Physical Therapy in Sport 37 (2019) 164–170

Contents lists available at ScienceDirect

Physical Therapy in Sport

journal homepage: www.elsevier.com/ptsp

Original Research

Effects of tailored advice on injury prevention knowledge and behaviours in runners: Secondary analysis from a randomised controlled trial

Heather Hollman [a, *], Allison Ezzat [b, c, d], Jean-Francois Esculier [e], Paul Gustafson [f], Alex Scott [e]

[a] UBC Rehabilitation Science Online Programs, Faculty of Medicine, Vancouver Campus, T325-2211 Wesbrook Mall, Vancouver, BC, V6T 2B5, Canada
[b] UBC School of Population & Public Health, 2206 East Mall, Vancouver, BC, V6T 1Z3, Canada
[c] BC Children's Hospital Research Institute, 938 West 28th Avenue, Vancouver, BC, V5Z 4H4, Canada
[d] Sport Injury Prevention Research Centre, University of Calgary, 2500 University Drive, NW, Calgary, AB, T2N 1N4, Canada
[e] UBC Department of Physical Therapy, Faculty of Medicine, 212 Friedman Building, 2177 Wesbrook Mall, Vancouver, BC, V6T 1Z3, Canada
[f] UBC Department of Statistics, Faculty of Science, 3182 Earth Sciences Building, 2207 Main Mall, Vancouver, BC, V6T 1Z4, Canada

ARTICLE INFO

Article history:
Received 8 February 2019
Received in revised form
4 April 2019
Accepted 5 April 2019

Keywords:
Running
Education
Physical activity
Health

ABSTRACT

Objectives: To determine whether biweekly tailored advice was more effective than general advice at baseline alone for enhancing evidence-based running-related injury (RRI) prevention knowledge and behaviours in runners.
Design: Randomised controlled trial, blinded statistical analysis, secondary analysis.
Setting: Recreational running clinics.
Participants: Running clinics were cluster randomised into intervention or control groups. All participants (n = 51) received general RRI prevention advice (baseline), after which the intervention group (n = 31) received additional biweekly tailored advice (weeks 3–11), before all participants completed a Final Questionnaire (week 13).
Main outcome measures: Between-group differences in change of evidence-based RRI prevention knowledge and behaviours.
Results: Compared to baseline, the number of correct knowledge responses significantly increased in the intervention group (5.77, 95% CI 4.73, 6.81) and remained unchanged in controls (0.25, 95% CI -1.04, 1.55), outlining a positive effect only in the intervention group ($p = 2.06 \times 10^{-8}$). The number of correct behaviour responses significantly increased in the intervention group (1.94, 95% CI 0.94, 2.93) however this increase was not significantly greater than controls ($p = 0.075$).
Conclusions: Biweekly tailored advice improved RRI prevention knowledge in runners. Further research into the impact of knowledge and behavioural change on RRI occurrence is warranted.
ISRCTN 17357362

1. Introduction

Running is a common and easily accessible form of physical activity associated with many health benefits (Kozlovskaia et al., 2018). Unfortunately, it can also result in a high incidence of running-related injury (RRI) with a recent systematic review reporting 17.8 RRIs per 1000 hours (h) of running in novice runners and 7.7 RRIs per 1000 h in recreational runners (Videbæk, Bueno, Nielsen, & Rasmussen, 2015). Videbæk et al. (2015) didn't explicitly define the difference between novice and recreational runners but examples of baseline characteristics of novice runners included either not running previously or not running on a regular basis for the past 12 months and those of recreational runners included those who ran 10 km per week or those who ran at least once a week between 9.4 and 10.8 times in the last 12 months. RRIs not only prevent individuals from accomplishing goals and participating in necessary physical activity for optimal health, but also result in societal and economic burdens such as increased

* Corresponding author.
E-mail addresses: h.hollman@alumni.ubc.ca (H. Hollman), aezzat@bcchr.ca (A. Ezzat), jean-francois.esculier@ubc.ca (J.-F. Esculier), gustaf@stat.ubc.ca (P. Gustafson), ascott@mail.ubc.ca (A. Scott).

https://doi.org/10.1016/j.ptsp.2019.04.003
1466-853X/

healthcare utilization and absence from work (Hespanhol Junior, van Mechelen, Postuma, & Verhagen, 2016).

Risk factors for RRIs in recreational runners include maladaptive training factors (i.e. too much too fast) (Damsted, Glad, Nielsen, Sørensen, & Malisoux, 2018), history of prior injury in the last 12 months (Hulme, Nielsen, Timpka, Verhagen, & Finch, 2017; Saragiotto et al., 2014; van Gent et al., 2007), minimal running experience (Videbæk et al., 2015), and biomechanical factors such as high peak braking force (Napier, MacLean, Maurer, Taunton, & Hunt, 2018). Most recreational runners are not aware of the risk factors identified in the scientific literature (Saragiotto, Yamato, & Lopes, 2014).

