

## INJURY INCIDENCE, DISTRIBUTION, AND SEVERITY DURING A MARATHON TRAINING SEASON AND THE IMPLICATIONS

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Marathon runners and their coaches are concerned about the potential for injury during an individual season. No published studies of running injuries address this training season as a meaningful entity. This study reports the incidence of injury and the distribution of injuries for runners (n=75) on two established marathon training teams during an individual season. An injury was defined as affecting seven consecutive days or three consecutive workouts. The incidence/risks of overuse injuries, for marathon runners in a single season were found to be: anterior knee pain (20%), iliotibial band syndrome (29%), plantar fasciitis (1%), Achilles tendonitis (9%) shin splints (16%) and stress fractures (4%). This risk, overall injury distribution, severity and length of longest run prior to presentation of injury are of interest to runners, coaches and biomechanists.

**KEY WORDS:** epidemiology, marathon, overuse injury, injury incidence, injury severity

**INTRODUCTION:** The importance of educating athletes about their particular injury risks cannot be underestimated. As the front line in any injury prevention effort, the individuals themselves can properly back-off their training/intensity only when aware of warning signs, risks and training errors. For marathoners and their coaches, the measure of importance is the individual season. Their goals, training intensity and mileage are established with an individual race in mind. For non-elite level runners, this season is likely to include one single race of that distance.

The mileage at which particular overuse injuries present themselves is valuable information for all runners. With this knowledge, coaches can adjust training near these distances, the runners can increase their awareness of warning signs, and researchers can compare the resilience of muscles, tendons and bones.

Recognizing these issues for these runners and coaches, we chose to follow a number of individual seasons for two organized marathon training teams. Runners can appreciate their risk of suffering from a particular injury. The distribution of injuries is more relevant to health professionals, while the severity of injuries is important to both groups.

The longest run at the time of presentation of injury has not been documented before. This epidemiological data will help coaches and runners design more successful training schedules.

**Previous investigations:** Several studies have documented common injuries of long-distance runners. In a review of 180 patients, with an average weekly mileage of 49 miles per week, it was found that those training for "long-distance" were most frequently injured (James et al., 1978). James et al. concluded that the majority of injuries among these long distance runners stemmed from improper training. They advised that a system that alternates days of hard and easy workouts may prevent overuse injuries.

In a retrospective survey of 1650 clinical records, Clement et al. reported the six most common injuries suffered by runners who ran at least two miles three days a week (Clement, et al., 1981). The injuries reported were patellofemoral pain, tibial stress syndrome, Achilles peritendonitis, plantar fasciitis, patellar tendonitis and iliotibial band syndrome (ITB).

A published study using a multiple choice questionnaire survey given to 1505 novice, intermediate and advanced runners reported the distributions of injuries as well as incidence rates (Brunet et al., 1990). The results of these previous investigations will be presented as a comparison with the results of the present study.

A cohort study targeting injuries associated with risk factors during the Auckland Citibank marathon does not apply directly to the training season and will not be used for comparison (Satterthwaite et al., 1998).

**METHODS:** All runners were members of organized marathon training teams. Over four seasons, a total of 75 (55F/20M) ( $31.2 \pm 7.1$  years,  $67.7 \pm 13.0$  kg,  $1.69 \pm 0.1$  m.) runners

logged their training, injury and running self-efficacy on an online survey. Each runner filled out a survey within six weeks of completing his/her training. The survey questions asked runners about their demographics, training history, cognitive training strategies and about the occurrences of different types of injuries (<http://spoon.inwildness.com/~dixie/survey.html>). For each injury, information on which leg, who diagnosed the injury, duration and recurrence was reported. The final 28 runners and their 35 injuries also reported the length of their longest run before the injury presented.

**RESULTS:** In this study, 74% of all the runners suffered at least one injury. 29% of the marathoners suffered an injury to their ITB (Table I). Anterior knee pain affected 20% of all runners while shin splints affected 15% of the runners. In this population ITB injuries were more prevalent and anterior knee injuries less prevalent than in previous studies.

It is also noted that the injury incidence was highest among women with 87.3% reporting an injury and 40.0% of the men reporting an injury.

**Table I Incidence / Risk of Injury**

Injury Study (n = runners)	Injured Runners		Ant Knee*		Iliotibial Band*		Plantar Fasciitis	Achilles	Shin Splints	Stress Fractures	Other
	Men	Women	Chondro- Malacia	Patellar Tendonitis	Hip	Knee					
Present Study n = 75	<b>20</b>	<b>55</b>	<b>15%</b>	<b>5%</b>	<b>16%</b>	<b>24%</b>	<b>1%</b>	<b>9%</b>	<b>16%</b>	<b>4%</b>	<b>19%</b>
					<b>29**%</b>						
Clement et al. N = 1650	987	663	28%	5%	5%*		5%	7%	14%	3%	25%
Brunet, et al. n = 1505	1130	375	49%*		-	-	-	18%	33%	9%	-
James et al. n = 180	152	28	28%*		-	-	-	-	-	-	-

\* The injury subgroups of these injuries were not reported in these studies.

\*\* Runners may injure the ITB at both the knee and hip so the incidence rate for any ITB injury is 29% in the present study. (Present study is the only overview for an individual marathon training season)

In this study, 34% of all the injuries suffered involved the ITB (Table II). Anterior knee injuries accounted for 16% of the injuries, which is substantially less than two of the published reports. Injuries often associated with bone recovery, shin splints and stress fractures, accounted for 20% of the injuries, which is a value that is consistent with the other published studies. In the present study recurrences of the same injury were not included.

