



# Injury Pattern in 100-Mile Ultramarathoners

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## Objectives

At the completion of this interactive earning activity, you will be able to:

- recognize common injuries and illnesses ultramarathoners face
- manage these injuries and illnesses
- identify potential research and quality improvement opportunities

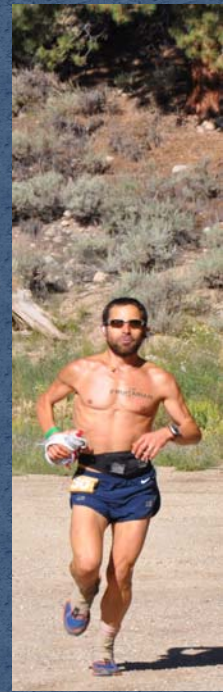


## Disclosure Statement

Nothing to Declare

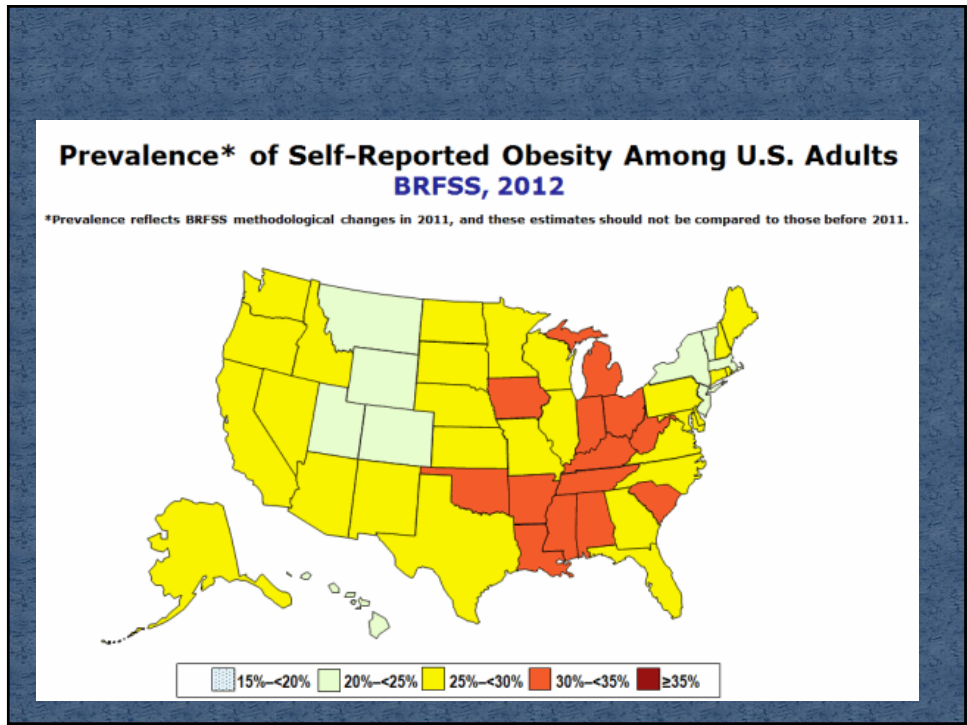
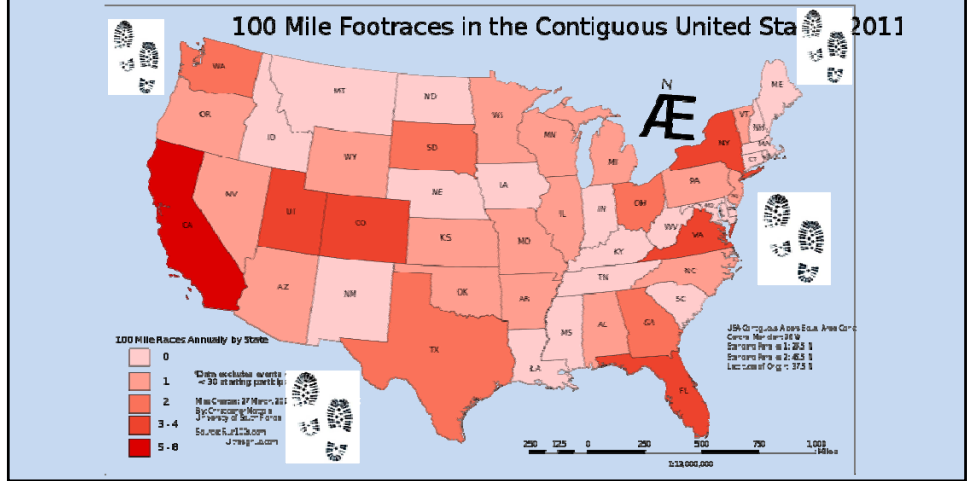
## Ultramarathons