A systematic review in 2001 found a lack of evidence to support many RRI prevention intervention strategies (Yeung & Yeung, 2001). RRI prevention interventions suggested by more recent literature include wearing comfortable running shoes (Nigg, Baltich, Hoerzer, & Enders, 2015), alternating between at least 2 different pairs (Malisoux et al., 2015), cross-training (Malisoux et al., 2015), maintaining load under 30% (optimally under 10%) increase per week (Nielsen et al., 2014), and interval training (van Poppel, de Koning, Verhagen, & Scholten-Peeters, 2016).

Despite best efforts, RRI rates remain high and more recent efforts are transitioning to a multifaceted approach (Adriaensens, Hesselink, Fabrie, Brugmans, & Verhagen, 2014; Hespanhol Junior, van Mechelen, & Verhagen, 2018). Adriaensens et al. (2014) found online multifaceted advice given to runners was effective on determinants and actual performance of RRI prevention behaviours. Hespanhol Junior et al. (2018) did not find this same effect, however they did find that tailored online advice reduced the prevalence of RRIs in a cohort of trail-runners. To the best of our knowledge, no study to date has looked at the effectiveness of tailored online advice on enhancing RRI prevention knowledge and/or behaviours in recreational road runners training for a 10 km road race.

The SportMedBC Vancouver Sun Run 'InTraining Program' is a 13-week graduated program that is designed to train beginner and experienced runners to complete a 10 km road race (Taunton et al., 2003). The intention of the InTraining Program is to prevent RRI, however a study in 2003 found an RRI incidence of 29.5% in this clinic (Taunton et al., 2003).

The original RCT sought to determine whether biweekly tailored online advice, in addition to general advice at baseline, was more effective than general advice at baseline alone for decreasing RRI prevalence in runners training with the InTraining Program. In the present study, a secondary analysis of the RCT was conducted with particular regards to RRI prevention knowledge and behaviours in runners training with the InTraining Program.

2. Methods

2.1. Study design

This study involved analysis of secondary outcomes from an RCT. The full RCT was previously registered with the International Standard Randomised Controlled Trial Number Registry (ISRCTN17357362) and approved by the University of British Columbia Behavioural Research Ethics Board. It took place from January 2018 to April 2018 for the 13 weeks of the InTraining Program and was based on the methods and intervention used by Hespanhol Junior et al. (2018).

2.2. Recruitment and study participants

Clinic Coordinators of the 55 clinics of various locations throughout British Columbia, Canada were asked to email study posters and web links to their clinic participants during the first 3 weeks of the InTraining Program. The web link took participants to an online study participation consent form and sign up page. Individuals eligible to participate had to currently be registered for the LearntoRun10K, RunWalk10K, or Run10KStronger of the InTraining Program, be 18 years or older, agree to participate through online informed consent, and provide their email address. Participants were excluded if they were a Clinic Coordinator or Leader, had a current RRI at the beginning of the study, or sustained an RRI during the first 3 weeks (prior to commencement of the intervention).

2.3. Questionnaires

A Baseline Questionnaire was given during weeks 1, 2, and 3, immediately after completing the online consent form and included questions on personal demographics, running experience, running program, history of RRIs (last 12 months) and current RRIs (Hespanhol Junior et al., 2018). It also included checkbox questions on RRI prevention knowledge and behaviours. Both responses that aligned with the most recent evidence along with responses that didn't align were available for selection on the checkbox questions and were based on the questionnaires used by Hespanhol Junior et al. (2018) and knowledge described by Saragiotto, Yamato, and Lopes (2014) in recreational runners. Responses that aligned with most recent evidence were considered ‘correct’ responses and those that didn't were considered ‘incorrect.’

The Follow-Up Questionnaires were given on weeks 3, 5, 7, 9, and 11, and were used to monitor running exposure and RRIs sustained. Running exposure was measured as the sum of the number and time (minutes) of InTraining Program running sessions plus additional or replacement sessions from the recommended running sessions completed during the 2 preceding weeks. RRIs were defined using the Delphi consensus definition “running related (training or competition) musculoskeletal pain in the lower limbs that causes a restriction on or stoppage of running (distance, speed, duration, or training) for at least 7 days or 3 consecutive scheduled training sessions, or that requires the runner to consult a physician or other health professional” (Yamato, Saragiotto, & Lopes, 2015). If an RRI was sustained, participants were asked to report the anatomical location, injury type, a description of the symptoms and onset, and the number of days of training lost (i.e. not fully accomplished or completely missed due to injury). In the case of multiple injuries during this period, participants were asked to register the injury that caused the most complaints. Any additional injuries could be recorded in an open question at the end. Participants were instructed to report all problems, regardless of whether they had already been reported in previous biweekly periods.

