Association of Different Factors with the Prevalence of Injuries in Runners of Rio de Janeiro’s Half Marathon

Mayara Fonseca, Alexandre Palma, Carolina Araujo, Eduardo Chaves, Riane de Paula, Gabriel Rodrigues Neto, Jefferson Novaes

Physical Education Graduate Program, Federal University of Rio de Janeiro (UFRJ), Rio de Janeiro, RJ, Brazil

ABSTRACT

Fonseca M, Palma A, Araujo C, Chaves E, de Paula R, Rodrigues Neto G, Novaes J. Association of Different Factors with the Prevalence of Injuries in Runners of Rio de Janeiro’s Half Marathon. JEPonline 2015;18(2):58-65. The aim of this study was to analyze the association of different surface types, types of hills, types of footstep, and body mass index (BMI) with the prevalence of injuries in of the Rio de Janeiro half marathon runners. One hundred and twenty-one healthy men participated in this study. The subjects were between 22 and 52 yrs of age and regularly practiced endurance training. A questionnaire was given with open and closed questions regarding the time of the run, the type of uphill and soil on which the training is performed and the type of footstep. Age, height, body mass, and BMI were also included. The results demonstrate a significant reduction in the prevalence of injury when the running was performed on the treadmill (P = 0.043). There were no significant differences for asphalt (P = 0.661), track (P = 0.288), soil (P = 0.053), and sand (P = 0.407). No significant differences were observed between the prevalence of injuries in uphill and downhill (P = 0.073) running, the prevalence of injuries vs. the types of footsteps (P = 0.148), the prevalence of injuries for different durations of running (P = 0.336), prevalence of injuries for different ages (P = 0.134), and the prevalence of injuries for different BMI values (P>0.05). There is a tendency for a decrease in the risk of injury when the subjects used a treadmill for training. However, it appears that uphill and downhill training, types of footstep, duration of running, age, and BMI are not related to the prevalence of injuries in half marathon runners.

Keywords: Half Marathon, Runners, Injuries
INTRODUCTION

Regular physical activity and exercise are associated with numerous physical and mental health benefits (1) and, therefore, men and women have begun to exercise because of these benefits. Running is an easy and inexpensive exercise modality with the highest number of practitioners (18). As a result, street running has become increasingly popular even though the participants are exposed to associated possible risks both in sports and in recreational running (17).

Several authors have sought to identify the risk factors associated with injuries in runners (2-4,6,8-12, 14-16,20-26-28,29). For example, the weekly distance run, the runners' history of previous injuries (2,3,11,12,15,29), and type of running surface (6,9,26-28) are the major risk factors. Evidence is limited for age, gender, the body mass index (BMI), and the type of footwear as possible risk factors in the development of musculoskeletal injuries in runners (2,3,10,12,24,29).

We found no studies associating the footstep type and degree of uphill exertion with the previously mentioned risk factors. The purpose of this study was to analyze the association of different types of surfaces, degree of uphill exertion, footstep types, and BMI with the prevalence of injuries in runners of the Rio de Janeiro half marathon.

METHODS

Subjects
One hundred and twenty-one men between 22 to 52 yrs of age participated in this study. The runners regularly practice endurance training and participated in the Rio de Janeiro 21-km race in 2013. The subjects had a minimum of 6 months experience in half marathon events. Each subject received an explanation of the risks and benefits of the study and signed a consent form in accordance with the Declaration of Helsinki. The experimental protocol was approved by the Ethics Committee on Research involving Human Subjects (protocol nº CAAE: 03432512.0.00005257).

Procedures
The data were collected using a questionnaire. To ascertain the reproducibility of the questionnaire, the runners answered questions twice (a test and retest), with an interval of 7 to 10 days between replies. The degree of agreement between the two measurements was estimated by the Kappa index (k). All the closed questions showed a 0.8 superior index and were significant (P<0.05).

The questionnaire included open and closed questions, and all the questions were approved. In addition to the personal and anthropometric data collected (sex, age, height, body mass, and BMI), questions regarding the time of the trial, the type and degree of incline of the running surface on which the training was conducted and the type of footstep were investigated. These variables were included in the questionnaire because they are frequently associated with the prevalence of injuries.

Anthropometric Measurements
The subjects’ height (m) and body mass (kg) were obtained by standard methods to calculate the BMI in kg·m⁻².

Statistical Analyses
Descriptive statistical analyses were performed using the chi-square test to compare the categorical data. The significance level was set at P<0.05. The statistical analyses were performed with the SPSS statistical software package version 20.0 (SPSS, Inc., Chicago, IL).
RESULTS

This study analyzed the data of 121 male subjects who took part in a 21-km street race in 2013 of which 33.1% (n = 40) of the runners who were interviewed had some type of running injury in the previous 6 months while 66.9% (n = 81) did not show any type of injury (Figure 1).

![Prevalence of injuries](image)

Figure 1. The Prevalence of Injuries in the Half Marathon Runners (n = 121).

The comparative analysis showed that there was a significant decrease in the prevalence of injuries when the subjects did their training on a treadmill (P = 0.043). There were no significant differences were found in the prevalence of injuries when the subjects trained on asphalt (P = 0.661), track (P = 0.288), soil (P = 0.053) and sand (P = 0.407).

Table 1 shows that the subjects who completed their training with uphill and downhill grades showed no significant differences (P = 0.073); whereas, those who never, always, and sometimes trained with uphill and downhill running showed 14.3%, 26.2%, and 41.5%, respectively, of the injuries. The same results were found with the footstep type variable in which the differences in the prevalence of injuries in those with pronated, supinated or neutral footsteps were not significant (P = 0.148).