- Ultramarathons has become more popular recently
- We see more nonelite athletes participation
- There are very limited data on injury pattern during training and during the race among ultramarathoners
- Ultramarathoners are usually highly motivated, goal oriented, and self coached athletes
- Compare to marathon runners, ultramarathoners are more experienced



# 100-mile (161-km) Ultramarathons

- There are 830 ultramarathon races worldwide
- There are 126 161-km races just in North America



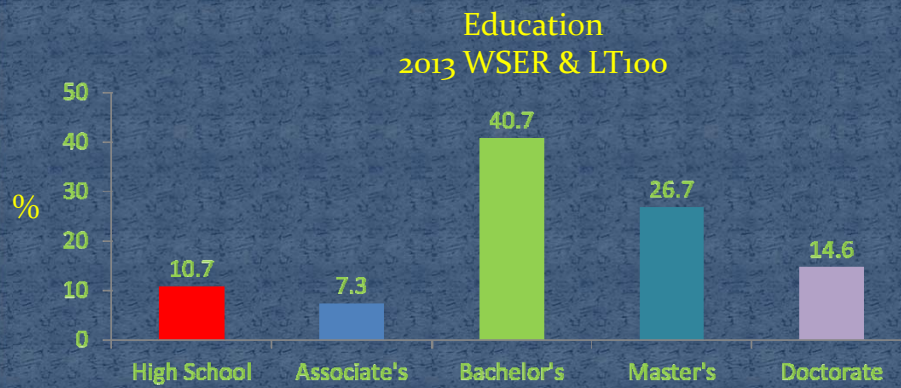
## Demographic Characteristics of 161-km Ultramarathon Runners

- Mean age early 40's (range 18-82)
- Male ~80%
- Married ~70%
- >90% Caucasians
- 50-70% take vitamins and/or supplements



- Hoffman MD, Fogard K. Demographic characteristics of 161-km ultramarathon runners. *Res Sports Med* 2012 Jan;20(1):59-69.
- Khodae M, Myers R, Spittler J, et al. Risk Factors for Injuries in a high-altitude ultramarathon. Abstract. *Br J Sports Med*. 2011; 45:355-6.
- Khodae M, Spittler J, Hill JC, Hoffman MD. Impact of Injury Pattern during Training on Ultramarathon Performance. Abstract. *Br J Sports Med*. 2014;48(7): 619.

## Demographic Characteristics of 161-km Ultramarathon Runners



- Khodae M, Spittler J, Hill JC, Hoffman MD. Impact of Injury Pattern during Training on Ultramarathon Performance. Abstract. *Br J Sports Med*. 2014;48(7): 619.

## Common Injuries & Illnesses

- During the race
  - Dermatologic
  - MSK
  - Respiratory
  - Hydration/hyponatremia
  - Renal/rhabdo
  - Trauma
  - High altitude illness
  - Heat-related illness
  - Exercise-associated collapse
  - Gastrointestinal problems
  - Vision problems
- During the training
  - MSK
  - Dermatologic
  - General health
  - Respiratory/allergy
  - Trauma
  - Others



## Injuries among 100-mile ultramarathoners

- The focus is on injuries in general
- Lots of these injuries may happen during the race
- There are many overlaps
- There are more overuse injuries during the training
- Less dermatologic and metabolic problems during the training