The Final Questionnaire, given on week 13, included questions about running exposure and RRIs sustained, along with checkbox questions on RRI prevention knowledge and behaviours similar to the Baseline Questionnaire (Hespanhol Junior et al., 2018). It also included a checkbox question for the sources of RRI prevention advice that runners used most and an open-ended question asking what prevented them from practicing RRI prevention interventions.

2.4. Randomisation

Prior to commencement of the InTraining Program, the 55 clinics were randomly and blindly allocated into intervention and control groups by HH and AS using sealed opaque envelopes. The randomisation was balanced and stratified by clinic size.

2.5. Blinding

It was not possible to blind the participants to group allocation

since they were notified in the consent form that their clinic would either be matched to the group that would receive biweekly advice or to the group that would not. All analyzed results had identifying information removed. The biostatistician (PG) was blinded to group allocation.

2.6. Intervention

All online advice for prevention of RRI was developed based on the most up-to-date research supporting prevention of RRIs at primary, secondary, and tertiary levels (Jacobsson & Timpka, 2015), along with the intervention used by Hespanhol Junior et al. (2018). Both control and intervention groups were provided with general RRI prevention advice during weeks 1, 2 or 3. During weeks 3, 5, 7, 9, and 11, only the intervention group received additional, biweekly advice that was tailored to their profile of Non-RRI, Non-Substantial RRI, or Substantial RRI determined using the 4 questions of the Oslo Sports Trauma Research Centre questionnaire on Health Problems (OSTRCQHP) (Clarsen, Rønsen, Myklebust, Flørenes, & Bahr, 2014), similar to the intervention used by Hespanhol Junior et al. (2018).

2.7. Outcome measures

The secondary outcome measures reported and analyzed here included 1) the change in number of correct responses for checkbox questions on RRI prevention knowledge and behaviours between Baseline and Final Questionnaires, 2) number of responses to sources of RRI prevention advice most used, and 3) a summary of common barriers that prevented participants from participating in the recommended RRI prevention interventions.

2.8. Statistical analyses

Initially, a cluster RCT design was chosen to prevent cross-contamination between the intervention and control group within each of the 55 clinics by ensuring that all participants within a given clinic were randomised to the same intervention (Campbell, Piaggio, Elbourne, & Altman, 2012): in the final analysis, the individual was the unit of analysis, because the clustering factor was not significant.

The difference in change of correct RRI prevention knowledge and behaviour responses using a simple regression linear mixed model with an x-coefficient indicating improvement of the intervention group compared to the control group and an intercept indicating the improvement of the control group compared to zero was calculated. The linear mixed model accounted for variation in the baseline scores. Participants who didn't complete the Final Questionnaire were excluded from this analysis. Within-clinic correlation was calculated to determine whether the model should be fitted to cluster or rather a simple regression; as a result of this analysis, the cluster effect was dropped from the model.

The sources of RRI prevention advice most used were calculated with percentages. The open-ended responses for the question on RRI prevention intervention barriers were summarized after combining common themes into separate groups. A detailed qualitative analysis was not needed since the majority of respondents reported the same answer.

3. Results

3.1. Participants

A total of 64 participants from 26 clinics enrolled in the study out of the potentially eligible 55 clinics who were invited. A subset of 51 participants (80%) were included for the intention-to-treat analysis of RRI prevention knowledge and behaviours with 20 in the control group and 31 in the intervention group: 13 participants were excluded from this analysis since they did not complete the Final Questionnaire. The flow of clinics and runners is shown in Fig. 1.

Baseline characteristics of the runners in each group are shown in Table 1.

The mean age was 48.8, 48.9, and 47.0 years and proportion of females was 80%, 68%, and 76% for the control group, intervention group, and entire pool of InTraining Participants respectively. In the control group, mean BMI was 27.3 kg/m^2, 50% were in the

