

Online supplementary appendix 4

Table 3: Trail running injury incidence, prevalence, clinical characteristics, and severity

Author(s) and publication year	Injury definition	Follow-up period and intervals	Incidence of injury	Injury prevalence	Frequency (n, %) of injury characteristics as stated by 2020 IOC consensus statement				Injury severity
					Anatomical region	Body area	Tissue type	Pathology type	
<i>Studies that included only race-related injury outcomes (n=13)</i>									
Buckler & Higgins (2000) ¹	Medical encounters on race day	Only followed-up for the duration of the race	Not reported	Not reported	Lower limb Head and neck Upper limb	Ankle Foot Hand Hip/groin Head	Tendon Nail Skin Ligament / joint capsule Cartilage / synovium / bursa	Blisters: n=7 (10%) Achilles tendonitis: n=3 (4.2%) In growing toenail: n=1 (1.4%) Dislocated metacarpophalangeal joint of the thumb: n=1 (1.4%) Trochanteric bursitis: n=1 (1.4%) Semimembranosus bursitis: n=1 (1.4%) Talocalcaneal ligament sprain: n=1 (1.4%) Dog bite: n=1 (1.4%) Laceration on head: n=1 (1.4%)	Not reported
Costa et al. (2016) ²	Dermatological injury diagnosed visually	Event 1: MSUM ^a Prospectively followed up over 4 days Event 2: Continuous marathon 24 h Prospectively followed-up for the	Not reported	Event 1: MSUM ^a 89% Event 2: Continuous marathon (24 h) 14%	Lower limb	Foot	Skin	Blisters Subungual haematoma Chafing/abrasion Sunburn	Not reported

		duration of the race							
Dawadi et al. (2020) ³	Medical encounters	Prospectively followed up over 7 days	MSK: ^b 1.2 injuries/1000km run 170 injuries/1000 runners	MSK: ^b 17%	Lower limb	Ankle	Skin Ligament / joint capsule	MSK ^b (sprain/strain): n=17 (ankle sprain most commonly reported) Abrasion/laceration: n=12 Blisters: n=8 Sunburn: n=1	Not reported
Garcia-Malinis et al. (2020) ⁴	Self-reported sunburn	None	Not reported	45.1%	Not reported	Not reported	Skin	Sunburn	Not reported
Gonzales-Lazaro et al. (2021) ⁵	Self-reported injury: Major injury: could not further participate in the race Minor injury: continue with race participation	Not reported	5.9 injuries/1000 runners 1.6 injuries/1000h of running	Not reported	Lower limb: 78% Upper limb: 18% Trunk: 7%	Ankle: 32% Knee: 14% Foot/toe: 11%	Not reported	Not reported	Major injury: 25% Minor injury: 75%
Graham et al. (2012) ⁶	Injuries clinically diagnosed following an assessment	Data recorded twice per day over 7 days	Not reported	Not reported	Lower limb	Lower leg Distal stump (above knee amputee) Achilles region Foot	Skin	% of injured participants: Abrasion: 100% (n=11) Blisters: 100% (n=11)	Not reported
Graham et al. (2021) ⁷	Medical encounters	Prospectively followed up over 3 days	Not reported	83.3%	Trunk Lower limb	Back Knee Ankle Lower leg Hip/groin	Skin	Abrasions: n=7 (58.3%) Blisters: n=2 (16.6%) Frost injury: n=2 (16.6%) Hip and back pain: no frequencies provided	Not reported
Hoffman & Stuempfle (2015) ⁸	Self-reported muscle cramping during an event	Data recorded once-off 1–15 days post-race	Not reported	Full muscle cramping: 14.3%	Lower limb Trunk Upper limb	Lower leg Thigh Hip/groin Forearm Upper arm Hand	Muscle	Muscle cramping of: Calf: 57.5%, Quadriceps: 57.5%, Hamstring: 45.0%, Hip flexors: 17.5%, Trunk: 10.0%, Hip adductors: 2.5%, Ankle dorsiflexors: 7.5% , Forearm: 7.5%, Foot:	Not reported

