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RUNNING INJURIES IN THE PARTICIPANTS OF LJUBLJANA MARATHON

TEKAŠKE POŠKODBE UDELEŽENCEV LJUBLJANSKEGA MARATONA

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ABSTRACT

Introduction. The aim of our study was to determine the self-reported incidence and prevalence of running-related injuries among participants of the 18th Ljubljana Marathon, and to identify risk factors for their occurrence.

Methods. A customized questionnaire was distributed over registration. Independent samples of t-test and chi-square test were used to calculate the differences in risk factors occurrence in the injured and non-injured group. Factors which appeared significantly more frequently in the injured group were included further into multiple logistic regression analysis.

Results. The reported lifetime running injury (absence >2 weeks) incidence was: 46% none, 47% rarely, 4% occasionally, and 2% often. Most commonly injured body regions were: knee (30%), ankle and Achilles' tendon (24%), foot (15%), and calf (12%). Male gender, running history of 1-3 years, and history of previous injuries were risk factors for life-time running injury. In the season preceding the event, 65% of participants had not experienced any running injuries, 19% of them reported minor problems (max 2 weeks absenteeism), but 10% and 7% suffered from moderate (absence 3-4 weeks) or major (more than 4 weeks pause) injuries. BMI was identified as the solely risk factor.

Conclusions. This self-reported study revealed a 53% lifetime prevalence of running-related injuries, with the predominate involvement of knee, ankle and Achilles' tendon. One out of three recreational runners experienced at least one minor running injury per season. It seems that male gender, short running experience, previous injury, and BMI do increase the probability for running-related injuries.

Keywords:
sports, running, marathons, injuries, prevalence, incidence, risk factors

IZVLEČEK

***Izhodišča**. V pretekli dekadi se je število rekreativnih udeležencev teka na dolge proge v Sloveniji pomembno zvišalo in znaša 40.000 tekačev, kar predstavlja približno 2 % prebivalstva. Leta 2013 se je 18. Ljubljanskega maratona udeležilo skoraj 20.000 tekačev. Več kot 1400 jih je nastopilo na maratonu, 6500 jih je teklo polmaraton, ostali so se udeležili teka na 10 km. Namen naše raziskave je bil določiti incidenco in prevalenco prijavljenih tekaških poškodb udeležencev 18. Ljubljanskega maratona in opredeliti dejavnike tveganja za njihov nastanek.*

***Metode**. Ob prijavi smo 14.176 udeležencem po elektronski pošti poslali povezavo do spletnega vprašalnika, ki je vseboval splošne podatke, tekaško zgodovino in življenjsko/sezonsko prevalenco/incidenco tekaških poškodb. Sodelovanje v raziskavi je bilo prostovoljno in anonimno. Odgovori so predstavljeni z ustreznimi merami opisne statistike. Statistično značilnost razlik v dejavnikih tveganja med poškodovanimi in nepoškodovanimi udeleženci smo vrednotili s Studentovim t-testom oziroma testom hi-kvadrat. Za dejavnike, ki so se izkazali za značilno pomembne v bivariatni analizi, smo v modelu multiple logistične regresije določali njihovo neodvisno napovedno vrednost za tekaško poškodbo.*

***Rezultati**. V raziskavi je sodelovalo 340 žensk in 357 moških. Njihova povprečna starost je bila 42 let, povprečen ITM je bil 23,1 kg/m2. Glede na pretečeno razdaljo je bila razporeditev naslednja: maraton 132, polmaraton 412 in tek na 10 km 153 udeležencev. Življenjska incidenca tekaških poškodb (odsotnost s teka 2 tedna ali več) je bila naslednja: 322 (46 %) nikoli, 328 (47 %) redko, 31 (4 %) občasno in 16 (2 %) pogosto. Najpogosteje poškodovani telesni deli so bili: koleno (30 %), gleženj in Ahilova tetiva (24 %), stopalo (15 %) in meča (12 %). Kot dejavniki tveganja za življenjsko tekaško poškodbo so bili opredeljeni moški spol, ukvarjanje s tekom 1-3 leta in zgodovina poškodb. V sezoni pred dogodkom 65 % udeležencev ni imelo tekaške poškodbe, 19 % jih je prijavilo manjšo težavo (največ 2 tedna odsotnosti s teka), 10 % jih je utrpelo zmerno poškodbo (odsotnost s teka 3-4 tedne) in 7 % večjo (več kot 4 tedne premora). ITM je bil edini ugotovljeni dejavnik tveganja.*

