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One in Five Trail Running Race Entrants Sustained an Injury in the 12 Months Training Period before the 2021 Mac Mac Ultra Race

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Abstract: Background: Trail running is characterised by large elevation gains/losses and varying uneven running surfaces. Limited literature is available to help guide injury prevention strategies among trail runners. The purpose of this study was to determine the epidemiology, clinical characteristics, and related risk factors for running-related injuries (RRIs) amid trail runners who entered the 2021 Mac Mac Ultra races. Methods: Design: Descriptive cross-sectional study. Setting: 2021 Mac Mac Ultra Race. Participants: Consent for data analysis was given by 251 of 330 (76%) race entrants. Main outcome measures: Point prevalence (%), frequency (n, %), retrospective annual incidence (RRIs/100 athlete-years), characteristics (pathology type, tissue type, body area, anatomical region), and associated injury risk factors (training and demographic variables) of RRIs. Results: In the sample, the retrospective annual incidence was 19.92/100 athlete-years. The point prevalence was 4%. Injuries mostly appeared in the lower limb (95%), with the lower leg (26%), thigh (22%), ankle and foot (13%) described as the highest injured body areas. Of tissue type injuries, muscle/tendon comprised 60%. Muscle injury (36%), tendinopathy (24%), and joint sprain (9%) were the most reported pathology types. No related injury risk factors were discovered in this study. Conclusions: One in five trail runners reported one or more RRI during the 12 months before a competitive event. RRIs commonly involved the lower limb, especially the lower leg, thigh, foot, and ankle. More studies are needed to establish injury risk factors.

Keywords: running-related injuries; clinical characteristics; trail running; epidemiology

Citation: Jooste, M.; Janse van Rensburg, D.C.; Scheer, V.; Jansen van Rensburg, A.; Ramagole, D.; Botha, T.; Viljoen, C. One in Five Trail Running Race Entrants Sustained an Injury in the 12 Months Training Period before the 2021 Mac Mac Ultra Race. *Appl. Sci.* **2023**, *13*, 9586. https://doi.org/10.3390/app13179586

Academic Editor: René Schwesig

Received: 21 July 2023
Revised: 18 August 2023
Accepted: 18 August 2023
Published: 24 August 2023

1. Introduction

Running is an easily accessible method of physical exertion that has an important role to prevent lifestyle illnesses and early mortality [1]. As a division of off-road running, trail running comprises running outdoors on foot in several types of natural environments (forest, desert, mountain, coastal areas, and jungles/rainforests). Trail running is not restricted by distance or elevation change and takes place over various terrains (e.g., forest trails, single track, dirt road, beach sand, etc.), limiting the amount of paved/asphalt roads to 20–25% of the total race distance [2]. Furthermore, the route is properly marked either by physical markings such as flags, signs, tapes, global positioning system (GPS coordinates), or map indication. Trail run races are usually self-sufficient, with athletes bringing their own equipment, food, and drink. It is important to mention that most ultramarathons (a race distance longer than the standard marathon distance of 42.195 km) held off-road can

be considered as trail running [2]. Trail runners are typically exposed to large elevation changes due to running in natural environments such as mountains. Although running presents with numerous health benefits, there is still a high risk of injury in trail running [3].

A living systematic review showed an injury incidence range of 0.7–61.2 injuries/1000 h of running among 12 studies that reported injury incidence in trail running [4–14]. Nineteen studies in current literature reported injury prevalence in trail running, ranging between 1 and 90% [5,6,8–12,15–26]. The body region most commonly injured in all studies reviewed is the foot/toe, ankle, and hip. The most common injury diagnosis reported was superficial tissue/skin injuries, muscle/tendon injuries, and ligament/joint capsule injuries [27]. They reported that the ankle was more frequently injured than the knee, specifically acute ankle sprains [3,8]. Furthermore, more severe injuries identified in this review included bone fractures, as well as concussions [9,10,28].

