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An analysis of running injuries at Vancouver Sun Run InTraining clinics

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M. Ryan, MSc [1], J.E. Taunton, MD [2], B. Zumbo, PhD [3], K.M. Khan, MD, PhD [4], D.R. Lloyd-Smith, MD [5]

Runners preparing for a 10-km run experienced a high rate of injuries, with injury to the knee being most common.

Objective: To provide an analysis of running injuries among those participating in Sun Run InTraining clinics during 2000 and 2001.

Method: Two different questionnaires were developed for InTraining clinic participants. These assessed participants' fitness, their running routines, and their injury history. One questionnaire was administered in 2000 and the other in 2001.

Results: Overall, 31.6% of the 1265 respondents were classified as injured during the study period. The knee was the most frequently injured area. In 2000, one-half of injured runners had experienced a running injury in the past. In 2001, the level of rehabilitation from previous injuries accounted for 90.1% of the explained variation in our training function score (TFS), with the remainder explained by differences in self-assessed physical fitness.

Conclusion: Runners who consider themselves unfit and have a history of injury should understand that they face an increased likelihood of experiencing a running injury.

The increased popularity of running among members of the general population is not surprising, given the ease and economy of participating in a running program. All that anyone needs is a stretch of road and a pair of running shoes. Within a few weeks of beginning such a program, an individual may experience the physiological and psychological benefits of aerobic training.

The InTraining clinics were established by the Sport Medicine Council of British Columbia to address the deconditioned state of many of those participating in the 10-km Vancouver Sun Run. These clinics proved to be immediately popular, having trained over 12 000 people since their inception in 1998. This success is thought to be, in part, a result of the program's design, which prepares participants to continuously run a 10-km distance with minimum exposure to injury. This design is substantiated by a 13-week training protocol that allows for gradual progression, experienced leadership within each clinic, detailed presentations on aspects of training important for neophytes (shoes, diet, safety, injury prevention, etc.), and a fun and encouraging atmosphere that sustains the participant's motivation throughout the program.

Objective

The aim of the investigation described here was to provide an analysis of the injuries that have occurred at Sun Run InTraining clinics in 2000 and 2001. In the first year we looked for a descriptive breakdown of associated variables to injury, while in the second year we applied a more formal quantitative multivariate analysis. Our primary concern was the lack of hard data indicating how many novice runners experience injury during the InTraining clinic's 13-week program. In addition, we sought to quantify the extent of training limitation that

occurred as a result of injury, and then analyze the training variables that most affected this training compromise (or running injury).

Method

The 13-week training protocol used by InTraining clinics was designed by sport medicine physicians practising at the Allan McGavin Sports Medicine Centre and includes two programs to accommodate novice and intermediate runners.

The novice program is for primarily sedentary and deconditioned individuals who are interested in establishing a running program for reasons related to improving health and fitness. The program incorporates walk/run repetitions that eventually lead to a continuous running session in the 12th week.

The intermediate program is designed for people who have completed the novice walk/run program and would like to safely and effectively increase their running endurance and the intensity of their workouts. Hill training and interval and fartlek sessions are implemented.

Both training programs require participants to run three times a week and include one group run on the day they attend their clinic. Participants are advised to allow for a day of rest (or cross-training) between any two running sessions. As each training session is based on time, there may be considerable variation in the distances covered on individual workouts. Training sessions vary in length from 35 to 66 minutes.

Two different questionnaires were developed for InTraining clinic participants. One questionnaire was used in 2000 and the other in 2001. Both questionnaires asked “Do you currently feel you are experiencing an injury as a result of running?” If a participant answered “yes,” this was taken to indicate a running injury.

The questionnaire administered in the first year focused on running shoe age, whether participants felt they were aerobically fit before starting with the InTraining program, weekly running frequency, cross-training frequency, running surface used, injury history, and current injury status.

The questionnaire administered in the second year had participants use a visual analog scale (VAS) to describe their weekly running mileage, weekly running frequency, level of competitive drive, level of physical fitness, running experience, and level of rehabilitation from previous injuries. Runners in the second year also completed a severity outcome measure for running-related pain in order to obtain a training function score or TFS. The items for the TFS were derived from the Victorian Institute of Sport Assessment severity scale, initially developed for patellar tendinopathy patients and since modified for Achilles tendon injuries. Within the training profile, the domains of pain and function are assessed with three and four questions, respectively, using a VAS for a description of the participant’s subjective symptoms. The final domain of activity is assessed by a categorical rating system based on an incremental range of values for running time.

The weighting for all questions in the TFS is the same. Questions 1 through 7 are scored out of 10 and question 8 is scored out of 30. All scores are summed to produce a final score out of 100. An asymptomatic runner would score 100, while a symptomatic runner with at least preliminary signs of injury would score less than 100.

