Author’s response to reviews

Title: Stimulating injury-preventive behaviour in sports: the systematic development of two interventions

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Author’s response to reviews:

Dear editor, and reviewers,

Enclosed please find our revised manuscript entitled “Stimulating injury-preventive behaviour in sports: the systematic development of two interventions” by Kemler, Valkenberg and Gouttebarge (Manuscript SSMR-D-18-00030).

We would like first to thank the two reviewers for their time spent reviewing our manuscript and for their useful comments. As required, we altered our manuscript in accordance with all comments and suggestions which have further improved our manuscript. Changes are marked in yellow in the revised manuscript. The point-by-point response to the reviewers is listed below. This revised manuscript has been read, reviewed and approved by all authors.

In accordance with one of the comments, we have written an appendix with the main results of four of the six research methods used. Due to the short time frame we were not able to check this appendix for the use of proper use of the English language yet.

We look forward to your decision about whether our revised manuscript is now suitable for publication in BMC Sports Science, Medicine and Rehabilitation.
Yours sincerely,
also on behalf of my co-authors,

Dr. Ellen Kemler

STIMULATING INJURY-PREVENTIVE BEHAVIOUR IN SPORTS: THE SYSTEMATIC DEVELOPMENT OF TWO INTERVENTIONS

By Kemler, Valkenberg and Gouttebarge

Manuscript SSMR-D-18-00030

COMMENTS FROM REVIEWER #1

Reviewer’s comment:. This manuscript provides an important view into the process of developing sports injury interventions, particularly in two sports (skiing and running) which are popular and also "do not automatically rely on coaches/trainers." A good process for developing interventions is provided. A main limitation of this paper is that procedures (lit review, expert meetings, surveys and focus groups) are not detailed enough in terms of the methods, analysis and results. Particularly, the role of athletes (target population) in developing the intervention is not described in much detail, although the process includes focus groups and surveys of athletes. Other critiques are offered below.

Authors reply: We thank the reviewer for her time reviewing our manuscript, as well as for the useful comments and suggestions. We strived to alter the manuscript appropriately by adding some details about the procedures applied in our approach and about the involvement of athletes. We sincerely hope that the reviewer is satisfied about the changes we have made.

Reviewer’s comment: ABSTRACT 1. Results should be expanded to include results from the lit review, expert meetings, and survey/focus groups with target athletes. In addition, a summary of the intervention content should be provided.
Authors reply: The results section of the abstract was indeed a little bit short. Because of the limited space available in the abstract, we have added information about the amount of experts and athletes that were involved in the development of the intervention and the systematic approaches we used. To give more insight in the results of the different research approaches used, we have written an Appendix (Appendix C). To include more details of all the methods used would have doubled the length of this article. Hence the appendix. We also have rewritten the background of the abstract and the method section.

Authors revision:

Background

In addition to the beneficial health effects of being active, sports are also associated with a risk of sustaining injuries. To avoid the occurrence of sports injuries, preventive measures can be applied. The use of the effective measures requires a behavioural change in sports participants. The current article describes the development of two interventions to change injury preventive behaviour, to give insight in the execution of the development of an intervention, e.g. in the required steps, the different research methods used and, the lengthy and time consuming development process.

Methods

For the development of the interventions, the four-step strategy of Intervention Mapping (IM) and Knowledge Transfer Scheme (KTS) were used. All the necessary information for this four-step strategy was collected through the following research approaches: review of the literature, expert meetings, quantitative study among target populations, focus group meetings with target populations, co-creation sessions, and pre-tests of the interventions.

Results

A total of 10 experts and 1000 athletes were involved in the development of two web-based interventions to stimulate injury-preventive behaviour in novice runners and skiers. Runners received injury preventive advices on a training schedule, strength exercises, and an active warm-up prior to running based on the amount of stress or force they can put on their body, and their goal-setting behaviour. Skiers received injury preventive advice on strength exercises, technical skiing skills based on their physical fitness and technical skiing ability, the use of a skiing helmet, and the ski slope regulations.