**Table II Overall Distribution of Injuries**

Injury Survey (n = injuries)	Injuries		Ant Knee*		Iliotibial Band *		Plantar Fasciitis	Achilles	Shin Splints	Stress Fractures	Other
	Men	Women	Chondro- Malacia	Patellar Tendonitis	Hip	Knee					
Present Study n = 82	<b>15</b>	<b>67</b>	<b>11%</b>	<b>5%</b>	<b>17%</b>	<b>17%</b>	<b>2%</b>	<b>10%</b>	<b>15%</b>	<b>5%</b>	<b>18%</b>
Clement et al. n = 1244	734	510	38%	7%	6%*		7%	9%	19%	4%	10%
Brunet, et al. n = 2959	2192	767	25%*		-	-	-	9%	17%	5%	44%
James et al. n = 232	-	-	11%	2%	10%*		7%	11%	13%	6%	40%

\* The injury subgroups of these injuries were not reported in these studies.

(Present study is the only overview for an individual marathon training season)

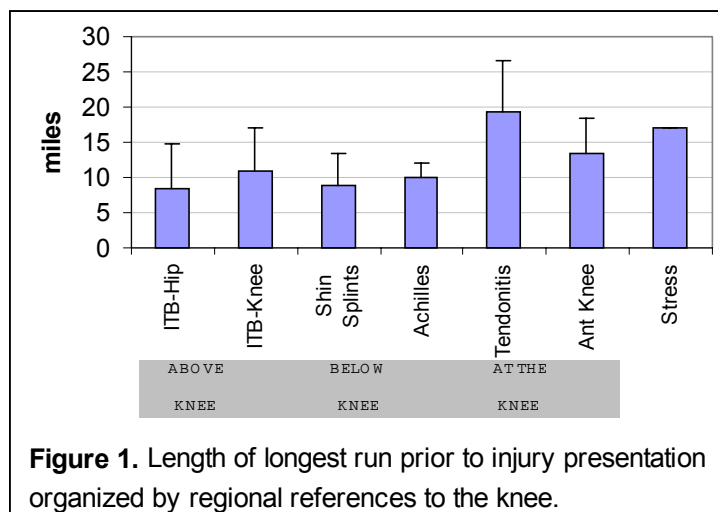
The severity of injuries is such that 45.1% of all injuries affected at least two consecutive weeks of training. At least 3 out of every 4 of injuries involving plantar fasciitis, patellar tendonitis and stress fractures are affected to such a degree. For any injury, a minimum of 1 in 5 will take greater than two weeks to recover.

**Table III Percentage of Injuries Taking Longer Than 2 Weeks to Recover**

Injury Survey (n = injuries)	Injuries		Ant Knee		Iliotibial Band		Plantar Fasciitis	Achilles	Shin Splints	Stress Fractures	Other
	Men	Women	Chondro- Malacia	Patellar Tendonitis	Hip	Knee					
Present Study n = 37	11	26	22%	75%	64%	29%	100%	38%	42%	75%	40%

The measure of the longest run prior to injury for particular injuries (28 runners and 35 injuries) can be grouped grossly by anatomical region. The regions of note are above, below and at the knee (Figure 1). The ITB (hip and knee) injuries are categorized as above the knee from research correlating this injury with loading of the hip musculature (Fredericson et al., 2000 & MacMahon et al., 2000). The above knee injuries present early in the training. Below the knee injuries are next with shin splints and Achilles tendonitis presenting near the 10 mile run. As a group the knee injuries, anterior knee and patellar tendonitis, took the longest average runs to present at 13.8 and 19.4 miles respectively.

As an injury, stress fractures presented at an average distance of 17.0 miles.



**Figure 1.** Length of longest run prior to injury presentation organized by regional references to the knee.

**DISCUSSION:** These data offer a view of the injuries associated with an individual training season. Compared to published studies, ITB injuries are more prevalent and anterior knee injuries less prevalent. Treating the marathon season as an entity produces the most applicable results for the runner and the coach. Runners want to know what is their risk for an injury while training for an individual goal. From a coach's perspective, he/she can incorporate more rest days or cross-training as the 10 - 15 mile threshold is reached. This may result in more runners training without injury.

Increasing mileage or intensity by greater than 10% per week is considered a common training error threshold. These training teams stay below this limit. Yet with 74% of their runners getting injured, development of a complimentary cross-training or a training plateau at 8 - 12 miles may be advisable. A potential dip in training mileage for a week as this mileage approaches may result in a net gain in overall training by avoiding the potential week of injury time common at this point.

Almost half of all injuries ended up affecting more than two weeks of training. The longer recoveries involved bone (stress fractures) and the highly loaded connective tissues (patellar tendonitis, plantar fasciitis). It is reasonable that for training success, runners and coaches need to be wary of warning signs associated with these injuries and act promptly.

Implications about injury mechanisms may also be present in this research. It is inferred that the ITB is the first to injure. The ITB injury has been reported to follow load on the hip abduction muscles (MacMahon et al., 2000). The muscles directly associated with the ITB, gluteus medius and tensor fascia latae, are quite small when compared to the other muscles of the thigh and may need the extensive conditioning to avoid fatigue early in the season. The presentation of anterior knee pains at longer mileage can be considered as a testament to the knee's biomechanical ability to absorb a pounding and recover.

Although the number of subjects is smaller than those previously published, the strength and applicability of this cohort study is quite reasonable. These results offer the runner, the coach

and the researcher pertinent measures to consider that are directly applicable to the next marathon training season.

**CONCLUSION:** Treating marathon runners and their goals in unison sheds a different light on the incidence and distribution of their injuries. Runners and coaches should note that in a particular season, the prevalence and distribution in ITB injuries is higher and the reports of anterior knee pain are lower than previously reported. At present, 40% of all injuries require a minimum of two weeks to recover from.

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