Basic descriptive statistics were used in the preliminary analysis. A chi-square contingency table was used to perform an analysis of baseline characteristics across gender. A univariate regression analysis was used to provide initial correlational data on each of the six predictor variables taken during the second year relative to the training function score. A forward stepwise multiple regression model was used to determine the relative importance of each predictor variable with respect to the explained variation in the TFS. The Pratt index was then used to calculate the individual variable importance in this regression model. The alpha level was set at .05 for significance for all statistical calculations.

Results

Data were recorded from 1265 runners over the 2-year period. In 2000, 844 questionnaires were completed, and in 2001 an additional 421 were completed. Of the 1265 runners, 400 (31.6%) identified themselves as experiencing a running injury.

2000 results

Baseline data for the study population during the first year are shown in Table 1 . One fact not shown is the large gender discrepancy noted in the first year of the study, with 635 (75.2%) females and 205 (24.3%) males participating (4 runners did not indicate their gender). A significantly greater percentage of participating females had body mass index (BMI) less than 19 (F = 4.3%, M = 1.0%; *P* = .002), and a BMI between 20 and 26 (F = 69.8%, M = 30.2%; *P* = .003). In addition, more women than men (F = 43.9%, M = 33.7%; *P* = .010) declared they were aerobically fit before beginning the 13-week program. A significantly larger percentage of men had a BMI greater than 26 (M = 41.0%, F = 16.7%; *P* < .001).

Most of the runners in 2000 wore shoes less than 3 months old (n = 354, 41.9% of 844). The distribution was quite similar among the other shoe age categories: 14.3% had shoes between 3 and 6 months old, 22.4% wore shoes that were 6 to 12 months old, and 15.4% had shoes that were 1 to 2 years old. Only 5.1% wore shoes more than 2 years old.

The majority of runners in 2000 (77.5% of 844) preferred running on roads, 20.1% preferred trails/off-road, and 13.9% preferred surfaces such as grass, track, or treadmill.

Close to 60% of the participants surveyed in 2000 complied with the recommended running frequency of 3 days per week. Approximately 30% of the runners reported running 2 days per week, 4.9% reported running 1 day per week, and 0.9% reported running 5 days per week.

In 2000, one-half of those reporting an injury had a history of injury to the same anatomical area, and of those with a previous injury a large percentage (42%) declared themselves not fully rehabilitated upon commencing the InTraining program. The knee was the most frequently injured location for both genders (), followed by the shin and foot. There was no significant difference in the number of injuries experienced by runners in the novice and intermediate programs.

2001 results

Baseline data from the second year's questionnaire are summarized in Figure 1 [6]. On average, respondents to the survey had more than 2 years of running experience and indicated modest levels of competitive motive level (4.3 out of 10) and physical fitness (5 out of 10). The mean weekly running mileage for this sample was 15 km over an average of 2.9 days of running per week.

The initial bivariate analysis of the data from 2001 reveals competitive motive, physical fitness, weekly distance, and degree of rehabilitation to be significantly associated with variations in the training function score (Figure 2). Degree of rehabilitation appears to be the strongest individual factor relating to the TFS (*r* = 0.483), followed in order of decreasing correlational strength by weekly distance (*r* = 0.178), physical fitness (*r* = 0.158), and competitive motive (*r* = 0.086).

The multivariate regression model was significant ($F_{2,376}$ = 63.861, *P*< .001) for two of the six predictor variables (degree of rehabilitation and physical fitness). The R squared for this model was 0.254, with 90.1% of that explained variation attributable to the degree of rehabilitation from previous injury.

Discussion

As with any epidemiological investigation, it is important to present the results in the context of the study population for valid and critical assessment. The subjects involved in the InTraining running program would be best described as novice or introductory runners with little or no running experience, average physical fitness, average competitive drive, and having at least vestigial effects of a previous injury. The mean running experience of 2.4 ± 2.6 years in this study is the lowest compared with other large population-based investigations,[1-4] and the weekly distance of 15 ± 8.5 km is also the lowest recorded among other authors.[1-9] These two points speak to the type of individual likely to register in InTraining clinics. Because of the paucity of running-injury literature with a similar demographic, it is not possible to make an adequate comparison of this data.

The 31.6% injury rate reported in this study is similar to other documented injury rates of 25% to 65%.[3,10] However, it was anticipated that the injury incidence in this study would be lower than that found in the general running literature because of the InTraining program's design, which is intended to minimize running injuries. It is difficult to put the injury frequency of this investigation into perspective as very few, if any, of the studies in the literature follow

runners for such a brief period of time. Furthermore, differences in injury definition may further confound appropriate comparison of studies.

Our finding that the knee is the most common site of injury is well supported in the literature.[2,4] A review of 5992 cases seen at the Division of Sports Medicine of the University of British Columbia between 1978 and 1991 reveals the knee to be the most frequently injured site among runners, and patellofemoral pain syndrome (PFPS) the most commonly occurring injury.[11,12] Ballas and colleagues[13] also reported PFPS as the most common injury in a breakdown of 860 overuse running injuries presented at the Franciscan Sports Medicine Center.

