

ORIGINAL ARTICLE

Effectiveness of an online tailored intervention on determinants and behaviour to prevent - running related sports injuries: a randomised controlled trial

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Abstract

Objective. Sports injuries are one of the most common injuries in the modern Western society. In line with the increased interest in eHealth, a tailor-based online injury prevention intervention was developed to influence determinants and actual sports injury preventive behaviour. An effect study was carried out among runners.

Methods. Runners between 18 and 35 years were randomly assigned to the intervention (n=109) or control group (n=105). Participants in the intervention group were invited to visit the website for 30 minutes. Those in the control group were invited to read magazines that did not contain information about running, injuries or other sport related issues for 30 minutes. Online questionnaires were completed just before (T0) and immediately after the intervention (T1), and after 3 months (T2). Outcome measures were knowledge, risk perception, attitude, intention and injury prevention behaviour.

Results. Immediately after the intervention (T1) an effect was found on all outcome measures. After three months (T2) the effect remained only for behaviours relating to warm-up and frequency of shoe replacement.

Conclusion. Short-term (3 months) effects were demonstrated on determinants and actual performance of sports injury prevention behaviour. These results confirm the value of online tailored interventions for the dissemination of injury prevention knowledge.

Résumé

Objectif. Les blessures du sport comptent parmi les accidents les plus fréquents dans la société occidentale modern. Avec l'intérêt croissant de la santé numérique (eHealth), nous avons développé une intervention personnalisée en ligne de prévention des blessures, afin d'influencer les déterminants et les comportements réels en matière de prévention des blessures. Une étude d'effets a été menée auprès de coureurs.

Méthodes. Des coureurs de 18 à 35 ans ont été alloués de façon randomisée à un groupe d'intervention (n=109) ou un groupe contrôle (n=105). Les participants à l'intervention ont été invités à visiter un site web pendant 30 minutes. Ceux du groupe contrôle ont été invités à lire des magazines ne contenant aucune information sur la course, les blessures ou d'autres thèmes liés au sport pendant 30 minutes. Des questionnaires en ligne ont été complétés juste avant (T0) et immédiatement après l'intervention (T1), et après 3 mois (T2). Les mesures de l'études étaient la connaissance, la perception du risque, les attitudes, intentions et le comportement par rapport à la prévention des blessures.

Résultats. Immédiatement après l'intervention (T1), on trouve un effet sur tous les points de mesures. Après 3 mois (T2), l'effet persiste seulement pour les comportements liés à l'échauffement et à la fréquence de remplacement des chaussures.

Conclusion. Des effets à court terme (3 mois) ont pu être démontrés sur les déterminants et la

réalisation de comportement de prévention des blessures. Ces résultats confirment la valeur d'intervention personnalisée en ligne pour la dissémination de connaissances en matière de prévention des blessures.

Introduction

Apart from positive health effects, sport related injuries are side effects of otherwise healthy sports and exercise pursuits. In fact, sports injuries are amongst the most common injuries in the modern Western society [1, 2, 3, 4]. In the Netherlands, for instance, every year 3.7 million out of around 8.4 million active sports participants sustain a sports related injury, and about 1.5 million of them require medical treatment [5, 6]. Within this population the annual direct and indirect costs are projected at 430 and 910 million euro's respectively [7]. The high prevalence and costs of injuries, combined with the fact that the number of active sport participants is rising in modern Western society, emphasizes the need for accessible and effective prevention interventions [8].

While the uptake of preventive advice and adoption of effective preventive measures by an athlete is driven by behaviour, key component of effective sports injury prevention strategies is a focus on behavioural change [9]. Studies in the realm of general lifestyle behaviours indicated that tailored online behavioural change interventions are an attractive and effective tool for a wide audience due to their convenience, availability, anonymity, and interactivity [10, 11, 12, 13, 14]. Overall, the relative low costs, the large amount of individuals that can be reached and the strong indications for (cost-)effectiveness, make tailored online interventions an innovative and promising tool also for the prevention of sports injuries [15]. Moreover, by the use of an online intervention the information and advice given can be adapted to an athlete's individual characteristics, needs and preferences. This will create optimal information for athletes to help them adjust their sport and preventive behaviour. To our knowledge, the effectiveness of such an online tailored intervention on determinants of behaviour to prevent sports injuries has not been described before. Therefore, the current study evaluates the effectiveness of an online injury prevention platform (www.voorkomblessures.nl) to change knowledge, risk perception, attitude, intention and behaviour in regards to the use of injury preventive measures.