## Health and Exercise-Related Medical Issues among 1,212 Ultramarathon Runners: Baseline Findings from the Ultrarunners Longitudinal TRacking (ULTRA) Study

Martin D. Hoffman<sup>1\*</sup>, Eswar Krishnan<sup>2</sup>

- Self-reported retrospective survey study (ULTRA)
- Out of 1,212 active ultra-runners, 94.7% responded
- The most prevalent chronic conditions:
  - Allergies/hey fever (25%)
  - Exercise-Induced asthma (13%)
  - Cancer (4.5%)
- Medication use was 28%
- Less medical care use compare to general public
  - 64% related to exercise

## Conclusion

- 77% reported exercise-related injuries (past year)
- Compared with the general population, ultramarathon runners appear healthier and report fewer missed work or school days due to illness or injury



**Table 5.** Number, distribution, and incidence of various exercise-related injuries in the prior 12 months among 1,212 active ultramarathon runners.

Injury Type and/or Location	n	Distribution (%)	Incidence (%)
Fractures not involving the extremities	12	0.6	1.0
Upper extremity injuries including fractures	17	0.9	1.4
Back injuries	150	7.9	12.4
Iliotibial band issue	191	10.1	15.8
Hip flexor strain	106	5.6	8.7
Hamstring strain	143	7.5	11.8
Stress fracture involving femur/hip	6	0.3	0.5
Other leg, pelvis or hip issues	45	2.4	3.7
Knee issues	291	15.3	24.0
Calf strain	159	8.4	13.1
Achilles tendinitis or tear	131	6.9	10.8
Lower leg or ankle tendinitis not involving Achilles	111	5.8	9.2
Stress fracture involving tibia or fibula	23	1.2	1.9
Other lower leg injuries	18	0.9	1.5
Ankle sprain	131	6.9	10.8
Plantar fasciitis	129	6.8	10.6
Stress fracture involving foot	41	2.2	3.4
Morton's neuroma	38	2.0	3.1
Metatarsalgia	38	2.0	3.1
Great toe metatarsal phalangeal joint pain (bunion)	30	1.6	2.5
Other foot and ankle injuries	54	2.8	4.5
Skin wounds, blisters, and infections	18	0.9	1.5
Other not previously specified	18	0.9	1.5

**Table 6.** Comparison of select characteristics of those reporting an exercise-related injury in the prior 12 months with those who had not been injured.

Characteristic	With Injury	Without Injury	P
	n = 933	n = 279	
Age (years)	42.3 ± 10.5	44.7 ± 10.9	0.0008
Sex (% women)	32.3	31.2	0.77
Running experience (years) <sup>a</sup>	15 ± 11	17 ± 12	0.0060
Ultramarathon running experience (years) <sup>b</sup>	5 ± 7	7 ± 7	0.0008
Running distance in past year (km)	3,347 ± 1,407	3,413 ± 1,392	0.29
Lifetime running distance (km)	27,906 ± 32,381	30,670 ± 36,604	0.15
Average lifetime running distance per year (km)	2,197 ± 2,771	1,950 ± 1,541	0.18
Running on concrete or asphalt in past year (%)	42 ± 27	45 ± 28	0.15
Running on concrete or asphalt in lifetime (%)	55 ± 25	55 ± 26	0.85
Relative exercise time spent running in past year (%)	82 ± 18	85 ± 17	0.0017
Relative exercise time spent running in lifetime (%)	70 ± 23	76 ± 20	0.0001
Exercise time at high intensity in past year (%) <sup>c</sup>	24 ± 19	23 ± 18	0.50
Exercise time at high intensity in lifetime (%) <sup>c</sup>	23 ± 18	20 ± 15	0.0050
Performed resistance exercise in the past year (%) <sup>d</sup>	48.1	39.8	0.16
Performed resistance exercise in lifetime (%) <sup>d</sup>	72.9	64.9	0.11

Data are reported as mean ± SD except for group percentages.

<sup>a</sup>Running experience was based upon the year the subject started running at least 3 days per week.