In trail running, multiple extrinsic and intrinsic injury risk factors are reported to have a significant association with injury among trail runners [27]. Identified risk factors include neglecting a warmup, not using a specialised training plan, training on asphalt, more than one training session a day, increased weekly running distance, longer race distance entered, and different race terrains [9,12,26]. Furthermore, running experience of more than six years, jobs with physical labour, a history of a running-related injury, and a history of allergy or chronic illness were also identified as risk factors [11,26]. Interestingly, specific to women, a link to menstrual dysfunction and bone stress fractures was identified [13]. These studies reported on individual risk factors related to the context of that specific study, while limited studies found associations with similar factors across various trail running settings [27]. Certain trail running races, such as the Mac Mac Ultra race in South Africa, are held in inaccessible locations where medical support is difficult and limited [29]. Trail runners who sustain an injury which results in an inability to proceed with running incur the risk of exposure to life-threatening conditions and extreme weather conditions while awaiting medical support [29]. It is therefore necessary to better understand the injury prevalence and injury profiles of injured runners who will start an ultra-trail running race, as the exacerbation of injury in an ultra-trail race might prove detrimental. Better knowledge could help race medical organisers plan more efficiently in terms of preparedness, management, and evacuation of runners on race-day. Understanding which factors are associated with injury during the training months before a race is important. This will help clinicians and runners mitigate the risk of injury in the training period ahead of the race.

We hypothesised that factors in the domains of runner demographics, training characteristics, and race distance entered would be associated with different levels of risk for injury. The objective of the study was to examine the epidemiology, as well as clinical characteristics of RRIs between race entrants of the 2021 Mac Mac Ultra race during the 12 months before the event and specifically the two weeks before the race. We further aimed to define associated risk factors in this trail running population.

2. Materials and Methods

2.1. Study Design

A retrospective cross-sectional study design was used in this study, examining data assembled two weeks before the 2021 Mac Mac Ultra Race, South Africa.

2.2. Participants and Data Collection

The study population was trail runners who entered any race distance category at the 2021 Mac Mac Ultra race (46 km, 80 km, 161 km, or 322 km), hosted in a mountainous region of the Mpumalanga province, South Africa. All the athletes completed an obligatory online pre-race medical screening questionnaire two weeks before the event. Two weeks before the race, race organisers shared the online questionnaire link in the pre-race information pack that each race entrant received via email. The online pre-race medical screening questionnaire (online Supplementary Materials) was hosted on the Qualtrics™ platform. The day before the race, each runner had to report to the race venue to allow for

a compulsory race gear check procedure. There, the medical staff ensured that all runners completed the online pre-race medical questionnaire. For the purpose of our research, we only analysed the data of race entrants that provided informed consent after the completion of the medical screening process, were 18 years or older, and entered one of the races at the 2021 Mac Mac Ultra event. Since the study population was well-defined, consisted of small numbers, and the whole population could be accessed, we utilised total population sampling in this study aiming to include 100% of the study population (Figure 1).

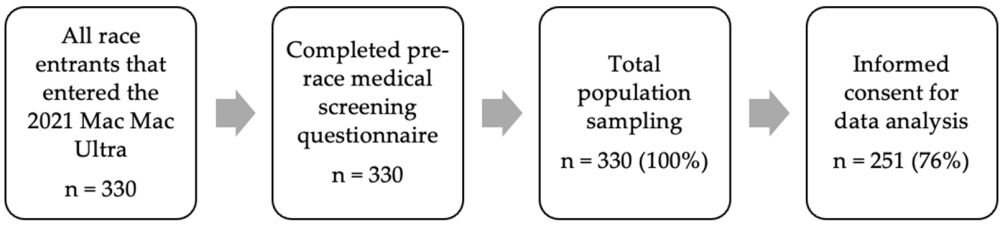

Figure 1. Flow chart of total population sampling.