Reviewer’s comment: BACKGROUND 2. Provide more background literature on existing evidence-based interventions used in skiing and running, if any.
Authors reply: We have added more background literature on interventions in both running and skiing on page 3 and 4. The interventions in running were developed to change injury preventive behaviour, or to prevent RRIs. The interventions in skiing were educational campaigns.

Authors revision: For running some interventions have been used in the recent past with promising results in stimulating injury preventive behaviour and even in the prevention of RRIs [16, 17]. Hespanhol et al. (2017) evaluated the effectiveness of adding online tailored advice to general advice on the prevention of RRIs and the determinants and actual preventive behaviour in Dutch trial runners participating in a trail running event. In this study, no effect was observed on determinant and actual preventive behaviour, but RRIs were prevented [16]. The intervention developed by Adriaensens et al. (Dutch Consumer Safety Institute) was effective in stimulating injury preventive behaviour among runners [17], but was however very time consuming. To prevent or reduce injury risk in snow sports, several educational interventions have been used in the past. Cusimano et al. (2013) evaluated the effectiveness of a brochure and video at improving skiing and snowboarding knowledge. The intervention aimed at youth skiers and snowboarders appeared to be effective at improving knowledge, attitudes and behaviors of skiing and snowboarding safety, but did not reduce injury risk. In another intervention, screening of a 45-min educational video on long-haul bus trips specifically to ski slopes was effective in reducing injury risk, collisions and falls, particularly in beginners (Jorgenson et al, 1998). According to a systematic review by Hume et al. (2015), the effectiveness of education interventions is unclear due to the diverse nature of the education campaigns and target populations, but could be possibly beneficial.

Reviewer’s comment: BACKGROUND 3. Provide information on the use of broad (not injury-specific) interventions in sports.

Authors reply: The interventions in running and skiing that we have added after comment Background 2, are broad intervention. Therefore we think we have addressed comment background 2 and background 3 at the same time. We believe that the addition of more broad interventions will have an added value to the background section.

Authors revision: Please see our revision after comment Background 2.

Reviewer’s comment: BACKGROUND 4. Provide background on intervention development procedures, and most specifically the IM/KTS strategies as these are used by the authors.
Authors reply: We have added more information on IM and KTS on page 4 and 5. However we think it is more suitable in the method section were IM and KTS were mentioned first. We hope the reviewer agrees with us.

Authors revision: IM is a protocol for developing effective behavior change interventions. The IM protocol describes the iterative path from problem identification to problem solving or mitigation. Each of the six steps of IM comprises several tasks each of which integrates theory and evidence. The completion of the tasks in a step creates a product that is the guide for the subsequent step. The completion of all of the steps serves as a blueprint for designing, implementing and evaluating an intervention based on a foundation of theoretical, empirical and practical information [16,17]. The KTS integrates existing implementation research frameworks into a tool which has been developed specifically to bridge the gap between knowledge derived from research on the one side and evidence-based usable information and tools for practice on the other side [18].

Reviewer’s comment: BACKGROUND 5. A contrast between sports that require compulsory injury prevention strategies (e.g., bicycling and football) versus the sports of interest (skiing and running) that require behavior change is offered. That may be a simplistic view, since even policy interventions require behavior change although the enforcement/penalties are motivating factors. It should also be noted that the intervention developed for skiers also include a policy education piece (the authors reference the FIS ski slope regulations).

Authors reply: The reviewer is correct, for every prevention strategy a behaviour change is necessary. With the mentioning of this contrast we have tried to make clear that it takes more effort to change your behaviour when there are no external consequences such as penalties. The FIS ski slope regulations are indeed used in the intervention for skiers. Skiers are advised to read the ski slope regulations and test their knowledge. As this is only one of our advices we found it difficult to mention this in this section of the article. We have revised the specific paragraph as follows:

Authors revision: To safeguard sports participants against injuries, and consequently from withdrawal from their activities, the use of effective injury-preventive measures is necessary. The use of the effective measures requires a behavioural change in sports participants. For some sports, the use of effective injury-preventive measures, such as helmets in bicycle races or shin guards in football, have been made compulsory. The enforcement of these compulsory measures and the risk for (external) penalties are motivating factors to stimulate injury-preventive behavior. However, for running and skiing, the use of effective injury-preventive measures has not been made compulsory for adults. Therefore huge efforts have to be made to accomplish a
behavioural change first to increase the use of effective measures and second to reduce the number of running-related and skiing-related injuries.