<sup>b</sup>Ultramarathon running experience was based upon year first ultramarathon was run.

<sup>c</sup>High intensity was defined as "will break a sweat after 3-5 minutes; breathing is deep and rapid; can only talk in short phrases."

<sup>d</sup>An affirmative response meant the subject had regularly performed resistance training for at least a continuous 3-month period of time.

**Table 7.** Comparison of select characteristics of those reporting an exercise-related stress fracture in the prior 12 months with those who had not suffered as stress fracture.

Characteristic	With	Without	P
	Stress Fracture n = 67	Stress Fracture n = 1145	
Age (years)	39.3±8.6	43.1±10.7	0.0070
Sex (% women)	49.3	31.0	0.0028
Running experience (years) <sup>a</sup>	13±10	16±12	0.060
Ultramarathon running experience (years) <sup>b</sup>	4±4	6±7	0.032
Running distance in past year (km)	3,876±1,526	3,332±1,390	0.0039
Lifetime running distance (km)	24,288±26,848	28,790±33,740	0.17
Average lifetime running distance per year (km)	2,259±1,918	2,133±2,576	0.76
Running on concrete or asphalt in past year (%)	41±26	43±27	0.53
Running on concrete or asphalt in lifetime (%)	51±27	55±25	0.23
Relative exercise time spent running in past year (%)	81±17	83±18	0.21
Relative exercise time spent running in lifetime (%)	69±24	72±22	0.33
Exercise time at high intensity in past year (%) <sup>c</sup>	31±25	24±19	0.064
Exercise time at high intensity in lifetime (%) <sup>c</sup>	27±19	22±17	0.033
Performed resistance exercise in the past year (%) <sup>d</sup>	44.8	46.3	0.23
Performed resistance exercise in lifetime (%) <sup>d</sup>	59.7	71.7	0.038
Prior history of exercise-related stress fracture (%)	47.8	20.8	<0.0001

Data are reported as mean ± SD except for group percentages.  
<sup>a</sup>Running experience was based upon the year the subject started running at least 3 days per week.  
<sup>b</sup>Ultramarathon running experience was based upon year first ultramarathon was run.  
<sup>c</sup>High intensity was defined as "will break a sweat after 3-5 minutes; breathing is deep and rapid; can only talk in short phrases."  
<sup>d</sup>

## Injury types during the training

- Two 100-mile ultramarathons (WSER & VT)
- Retrospective survey study of participants
- ~50% entries had suffered a running injury in the previous year
- average of 21 d of training loss
- the main reason for not starting in 65% nonstarters who responded to the survey was an ongoing injury



**ORIGINAL INVESTIGATIONS**

International Journal of Sports Physiology and Performance, 2011, 6, 25-37  
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### Factors Related to Successful Completion of a 161-km Ultramarathon

Martin D. Hoffman and Kevin Fogard



**Table 2 Comparison among the three groups of survey respondents of frequency of running-related injuries, and training days lost due to running-related injury (means  $\pm$  SD)**

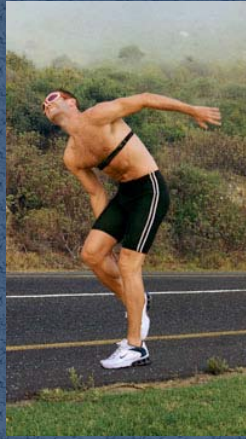
Group	Finishers	Nonfinishers	Nonstarters
Suffered a running injury in the previous year that was severe enough to interfere with training (%)	51.2*	50.0*	76.9
Training lost in the previous year due to a running-related injury (days)	18.3 $\pm$ 38.1*	23.2 $\pm$ 39.1*	44.4 $\pm$ 41.2
Training lost in the previous year due to a running-related injury considering only those reporting such (days)	27.6 $\pm$ 44.0*	37.3 $\pm$ 44.0	52.4 $\pm$ 39.7

\*  $P < .05$  compared with nonstarters.