Data gathered during the pre-race medical screening process included trail runners' demographics (BMI, height, age, running experience, weight), training variables with respect to running (weekly frequency, weekly distance, surface, average pace, shoes, vertical gain, cross-training), injury history (clinical characteristics of injury, RRI in the past 12 months, current RRI, severity of injury), history of disease (chronic disease, current illness), and usage of medication (current, chronic medication). The questionnaire is used in pre-race medical screening at various trail running events across South Africa [10]. Race entrants self-report their injuries sustained in the past 12 months by responding "yes" to the question: "Did you sustain any running-related injuries in the past 12 months?". Runners currently injured had selected "injury" in response to the question: Do you have a current injury or illness? If "injury" was selected, then additional questions were posed in relation to the four main considerations of the Oslo Sports Trauma Research Center Questionnaire on Health Problems (OSTRC-H) [30]. To be recorded as a current injury, the race entrant had to indicate that training modification was needed during the two weeks before the race. Furthermore, similar to the study on the 2019 Sky Run Race, questions that focused on the clinical aspects of injuries were asked [10]. After data collection, the data were coded and stored in an Excel spreadsheet keeping entrants' information anonymous. The data will be stored for a minimum of 10 years at the Department of Physiotherapy, University of Pretoria. For this study, only the injury-related data were analysed.

2.3. Ethical Considerations

This study forms part of a bigger project: "Reducing Injuries and Illness at Adventure Sports Events: A 10-Year Longitudinal Study (2018–2028)" (REC: 460/2018) that the Research Ethics Committee (REC) of the University of Pretoria approved. Before conducting this sub-study, another protocol was submitted to the REC to provide a detailed description of the framework underlying the data analysis in this study. Following the review process, the REC at the University of Pretoria also approved this study (REC: 404/2022). The pre-race medical screening process was designed to provide at-risk race entrants with additional medical information to benefit them in safer race participation. None of the participants were exposed to any physical or mental harm during this study. All participants were provided with the study information and were required to give informed consent to analyse their pre-race medical screening data. The study information document contained the research team's contact details, allowing participants to ask any additional questions regarding the study. No deception or coercion was involved in the recruitment of participants. Participants could decline the opportunity to participate or withdraw from the study at any time and not be negatively affected by this decision in any way. Participants' data were treated confidentially. De-identified data were provided to the research team by the custodian of the pre-race medical screening data. Furthermore, our data analysis

and reporting ensured no identification of a participant through the data presented in the results section of this publication.

2.4. Study Outcomes

We reported the point prevalence (% of current participants who were injured), retrospective annual incidence (RRIs per 100 athlete-years), and frequency (n,%) of RRI clinical characteristics (pathology type, tissue type, body area, anatomical region) in agreement with the 2020 International Olympic Committee (IOC) consensus statement for reporting and recording of epidemiological data on sports injuries [31]. Race entrants could report up to three injuries for a section related to being currently injured. The variables of BMI, sex, age, average weekly vertical gain, average weekly running distance, total years of active trail running, total years of active running, the average number of trail running sessions per week, and average number of any running sessions per week were investigated as possible related injury risk factors (OR, *p*-values).

2.5. Statistical Analysis

We used the Pearson Chi square test to compare categorical variables of all athletes in the event versus consenting athletes in the event to establish if our sample was demonstrative of the population (all 2021 Mac Mac Ultra race entrants). Frequencies (%) of injury for pathology type, tissue type, body area, and anatomical region utilised descriptive statistics. Inferential statistics (Independent *t*-test and Mann Whitney U test, and Chi Squared tests) were applied to contrast the training and demographic data of entrants between injured and non-injured entrants to examine and find connected injury risk factors. Odds ratios were calculated using binary logistic regression to investigate further the association between exposure and outcome (sustaining RRIs). Entrants were categorised into those who experienced an RRI during the previous 12 months vs. non-injured participants. Due to zero of the univariate examinations yielding statistically significant results ($p < 0.05$), a multivariate evaluation was omitted.