Reviewer’s comment: METHOD 6. Describe how all participants (i.e., experts, survey participants, focus group participants) were identified/recruited, enrollment rates (if applicable) and incentives (if any). How long were expert meetings and focus groups? How long was the online survey administered? Was there follow-up? More details are needed about these procedures.

Authors reply: We have revised the specific paragraphs and have added extra information on eg. recruitment, time, and incentives.

Authors revision: i) review of the literature to explore the most recent developments in injury prevention in running and skiing, and the mechanisms behind the effectiveness of these injury-preventive measures. In March 2016, articles published in PubMed after the year 2000 were searched, using the following terms: injury*, prevent*, running, skiing, snowboard, effect*, intervent*, measure. Reviews, RCTs, and prospective studies were included.

ii) expert meetings (one with running experts and one with skiing experts) were conducted in April 2016, to target high-risk groups and prioritize preventive measures. During these two-hour sessions, the scientific literature on the incidence, prevalence, aetiology, and preventive measures of injuries was discussed, alongside strategies for injury prevention. Sport specific experts were recruited by the Royal Dutch Running Association (RDRA) and the Dutch Skiing Association, and could charge their invested time. The running expert group consisted of a sports physician, a sports physiotherapist, two running coaches, and a researcher in sports injuries. The skiing expert group consisted of three sports physiotherapists/skiers, two employees of the Dutch Skiing Association, and a researcher in sports injuries. The expert meetings were guided by two persons. All the topics, questions, answers, and conclusions were written down during the sessions. The answers and conclusions were used as input information during the development of the intervention. No specific qualitative data analyses program was used.

iii) quantitative study among target populations: an anonymous one-time online survey was distributed among both target populations (running and skiing) in May 2016 and administered for two weeks. The respondents were recruited through social media accounts (Facebook, twitter, LinkedIn) from the RDRA, the Dutch Skiing association, the magazine Runner’s World, and the Dutch Consumer Safety Institute. Respondents who completed the questionnaire were entered into a draw to win a one-year subscription to the Magazine Runner’s World (5 subscriptions in total). The online survey was set up to explore whether the (qualitative) information collected through the expert meetings was largely supported. Questions were formulated in relation to, among others: (i) RRIIs and skiing injuries; (ii) current and future injury-prevention behaviour in running and in skiing; (iii) needs and support for the intervention; (iv) characteristics (content,
form) of the intervention; and (v) effective strategies to deliver the intervention to the athletes. Descriptive statistics, in SPSS version 23, were used to analyse the data from the online survey.

iv) focus group meetings with target populations were conducted in order to establish the best ways to approach runners and skiers for preventive actions. Two two-hour meetings were organized with runners, one with four runners and one with five. Focus group meetings (two hours per meeting) for skiing also consisted of four and five participants. The participants were recruited through the online questionnaire of the quantitative study. At the end of this questionnaire, respondents were asked whether they would like participate in focus group meetings. The participants were randomly selected from a list with respondents willing to participate in further research. Focus group meetings were held in June/July 2016. All participants received a €20 gift voucher. Alike the expert meetings, the focus group sessions were guided by two persons. All questions, answers, and conclusions were written down during the sessions. The answers and conclusions were used as input information during the development of the intervention. No specific qualitative data analyses program was used.

Reviewer’s comment: METHOD 7. It seems that the Fogg Behavior Model would have been selected after the procedures (lit review, expert meetings, surveys, focus groups) were conducted. It may be more reasonable to present this in the results section as part of step 3 (selection of theory) rather than the methods.

Authors reply: The Fogg Behaviour Model was not selected after the procedures. The vision of the creative bureau that guided the development of the intervention is based on this model. The FBM is comparable to other behaviour change models, like the ASE-Model. The content and form of the intervention have been selected after the procedures. We have added some information to the current text on page 6, last paragraph.