**Table 3 Type/location of injuries among those reporting injuries that were severe enough to interfere with training during the previous year**

Injury Type / Location	%
Knee pain	19.9
Lower leg or ankle tendinitis not involving Achilles	15.3
Achilles tendinitis or tear	11.5
Hamstring strain	11.1
Plantar fasciitis	9.6
Ankle sprain	9.2
Calf strain	8.8
Iliotibial band issue	7.3
Stress fracture involving foot	4.6
Hip flexor strain	4.2
Back problem	4.2
Stress fracture involving tibia	3.8
Morton's neuroma	1.9
Metatarsalgia	1.5
Stress fracture involving femur	1.1
Great toe metatarsal phalangeal joint pain	0.8





**Table 4 Main reason given for dropping out among nonfinishers**

Problem	%
Nausea and/or vomiting	23.0
Unable to make cutoff times	18.7
Other, not categorized	12.2
Ongoing injury	7.9
Injury during the race	7.2
Inadequately heat acclimatized	7.2
Blisters or "hot spots" on feet	5.8
Muscle cramping	5.0
Muscle pain	4.3
Exhaustion	3.6
Illness before the race	2.9
Vision problems	0.7
Started out too fast	0.7
Inadequately trained	0.7

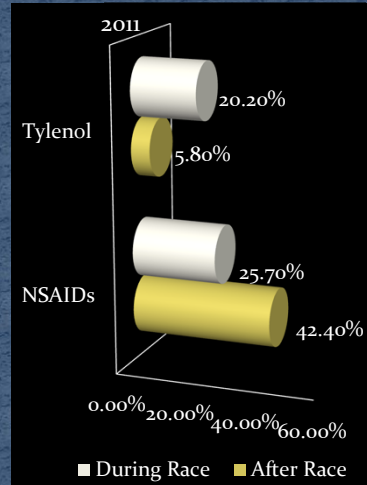
## NSAID use during the race

**Table 6 Comparison of medication use during the event among finishers and nonfinishers expressed as percentages within each group**

Medication	Finishers	Nonfinishers	P-value
Nonsteroidal anti-inflammatory drugs	60.5	46.4	0.0061
Acetaminophen	16.8	10.0	0.065
Asthma medication	2.4	2.1	1.00
Antacids	2.1	0.7	0.45
Antidiarrhea medication	1.8	1.4	1.00
None	28.7	43.6	0.0027

## NSAIDs Use - LT 100 Run

- NSAID's were used before and/or during the race by 39.7% of respondents in 2008
- In 2011 still significant number of runners used NSAIDs



## Ultrarunners and NSAID Use

- Many ultra-endurance athletes still use NSAIDs during training and race
- More common among runners than cyclists

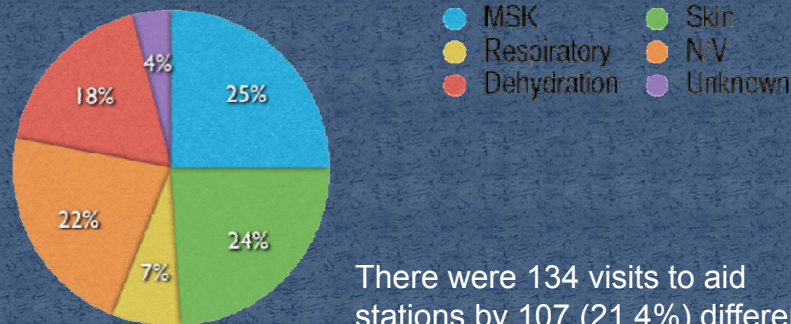


## MSK Injuries

- Typically from overuse and not dangerous, but may significantly impact performance
- Anywhere from 1-24% of endurance race injuries
- Most common injuries:
  - Patellofemoral pain (7-33%)
  - Achilles tendinopathy (8-19%)
  - Knee/foot/ankle tendinopathy (<10%)
  - IT band syndrome (7%)
  - Medial Tibial Stress syndrome (8%-11%)
  - Stress Fx (5-10%)
  - Chronic Exertional Compartment Syndrome
- Treatment during race limited to taping, massage, and stretching
- Limit use of NSAIDs!