Krabak et al. (2011) ⁹	Medical encounter: Disability sustained during a race, resulting in a medical encounter	7-day period (during each of the four events)	Injury rates/1000 runners (95% CI) MSK ^b (major): 46.2 (25.2-77.5) MSK ^b (minor): 670.0 (581.0-768.7) Skin (major): 39.6 (20.4-69.2) Skin (minor): 2726.1 (2543.3-2918.5) Injury rates/1000h of running (95% CI) MSK ^b (major): 0.8 (0.4-1.3) MSK ^b (minor): 11.2 (9.8-12.9) Skin (major): 0.7 (0.3-1.1) Skin (minor): 45.8 (42.8-48.9)	Not reported	Lower extremity (92.6%), Hip & lumbar spine injuries (3.8%), Upper limb, thoracic spine & head/neck regions (3.6%)	Hip/groin Lumbosacral Thoracic spine	Skin Bursa Tendon	5.0%, Upper arm: 2.5%, Hand: 2.5% Bursitis: n=12 Sprain: n=27 Strain: n=28 Tendonitis: n=122 Abrasion: n=43 Blister: n=652 Cellulitis: n=9 Hematoma: n=107 Other: n=55	Major: unable to continue in race (n=26) Minor: able to continue in race (n=1029)
McGowan & Hoffman (2015) ¹⁰	Medical encounters	During the race and immediate post-race	Not reported	Not reported	Not reported	Not reported	Muscle Ligament / joint capsule Nervous	Sprain, strain or tendinitis: n=7 (0.9%), Muscle cramping: n=6 (0.8%), Muscular pain: n=5 (0.7%), Contusion: n=2 (0.3%), Concussion: n=1 (0.1%), Skin wound: n=1 (0.1%), Visual impairment: n=1 (0.1%)	Not reported
Scheer & Murray (2011) ¹¹	Medical encounters	5 days: Data recorded daily during a stage race	Overall Incidence (injury and illness): 56.5%	Not reported	Lower limb	Ankle Lower leg Hip / groin	Skin Cartilage / synovium / bursa	The number of consultations: Blisters: n=33, patellofemoral pain: n=9, chafing: n=9, Ankle inversion injury: n=5,	Runners not able to complete the race: n=9

								trochanteric bursitis: n=3, muscle cramps: n=3, achilles tendinopathy: n=2, dog bite: n=2, subungual hematoma: n=2, ultramarathoner's ankle: n=1, quadriceps muscle pain: n=1, tibialis anterior muscle pain: n=1, laceration: n=1	
Scheer et al. (2014) ¹²	Blisters as inspected by the researcher	5 days: Data recorded daily during a stage race	Not reported	76%	Lower limb	Toe: n=71 (65%), Ball of the foot: n=18 (16%), Heel: n=15 (14%), Sole: n=6 (5%)	Skin	Blisters: n=110	Not reported
Vernillo et al. (2016) ¹³	Medical encounters reported during the race	None	Total injuries and illnesses: n=132 Injury rates/1000 runners (90% CI): MSK: ^b 614.3 (559.0-761.7) Skin: 314.3 (286.0-389.7) Injury rates/1000h (90% CI): MSK: ^b 61.2 (48.0-78.1) Skin: 31.3 (22.2-44.2)	Not reported	Lower limb Head and neck	Neck Foot Ankle Thigh Knee	Muscle Tendon Ligament / joint capsule Skin	Cramps: n=16 (26.2%), plantar fasciitis: n=16 (28.6%), ankle sprain: n=16 (28.6%), knee sprain: n=8 (14.3%), thigh strain: n=8 (14.3%), foot blisters: n=7 (53.8%), achilles tendinopathy: n=4 (7.1%), neck/cervical spine strain: n=4 (7.1%), laceration: n=2 (15.4%), subungual hematoma: n=2 (15.4%), chafing: n=2 (15.4%)	Not reported
<i>Studies that included training/race-related injury outcomes (n=6)</i>									
Babi' et al. (2018) ¹⁴	None	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported

Hespanhol Junior et al. (2017) ¹⁵	Disorders of the MSK ^b system or concussions Acute onset: linked to a specific injury event. Overuse injuries: not linked to a identifiable event. Recurrent RRI: ^d same location and of the same type as the index RRI, ^d Re-injuries: after full recovery Exacerbations : not fully recovered	Median: 34.0 weeks (IQR ^c 28.0–36.0)	Overall: 10.7 RRIs ^d injuries rate/1000h of running (95%: CI ^c 9.4-12.1) Males: 11.3 (9.7-12.9) Females: 9.1 (6.6-11.6) Overuse: 8.1 (6.9-9.3) Acute: 2.7 (2.0-3.4)	Overall: 22.4 % (95 % CI ^c 20.9-24.0). Males: 23.0 % (21.3-24.7) Females: 20.7 % (18.2-23.2), Overuse: 17.7 % (15.9-19.5) Acute: 4.1 % (3.3-5.0) Not reported Total number of injuries: n=242	Lower limb Trunk Upper limb Multiple regions	Lower leg: n=49 (20.6%), knee: n=44 (18.9%), foot: n=36 (14.9%), achilles: n=31 (12.8%), pelvis/hip/groin: n=25 (10.3%), upper leg: n=23 (9.5%), ankle: n=22 (9.1%), lower back: n=5 (2.1%), chest: n=2 (0.8%), wrist/hand: n=2 (0.8%), multiple regions: n=3 (1.2%)	Muscle: n=67 (27.7%), tendon: n=57 (23.6%), ligament: n=18 (7.4%), bone: n=13 (5.4%), fascia: n=9 (3.7%), skin: n=8 (3.3%), cartilage: n=7 (2.9%), joint (multiple tissues) n=2 (0.8%), nerve: n=2 (0.8%), bursa: n=1 (0.4%), unknown: n=58 (24.0%)	Achilles tendon injury: n=31 (12.8%), Calf muscle trigger points/spasm: n=26 (10.7%), Knee pain undiagnosed: n=21 (8.7%), Ankle sprains: n=17 (7.0%), Buttock muscle strain: n=10 (4.1%), Foot pain undiagnosed: n=10 (4.1%), Muscle strain lower limb (crossing anatomical boundaries): n=9 (3.7%), Hamstring strain: n=8 (3.3%), Plantar fasciitis strain: n=8 (3.3%), ITB ^g syndrome: n=7 (2.9%), Tenoperiostitis of lower leg: n=7 (2.9%), Blisters foot: n=5 (2.1%), Knee tendon injury: n=5 (2.1%), Lower leg pain undiagnosed: n=5 (2.1%), Hip/groin pain undiagnosed: n=4 (1.7%), Patellar tendinopathy: n=3 (1.2%), Lumbar pain undiagnosed: n=3 (1.2%), Patellofemoral pain: n=3 (1.2%), Thigh muscle strain/ spasm/trigger points: n=3 (1.2%)	Average OSTRC ^f severity score: 35.0 (22.0-55.7) Time loss: The average duration of RRIs ^d 2.0 weeks
Malliaropoulos et al. (2015) ¹⁶	Self-reported injury	None	Not reported	90% of runners reported at least on injury Total injuries (n=135)	Lower limb Trunk	% of injured runners Low back: 42.5%, Knee: 40.0%, Hip: 35.0%, Thigh (lateral): 35.0%, Foot plantar: 32.5%, Thigh (posterior): 30.0%, Leg (anterior): 27.5%, Foot dorsal: 27.5%,	Muscle Tendon Bone Cartilage / synovium / bursa	% of all diagnosed injuries Overuse bone stress injuries: 22% ITB: 16% Spinal disc injuries: 14% Meniscus injuries: 14% Hamstring strain: 12% Achilles tendonitis: 7% Plantar fasciitis: 7%	Grade 1: n=68 (50.4%) symptoms that appear after running. Grade 2: n=2 (1.5%) appears