In regards to the subjects’ duration of running, no significant difference was observed for the subjects who performed for a lower amount time, equal to or higher than 2 hrs (P = 0.336). As to the subjects’ age variable, no significant difference (P = 0.134) was found. Similarly, with respect to the subjects’ BMI, there was no significant difference (P > 0.05) for subjects with a BMI ≤ 24.9 and those with a BMI ≥ 25.
Table 1. Comparison of Different Surface Types, Type of Hill, Type of Ground, and BMI with the Prevalence of Injuries in Runners of Rio de Janeiro’s Half Marathon.

<table>
<thead>
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<td>35.6</td>
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<td>9</td>
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<td>59.2</td>
<td>20</td>
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<td>&lt; 24.9</td>
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<td>23</td>
<td>29.9</td>
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<tr>
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**DISCUSSION**

This study analyzed the association between the time of the test, age, different surface types, degree of uphill and downhill running, footstep types, and BMI with the prevalence of injuries in the Rio de
Janeiro half marathon runners. Finding an association of the prevalence factors of injuries in the half marathon runners is of paramount importance because preventive measures should be taken to improve the efficiency and safety of the half marathon runners in Rio de Janeiro.

The main finding in this study was that, among the surface types, treadmill running was associated with a 20.5% decrease in the prevalence of injuries, which is statistically significant (P = 0.043). Studies have investigated the risk factors associated with injuries in runners. Although most have focused on the association of the prevalence of injuries with concrete, rubber, and grass surfaces (6,9,26,28), they have not compared asphalt with the treadmill.

In all the comparisons, it was observed that asphalt tends to exert greater myoarticular plantar pressure, which would explain the reason for this study finding a 33.1% prevalence of injuries in half marathon runners who trained on asphalt. These results suggest that the plant charge distribution on a treadmill is not identical to that of fixed surfaces, which explains the higher percentage of injuries with other running surfaces.

The runners who trained for less than 2 hrs showed 35.6% of the injuries, compared with the runners who trained for 2 or more hrs. Similar results were found by Middelkoop et al. (15) who described the prevalence and incidence of lower limb injuries that occurred before and during the Rotterdam marathon.

The interviewees had 3.2 injuries for each 1000 hrs of running. These findings suggest that the time of the race appears to be associated with the prevalence of injuries in runners. Fredericson and Misra (7) concluded that running more than 40 hrs (64 km approximately) per week is associated with higher injury risks.

In earlier studies, four factors were responsible for generating injuries in runners. Among these factors, the first is related to biomechanical and structural issues. According Middelkoop et al. (15), the increase in the number of lesions is directly related to previous injuries, inadequate rehabilitation, and premature return to physical activity.

Additionally, according to Middelkoop et al. (16), cultural factors might favor a higher incidence of risk. Additional factors that could be related to the training load are the distance and the number of consecutive days of running (7). The final factor, according Fredericson and Misra, (7) is related to muscle imbalance because (particularly, the hip muscles) weakening of the abductor muscles might be a predisposing factor for the overuse of the lower limbs of runners.

Regarding uphill and downhill running, our results showed that while 26.2% had some type of injury associated with the grade of the terrain, 73.8% of the subjects did not present with injuries associated with uphill and downhill running. Although these variables have been studied much less than the other variables, Pierrynowski et al. (19) conducted a study with 9 men who trained on a treadmill with a 12-min protocol at 60% of VO₂ max with 10% uphill and 10% downhill for two consecutive days. All the participants reported considerable muscle soreness in downhill training and not in uphill training. The authors concluded that a 2-day 12-min running protocol was sufficient to protect against the occurrence of muscle soreness in subsequent downhill runs.

Similar data were found by Eston et al. (5). These authors evaluated the effects of changes in the step length of 28 male and female runners on the symptoms of exercise-induced muscle injury during repeated downhill runs. Muscle tenderness, plasma activity, CK, and isometric strength were assessed before and after two downhill runs. The authors observed small changes in the normal gait
pattern during a steady speed in the downhill run. The data appear to indicate that uphill and downhill training is not associated with the prevalence of injuries in the subjects.

Regarding the footstep type, 83.3% of the runners did not know their footstep type and showed no injury. Among the runners who knew their footstep type, the majority (81.8%) of them had pronation without an injury. In addition, 63% had a neutral footstep without injuries, and 57% of the runners with supination had no injuries.

Of the runners who were less than 40 yrs of age, 27.8% had injuries compared with 40.8% of the runners who were ≥40 yrs of age. The study by Hino et al. (8) is in agreement with our findings. The authors analyzed the prevalence of injuries in 295 sports and associated factors in street runners. They concluded that 28.5% of the athletes showed injuries. The majority of the injured subjects were between 30.1 and 45 yrs of age, and this age group made up 32.8% of the subjects. However, there were no significant differences between the groups. Therefore, although there appears to be a tendency for more injuries in older runners, there is no direct relationship between age and injuries in half marathon runners. Interestingly, McArdle et al. (13) showed no significant differences between the younger and older age groups.

In terms of the BMI, the results showed no significant differences when the values of ≤24.9 kg·m⁻² and ≥25.0 kg·m⁻² were compared. These findings are in agreement with the studies of Hino et al. (8). They reported that there was no significant relationship between the prevalence of injuries and the BMI in runners. Thus, the BMI does not appear to be related to the prevalence of injuries.

CONCLUSIONS

The treadmill appears to be the most appropriate surface for training because it results in fewer injuries in half marathon runners. Also, the findings indicate that the duration of running, age, BMI, slope, and footstep types show no association with the prevalence of injuries in half marathon runners.

Address for correspondence: Carolina de Oliveira Araujo, Rio de Janeiro Federal University, Physical Education Graduation Program. Rio de Janeiro – RJ, Brazil. Zip-code 24120-191. Phone 5521 972109954, Email: karol.eefd@gmail.com

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