***Zaključki**. Raziskava prijavljenih poškodb udeležencev 18. Ljubljanskega maratona je pokazala 53-odstotno življenjsko incidenco tekaških poškodb; prevladujejo poškodbe kolena ter gležnja in Ahilove tetive. Eden od treh rekreativnih tekačev utrpi vsaj eno manjšo tekaško poškodbo na sezono. Dejavniki, ki povečajo tveganje za nastanek tekaške poškodbe, so moški spol, kratkotrajno ukvarjanje s tekom, pretekla poškodba in ITM.*

Ključne besede:
šport, tek, maratoni, poškodbe, prevalenca, incidenca, dejavniki tveganja

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1 INTRODUCTION

The public perception of running as a health promoting activity is important in many respects, and distance runners are now accepted as a significant leisure interest group in society. Exercise has increasingly been seen as an important facet of a 'healthy society', with leisure and sport providing many of the activities through which it is hoped this can be achieved (1). Moreover, endurance running has shown to be effective in providing substantial beneficial effects on body mass, body fat, resting heart rate and cholesterol levels in physically inactive individuals, making it an important asset for public health programs (2). The result is an increased popularity of marathon and long distance running in the last decade that produced around 40,000 competitive runners across Slovenia, which represents 2% of the population (3). The 18th Ljubljana Marathon in 2013, recorded almost 20,000 participants. More than 1,400 participants attended the 42-km run, 6,500 participated in half-marathon, and the rest ran over 10 km distance. The increasing amount of runners willing to have a positive impact on their health is followed by an increased incidence of running-related injuries (RRI), ranging from 18.2% to 92.4%, and prevalence ranging from 6.8 to 59 injuries per 1,000 hours of training (4). At any given time, 25% of long distance runners are injured, and about a half experience an injury that stops their activity for a period during a year (5). Although some injuries are traumatic, most are due to overuse. The definition of an ''injury'' varies in the literature. However, the most common definition of RRI is: a musculoskeletal ailment that is attributed to running and that causes a restriction of running speed, distance, duration, or frequency for at least 1 week (6). The aetiology of RRI is usually related to overuse with repeated musculoskeletal microtrauma, and can be attributed to several risk factors described in the literature. Each one of them is affected by personal characteristics of the runner (anatomical and biomechanical factors), training errors (such as training volume, weekly distance), and running experience (4).

The aim of our study was to evaluate the frequency of RRI and determine the self-reported incidence and prevalence of those injuries among participants of the 18th Ljubljana Marathon. We also tried to discriminate risk factors for the occurrence of RRI and contribute to better prevention in this study population.

2 METHODS

The study was designed as a retrospective cohort study based on a customized questionnaire, distributed over registration emails to 14,176 participants of the 18th Ljubljana Marathon (held on 27 October 2013). Participation in the study was voluntarily and anonymous. Only the runners' race numbers were tracked. The data was collected prior to the race and advertised during registration. The customized questionnaire in Slovenian language contained general data, running history, running distance per week, previous participation at an official event, type of training for the event, regions of RRI, other sports participation, barefoot running, and life/season prevalence/incidence of RRI. RRI was defined as a cause of absence from running for 2 weeks or more due to an injury that was caused with running only. Questions were specifically designed to target RRI risk factors reported elsewhere (4, 7, 8). The questionnaire had to be filled completely to be submitted. All answers were received electronically and screened. Participants who did not appear on the race, or the ones not finishing the run, were excluded from the data analysis.

Simple descriptive statistics was used to present the characteristics of the study population. Two different outcomes were observed in regard to running related injuries, namely: runners injured during last season (incidence), and runners with a life-time injury (prevalence). We used gender, age, BMI, running experience, running distance per week, other sports participation, barefoot running, types of preparation for the marathon, official event experience, and history of previous running injuries as explanatory variables. The data is presented as mean±SD. Independent samples of t-test and chi-square test were used to calculate the differences in potential risk factors occurrence in the injured and non-injured group. Factors which appeared significantly more frequently in the injured than in non-injured group were included further into multiple logistic regression analysis with the aim to confirm or reject their role as independent risk factors for running-related injuries. All variables were included simultaneously, using the ENTER method. P value of less than 0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics version 24.