Methods

Study design

A randomized controlled trial was carried out amongst recreational runners. From mid September 2009 until the end of October 2009, runners between 18 and 35 years of age were invited to take part in the study. A runner was defined according to the "Dutch Directive Sport Involvement Research" norm, as any individual who in the past year ran at least in 12 sessions for a duration of one hour per session [16]. Participants were recruited via posters and information flyers in (sport-)shops, central libraries and universities in six cities in the Netherlands.

Runners were selected as the population for the current study, while running is a popular and

still growing sport with a high risk for injury [6]. Furthermore, many runners are exposed to little or no information on injury preventing measures because they are often not members of a running club nor are they supported by a trainer or coach.

Participants were invited to visit a central research location. After completing an informed consent and baseline questionnaire, they were randomly allocated to an intervention and control group. Participants were not aware of the study goals and the different study conditions. Those who mentioned at baseline that they visited the website before the trial were excluded from the analysis.

Participants in the intervention group were invited to visit the study website for 30 minutes. They were instructed to particularly study the sport specific information for runners, but were free to scroll through other parts of the website. As such, each participant was free to decide which elements of the website they accessed and whether they would take part in the tailored part of the website. Participants in the control group read magazines that did not contain information about running, injuries or other sports related issues for 30 minutes.

Intervention

The website (www.voorkomblessures.nl) is an online tailored module aimed to prevent sports injuries by modifying the determinants of preventive behaviour and ultimately increase positive behaviour towards the prevention of sports injuries. The website has been online since 2007 and currently integrates specific evidence-based preventive information for 15 sports; running, fitness, swimming, football, tennis, skating, ice-skating, basketball, field hockey, volleyball, snowboarding, mountain biking, road cycling, skiing and horse riding. The website primarily focuses on individual athletes aged between 18 and 35 years.

The content consists of informational videos about the aetiology and mechanisms of sports injuries combined with evidence-based injury prevention advice. Additionally, for each sport there is an online questionnaire that allows the module to provide tailored feedback based upon a series of predefined questions that create a personal risk profile of the user.

Before the website was developed, a needs assessment for each sport was conducted to gain insight in injury numbers and accident types. Measures to prevent the most common accident types were selected through literature research. When scientific evidence was missing experts were consulted. Specifically for runners this resulted in the following preventive measures to prevent running related injuries:

- Always perform a warm-up before training and competition.
- Buy new shoes annually.
- Use a suitable training schedule.

Outcome measures and measurements

All participants were invited to complete three questionnaires; just before the intervention (baseline, T0), immediately after the intervention (T1) and approximately three months after the intervention (T2). The first and second questionnaires were completed at the research location. The third questionnaire was sent by email and completed at home. To increase response to this third questionnaire, a reminder was sent after one week. Additionally,

participants received an incentive after they completed all measurements and running related presents were raffled.

During the baseline measurement (T0), information was gathered about participant demographics, such as gender, age, educational level, and compliance to recommended physical activity guidelines [17]. Participants were also asked about their running experience, their weekly running exposure, organization level of their running participation, and whether they participated in a competition in the last year. Participants were asked about their injuries in the past 12 months (T0) and 3 months (T2), knowledge, risk perception, attitude, intention and behaviour.

An injury was defined as a musculoskeletal complaints with one or more of the following consequences: the participant [1] had to stop running and/or [2] could not (fully) participate in the next planned activity and/or [3] could not go to school the next day and/or [4] required medical attention.

Outcome measures were knowledge, risk perception, attitude and intention in regards to the injury prevention advice encapsulated in the module. The choice of these outcome measures was based upon their importance in several behaviour explanatory models (e.g. Theory of Planned Behaviour [18], Health Belief Model [19]).

Knowledge about running injuries was assessed through a single open question “Which measures can you mention to prevent running injuries? Mention as much measures as you can.” One point was given to the answers “perform a warm-up”, “buy new shoes” or “use a suitable training schedule”.