3. Results

3.1. Demographics of Race Entrants

A total of 330 trail running athletes entered the 2021 Mac Mac Ultra race, and 251 (76%) race entrants gave consent for the use of their data in this study (46 km (n = 156), 80 km (n = 58), 161 km (n = 28), 322 km (n = 9)). Table 1 confirms that no statistically significant difference existed between all race entrants (population) and consenting race entrants (our sample) and race distances ($p = 0.423$) and in the sex ($p = 0.701$), which indicates a representative study sample. Most consenting race entrants were males (70%, n = 232), while most of the participants entered the 46 km race category (56%, n = 185).

Table 1. Characteristics (sex, race distance) of all athletes and consenting athletes.

Characteristics		All Trail Run Entrants (n = 330)		Trail Runners Consenting as Study Participants (n = 251)		*p*-Value
		n	% of All Entrants	n	% of Study Participants	
Sex	Males	232	70	181	72	0.701
	Females	98	30	70	28	
Race Distance	46 km	185	56	156	62	0.423
	80 km	85	26	58	23	
	161 km	49	15	28	11	
	322 km	11	3	9	4	

As noted in Table 2, the 161 km race entrants had the peak mean age (44 years), height (181 cm), and weight (76 kg). The 161 km race entrants also had the lowest mean BMI (23 kg/m^2). Males reported a higher height (180 cm), age (40 years), weight (78 kg), and BMI (24 kg/m^2) compared to female race entrants.

Table 2. Characteristics of mean age (years), height (cm), weight (kg), and BMI (kg/m^2) by distance categories (46 km, 80 km, 161 km, 322 km).

Characteristic of Participants		All Consenting Race Entrants (n = 251)	46 km (n = 156)	80 km (n = 58)	161 km (n = 289)	322 km (n = 9)
Mean age (years) Missing (n = 0)	All participants	40	39	39	44	43
	Males	40	40	39	44	43
	Females	40	39	41	46	42
Mean height (cm) Missing (n = 0)	All participants	176	176	175	181	177
	Males	180	180	178	183	180
	Females	167	168	166	170	148
Mean weight (kg) Missing (n = 4)	All participants	73	73	72	76	74
	Males	78	78	76	78	77
	Females	61	62	59	60	52
Mean BMI (kg/m^2) Missing (n = 4)	All participants	23	24	24	23	24
	Males	24	24	24	23	24
	Females	22	22	21	21	24

BMI: Body Mass Index.

3.2. Running Surface Exposure

Across all race distances, the preferred training surface among race entrants included dirt roads (trails) (n = 193; 77%) followed by road/street (n = 186; 74%). Race entrants rarely trained on treadmills (n = 19; 8%) or tartan (track) (n = 4; 2%) (Figure 2).

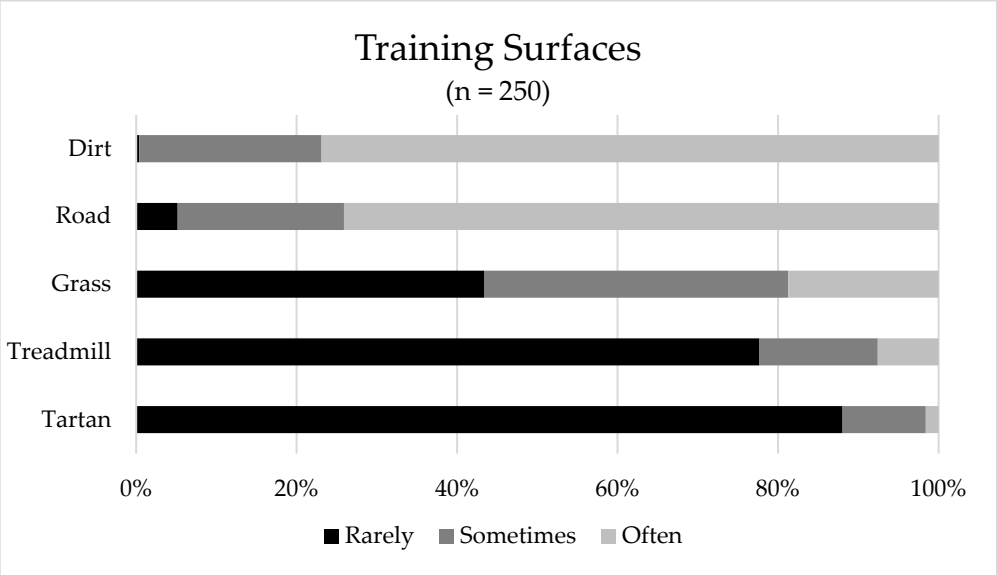

Figure 2. The frequency (n, %) of reported running surfaces trained on often, sometimes, and rarely by consenting race entrants.