3 RESULTS

Out of 14.176 distributed questionnaires, 814 were returned (response rate= 5.7%). 213 runners did not appear and 4 did not finish the race, and were removed from the research. At the end, 697 were eligible for further analysis.

There were 340 (48.8%) females and 357 (51.2%) males participating in the study. Their average age was 42±11 years, and their average body mass index (BMI) was 23.1±2.6 kg/m^2. Runners' distribution according to the running distance at the event was: full marathon 132 (18.9%), half-marathon 412 (60.1%), and 10 km run 153 (21%) participants. The participants reported lifetime

running injury (absence more than 2 weeks) prevalence as following: 322 (46%) none, 328 (47%) rarely, 31 (4%) occasionally, and 16 (2%) often. Most commonly injured body regions were: knee (30%), ankle and Achilles' tendon (24%), foot (15%), and calf (12%). Incidence was observed in the season preceding the 18th Ljubljana Marathon event. 452 (65%) participants had not experienced any running injuries, 131 (19%) of them reported minor problems (max 2 weeks absenteeism), but 66 (10%) and 48 (7%) participants suffered from moderate (absence 3-4 weeks) or major (more than 4 weeks healing pause) running-related injuries. The results are presented in the Table 1.

Table 1. Baseline characteristics of runners in a study group at 18th Ljubljana Marathon (N=697).

Variable	Analyzed group (n=697)
Gender	
Females vs. Males	340 (49%) / 357 (51%)
Age (mean±SD)	42±11 years (14 to 68 years)
10-19 years	9 (1%)
20-29 years	94 (13%)
30-39 years	184 (26%)
40-49 years	247 (35%)
50-59 years	121 (17%)
60-69 years	42 (6%)
BMI (mean±SD)	23.1±2.6 kg/m^2 (16.9 to 38.1 kg/m^2)
<25	545 (78%)
≥25	152 (22%)
Running distance at the 18th Ljubljana Marathon	
Full marathon	132 (19%)
Half-marathon	412 (60%)
10 km	143 (21%)
Life-time running injury prevalence (more than 2 week absence)	
None	322 (46%)
Rarely	328 (47%)
Occasionally	31 (4%)
Often	16 (2%)
Running injury body regions	30% knee / 24% ankle and Achilles' / 15% foot / 12% lower leg / 9% thigh / 8% lower back / 6% hip / 2% pelvis / 1% shoulder / 1% neck / 1% chest
Previous season running injury incidence	
None	452 (65%)
Minor (2 week absence)	131 (19%)
Moderate (3-4 weeks absence)	66 (10%)
Severe (more than 4 week absence)	48 (7%)
Running experience	
Less than 1 year	52 (8%)
1-3 years	213 (30%)
4-10 years	293 (42%)
More than 10 years	139 (20%)
Running distance per week	
Less than 10 km	46 (7%)
11 to 20 km	167 (24%)
21 to 30 km	237 (34%)
31 to 50 km	170 (24%)
More than 50 km	77 (11%)
Other sport activities participation	
Yes vs. No	606 (87%) / 91 (13%)
Previous injury	
Yes vs. No	387 (56%) / 310 (44%)
Barefoot running	
Yes vs. No	89 (13%) / 608 (87%)

We compared two group of runners: one with no life-time RRI and the other with occasional and recurrent injuries. A multiple regression logistic analysis revealed that male gender (p<0.01, ß=0.479), running experience of 1 to 3 years (p<0.01 ß=0.348), and personal history of previous injuries (p<0.01, ß=1.78) were risk factors for life-time RRI. It also showed that higher age was a risk factor for lower leg life-time RRI (p<0.01, ß=0.947), and running distance of 21-30 km (p<0.05, ß=0.453) and 31-50 km per week (p<0.05, ß=0.48) were risk factors for foot lifetime RRI. Barefoot running was also considered a statistically significant risk factor for lower leg life-time RRI (p<0.05, ß=0.523). On the contrary, BMI, running experience of 4 years or more, and other sports participation were not related to lifetime running injuries (Table 2).