1. Khodaei & Ansari, Curr Sports Med Rep. 2012.  
 2. Krabak et al. Curr Sports Med Rep. 2013.

## LT100 - Injury Report - Run Race 2009



There were 134 visits to aid stations by 107 (21.4%) different runners. Five runners were referred to the ED.

## MSK Injuries

- PFPS and IT Band friction syndrome
  - Very common
  - Running analysis?
  - Shoes
  - Rehab and strengthening
- Stress Fr & medial tibial stress syndrome (shin splint)
  - Mainly in the foot (MT) and tibia
  - Diagnosis & treatment crucial
- Exercise-associated muscle cramp
  - Etiology?
- Chronic exertional compartment syndrome
  - DDX is important
  - Diagnostic method and definitive treatment are invasive!

## MSK Injuries

- Plantar Faciitis
  - M>F
  - ~8-10% of all running injuries
  - DDX and management
- Tnedinopathy
  - Achilles
  - Patellar
  - Posterior tibial
  - Ant tibial
  - Peroneal



Patellar tendinopathy

## Dermatologic problems

- Less common during the training
- Blisters most common reason for medical tent visits during the race



1. Hoffman & Fogard. Int J Sports Physiol Perform 2011.
2. Krabak et al. Med Sci Sports Exerc. 2011.
3. Scheer & Murray. Clin J Sports Med. 2011.
4. Lipman & Krabak. Wilderness Medicine. 2012.
5. Krabak et al. Curr Sports Med Rep. 2013.

## Skin Breakdown

- Protect overlying skin with bandage or moleskin
- Chafing affects around 9% of runners - mostly groin, back, and nipple area
  - Treat with lubricants or a topical corticosteroid



## Road Rash & Lacerations

- Common in bike races or trail running events
- Important to have pressure irrigation
  - Remove debris
  - Explore wound
- Topical lidocaine for symptom relief
- Cover with sterile dressing and hold with mesh sleeve if extremity
- Can consider repair if superficial, but may need to refer athlete if large/deep



## Subungual Hematomas

- Occur in 2.9-9.5% of runners
- Treated by piercing the skin at the tip of the nail, if possible
- Can pierce nail with a clean, wide-bore hypodermic needle or heated paper clip



## Corn & Callus

- Very common
- Hyperkeratosis over the bony prominence
- Callus is usually less painful
- Treat the cause and you can remove them



## Asthma Exacerbation

- More likely in athletes with known asthma
  - Higher incidence allergies/asthma in endurance athletes
- Potential triggers: cold, dust, allergens, exercise
- Important to listen to lungs to distinguish from other causes of SOB
- Treatment:
  - Mild/moderate: Inhaled beta-2 agonists
  - Severe: epinephrine IM and emergency transport
  - Oxygen if O<sub>2</sub> sats low
- Ensure clinical improvement before return to race

Robson-Ansley et al. Med Sci Sports Exerc. 2012.

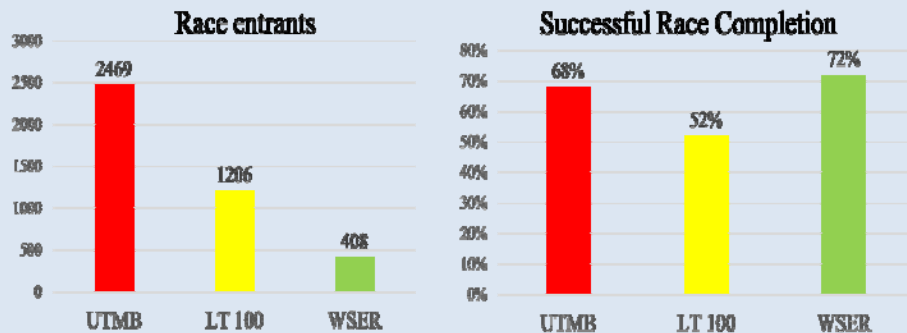


## Collaboration of LT 100, WSER & UTMB

- Out of 4,110 race entrants 2,794 (69%) completed the pre-race survey.
- Out of 2,469 UTMB, 1206 LT100, and 408 WSER entrants, 1,563, 893, and 368 completed the pre-race survey (63.3%, 73.9%, and 90.1%, respectively).
- Among participants who responded, 18.3% reported they failed to complete an ultramarathon of ~161km in the past year.