						Leg (posterior): 22.5%, Thigh (medial): 20.0%, Achilles tendon: 20.0%, Thigh (anterior): 5.0%		Morton's Neuroma: 5% Tibiofibular joint injury: 2% Adductor tendonitis: 2%	hours after running. Grade 3: n=14 (10.4%) appears during running. Grade 4: n=51 (37.8%) chronic symptoms
									Time loss: None: n=73 (54%) 1-5 days: n=30 (22.22%) <3 weeks: n=16 (11.85%) > 3 weeks: n=16 (11.85%)
Matos et al. (2020) A ¹⁷	Not given	12 months retrospective	All: 10 injuries/1000h Males: 10.13 Females: 9.62	87.8% of participants injured	Lower limb Trunk Head and neck	Knee: n=377 (17.5%), Ankle: n=312 (14.5%), Leg: n=192 (8.9%), Toes: n=173 (8%), Anterior thigh: n=108 (5%), Posterior thigh: n=103 (4.8%), Lumbar spine: n=98 (4.5%), Hip: n=97 (4.5%), Other: n=85 (3.9%), Cervical spine: n=30 (1.4%), Dorsal spine: n=25 (1.2%), Chest: n=11	Toenails: n=535 (24.8%) Skin Muscle Tendon Bone Ligament / joint capsule	Blisters: n=554 (20%) Irritation (chafing): n=387 (14%), Superficial wound: n=321 (12%), Sprains: n=318 (11%), Micro strain: n=126 (5%) Shin splints: n=122 (4%) ITB syndrome: n=181 (7%), Plantar fasciitis: n=108 (4%), Tendinitis (other areas): n=108 (4%) Achilles tendinitis: n=94 (3%), Contusion: n=92 (3%), Patellofemoral pain: n=78 (3%) Other: n=77 (3%), Luxation: n=65 (2%),	Not reported

						(0.5%), Ears: n=9 (0.4%)		Muscle strain: n=66 (2%), Tendon strain: n= 35 (1%), Stress fracture: n=30 (1%), Bone fracture: n=22 (1%)	
Matos et al. (2020) B ¹⁸	Self-reported injury	Daily surveyed over 52 weeks	Not reported	52% (13 runners reported at least one injury)	Not reported	Not reported	Total injuries: n=38 MSK: ^b n=33 Dermatological: n=5	Not reported	Time loss: 1-3 days: n=25 4-7 days: n=10 8-21 days: n=3
Viljoen et al. (2021) ¹⁹	Self-reported	None	Retrospective annual incidence: 49.5 RRI ^d /1000h of running.	Point prevalence of RRI: 1.3% Annual prevalence of RRI: 28.2% Total injuries (n=102)	Lower limb: n=89 (87.3%) Upper Limb: n=6 (5.6%) Trunk: n=6 (5.6%) Head and neck: n=1 (1.0%)	Knee: n=27 (26.5%), Ankle: n=22 (21.6%), Foot: n=17 (16.7%), Lower leg: n=12 (11.8%), Thigh: n=8 (7.8%), Lumbo-sacral: n=5 (4.9%), Shoulder: n=3 (2.9%), Hand: n=2 (2.0%), Hip/groin: n=2 (2.9%), Wrist: n=1 (1.0%), Head: n=1 (1.0%), Chest: n=1 (1.0%)	Muscle/tendon: n=45 (44.1%) Ligament/joint capsule: n=20 (19.6%) Cartilage/synovium/bursa: n=14 (13.7%) Bone: n=10 (9.8%) Superficial tissues/skin: n=1 (1.0%) Nervous: n=2 (2.0%)	Tendinopathy: n=28 (27.5%), Joint sprain: n=20 (19.6%), Muscle injury: n=16 (15.7%), Synovitis/capsulitis: n=10 (9.8%), Fracture: n=5 (4.9%), Bone stress injury: n=5 (4.9%), Cartilage injury: n=3 (2.9%), Tendon rupture: n=1 (1.0%), Brain/concussion/spinal cord injury: n=1 (1.0%), Peripheral nerve injury: n=1 (1.0%), Bursitis: n=1 (1.0%), Laceration: n=1 (1.0%)	Average OSTRC ^f injury severity score: 31.6 (95% CI: 27.9-35.3)

a: Multistage ultramarathon

b: Musculoskeletal

c: interquartile range

d: RRI: Running related injury

e: Confidence interval

f: Oslo Sports Trauma Research Centre

g: Iliotibial band

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