Other researchers have reported that a history of injury is a significant predictor of re-injury in runners.[3,4] The present study's results appear in line with these conclusions: one-half of runners with an injury had a previous injury to the same anatomical location in 2000, and lack of full rehabilitation was the strongest predictor of a decrease in training function in 2001. It is still not clear whether the high rate of re-injury in runners is suggestive of incomplete healing of the original injury, a personal propensity for re-injury, or an uncorrected biomechanical problem.[14]

The multivariate model in this study demonstrated that lack of complete rehabilitation explained almost all (90.1%) of the explained variation in the TFS. Although the implication that a previous injury is associated with re-injury is hardly a novel one, up until this study researchers have yet to attach to it any objective measure of importance. The consistent finding that a history of injury is associated with re-injury speaks to the importance of proper and complete rehabilitation for novice runners entering a training program. In particular, we need to determine the relative importance at the pre-injury level of such rehabilitative outcome measures as range of motion, flexibility, strength, and neuromuscular control (proprioception and kinesthesia) for the prediction of future injuries.

We hope that future research at InTraining clinics will build on the base of findings established in 2000 and 2001. First, we plan to use functional strength training for a group of runners within the InTraining program to investigate the role that core, calf, hamstring, and hip abductor strength play in reducing the injury rate for neophyte runners. Second, we plan to incorporate a measure of exposure time to injury through detailed training logs and will interview participants for all relevant information on their training history, paying particular attention to any previous injuries. Finally, we plan to incorporate a greater number of explanatory variables at baseline (including general health, patellar angle, knee alignment, rear foot angle, evidence of overpronation, tightness in gastrocnemius/soleus) in order to help account for variations in the TFS. The TFS itself will undergo further validity and reliability testing, including a peer review screening for construct validity.

Conclusion

The injury rate of 31.6%, recorded during the study period suggests a relatively high injury rate despite the InTraining program's potential to minimize the risk of injury. Unfortunately, because of the paucity of comparison populations, a full understanding of the context of these results is lacking.

The multivariate analysis in this investigation suggests that novice runners who begin a training program to complete a 10-km run after 13 weeks should be aware that lack of full rehabilitation from a previous injury accounted for nearly one-quarter of the decrease in training function experienced during the 2001 InTraining clinics. Furthermore, in 2000, one-half of the re-injured runners experienced an injury to the same anatomical area. The level of an individual's physical fitness upon entering a training program should also be considered.

The somewhat low value in R^2 or explained variation in the TFS with respect to the predictor variables is difficult to interpret because of the lack of a reference base in this subject area. Nevertheless, optimizing this analysis procedure is encouraged through either a more objective measurement system of the existing risk factors or including a greater number of predictor variables felt to contribute to the risk of injury.

We expect that data from the current study and our future investigations in this area will strengthen our ability to identify the different precipitating factors for injury in novice versus high-performance runners. Once we have clear information outlining the role of all injury risk factors for these runners, we will be in a better position to comment on specific aspects of the InTraining program.

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Competing interests
None declared.

Table 1. Baseline data for runners surveyed in 2000.

	Mean	Standard deviation
Height (cm)	146.2	77.8
Weight (kg)	55.9	30.15
BMI (kg/m2)	23.1	6.27
Age (years)	41.1	10.6

Table 2. Location of injuries experienced among 844 runners in 2000, in order of frequency.

Location	Number
Knee	84
Shin	39
Foot	34
Achilles/calf	25
Hip/pelvis	23
Low back	14
Hamstring	6
Thigh	2

Figure 2. Regression analysis of predictor variables and training function scores (TTS) in 2001.

Bivariate analysis

P value *F* value Competitive motive = .048 0.086 Physical fitness = .001 0.158 Weekly distance < .001 0.178 Degree of rehabilitation < .001 0.483

Multivariate analysis

P value R^2 value
< .001 0.254

Proportion of R^2 * Degree of rehabilitation 90.9 Physical fitness 9.1

* Importance of individual variables calculated with Pratt index

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M. Ryan, MSc, J.E. Taunton, MD, B. Zumbo, PhD, K. Khan, PhD, MD, R. Lloyd-Smith, MD

Mr Ryan is a research associate at the Allan McGavin Sports Medicine Centre. Dr Taunton is a primary care sports medicine physician and director of the Allan McGavin Sports Medicine Centre, as well as professor in the Department of Family Practice and School of Human Kinetics at the University of British Columbia. Dr Zumbo is a professor in the department of Measurement Evaluation and Methodolgy Research in the Faculty of Education, UBC. Dr Khan is a primary care physician at the Allan McGavin Sports Medicine Centre and a professor in the department of Human Kinetics, UBC. Dr Lloyd-Smith is a primary care physician at the Allan McGavin Sports Medicine Centre and an associate professor in the School of Human Kinetics, UBC.