## Collaboration of LT 100 WSER & UTMB

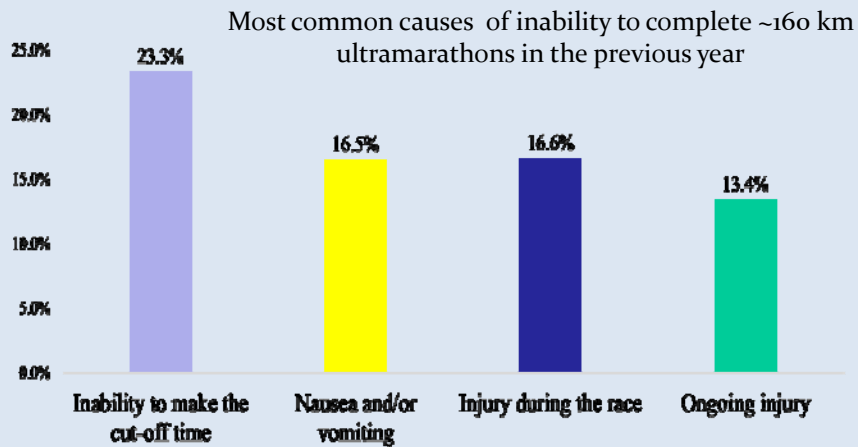


Common causes for not being able to complete at least one 160-km race in the previous year (N=374)	
Reason	N (%)
Unable to make cut-off time	87 (23.3)
Nausea/vomiting/diarrhea	73 (19.5)
Injury during the race	62 (16.6)
Ongoing injury	50 (13.4)
Exhaustion	36 (9.6)
Inadequately trained	33 (8.8)
Muscle cramping/Soreness	33 (8.8)
Blisters or "hot spots" on feet	28 (7.5)
Started out too fast	25 (6.7)
Inadequate heat acclimatization	22 (5.9)
Illness before the race	20 (5.3)
Inadequate altitude acclimatization	12 (3.2)
Severe shortness of breath	6 (1.6)
Dizziness	6 (1.6)
Vision problems	2 (0.5)
Other	32 (8.6)

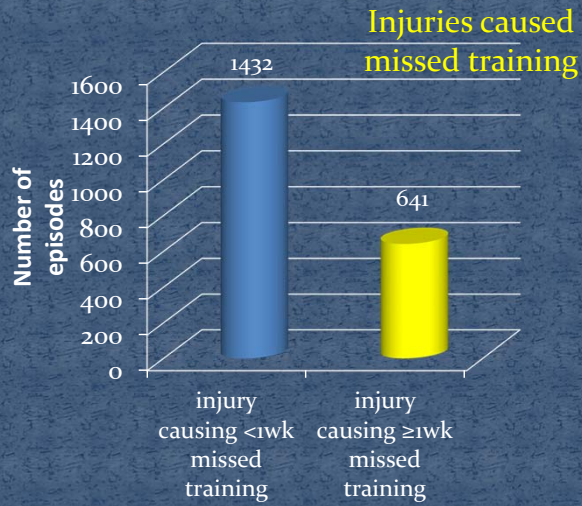


photo by Rob O'Dea

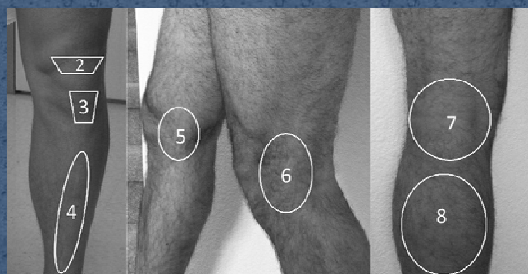
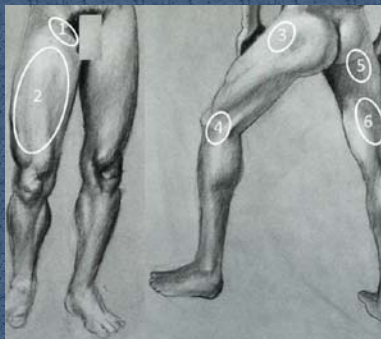
## Collaboration of LT 100, WSER, & UTMB