Risk perception was measured by the question: “How likely do you think to sustain a running related injury during recreational running or a training?” (Response followed a Likert scale ranging from 1 “very low” to 5 “very high”).

Attitude was measured by two propositions: “It is important to take measures to prevent running injuries” and “There are measures to prevent running injuries”. Response followed a Likert scale ranging from 1 “strongly disagree” to 7 “strongly agree”).

The measurement of intention included four questions namely “are you planning to: [1] perform a warm-up before training; [2] perform a warm-up before competition; [3] buy new shoes annually; and [4] use a suitable training schedule”. Response categories were on a 3-point Likert scale; “yes”, “maybe” or “no”.

Questions to measure preventive behaviour consisted of four questions namely “do you perform: [1] a warm-up before training; [2] a warm-up before competition; [3] buy new shoes annually; and [4] use a suitable training schedule”. These behaviour questions followed a 7-point Likert scale ranging from “always” to “never”. The response categories from the question with regards to buying new shoes ranged from 1 “less than one time in two years” to 4 “each half year or more often”. Behaviour questions were only measured before the intervention (T0) and after three months (T2).

Statistical analysis

Analyses were based on intention-to-treat principle. Chi-square and t-test were used in cross sectional analyses to check for differences between the intervention and the control group at

baseline. Standard linear or logistic regression analyses were used for data with 1 follow-up measurement (T0–T1 and T0–T2) and linear or logistic GEE analyses were used for data with two follow-up measurements (T0, T1 and T2) [20]. Crude and adjusted analyses were performed for all outcome measurements, and both were standardised for the baseline measurement of the outcome. Possible effect modification was analysed for the variables: training with a trainer, participation in competition and having an injury during the past year.