Authors revision: The development of the intervention was guided by a creative bureau, specialised in simplifying the choices people have to make and offering easy steps for behavioural change by means of a creative, intuitive, and visual concept. Their vision is, and in accordance, the development of the intervention was based on the Fogg Behaviour Model (FBM) to achieve behaviour change.

Reviewer’s comment: METHOD 8. How were focus group and survey data analyzed?

Authors reply: The survey data were analyses in SPSS, version 23. Only descriptive statistics were used. We have added a sentence about these analyses on page 6. The focus group sessions were guided by two persons. All the topics, questions and answers and conclusions were written
down during the sessions. The answers and conclusions were used as input information during the development of the intervention. No specific qualitative data analyses program was used.

Authors revision: Expert meetings: The expert meetings were guided by two persons. All the topics, questions, answers, and conclusions were written down during the sessions. The answers and conclusions were used as input information during the development of the intervention. No specific qualitative data analyses program was used.

Online survey: Descriptive statistics, in SPSS version 23, were used to analyse the data from the online survey.

Focus group sessions: Alike the expert meetings, the focus group sessions were guided by two persons. All questions, answers, and conclusions were written down during the sessions. The answers and conclusions were used as input information during the development of the intervention. No specific qualitative data analyses program was used.

Reviewer’s comment: RESULTS 9. The actual results from the lit review, expert meetings, quantitative surveys and focus groups are as clearly presented and perhaps provided more as overall summaries, but more detail should be provided. For example, in the assessment results, it seems that all results were summarized in a simplistic fashion. To increase the rigor of this paper, it would help to present specific findings from each piece (lit review, expert meeting, survey, focus groups). Themes should be presented from focus groups and expert meetings. Quantitative results should be presented as well as summary findings from the lit review. All this would help frame how and why decisions were made for the intervention content and development.

Authors reply: The results from the different research methods used are indeed summarized in the result section of the article. To include more details of all these methods would increase the length of the article too much. Hence we have written a nine page appendix to give more insight in the results of the first four research methods used. The results of the co creation sessions and the pre-test are mentioned in step 4 of the results section.

Authors revision: In this article the main results of these four research approaches have been summarized. An more comprehensive overview of the results of these four research approaches is available in Appendix C.
Reviewer’s comment: RESULTS 10. The use of quadrants to classify athletes is interesting. Tell us more about this approach, how it was decided upon and the background literature (if any) on this.

Authors reply: The use of quadrants is based upon the Fogg Behavioural Model (strategy b: increase Ability through the simplicity of the web-based tool (a few, easily accessible and easy-to-perform preventive measures), and by tailoring the intervention towards specific subgroups and adjusting the preventive measures to the characteristics and ability of the subgroup). The specific subgroups for tailoring were based on the two main themes in the expert meetings and focus groups. Obviously this was not made clear enough in our paper. We have revised the specific paragraph on page 8.

Authors revision: The two main risk factors were used to tailor the intervention towards specific subgroups and adjusting the preventive measures to the characteristics and ability of the subgroup (strategy b of the FBM).

Reviewer’s comment: RESULTS 11. Please describe more the use of co-creation sessions. It comes up in the results but it is not clear what this was, and who it involved. Sounds like it was promising and maybe involved athletes? Does this need to be added in the methods?

Authors reply: Co-creation sessions did indeed involve actual athletes. We have added some information to the method section on page 7.

Authors revision: co-creation sessions with target population were held to discuss the first concepts of the intervention. Runners and skiers were invited to comment on content, visuals, and the design of the intervention. A two-hour meeting was organized with three runners, and a two-hour session was organized with three skiers. The participants were recruited from the focus group sessions. The comments of the runners and skiers were used to fine-tune and finalize the intervention.

Reviewer’s comment: RESULTS 12. The short questionnaire that was developed needs to be described more - did this result from the expert feedback, did athletes review? There are very subjective questions - example, "how sensitive are you to injuries" which may be less specific than a more direct question like "how many injuries have you ever sustained while running/skiing". The scales are not described.