# Injuries caused missed training



# Survey



## WSER & LT<sub>100</sub>



**Common causes interfering with training in the previous year (N=2073)**

Reason (pain or other symptoms)	N (%)
Achilles	196 (9.5)
Distal iliotibial band	164 (7.9)
Calf	162 (7.8)
Edema	125 (6.0)
Heel	120 (5.8)
Proximal hamstring	115 (5.5)
Groin	106 (5.1)
Lateral knee	105 (5.1)
Patellar tendon	99 (4.8)
Proximal iliotibial band	91 (4.4)
Metatarsal	82 (4.0)
Distal hamstring	64 (3.1)
Anterior thigh	40 (1.9)

## WSER & LT<sub>100</sub>

**Binary logistic regression model:  
Successfully completing the race as dependent variable**

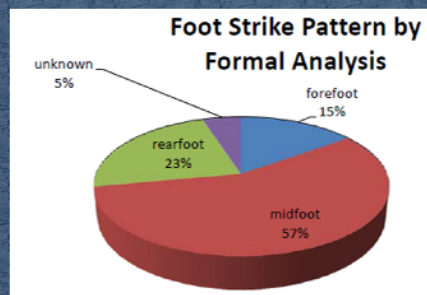
Variables in the model	P value	95% CI of the Difference
Gender	0.085	0.218 to 1.105
Age	0.049	1 to 1.068
BMI	0.066	0.991 to 1.332
Education	0.721	*
Months of Training	0.269	0.946 to 1.221
Completing ultramarathons before	0.760	0.969 to 1.023
Taking vitamins/supplements	0.648	*
Shoe type during race	0.374	*
Self-reported foot strike	0.108	*
Stress Fracture during training	0.492	0.237 to 1.997
Miss Training due to Injury/illness	0.866	0.991 to 1.011

\*Categorical variable with more than 2 categories

## WSER & LT100



- 25% of respondents reported undergoing a formal foot strike evaluation
  - majority done at a running store/company (58%), clinical settings (19%), and university/research center (10%)
- 45 (2.8%) reported stress fracture during training in the past year [27 (60%) involved the metatarsals and 10 (22%) involved the tibia]



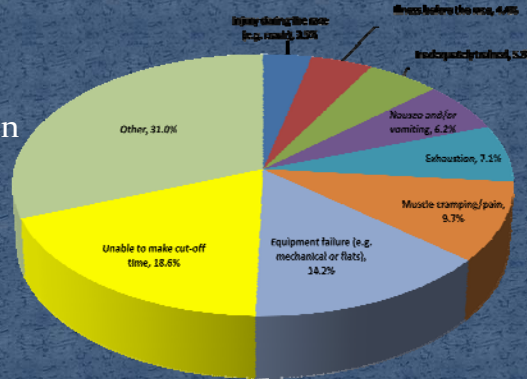
## WSER & LT100

- Neither foot strike pattern (reported from formal evaluation and self-evaluation) nor shoe type during the race differed between those who finished and did not finish the races.
- Foot strike pattern and shoe type also did not differ between those with and without stress fractures during the prior year of training.



## LT 100 MTN Bike

- Only 5.8% reported having failed to complete a mountain bike race of ~161km in the past year
- 23% of respondents reported injuries from crashes during training in the previous year.
- 63% of respondents reported a professional bike fit



## Opportunities and Research

- Hope for more collaborations between races
- Many opportunities for residents, fellows, and students to conduct research projects.



## Main References

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