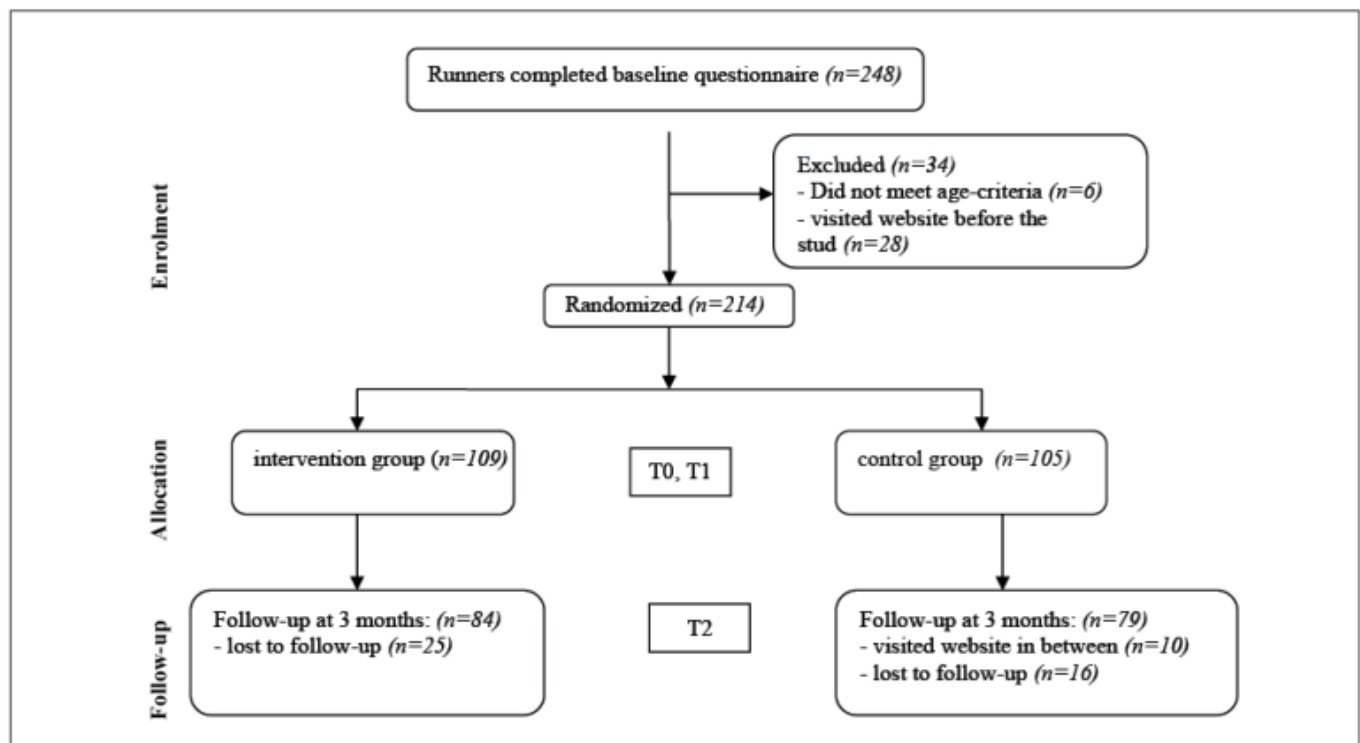


Figure 1: Flowchart of respondents through the study.

Results

The participants flow is presented in Figure 1. Of the 248 respondents who completed the baseline questionnaire (T0), 28 had to be excluded because they visited the website before the baseline measurement and 6 did not meet the age-criteria. The 214 remaining respondents were randomly allocated to the intervention (n=109) or control group (n=105) and completed both the T0 and T1 measurement. After T2 questionnaire, 84 (77%) participants of the intervention and 79 (75%) of the control group were available for the analyses.

Sociodemographic characteristics of included participants are presented in Table 1. Of all participants 152 (71%) were female. The mean age of participants was 23.9 years (SD 4.3) and 109 (51%) of all participants had a high degree of education. A total of 163 (76%) participants were experienced runners (running longer than one year) and participants spend an average of 1.5 (SD 1.8) hours per week on running. In total 45 (20%) were also club members. Injuries in the past year were reported by 101 (41%) participants. No differences were found in

baseline characteristics between the intervention and control group.

Outcome measures

Main results are presented in Table 2. Immediately after the intervention (T1) an effect was found on all outcome measures. After three months (T2) the effect remained for the items “intention to perform a warming up before training”, “performing a warm-up before training and/or competition” and “the intention to buy new shoes more often”.

Taking into account both T1 and T2 an intervention effect was found on risk perception ($\beta=0.15$; 95%CI 0.05 – 0.26) and attitude towards the importance of taking measures to prevent injuries (OR=2.01; 95%CI 1.15 – 3.51). Additionally, an effect remained for all assessed intention items and three of the four behaviour measurements. Although we have found an effect on the intention to “buy new shoes every year” (OR=2.16; 95%CI=1.25 – 3.76) no significant effect was found on actually buying them (OR=1.03; 95%CI=0.42 – 2.52). From the adjusted analyses no effect modification was found for training with the trainer, participation in competition or being injured during the last year.

		Intervention group (n=109) % or mean $\pm$ sd	Control group (n=105) % or mean $\pm$ sd
Gender (male)		27.5%	30.5
Age (average in years)		24.07 $\pm$ 4.08	23.7 $\pm$ 4.45
Education ²	low/moderate	43.1	49.4
	high	56.9	50.6
Compliance to PA guidelines ¹		75.2	70.5
>1 year of running experience		75.2	77.1
Running exposure (hours per week)		1.45 $\pm$ 1.69	1.53 $\pm$ 1.91
Running club membership		20.2	20.0
Supervised running (with trainer)	always/often	22.0	16.2
	sometimes	15.6	21.9
	never	62.4	61.9
Participation in competition last year (yes)		54.1	52.4
Sustained an injury in past 12 months		41.3	40.0

¹ At least half an hour of moderately intensive physical activity on at least five days a week (NISB, 2007).

² Low/moderate is primary education, secondary school and selective school; high is everything higher than selective school.