In the season preceding the 18th Ljubljana Marathon event, 452 (65%) participants had not experienced any running injury, 131 (19%) of them reported minor problems (max 2 weeks absenteeism), but 66 (10%) and 48 (7%) participants suffered from moderate (absence 3-4 weeks) or major (more than 4 weeks healing break) running-related injuries. BMI was the only risk factor for one-season running period incidence (increase in one point increases the risk for injury for 5.7%). Furthermore, runners that were overweight or obese had significantly more injures than runners with a BMI of less than 25 kg/m^2 (p<0.05). Other factors, such as gender, age, personal running experience, running distance per week, previous participation at a official event, type of training for the event, other sports participation, and barefoot running did not represent a one-season risk factor in our study group. Details are presented in Table 3.

Table 2. Risk factors for running related injuries incidence among participants of 18th Ljubljana Marathon (N=697).

Variable	No injuries (NI) (N=322)	Occasional injuries (OI) (N=328)	Recurrent injuries (RI) (N=47)	OI+RI (N=375)	* NI:OI+RI *p-value; ß- factor*
Gender					
Females	189 (59%)	138 (42%)	13 (28%)	151 (40%)	*0.006; 0.497*
Males	133 (41%)	190 (58%)	34 (72%)	224 (60%)	
Age (mean±SD)	41 years (11)	42 years (11)	44 years (10)	42 years (11)	*Lower leg only: 0.000; 0.947*
BMI (mean±SD)	23 kg/m^2 (2.7)	23.1 kg/m^2 (2.6)	23.8 kg/m^2 (2.3)	23,2 kg/m^2 (2.6)	*ns*
<25 kg/m^2	246 (76%)	263 (80%)	36 (77%)	299 (80%)	*ns*
≥25 kg/m^2	76 (24%)	65 (20%)	11(23%)	76 (20%)	
Running experience					
Less than 1 year	40 (12%)	9 (3%)	3 (6%)	12 (3%)	*ns*
1 to 3 years	109 (34%)	99 (30%)	5 (11%)	104 (28%)	*0.007; 0.348*
4 to 10 years	118 (37%)	157 (48%)	18 (38%)	175 (47%)	*ns*
More than 10 years	55 (17%)	63 (19%)	21 (45%)	84 (22%)	*ns*
Running distance per week					
Less than 10 km	29 (9%)	13 (4%)	4 (9%)	17 (5%)	*ns*
11 to 20 km	91 (28%)	69 (21%)	7 (15%)	76 (20%)	*ns*
21 to 30 km	112 (35%)	116 (35%)	9 (19%)	125 (33%)	*Foot only: 0.038; 0.453*
31 to 50 km	62 (19%)	90 (28%)	18 (38%)	108 (29%)	*Foot only: 0.036; 0.480*
More than 50 km	28 (9%)	40 (12%)	9 (19%)	49 (13%)	*ns*
Other sports activities					
Yes	282 (88%)	284 (87%)	40 (85%)	324 (86%)	*ns*
No	40 (12%)	44 (13%)	7 (15%)	51 (14%)	
Previous injury					
Yes	215 (67%)	156 (48%)	16 (34%)	172 (46%)	*0.000; 1.78*
No	107 (33%)	172 (52%)	31 (66%)	203 (54%)	
Barefoot Running					
Yes	31 (10%)	51 (16%)	7 (15%)	58 (15%)	*Lower leg only: 0.035; 0.523*
No	291 (90%)	277 (84%)	40 (85%)	317 (85%)	

OI+RI - cumulative number of all injuries together; NI:OI+RI – statistical comparison between non-injured to injured runners; ns – no significant differences; * - significant differences are given for the whole body, unless otherwise stated.

Table 3. Risk factors for running related injuries prevalence among participants of 18th Ljubljana Marathon (N=697).