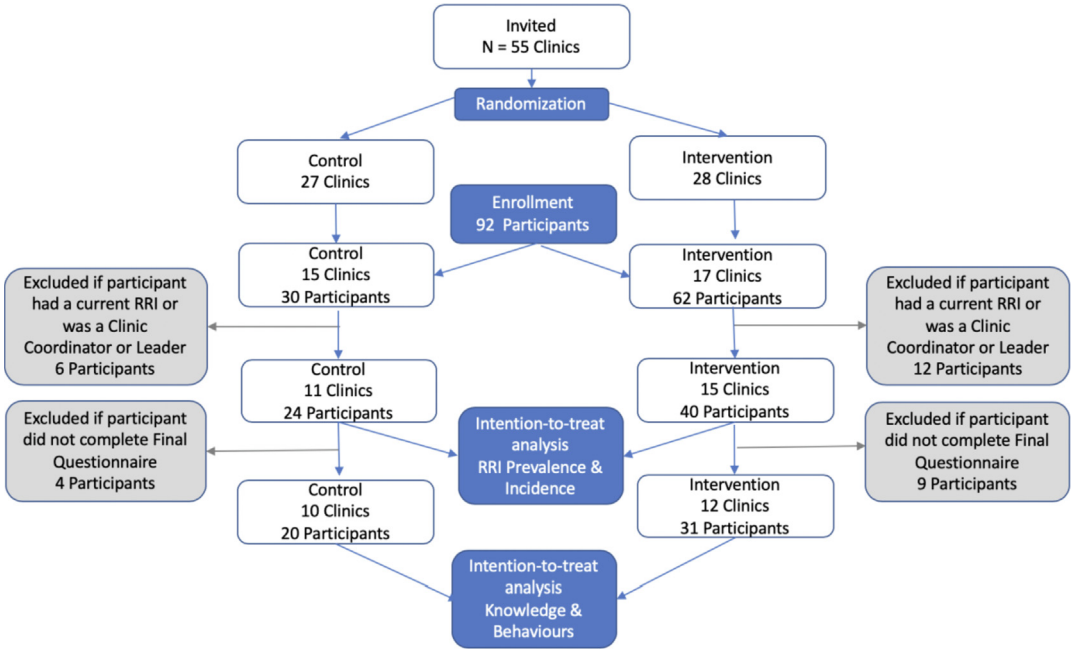

Fig. 1. Flow of the clinics and participants throughout the study.

Table 1
Baseline characteristics for participants included in the second intention-to-treat analysis for RRI prevention knowledge and behaviours.

		Control	Intervention	Total InTraining Participants 2018
Participants	Total	20	31	1765
	Female	16 (80%)	21 (68%)	1345 (76%)
	Male	4 (20%)	10 (32%)	420 (24%)
Age (years)	Total	48.8 (95% CI 43.0, 54.6)	48.9 (95% CI 44.9, 52.9)	47
	Female	45.1 (95% CI 40.0, 50.6)	47.7 (95% CI 43.1, 52.2)	
	Male	63.5 (95% CI 53.9, 73.1)	51.4 (95% CI 43.4, 59.4)	
BMI (kg/m^2)	Total	27.3 (95% CI 24.8, 29.8)	26.4 (95% CI 25.0, 27.7)	
	Female	27.0 (95% CI 24.1, 29.9)	26.4 (95% CI 24.6, 28.2)	
	Male	28.4 (95% CI 23.7, 33.0)	26.3 (95% CI 24.6, 28.0)	
Running Group	RunWalk10K	3 (15%)	7 (23%)	
	LearntoRun10K	10 (50%)	18 (58%)	
	Run10KStronger	7 (35%)	6 (19%)	
Previous Running Experience (Are you new to running?)	Yes, totally new to running	5 (25%)	8 (26%)	
	Yes, I have only started running within the last year	2 (10%)	3 (10%)	
	No, but I haven't been running consistently for the past year	10 (50%)	18 (58%)	
	No, and I have been running consistently for the last year	3 (15%)	2 (6%)	

LearntoRun10K group, and 85% were either new to running within the past year or hadn't been running consistently for the past year. In the intervention group, mean BMI was 26.4 kg/m^2, 58% were in the LearntoRun10K group, and 94% were either new to running within the past year or hadn't been running consistently for the past year.

3.2. Response rate to follow-up and final questionnaires

The mean response rate on the 5 Follow-Up and Final Questionnaires was 87.6% (95% CI 83.1, 92.2), with mean 90.3% (95% CI 83.7, 96.8) in the control group and mean 85.0% (95% CI 78.9, 91.1) in the intervention group.

3.3. RRI prevention knowledge and behaviours

Selection of RRI prevention knowledge and behaviours can be seen in Tables 2 and 3.

Participants in the intervention group selected a mean of 5.77 (95% CI 4.73, 6.81, $p = 4.76 \times 10^{-15}$) more correct knowledge responses on the Final Questionnaire compared to the Baseline Questionnaire which was significantly different than zero. Meanwhile the control group selected 0.25 (95% CI -1.04, 1.55, $p = 0.70$) more correct knowledge responses, which was not significantly different from zero. The difference in these increases, 5.52, was statistically significant (95% CI 3.86, 7.19, $p = 2.06 \times 10^{-8}$), suggesting a benefit of the intervention.