3.3. Epidemiology (Point Prevalence and Retrospective Annual Incidence) of RRIs among Consenting Race Entrants

The retrospective annual incidence of RRIs for trail runners that developed an injury in the last 12 months was 19.92 per 100 athlete-years. Amongst the 251 consenting trail runners, 50 (20%) reported an RRI in the 12 months before the race, and 20 (40%) of these runners still experienced symptoms at the start of the race. The point prevalence of injury reported in the two weeks before the race was 4%.

3.4. Clinical Characteristics of RRIs among the Consenting Race Entrants in the Past 12 Months

The clinical characteristics of RRIs are offered in the groups of injured anatomical region, body area, tissue type, and pathology type.

Table 3 depicts the frequencies (%) and number (n) of RRIs (anatomical region, body area) in the past 12 months and two weeks before the race through all race distance classes.

Table 3. RRIs amid consenting race entrants by anatomical region and specific body area (% RRIs) (n = 55; n = 12).

Anatomical Region	Body Area	Injuries Reported in the 12 Months Leading up to the Race		Injuries Reported in the Two Weeks before the Race	
		Number of RRIs (n = 55)	% of All RRIs	Number of RRIs (n = 12)	% of All RRIs
Upper Limb	All	-	-	1	8
	Hand	-	-	1	8
Trunk	All	2	4	1	8
	Lumbosacral	2	4	1	8
Lower Limb	All	52	95	10	83
	Hip/groin	2	4	2	17
	Thigh	12	22	-	-
	Knee	5	9	2	17
	Lower leg	14	26	2	17
	Ankle	7	13	1	8
	Foot	7	13	3	25
Unspecified		6	11	-	-

The anatomical region most affected by RRIs in the 12 months leading up to the race and in the two weeks before the race was the lower limb (12 months: 95%, n = 52; 2 weeks: 83%, n = 10). The main body areas injured in the 12 months leading up to the race were the lower leg (26%, n = 14), followed by the thigh (22%, n = 12), and both ankle and foot (13%, n = 7). The most injured body areas reported two weeks before the race were the hip/groin, knee, and lower leg (17%, n = 2).

Table 4 portrays the frequencies (%) and number (n) of RRIs (pathology and tissue type) in the past 12 months and two weeks before the race across all four race distance categories.

Muscle and tendon type injuries represent the majority of RRIs among race entrants for both injuries sustained in the 12 months before the race and in the two weeks before the race (12 months: 60%, n = 33; 2 weeks: 58%, n = 7). Muscle injury (12 months: 36%, n = 20; 2 weeks: 25%, n = 7), tendinopathy (12 months: 24%, n = 13; 2 weeks: 33%, n = 4), and joint sprain (12 months: 9%, n = 5; 2 weeks: 17%, n = 2) were the pathology types most affected by RRIs in both the 12 months and two weeks before the race.

Table 4. RRIs among consenting race entrants by tissue and pathology type (% RRIs) (n = 55).

Tissue Type	Pathology Type	Injuries Reported in the 12 Months Leading up to the Race		Injuries Reported in the Two Weeks before the Race	
		Number of RRIs (n = 55)	% of All RRIs	Number of RRIs (n = 12)	% of All RRIs
Muscle/Tendon	All	33	60	7	58
	Muscle injury	20	36	3	25
	Tendinopathy	13	24	4	33
Nervous	All	1	2	1	8
	Peripheral nerve injury	1	2	1	8
Bone	All	3	5	1	8
	Fracture	2	4	-	-
	Bone contusion	1	2	-	-
Cartilage/Synovium/Bursa	All	2	4	1	8
	Cartilage injury	1	2	-	-
	Bursitis	1	2	1	8
Ligament/Joint capsule	All	5	9	2	17
	Joint sprain	5	9	2	17
Nonspecific	All	11	20	1	8