Authors reply: The short questionnaire was proposed by the experts, as a simple means of distinguishing target groups, was developed by the creative bureau and a researcher from the
project group. This short questionnaire was judged by athletes several times, during focus group sessions, co-creation sessions and pre-testing, and adjusted to athletes preferred way of determining their own (subjective) fitness/experience/vulnerability/motivation. Athletes commented that they needed to recognize themselves in the questions, and targeting, and the given advices. For example, based on objective data the researchers can decide that an athlete with 2 injuries sustained while running in the past year is vulnerable to RRIs. However, more information is needed, e.g. how many times per week did the athlete run, and how many minutes per session. Furthermore, researchers can decide on the ‘right’ definition of being vulnerable for injuries. This does not automatically mean that athletes agree with this definition. And if they don’t agree, they might disagree with the given advices as well. Therefore they were asked for their subjective opinion. We have added a sentence on the development of the short questionnaire on page 11.

Authors revision: The short questionnaire was proposed by the experts, as a simple means of distinguishing target groups, was developed by the creative bureau and a researcher from the project group. This short questionnaire was judged by athletes several times, during focus group sessions, co-creation sessions and pre-testing, and adjusted to athletes preferred way of determining their own (subjective) fitness/experience/vulnerability/motivation.

Reviewer’s comment: RESULTS 13. Tell us more about the content of the FIS ski slope regulations. This again suggests that there is some integration of policy that became part of the intervention. This is relevant to point 5 above.

Authors reply: FIS has since many decades published guidelines to assist in the promotion of skiing and snowboarding, such as the rules for the conduct of skiers and snowboarders. These are to be used for guidance only and are subject to and do not replace the specific rules applicable to any given ski area, course, park or competition. The FIS Rules must be considered an ideal pattern of conduct for a responsible and careful skier or snowboarder and their purpose is to avoid accidents on the slope. The FIS Rules apply to all skiers and snowboarders. The skier or snowboarder is obliged to be familiar with and to respect them. If he fails to do so, his behaviour could expose him to civil and criminal liability in the event of an accident (www.fis-ski.com). As the purpose of the rules is to avoid danger at the slopes, and all skiers and snowboarders are obliged to be familiar with these rules, one of our advices in the intervention is to read the rules and/or to test your knowledge about these rules.

Reviewer’s comment: DISCUSSION 14. Discussion indicates that actual athletes provided feedback. It is hard to glean this from the results.
Authors reply: It is true that actual athletes provided feedback. Athletes, both runners and skiers were consulted during several stages in the development of the intervention. First in the online questionnaire and the focus group sessions. The information gathered from the survey and focus group sessions was used as input information for the intervention. Second, in co-creation sessions and during a pre-test of the intervention, athletes provided feedback, to improve the actual design of the intervention. We have added a paragraph about the pre-test to the method section. Furthermore, we have added the main results from the co-creation sessions and pre-test to the result section (step 4).

Authors revision: a pre-test of the intervention was held after the intervention was optimized. To recruit the athletes, an email was sent to contact persons of the Dutch Consumer Safety Institute, who were involved in running or skiing, and the participants of the quantitative studies. Those who were interested got access to the intervention and filled in a questionnaire on how they experienced the intervention. Both 17 runners and 17 skiers provided their feedback. The intervention was finalized using their feedback.

Main results of the co-creation sessions: In the co-creation sessions, athletes indicated their final preferences in design and description of all content of the interventions. For example, questions in the questionnaire were adjusted to the target group, categorization of the target group into the four quadrants was discussed, and the visuals in questionnaire and injury prevention advice were finalized. Main focus in these sessions was to maximize the possibility of athletes actually increase injury prevention behaviour.