Participants in the intervention group selected a mean of 1.94 (95% CI 0.94, 2.93, $p = 2.78 \times 10^{-4}$) more correct behaviour responses on the Final Questionnaire compared to the Baseline Questionnaire, whereas the corresponding increase in the control group was 0.50 (95% CI -0.74, 1.74, $p = 0.42$) more correct responses. The difference in these increases, 1.44, was not statistically significant (95% CI -0.15, 3.02, $p = 0.075$). No within-clinic correlation was found for either analysis on knowledge or behaviours.

Sources of RRI prevention advice most used is seen in Table 4.

The intervention group received advice at baseline plus additional biweekly tailored advice and 87% reported using this advice. The control group received advice at baseline alone and 45% of participants reported using this advice.

3.4. Open ended question: Barriers to practicing RRI prevention interventions

Most respondents (91%) stated there wasn't anything that prevented them from practicing RRI prevention interventions. 2

Table 2
RRI prevention knowledge on Final Questionnaire.

	Control No RRI (n = 11)	Control RRI (n = 9)	Intervention No RRI (n = 18)	Intervention RRI (n = 13)
Alternate between at least 2 different pairs of running shoes[a]	6 (55%)	2 (22%)	13 (72%)	6 (46%)
Cross-train with water running, cycling, or swimming[a]	8 (73%)	6 (67%)	15 (83%)	12 (92%)
Follow a consistent training program[a]	11 (100%)	8 (89%)	16 (89%)	13 (100%)
Listen to my body[a]	11 (100%)	9 (100%)	16 (89%)	13 (100%)
Practice warm-ups and cool-downs before and after my runs[a]	10 (91%)	8 (89%)	16 (89%)	13 (100%)
Reduce my running volume or intensity if I feel an injury coming on[a]	9 (82%)	6 (67%)	17 (94%)	12 (92%)
Seek advice from a Healthcare Professional for new injuries[a]	8 (73%)	7 (78%)	16 (89%)	12 (92%)
Seek advice from a Healthcare Professional for previous running injuries[a]	8 (73%)	2 (22%)	9 (50%)	10 (77%)
Static stretching after running	11 (100%)	8 (89%)	14 (78%)	12 (92%)
Static stretching before running	6 (55%)	3 (33%)	5 (28%)	8 (62%)
Take time off if I feel an injury coming on[a]	7 (64%)	3 (33%)	9 (50%)	10 (77%)
Understand my risks[a]	8 (73%)	4 (44%)	12 (67%)	11 (85%)
Wear comfortable running shoes[a]	8 (73%)	7 (78%)	16 (89%)	11 (85%)
Wear compression clothes	3 (27%)	4 (44%)	2 (11%)	5 (38%)
Wear running shoes according to my foot type	11 (100%)	8 (89%)	12 (67%)	8 (62%)
Wear cushioned running shoes	6 (55%)	4 (44%)	4 (22%)	7 (54%)
Other	0	0	1 (6%)	0

[a] These items are supported by up-to-date research to prevent RRI. Therefore, high percentages indicate accurate knowledge of current evidence.

Table 3
RRI prevention behaviours on Final Questionnaire.

	Control No RRI (n = 11)	Control RRI (n = 9)	Intervention No RRI (n = 18)	Intervention RRI (n = 13)
Alternate between at least 2 different pairs of running shoes[a]	5 (45%)	1 (11%)	7 (39%)	5 (38%)
Cross-train with water running, cycling, or swimming[a]	3 (27%)	2 (22%)	8 (44%)	6 (46%)
Follow a consistent training program[a]	10 (91%)	6 (67%)	13 (72%)	11 (85%)
Listen to my body[a]	8 (73%)	7 (78%)	15 (83%)	12 (92%)
Nothing	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Practice warm-ups and cool-downs before and after my runs[a]	10 (91%)	9 (100%)	13 (72%)	13 (100%)
Reduce my running volume or intensity if I feel an injury coming on[a]	8 (73%)	5 (56%)	14 (78%)	10 (77%)
Seek advice from a Healthcare Professional for new injuries[a]	4 (36%)	6 (67%)	5 (28%)	9 (69%)
Seek advice from a Healthcare Professional for previous running injuries[a]	4 (36%)	2 (22%)	2 (22%)	4 (31%)
Static stretching after running	9 (82%)	5 (56%)	9 (50%)	11 (85%)
Static stretching before running	5 (45%)	2 (22%)	2 (11%)	5 (38%)
Take time off if I feel an injury coming on[a]	7 (64%)	4 (44%)	8 (44%)	7 (54%)
Understand my risks[a]	3 (27%)	4 (44%)	10 (56%)	6 (46%)
Wear comfortable running shoes[a]	8 (73%)	4 (44%)	16 (89%)	8 (62%)
Wear compression clothes	2 (18%)	4 (44%)	2 (11%)	3 (23%)
Wear running shoes according to my foot type	11 (100%)	7 (78%)	10 (56%)	6 (46%)
Wear cushioned running shoes	5 (45%)	4 (44%)	7 (39%)	3 (23%)
Other	0	0	1 (6%)	0

[a] These items are supported by up-to-date research to prevent RRI. Therefore, high percentages indicate accurate behaviours that align with current evidence.