3.5. Univariate Analysis (Unadjusted) of Potential Risk Factors Associated with RRIs among Consenting Race Entrants in the 12 Months before the Race

The following variables were investigated as related RRI risk factors amongst consenting race entrants: BMI, sex, age, average weekly vertical gain, average weekly running distance, total years of active trail running, total years of active running, the average number of weekly trail running sessions, and average number of weekly running sessions.

Table 5 represents the univariate examination results (p-values) with the statistical significance set at $p < 0.05$.

Table 5. Univariate analysis (Odds ratio, 95% CI, p-value) of variables in relation to RRIs sustained in 12 months preceding the race.

Variable		OR (95% CI)	p-Value
Age		1.01 (0.97–1.05)	0.709
Sex		0.59 (0.26–1.21)	0.168
BMI		0.96 (0.85–1.07)	0.433
46 km		1.94 (0.81–4.43)	0.123
80 km		1.06 (0.41–2.68)	0.900
Average weekly vertical gain	501–1000 m	1.01 (0.44–2.28)	0.974
	1001–1500 m	0.93 (0.37–2.36)	0.880
	>1501 m	1.08 (0.42–2.91)	0.871
Total running experience > 5 years	Running	1.39 (0.71–2.64)	0.326
	Trail running	1.62 (0.85–3.19)	0.149
Average number of running sessions per week > 3 sessions	Running sessions	1.93 (0.90–3.98)	0.082
	Running sessions on trail	1.16 (0.50–3.03)	0.738

CI: Confidence Interval. OR: Odds ratio.

None of the variables listed in Table 5 showed a statistically significant connotation with sustaining RRIs in the 12 months before the race.

4. Discussion

This study investigates trail runners competing in the 2021 Mac Mac Ultra Race. Our key findings are: (1) 20% of participants described one or more RRI in the 12 months before the race, portraying a retrospective annual incidence of 19.92 per 100 athlete-years and a point-prevalence of 4%; (2) most injuries involved in the lower limb in the 12 months (95%) and two weeks (83%) before the race; (3) the body areas most commonly injured in the 12 months before the race was the lower leg (26%), thigh (22%), ankle (13%), and foot (13%). In the two weeks before the race, the most commonly injured body areas were the foot (25%), hip/groin (17%), knee (17%), and lower leg (17%); (4) in both the 12 months (60%) and two weeks (58%) before the race, the tissue type muscle/tendon was the most common injury; (5) muscle injury (36%), tendinopathy (24%), and joint sprain (9%) were the most frequent pathology types reported in the 12 months before the race. However, during the two weeks before the race, tendinopathy (33%), muscle injury (25%), and joint sprain (17%) were reported; (6) no variables involved in the univariate investigation showed a significant connotation with RRIs.

According to the living systematic review, 14 studies investigated training/race-related injury outcomes [27]. In these studies, runners were exposed to diverse running surfaces and ecological settings, making it challenging to compare our results with the current literature. Furthermore, only four of these studies investigated the same variables for comparison to our results.

4.1. Epidemiology of Injury

According to a cross-sectional study examining 40 Greek trail runners, at least one RRI was reported by 90% of the sample [26]. Of 719 trail runners in a retrospective cross-sectional study in Portugal, 87.7% reported a RRI during training [9]. Moreover, 42.1% of Dutch trail runners reported a RRI during the previous 12 months of training, with 18% stating being currently injured with an incidence of 10.7 injuries per 1000 h of running [8]. The abovementioned studies have a much bigger percentage of injury compared to our study, where only 20% of trail runners reported a RRI during the last 12 months. Furthermore, a study of Spain trail runners competing in mountain races recorded an injury incidence of 1.6 per 1000 h of running with 75% of participants reporting a minor musculoskeletal injury [7]. Another study on trail runners competing in the Himalayas reported an incidence of 30.7 per 1000 h of running [6]. These differences in the percentage of injuries during training might be due to different landscapes in the different countries where trail runners train.