Discussion

To our knowledge this is the first time the effectiveness of an online tailored intervention on determinants and actual preventive behaviour against sports injuries was studied. The study revealed a positive effect on knowledge, attitude, intention, and actual injury preventive

behaviour. The effect was strongest immediately after the intervention, but effects remained after three months follow-up by which time the behavioural changes found in this study might be a positive predictor of a persistent behavioural change. Long-term effects of the online tailored intervention, however, need to be studied further as behavioural change is complex [21]. Further research is needed to investigate the intervention's effectiveness on injury risk. Previous studies also reported effects of online tailored programs on (secondary) prevention through behavioural change. Del Poz (2012), for instance, established for office workers with a history of subacute nonspecific low back pain, that a 9-month web-based intervention on behavioural change was effective to improve function and health-related quality of life and to decrease episodes of low back pain [22]. Study results of other online interventions directing on behavioural topics are also promising but their effectiveness is inconclusive, e.g. promoting physical activity, dietary behaviours, smoking cessation [10, 11, 12, 13, 23]. Recently it was also found that a Web-Based eHealth intervention increases the safety behaviour of parents in comparison with standard leaflets in routine childcare counselling [14].

Until now there is little scientific evidence for the effectiveness of interventions to reduce running related injuries. A Cochrane review by Yeung et al. that included 25 trials, of whom only three were carried out in a general running population, did not find evidence for the effectiveness of interventions to reduce soft-tissue running related injury [24]. Our study also did not give insight in the effectiveness of the intervention on running related injuries, nor can we expect a significant reduction of injury risk in the absence of effective interventions. It could be argued, however, that most intervention studies have been carried out in a well trained running population. Novice runners have a higher injury risk and another injury spectrum when compared to trained runners [25]. Simple preventive measures as advocated in the online intervention employed in the present study, may very well have a positive effect on injury risk in the novice running population, while such measures are already common practice in trained runners. An online intervention like in the present study is primarily targeted at the more novice athlete. Nonetheless, the aim of the present study was to study the effectiveness of an online tailored intervention on determinants, intention, and actual preventive behaviour. Positive effects were found, and if effective preventive measures are advocated this means arguably injury risk can be reduced.

The positive effects found in our study might be translated to prevent injuries in other sports. At this moment within the studied module, comparable tailored interventions exist (www.voorkomblessures.nl) for 14 other sports. When translating the results of the present study to other sports it needs to be taken into account that other preventive measures need to be advocated and that determinants and actual behaviour towards these other measures may result in different outcomes.

Additionally, since both the website and the study were directed at runners grossly between the ages of 18 and 35 years, no strong statements can be made on the effectiveness of the intervention on other age groups. While most medically treated sports injuries in the Netherlands were found among runners between 34 and 54 years of age, this limits the generalizability and conclusions of the present study [6]. Even though the use of internet has become accessible to all age groups and it can be argued that an online intervention is able to

reach the total population, actual use and effectiveness of online interventions as the present may differ between age groups.

Outcome measure	Group ¹	T0 IC n=109 C n=105	T1 ² IC n=109 C n=105	T2 ² IC n=84 C n=79	Unadjusted model ³ β (95% CI) / OR (95% CI)	Adjusted model ^{4, 5, 6} β (95% CI) / OR (95% CI)
Knowledge						
Spontaneously mentioned measures (2 or 3 correct answers)	IC C	44.0% 39.0%	88.1% ** 66.7%	53.3% 64.6%	1.54 (0.95 – 2.49)	1.56 (0.67 – 2.53) ^{4,6}
Risk perception (higher score means higher perception of a running related injury)	IC C	3.52 +/- 0.96 3.42 +/- 1.00	3.09 +/- 0.90* 3.24 +/- 0.92	2.48 +/- 0.94 2.82 +/- 0.82	-0.15 (-0.28 – 0.02)*	X
Attitude						
Agreement on importance of taking prevention measures (yes) ⁷	IC C	39.4% # 27.6%	38.5% 23.8%	31.7% 21.5%	2.01 (1.15 – 3.51)*	X
Agreement on believe in the existence of prevention measures (yes) ⁷	IC C	38.5% 29.5%	69.7% ** 34.3%	56.7% 41.8%	3.06 (1.80 – 5.22)	3.08 (1.81 – 5.25) ⁵
Intention						
Perform a warm-up before training more often (yes)	IC C	51.4% 54.3%	83.5% ** 42.9%	73.6% ** 54.1%	5.35 (3.11 – 9.22)**	X
Performing a warm-up before competition more often (yes)	IC C	74.6% 61.8%	89.8% ** 56.4%	87.5% 65.8%	7.17 (2.76 – 18.62)**	X
Buy new shoes more often (yes)	IC C	43.1% 35.2%	58.7% * 41.9%	63.3%* 44.9%	2.16 (1.25 – 3.76)**	X
Perform a proper workout regime more often (yes)	IC C	90.8% 84.8%	97.2% * 88.6%	92.0% * 75.7%	4.61 (1.74 – 12.17)**	X
Behaviour						
Always perform a warm-up before training (yes)	IC C	22.0% 15.2%	– ⁷	34.6% ** 10.8%	4.07 (1.46 – 11.35)**	X
Always perform a warm-up before competition (yes)	IC C	47.5% * 25.5%	– ⁷	58.3% * 28.9%	3.09 (1.01 – 9.44)*	X
Buy new shoes every year (each year; yes)	IC C	32.1% 30.5%	– ⁷	25.0% 28.2%	1.12 (0.46 – 2.70)	1.03 (0.42 – 2.52) ^{4,5,6}
Perform a proper workout regime (yes)	IC C	85.3% 78.1%	– ⁷	76.0%* 63.5%	2.34 (1.04 – 5.29)*	X