Table 4
Sources of RRI prevention advice used on Final Questionnaire.

	Control No RRI (n = 11)	Control RRI (n = 9)	Intervention No RRI (n = 18)	Intervention RRI (n = 13)
The advice from this study	6 (55%)	3 (33%)	16 (89%)	11 (85%)
The advice given in the weekly InTraining Program emails	8 (73%)	5 (56%)	10 (56%)	8 (62%)
The advice I received from my Healthcare Professional	2 (18%)	5 (56%)	2 (11%)	7 (54%)
The advice I received from a Healthcare Professional that did a talk at my InTraining Clinic	6 (55%)	2 (22%)	3 (17%)	2 (15%)
Online Website	4 (36%)	5 (56%)	1 (6%)	4 (31%)
Book	1 (9%)	0	2 (11%)	2 (15%)
Magazine	1 (9%)	1 (11%)	0	1 (8%)
Other	1 (9%)	0	4 (22%)	0

respondents reported they either couldn't afford or didn't have a second newer pair of running shoes to alternate with and 1 respondent reported her own personal time was in the way of practicing RRI prevention interventions.

4. Discussion

4.1. Effectiveness of the intervention

This study found a shift of RRI prevention knowledge and a trend toward a shift in behaviours which were consistent with evidence-based guidelines on RRI prevention. The shift in knowledge has not previously been studied in recreational runners and is a promising finding considering previous literature on recreational runners found that they weren't knowledgeable about evidence-based RRI risks (Saragiotto, Yamato, & Lopes, 2014). The shift in behaviours is inconsistent in previous literature with Adriaensens et al. (2014) reporting a similar change and Hespanhol Junior et al. (2018) reporting no change. One of the reasons for applying this intervention was to mitigate the group think phenomenon that exists within groups of runners (Parker, Weitzenberg, Amey, & Nied, 2011) by providing advice tailored to the individual. Perhaps further methods were needed to manage additional psychological aspects such as personal standards, concerns over mistakes, and doubts about actions, which are facets of perfectionism and were recently found to be associated with increased RRI risk (Luedke, Wallace, Puleo, & Rauh, 2018).

The connection between RRI prevention knowledge and behaviours, as seen in this study, along with determinants and behaviours, as seen by Adriaensens et al. (2014) and Hespanhol Junior et al. (2018), are based on cognitivist theories of behaviour change. Research on health behaviours has found that such information-based connections may not account for significant portions of behavioural variance (Strack & Deutsch, 2004). A dual-process conceptualization might be more appropriate that includes the influences of affect, such as daily energy state or pleasure and displeasure responses to previous behaviours (Williams & Evans, 2014). Perhaps these influences also accounted for the proportion of participants in each group who reported using the advice provided from this study in comparison to other sources of RRI prevention advice.

4.2. Barriers that prevent runners from practicing RRI prevention interventions

To our knowledge, no other study has looked at barriers to practicing RRI prevention interventions. The majority of participants (91%) reported nothing prevented them from practicing the recommended interventions. Future studies should examine whether subconscious barriers to RRI prevention behaviours exist such as those related to motivation or perceived satisfaction (Chan & Hagger, 2012; Williams et al., 2008).

4.3. Strengths and limitations of this study

Strengths included a high follow up rate, indicating compliance and low attrition bias, and the concealment of clinic allocated to intervention or control group, reducing selection bias. Type 1 error

was minimally present for the intervention effect on behavioural change (p-value of 0.075). The low study registration was surprising considering it was a simple online sign-up and the majority of participants signed up for the InTraining Program itself through an online platform. This might have been due to the limited time available within the 13-weeks, especially since Clinic Coordinators didn't have contact with participants until week 1 of the program and participants were able to sign up for the InTraining Program for 3 weeks after the start date. It is not uncommon for an RRI prevention study to have a small sample size and emphasis should be put on recruitment optimization in future studies (Verhagen, 2012). There was no follow up after the end of the InTraining Program, which prevents determination of longer term effects of the intervention. A longer follow up was not completed because it was understood that the majority of participants in the InTraining Program would not continue running after the 13-weeks and the purpose of the study was to see if a change could be made within the InTraining Program duration. Finally, we were unable to determine whether the treatment effects were due to the multiple prevention levels included in the tailored RRI prevention advice or simply the higher volume of RRI prevention advice.