Variable	No injuries (NI) (N=452)	Minor injuries (Mil) (N=131)	Major injuries (Mal) (N=114)	Mil+Mal (N=245)	NI:Mil+Mal; *p-value; ß-factor*
Gender					
Females	232 (51%)	59 (45%)	49 (43%)	108 (44%)	*ns*
Males	220 (49%)	72 (55%)	65 (57%)	137 (56%)	
Age (mean±SD)	42 years (11)	41 years (10)	43 years (11)	42 years (11)	*ns*
BMI (mean±SD)	22.9 kg/m^2 (2.5)	23.5 kg/m^2 (2.9)	23.2 kg/m^2 (2.7)	23.4 kg/m^2 (2.8)	*0.036; 1.057*
<25 kg/m^2	365 (81%)	93 (71%)	87 (76%)	180 (73%)	*0.028*
≥25 kg/m^2	87 (19%)	38 (19%)	27 (24%)	65 (27%)	
Running experience					
Less than 1 year	40 (9%)	7 (5%)	5 (4%)	12 (5%)	*ns*
1 to 3 years	141 (31%)	44 (34%)	28 (25%)	72 (30%)	
4 to 10 years	177 (39%)	62 (47%)	54 (47%)	116 (47%)	
More than 10 years	94 (21%)	18 (14%)	27 (24%)	45 (18%)	
Running distance per week					
less than 10 km	33 (7%)	8 (6%)	5 (4%)	13 (5%)	*ns*
11 to 20 km	112 (25%)	25 (19%)	30 (26%)	55 (22%)	
21 to 30 km	157 (35%)	47 (36%)	33 (29%)	80 (33%)	
31 to 50 km	102 (22%)	39 (30%)	29 (26%)	68 (28%)	
More than 50 km	48 (11%)	12 (9%)	17 (15%)	29 (12%)	
Running on official event					
First time	89 (20%)	18 (14%)	16 (14%)	34 (14%)	*ns*
One to five times	221 (49%)	80 (61%)	58 (51%)	138 (56%)	
Six to ten times	76 (17%)	18 (14%)	17 (15%)	35 (14%)	
More than ten times	66 (14%)	15 (11%)	23 (20%)	38 (16%)	
Preparation for marathon					
No special training	46 (10%)	6 (4%)	10 (9%)	16 (7%)	*ns*
Training alone	262 (58%)	81 (62%)	62 (54%)	143 (58%)	
Supervised formal training	94 (21%)	26 (20%)	27 (24%)	53 (22%)	
Self-organized informal group	44 (10%)	17 (13%)	14 (12%)	31 (13%)	
Official running club	6 (1%)	1 (1%)	1 (1%)	2 (1%)	
Other sports activities					
Yes	392 (87%)	114 (87%)	100 (88%)	214 (87%)	*ns*
No	60 (13%)	17 (13%)	14 (12%)	31 (13%)	
Barefoot Running					
Yes	57 (13%)	19 (15%)	13 (11%)	32 (13%)	*ns*
No	395 (87%)	112 (85%)	101 (89%)	213 (87%)	

Mil+Mal - cumulative number of all injuries together; NI:Mil+Mal – statistical comparison between non-injured to injured runners; ns – no significant differences

4 DISCUSSION

This retrospective self-reporting study on Slovenian long-distance runners revealed that they had over 50% of lifetime prevalence of RRI. One out of three runners sustained at least one minor RRI per season. Mostly injured body regions were knee and ankle with Achilles' tendon. Male gender, short running history, previous injury, and an increased BMI seem to increase risk of RRI in general. We also established higher risk for lower leg RRI with increased age and barefoot running, and increased risk for foot RRI in relation to weakly mileage.

Current reports show that 19%-79% sustain a RRI (7). The differences between studies originate from a non-uniform definition of RRI and from the enrolled study populations (9). The most common conclusions that one out of two runners sustained an RRI in life, and that one of three runners was injured per season, was confirmed also in our data. Individual factors identified by the literature suggest that the majority of RRI are of multifactorial origin. Most commonly, reported risk factor in prospective studies is previous injury in the past 12 months, followed by higher quadriceps angle of the knee (Q angle) and a running distance per week (over 40 miles/64 km) (4). Increased BMI, male gender, running experience, participation in races of greater distance, increase in days of training per week, increase in training distance per week, shoe age, and running throughout the whole year have also been reported as limited evidence risk factors for RRI (7, 10). Greater training distance (30-39 miles/50-64 km), age,