Main comments of the athletes in the pre-test: One of the main comments was that the introduction page of the intervention was not attractive enough to stimulate the participants to fill in the short questionnaire. Furthermore the aim of the intervention was not clear enough as well. The comments of the runners and skiers were used to fine-tune and finalize the intervention and introduction page. For example, the introduction text was shortened, and more keywords were used. The aim of the intervention, providing an easy way to start with or to change injury preventive behaviour was better explained as well. Finally, some participants commented that this intervention was not appropriate for experienced runners, but only for beginners. That was however exactly what we had in mind with the development of this intervention.
Reviewer’s comment: RESULTS 15. If there were decisions to focus on falls/collisions and broad injuries, again, this is hard to glean from the results.

Authors reply: Experts in running and skiing agreed that a focus on a specific injury was not desirable. This was supported by the review of the literature. It is mentioned in the results section, but we agree that the start of the paragraph in the discussion section is a little bit confusing. Therefore, we have added the following sentences in the discussion session:

Authors revision: During the expert sessions, it was indicated that a focus on a specific type of running or skiing injury was not desirable. This was supported by the review of the literature conducted. While there was no reason to focus attention to specific types of injury, there was evidence for specific risk factors for sustaining a running or skiing injury.

Reviewer’s comment: CONCLUSION 16. Expand the conclusion a bit more to tell the story of the rigorous process of intervention development. That seems to be a key aspect of this study - the process.

Authors reply: The reviewer is right, the conclusion section was a little bit short. We have expanded this section.

Authors revision: This article describes a real-life example of the development of an intervention. It describes required steps in the development, gives insight in the methods used and, the lengthy and time consuming development process. To develop an intervention that fits the needs of the target population, and will be used by them, it is necessary to involve this population as soon as possible. Based on IM and KTS strategies two interventions to stimulate injury-preventive behaviour among runners, skiers, and snowboarders have now been developed.

STIMULATING INJURY-PREVENTIVE BEHAVIOUR IN SPORTS: THE SYSTEMATIC DEVELOPMENT OF TWO INTERVENTIONS

By Kemler, Valkenberg and Gouttebarge

Manuscript SSMR-D-18-00030
Reviewer’s comment: The article describes the development of two interventions so it is not what is generally considered a 'study'. Overall, I found the article of interest but am not sure how applicable the learnings will be to other researchers. The authors have done an excellent job at applying health promotion to developing sports injury prevention interventions. The have also provide a good summary of the relevant background literature on this topic. My main issue with this article is that it does not provide enough justification for the approach used and there is not sufficient discussion about the principles underpinning the planning models used to enable the reader the understand 'why' this approach was taken.

Authors reply: We thank the reviewer for his or her time reviewing our manuscript, as well as for the useful comments and suggestions. We strived to alter the manuscript appropriately by providing the readers with more information about the approach and principles underpinning the planning models used.

Reviewer’s comment: I think the authors need to be clear about the purpose of the article. At present the purpose of the article is stated as describing "the development of both interventions". I am not convinced that describing a process for developing an intervention is a significant contribution to the scientific literature without a more detailed description of why the approach was undertaken and how it is an improvement of previous approaches to intervention development.

Authors reply: We thank the reviewer for his comment. We have added more information about why describing the development is a significant contribution.

Authors revision: It is well-known the development of effective (behavior change) interventions and implementation of these (cost)-effective interventions under real-life conditions are an ongoing challenge [21-22]. It is important to take the complex nature of sports injuries into account. Both quantitative and qualitative research is needed to give insight in this complex nature [22]. In sport injury-prevention research, interventions have often been developed following structured and systematic processes often applied in health promotion research, namely Intervention Mapping (IM) and Knowledge Transfer Scheme (KTS) [23-25]. The current article describes a real-life example of the development of two interventions to change injury preventive behaviour, to give insight in the execution of the development of an intervention, e.g. in the required steps, the different research methods used and, the lengthy and time consuming development process.
Reviewer’s comment: I think this paper would really benefit from a visual representation of the intervention development process that could be used as a template for readers to follow when developing interventions in the future

Authors reply: The steps we took in the developmental process are steps of IM and KTS. We agree that readers might benefit from visualisation of the steps. A visual representation of these steps are available online in the mentioned references. We could refer to these visual representations in appendices.

Authors revision: See appendix A and B.