public Health* 2020;20:431.
- Richmond SA, Donaldson A, Macpherson A, *et al*. Facilitators and barriers to the implementation of iSPRINT: a sport injury prevention program in junior high schools. *Clin J Sport Med* 2020;30:231–8.
- Steffen K, Meeuwisse WH, Romiti M, *et al*. Evaluation of how different implementation strategies of an injury prevention programme (FIFA 11+) impact team adherence and injury risk in Canadian female youth football players: a cluster-randomised trial. *Br J Sports Med* 2013;47:480–7.
- Richmond SA, Black AM, Jacob J, *et al*. 'Active & Safe Central': development of an online resource for the prevention of injury in sport and recreational activity. *Inj Prev* 2019;25:546–51.
- Graham ID, Kothari A, McCutcheon C, *et al*. Moving knowledge into action for more effective practice, programmes and policy: protocol for a research programme on integrated knowledge translation. *Implement Sci* 2018;13:22.
- Emery CA, Meeuwisse WH, Hartmann SE. Evaluation of risk factors for injury in adolescent soccer: implementation and validation of an injury surveillance system. *Am J Sports Med* 2005;33:1882–91.
- Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health* 1999;89:1322–7.
- Carsley S, Prowse R, Richmond SA, *et al*. Supporting public health practice in healthy growth and development in the province of Ontario, Canada. *Public Health Nurs* 2020;37:412–21.
- Prowse RJ, Richmond SA, Carsley S, *et al*. Strengthening public health nutrition: findings from a situational assessment to inform system-wide capacity building in Ontario, Canada. *Public Health Nutr* 2020;23:3045–55.
- Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* 2007;19:349–57.
- Emery C, Tyreman H. Sport participation, sport injury, risk factors and sport safety practices in Calgary and area junior high schools. *Paediatr Child Health* 2009;14:439–44.
- Emery CA, Meeuwisse WH, McAllister JR. Survey of sport participation and sport injury in Calgary and area high schools. *Clin J Sport Med* 2006;16:20–6.
- Poulos R, Donaldson A, Finch C. Towards evidence-informed sports safety policy for new South Wales, Australia: assessing the readiness of the sector. *Inj Prev* 2010;16:127–31.
- Re-AIM. Reach, effectiveness, adoption, implementation, maintenance, 2020. Available: <http://www.re-aim.org/about/what-is-re-aim/> [Accessed 20 Jan 2020].
- Jacob RR, Baker EA, Allen P, *et al*. Training needs and supports for evidence-based decision making among the public health workforce in the United States. *BMC Health Serv Res* 2014;14:564.
- Katz J, Wandersman A. Technical assistance to enhance prevention capacity: a research synthesis of the evidence base. *Prev Sci* 2016;17:417–28.
- Leeman J, Calancie L, Kegler MC, *et al*. Developing theory to guide building practitioners' capacity to implement evidence-based interventions. *Health Educ Behav* 2017;44:59–69.