Similar to our study, a retrospective cross-sectional study on South African trail runners reported that 28% of runners had at least one RRI in the 12 months prior the race [10]. In the current study, only 1% of runners reported injury at the day of the race, and 4% of runners reported injuries in the two weeks before the race. This low prevalence is in keeping with the retrospective cross-sectional study and can be due to false reporting because runners fear disqualification before the start of the race.

4.2. Clinical Characteristics of Injury

4.2.1. Anatomical Region and Body Area

Similar to the findings of the living systematic review, the lower limb was the most frequent anatomical region of injury in our study in both the 12 months (95%) and the two weeks before the race (83%). The study on Spain trail runners in the Al Andalus Ultra trail reported the lower limb as the most common anatomical region for injury (22%) with the knee being the most common (17%) [14]. The study on Greek trail runners reported the lower leg as the most frequent anatomical region (20%), followed by the knee (18%) and foot (15%). These trail runners reported the lower back (43%) as the most commonly reported

injured body area, followed by the knee (40%) [26]. Although our study also reported the lower leg (26%) and foot (13%) as commonly injured, unlike the two above mentioned studies [8,26], the knee was not reported as a frequent anatomical region of injury. The difference could be that in Greece, training is mostly on mountainous terrain, according to the study. In contrast, most of our participants trained five or more sessions per week on road surfaces (50%) and less than 1000 m elevation gain per week (50%). Another study on South African trail runners described the most common body area injured as the knee (27%), followed by the ankle (22%) and foot (17%) [10]. Our most reported body area was the lower leg (26%). A study on trail runners in Spain reported the lower limb as the most injured anatomical region (78%), and the most injured body area was the ankle (32%), followed by the knee (14%) and foot/toe (11%). They did however report injuries in the upper limb (18%) where the trunk was the most common (7%) [7]. The difference between the studies may be because the participants of these studies trained for different races in different geographical settings regarding terrain and elevation changes. Participants also trained for different race distances.

In our study, in the two weeks before the race, the foot (25%) was the most reported injured body area, followed by the hip/groin (17%), knee (17%), and lower leg (17%). Our study is the first to investigate injuries in the two weeks before the race and thus cannot be compared to other studies.

4.2.2. Tissue and Pathology Type

In our study, the muscle/tendon was the most injured tissue type reported among all consenting trail runners in the 12 months (60%) and two weeks (58%) before the race. This coincides with the Dutch (28%) and South African (44%) trail runners [8,10].

The most frequent pathology type reported was muscle injuries (36%) among all trail runners in our study, followed by tendinopathy (24%) and joint sprains (9%). This agrees with the results of the Dutch study that stated muscle injuries (28%) as the most frequently injured tissue type, followed by tendon injuries (24%) and ligament injuries (7%) [8]. The study on Greek trail runners found overuse bone injuries to be the most common tissue and pathology type (22%) followed by iliotibial band syndrome (ITBS) (16%) and meniscus and spinal disk injuries (14%) [26] Our results are further supported by the retrospective cross-sectional study on South African trail runners that reported tendon injuries (28%) as the most common injured tissue type, followed by joint sprains (20%) and muscle injuries (16%) [10]. According to the study on trail runners in the Al Andalus Ultra Trail in Spain, patellofemoral pain syndrome was the most common pathology type (7%), followed by Achilles tendinopathy (3%) and ultramarathoner's ankle, which classifies as tendinopathy (1%) [14]. This also coincides with our results from the two weeks before the race: tendinopathy (33%), muscle injury (25%), and joint sprain (17%). This is important to note as running demands repetitive lower limb movements where soft tissue is required to absorb ground reaction forces [32]. Furthermore, trail running requires increased eccentric muscle control, especially during steep descents, which can result in added muscle damage. This unique pattern of recurring ground force absorption and increased eccentric control could cause the increased occurrence of tendon and muscle injuries described among trail runners [33].