5. Conclusion

This study found that delivering an online RRI prevention program resulted in positive changes in RRI prevention knowledge and a trend towards positive change in behaviours. Further study is needed to see if observed trends toward improvement in RRI prevention knowledge and behaviour can translate to reduction in RRI prevalence and incidence and whether this holds true in a larger group of runners.

Conflicts of interest

None declared.

Ethical approval

This study was approved by the University of British Columbia Behavioural Research Ethics Board. Participants gave informed consent for their participation in the study.

Clinical trial registry

The full RCT was registered with the International Standard Randomised Controlled Trial Number Registry (ISRCTN17357362).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The authors would like to thank the study participants along with SportMedBC, SportMedBC Vancouver Sun Run InTraining Program, Vancouver Sun, and Vancouver Sun Run for their participation and support of this study.

References

Adriaensens, L., Hesselink, A., Fabrie, M., Brugmans, M., & Verhagen, E. (2014). Effectiveness of an online tailored intervention on determinants and behaviour to prevent running related sports injuries: A randomised controlled trial. *Schweizerische Zeitschrift Für Sportmedizin & Sporttraumatologie, 62*(3).

Campbell, M. K., Piaggio, G., Elbourne, D. R., & Altman, D. G. (2012). Consort 2010 statement: Extension to cluster randomised trials. *BMJ British Medical Journal, 345*. https://doi.org/10.1136/bmj.e5661.

Chan, D. K., & Hagger, M. S. (2012). Theoretical integration and the psychology of sport injury prevention. *Sports Medicine, 42*(9), 725–732. https://doi.org/10.1007/BF03262291.

Clarsen, B., Rønsen, O., Myklebust, G., Flørenes, T. W., & Bahr, R. (2014). The oslo sports trauma research center questionnaire on health problems: A new approach to prospective monitoring of illness and injury in elite athletes. *British Journal of Sports Medicine, 48*(9), 754–760. https://doi.org/10.1136/bjsports-2012-092087.

Damsted, C., Glad, S., Nielsen, R. O., Sørensen, H., & Malisoux, L. (2018). Is there evidence for an association between changes in training load and running-related injuries? A systematic review. *International Journal of Sports Physical Therapy, 13*(6), 931.

van Gent, R. N., Siem, D., van Middelkoop, M., van Os, A. G., Bierma-Zeinstra, S. M. A., Koes, B. W., et al. (2007). Incidence and determinants of lower extremity running injuries in long distance runners: A systematic review commentary. *British Journal of Sports Medicine, 41*(8), 469–480. https://doi.org/10.1136/bjsm.2006.033548.

Hespanhol Junior, L. C., van Mechelen, W., Postuma, E., & Verhagen, E. (2016). Health and economic burden of running-related injuries in runners training for an event: A prospective cohort study: Health and economic burden of running injuries. *Scandinavian Journal of Medicine & Science in Sports, 26*(9), 1091–1099. https://doi.org/10.1111/sms.12541.

Hespanhol Junior, L. C., van Mechelen, W., & Verhagen, E. (2018). Effectiveness of online tailored advice to prevent running-related injuries and promote preventive behaviour in Dutch trail runners: A pragmatic randomised controlled trial. *British Journal of Sports Medicine, 52*(13), 851–858. https://doi.org/10.1136/bjsports-2016-097025.

Hulme, A., Nielsen, R. O., Timpka, T., Verhagen, E., & Finch, C. (2017). Risk and protective factors for middle- and long-distance running-related injury. *Sports Medicine, 47*(5), 869–886. https://doi.org/10.1007/s40279-016-0636-4.

Jacobsson, J., & Timpka, T. (2015). Classification of prevention in sports medicine and epidemiology. *Sports Medicine, 45*(11), 1483–1487. https://doi.org/10.1007/s40279-015-0368-x.

Kozlovskaia, M., Vlahovich, N., Rathbone, E., Manzanero, S., Keogh, J., & Hughes, D. C. (2018). A profile of health, lifestyle and training habits of 4720 Australian recreational runners-the case for promoting running for health benefits. *Health Promotion Journal of Australia*. https://doi.org/10.1002/hpja.30.

Luedke, L. E., Wallace, B. J., Puleo, M. L., & Rauh, M. J. (2018). Perfectionist concerns predict injury risk in collegiate distance runners - preliminary findings from a prospective study: 2354 board #190 june 19. *Medicine & Science in Sports & Exercise, 50*, 580. https://doi.org/10.1249/01.mss.0000537001.49263.cf.