p-value: # < 0.10, * P<0.05, ** < 0.01

Note: β = Beta; OR = odds ratio; CI = confidence interval

¹ Group: IC = intervention group, CC = control group; ² Analyses are corrected for baseline value (T0) of the outcome measure;

³ Crude model: adjusted for baseline value (T0) of the outcome measure; ⁴ Corrected model: crude model adjusted for training with the trainer; ⁵ Corrected model: crude model adjusted for participation in competition; ⁶ Corrected model: crude model adjusted for injured during the last year; ⁷ Behavioural factors were not measured at T1.

Table 2: Outcome measures at T0, T1 and T2 and changes in the outcome measures.

Strength and weakness

The design of the study (randomized controlled trial), the representative and large sample size (n=214) and the high follow-up response rate (76%) are strengths of the current study.

Furthermore, comparable to the majority of the Dutch running population, the participants of the present study were individual recreational runners who run an average of 2 hours per

week.

Unfortunately, in the present study we have not been able to link a behavioural change to an actual reduction in running related injury risk. The scientific evidence base of measures to prevent running related injuries is shallow, and as such included measures were chosen by experts. Also, while an effect study on injury risk was not the current goal, the study was not powered to show an effect on injury reduction, nor was the follow-up long enough to establish a true preventive effect.

Another study limitation is that only positive formulated questions were employed and that determinants were studied mostly by a single question. There is a trade-off between burden for the participant and depth of data registration. For the present study it was chosen to keep the burden to a minimum and employ a limited set of questions. We believed that this would keep the response rate as high as possible while minimizing risk of dropouts. A positive effect was found, proving the potential of online tailored intervention promoting sports injury prevention behaviours, and future studies should use more thorough questionnaires to acquire more in-depth behavioural information.

Participants were recruited via central libraries and universities, which might have led to selection bias. The high education level in our study needs to be considered when interpreting the results. A higher education level is positively associated with an increased use of the intervention and because of that also with the possible effects of the intervention [26]. Nonetheless, of the Dutch running population, about half (52%) is highly educated just as in our sample [6].

Implications for practice

The results of this study are promising for online tailored interventions for the prevention of sports injuries. Such interventions are able to reach a large population at relatively low costs. The rapidly growing penetration and use of social media platforms within the population and the widespread availability of mobile devices give opportunities to further tailor and disseminate behavioural interventions against sports injuries [27, 28, 29, 30].

Conclusion

In this study, short term (3 months) effects of an online tailored intervention were demonstrated on determinants and actual performance of sports injury prevention behaviour. These results confirm the value of online tailored interventions for the dissemination of injury prevention knowledge. Future studies should focus on different sports, sustenance of the effects over a longer period of time and the actual (cost-)effectiveness on injury risk.

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Competing interests

The authors declare that they have no competing interests to disclose.

Authors' contributions

LA and MF were responsible for study conceptualization, design of the study and collecting the data. AH and LA drafted the manuscript. MF, MB and EALMV revised the manuscript. All authors approved the manuscript.

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