previous sports activity, and running on concrete surfaces were associated with greater RRI in female runners, whereas greater training frequency, running experience of 0-2 years, and weekly running distance of 20-29 miles/32-49 km were associated with more RRI in men (7, 10). Training distance per week has been shown as the only protective factor for RRI of the knee (7). The strongest general RRI risk factors established with our study concur with previous publications: male gender, running experience of 1-3 years, previous injury, and weekly running distance. The later was significant only from 20 to 50 km; we speculate too few participants with weakly distance over 50 km were enrolled. An increased lifetime RRI risk for fresh (1 to 3 years), but not novice runners in comparison to runners with longer history was revealed. This suggests a natural selection bias: fresh runners who get injured early in their running carrier probably discontinue with this sporting activity, and only people with more appropriate biomechanical running dispositions persist. When we specifically focused on lower leg RRI, then higher age and barefoot running stood out as significant risk factors. Lower leg question on the distributed questionnaire was targeting body regions below the knee, and above the ankle. Herein, we would find mostly diagnoses-related shin and calf muscle-tendons, and less likely activity-induced compartment syndrome or tibia/fibula stress fractures. The muscle-tendon lower leg problems are probably related to degeneration and stiffness with increasing person's age, as such tissue is being less resistant to overuse (11). Shin/calf pain may also be related to foot pronation, as it has been previously shown that feet become flatter in older adults (12). Barefoot running itself has been shown to reduce foot soft-tissue overuse RRI, but it has a tendency to increase stress fractures (13). Recent studies tried to evaluate the effect of barefoot running on running injuries without any strong evidence beside supporting a forefoot strike pattern that improves running efficiency (14). Running barefooted or in minimalistic shoes requires higher activity of extrinsic shin/calf muscles to avoid heel strike and to adjust for the running terrain (13). We would suggest that such overload results increase lower leg RRI. Nevertheless, we need to interpret barefoot running with caution due to self-reporting of RRI and limited number of runners involved in barefoot running. BMI was exposed as a risk factor for one season injury, but not as a life-time prevalence risk factor. Here, we probably come across another natural history bias: novice/fresh overweight runners involved in running either quit this activity early due to an injury, or lose weight and continue with an injury free running career.

By reviewing recent studies about body parts affected by RRI in long-distance runners, most them can be attributed to the knee (7.2%-50%), followed by the lower leg (9%-32.2%), the foot (5.7%-39.3%), and thigh (3.4%-38.1%). Less common sites were the ankles (3.9%-16.6%) and the hip (3.3%-11.5%) (7). The most common clinical diagnoses are represented by the iliotibial band syndrome, patellofemoral pain syndrome, stress fractures, medial tibial stress syndrome, Achilles tendon and calf injuries, meniscus injuries, and muscle injuries to the hamstrings and quadriceps (5, 15). Among marathon runners, men report more hamstring and calf problems, whereas women report more hip complains (16). Knees and ankles/Achilles in our study, encounter for more than 50% of all RRI, and there seems to be good correlation to the other authors. Knowing the overuse problems of these particular regions, preventive training programs need to be implemented. Cross-training was previously shown to reduce risk for RRI (17, 18), but we were not able to prove this in our study population. Despite the expectations, we were also not able to show that supervised training in a club or in a dedicated training group, influences RRI risks. It looks like a supervised training provides motivational effect of running, but improvements of training protocols in terms of RRI prevention are required. Three main target groups of RRI prevention can be exposed from this study: males, overweight runners (BMI≥25 kg/m2), and previously injured runners. Lessons learned from anterior cruciate injuries and hamstring muscle tears have clearly shown that both can be reduced with dedicated preventive exercise (19, 20). Both injuries are quite easy to detect after an abrupt injury, as sportsmen are unable to continue with sports without medical help. On the other hand, RRI overuse injuries are less stressful, there is a wide spectrum of problems, and lots of runners do not seek medical attention for minor injuries. Overweight novice runners require soft transition into running, and they should be stimulated to lose weight also by other means, not just running itself. Although the population with previous RRI seems an easily accessible target for secondary prevention, the studies on functional diagnostics were not able to delineate clear criteria for RRI (21-23). Unfortunately, secondary prevention in such cases can be relied only on personal expert opinions.

This study needs to be interpreted considering the following limitations: limited sample size, self-reporting of RRI in a form of questionnaire, voluntary participation, and retrospective data acquisition. But on the other hand, the response rate of nearly 6% and similar distribution of age, gender, and running distances (referring to publicly available data) allowed us to draw statistically important conclusions.

5 CONCLUSIONS

This self-reported retrospective study on Ljubljana Marathon participants revealed a 53% lifetime prevalence of running-related injuries, with the predominate

involvement of knee, ankle, and Achilles tendon. One out of three recreational runners experienced at least one minor running injury per season. Male gender, short duration of running experience, previous injury, and higher BMI are linked to an increased risk of RRI in general. Higher age and barefoot running do increase risk for specific lower leg RRI, and so does the weakly running distance of over 20 km regarding specific foot RRI.

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CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

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ETHICAL APPROVAL

The study protocol was approved by the Slovenian National Medical Ethics Committee (No. 174/08/14).

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