Malisoux, L., Ramesh, J., Mann, R., Seil, R., Urhausen, A., & Theisen, D. (2015). Can parallel use of different running shoes decrease running-related injury risk? *Scandinavian Journal of Medicine & Science in Sports, 25*(1), 110–115. https://doi.org/10.1111/sms.12154.

Napier, C., MacLean, C. L., Maurer, J., Taunton, J. E., & Hunt, M. A. (2018). Kinetic risk factors of running-related injuries in female recreational runners. *Scandinavian Journal of Medicine & Science in Sports, 28*(10), 2164–2172. https://doi.org/10.1111/sms.13228.

Nielsen, R.Ø., Parner, E. T., Nohr, E. A., Sørensen, H., Lind, M., & Rasmussen, S. (2014). Excessive progression in weekly running distance and risk of running-related injuries: An association which varies according to type of injury. *Journal of Orthopaedic & Sports Physical Therapy, 44*(10), 739–747. https://doi.org/10.2519/jospt.2014.5164.

Nigg, B. M., Baltich, J., Hoerzer, S., & Enders, H. (2015). Running shoes and running injuries: Mythbusting and a proposal for two new paradigms: 'Preferred movement path' and 'comfort filter. *British Journal of Sports Medicine, 49*(20), 1290–1294. https://doi.org/10.1136/bjsports-2015-095054.

Parker, D. T., Weitzenberg, T. W., Amey, A. L., & Nied, R. J. (2011). Group training programs and self-reported injury risk in female marathoners. *Clinical Journal of Sport Medicine, 21*(6), 499–507. https://doi.org/10.1097/JSM.0b013e3182377080.

van Poppel, D., de Koning, J., Verhagen, A. P., & Scholten-Peeters, G. G. M. (2016). Risk factors for lower extremity injuries among half marathon and marathon runners of the lage landen Marathon Eindhoven 2012: A prospective cohort study in The Netherlands: Risk factors for lower extremity injuries in runners. *Scandinavian Journal of Medicine & Science in Sports, 26*(2), 226–234. https://doi.org/10.1111/sms.12424.

Saragiotto, B. T., Yamato, T. P., Hespanhol, L. C., Rainbow, M. J., Davis, I. S., & Lopes, A. D. (2014). What are the main risk factors for running-related injuries? *Sports Medicine, 44*(8), 1153–1163. https://doi.org/10.1007/s40279-014-0194-6.

Saragiotto, B. T., Yamato, T. P., & Lopes, A. D. (2014). What do recreational runners think about risk factors for running injuries? A descriptive study of their beliefs and opinions. *Journal of Orthopaedic & Sports Physical Therapy, 44*(10), 733–738. https://doi.org/10.2519/jospt.2014.5710.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220–247. https://doi.org/10.1207/s15327957pspr0803_1.

Taunton, J. E., Ryan, M. B., Clement, D. B., McKenzie, D. C., Lloyd-Smith, D. R., & Zumbo, B. D. (2003). A prospective study of running injuries: The Vancouver Sun Run "in training" clinics. *British Journal of Sports Medicine, 37*(3), 239–244. https://doi.org/10.1136/bjsm.37.3.239.

Verhagen, E. A. L. M. (2012). Prevention of running-related injuries in novice runners: Are we running on empty? *British Journal of Sports Medicine, 46*(12),

836–837. https://doi.org/10.1136/bjsports-2012-091505.
Videbæk, S., Bueno, A. M., Nielsen, R. O., & Rasmussen, S. (2015). Incidence of running-related injuries per 1000 h of running in different types of runners: A systematic review and meta-analysis. *Sports Medicine, 45*(7), 1017–1026. https://doi.org/10.1007/s40279-015-0333-8.
Williams, D. M., & Evans, D. R. (2014). Current emotion research in health behavior science. *Emotion Review, 6*(3), 277–287. https://doi.org/10.1177/1754073914523052.
Williams, D. M., Lewis, B. A., Dunsiger, S., Whiteley, J. A., Papandonatos, G. D., Napolitano, M. A., … Marcus, B. H. (2008). Comparing psychosocial predictors of physical activity adoption and maintenance. *Annals of Behavioral Medicine, 36*(2), 186–194. https://doi.org/10.1007/s12160-008-9054-7.
Yamato, T. P., Saragiotto, B. T., & Lopes, A. D. (2015). A consensus definition of running-related injury in recreational runners: A modified delphi approach. *Journal of Orthopaedic & Sports Physical Therapy, 45*(5), 375–380. https://doi.org/10.2519/jospt.2015.5741.
Yeung, E. W., & Yeung, S. S. (2001). A systematic review of interventions to prevent lower limb soft tissue running injuries. *British Journal of Sports Medicine, 35*(6), 383–389. https://doi.org/10.1136/bjsm.35.6.383.