Interestingly, only 9% of injuries were reported as joint sprains. This difference from the 20% in the retrospective cross-sectional study might be due to our participants training for a different geographical area, race distance, and elevation gain [10]. Our injury data from the two weeks before the race, however, showed a similar result as the retrospective cross-sectional study for joint sprains (17%); this might be because nearing the race date, runners trained more on trails in preparation for the race [10].

4.2.3. Associated Injury Risk Factors

In total, 16 studies [4,9,10,12,13,15,16,18–20,22–24,26,34] reported injury risk factors in trail running literature to date. Among Greek trail runners, physical labour, double

training sessions, and more than six years of running experience were risk factors for injury. The study on trail runners in Portugal found no warm up and less exposure time as risk factors for sustaining injuries [9,26]. In contrast to the abovementioned studies, none of the variables involved in the univariate investigation in our study showed a statistically significant connotation with developing an RRI in the 12 months before the 2021 Mac Mac Ultra. Therefore, we could not reject our null hypothesis, i.e., we found no association between injury and demographics, training characteristics, or race distance entered. This is similar to the retrospective cross-sectional study on South African trail runners [10]. These inconsistent findings indicate the complex nature of sports injuries [35]. Sports injuries do not occur in isolation but are likely due to multifaceted relationships between various variables, known as a "web of determinants" [35]. This study examined a limited number of possible injury risk factors as per the sample size and information available. Further studies utilising greater sample sizes should incorporate more intrinsic variables and have a multivariate examination to assess potential injury risk factors.

4.3. Strengths and Limitations

A strength of this study was that 76% of all the 2021 Mac Mac Ultra race entrants consented to participate in the study and were a confirmed illustrative sample of the total population. This study addresses the significant lack of trail running information concerning the clinical characteristics and epidemiology of injury in preparation for trail run races. The results of this study need to be considered in the context of the limits such as recall bias of the cross-sectional study that used self-reported injury statistics based on injuries that transpired during the previous 12 months. The low point prevalence might be due to trail runners dreading disqualification due to the pre-race medical screening procedure. Upcoming studies should aim for prospective cohort study designs with frequent follow-up to limit recall bias. We acknowledged that participants might have misunderstood all the medical terms used to report injury pathology in this questionnaire. The lack of identified injury risk factors may be due to the small sample size. We acknowledge that runners with severe injuries that were unable to participate would not have been at race registration to fill out the questionnaire; thus, those injuries would not have been included in the study. Furthermore, we acknowledge that we studied a particular population of trail runners preparing for a specific race in a rugged region at extreme altitudes. Hence, the results of this study cannot be universalised to trail runners preparing towards races in diverse environmental settings (desert, forest etc.).

5. Conclusions

One in every five Mac Mac Ultra trail runners reported one or more injuries in the previous 12 months. Trail runners preparing for the 2021 Mac Mac Ultra race reported RRIs most commonly affecting the lower limb, explicitly the lower leg, thigh, ankle, and foot. Furthermore, our study identified that runners may choose to compete regardless of an injury. This accentuates the necessity to identify injury risk factors to aid in designing injury prevention tactics, since the occurrence of injury during a trail run may have devastating complications.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/app13179586/s1, File S1: Mac Mac Ultra Pre-race 2021.

Author Contributions: Conceptualisation, C.V. and D.C.J.v.R.; methodology, M.J., C.V., V.S. and D.C.J.v.R.; formal analysis, T.B., M.J. and C.V.; data collection, M.J., C.V., D.C.J.v.R., D.R., A.J.v.R. and T.B.; data curation, C.V.; writing—original, M.J.; writing—review and editing, M.J., C.V., D.C.J.v.R., D.R., V.S., A.J.v.R. and T.B.; visualisation, M.J., C.V. and D.C.J.v.R.; supervision, C.V. and D.C.J.v.R.; project administration, C.V. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of University of Pretoria (protocol code REC: 404/2022) approved on 13 July 2022.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are available upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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