A Large, Randomized, Prospective Study of the Impact of a Pre-Run Stretch on the Risk of Injury in Teenage and Older Runners

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A more thorough technical report is being prepared for peer review. This report is meant to provide interested parties more detail than is reported in the USATF press release.

Introduction

Recreational and competitive running are two of the most popular athletic activities in the world. It is estimated that more than 70 million people worldwide participate in running in some form. Great controversy exists as to whether runners should stretch before or after running or even stretch at all.

There have been many studies of stretching prior to physical exercise. To date, a number of studies have found that stretching and warm-up activities improve flexibility [McKay], and a number of other published studies showing that various pre-event warm-up exercises combined with stretching can lessen the risk of injury [Amocko]. Stretch studies in connection with ballistic sports like weight lifting, gymnastics and wrestling suggest that a pre participation stretch routine does not prevent injury in those sports. However, those studies have been extrapolated to running and a popular notion has evolved that stretching before running is detrimental to both performance and health.

There have been no prospective-randomized studies to specifically evaluate the effectiveness of a pre-run stretch in preventing injury in a running-only activity. Despite the multitude of studies, the absence of controlled, randomized prospective studies leaves many contradictory conclusions. [Shrier 2004, Thacker 2004] Stretching before running is an assumed practice of most runners and especially those involved with team sports. Knowing whether this practice is helpful, harmful, or indifferent would significantly contribute to the training habits of a great many athletes.

The authors conducted a prospective, randomized, 2-arm, unmasked, comparative study of pre-run stretching versus no stretching with the objective of evaluating the impact of pre-run stretching on the prevention of injury during running.

Materials and Methods

Volunteers must have been over the age of 13 and run at least 10 miles per week and participate in their randomized group for a 3 month study period. Runners were solicited through the USA Track& Field (USATF) website. The study was consistent with the Declaration of Helsinki and the study protocol, informed consent documents, case report

forms, and recruitment materials were reviewed by the Holy Cross Hospital of Silver Spring, MD Institutional Review Board. Volunteers consented to participate and provide a valid email address to participate; no other identifying information was collected.

Those volunteers randomized to the stretch group were presented with photographs and text describing the correct manner of stretching and the amount of time for stretches of the quadriceps, hamstrings, and gastrocnemius/soleus muscle groups. The entire stretching routine was to take 3 to 5 minutes and was to be performed immediately before running (figure 1). Volunteers randomized to the non-stretch group were to refrain from any stretching before running. Other than the pre-run stretching routine, runners were to keep every other aspect of their running routine the same for the 3-month period, including any non-stretching warm-up activities.

All volunteers were asked to complete a pre-study baseline report; variables collected are listed in Table 1. During the study period, volunteers were to report any injury that prevented the volunteer from following their usual running regimen for at least 3 days and the total number of days the injury prevented them from running. In addition to all self-reported injuries of this type, volunteers were to indicate whether they experienced an injury diagnosed by a healthcare practitioner and to provide the diagnosis. If volunteers participate in other activities such as tennis, basketball, hockey, skiing/snowboarding, or other activities that have the potential to cause injury, injuries occurring due to these outside activities were are recorded as injuries occurring as a result of other activity. Finally, at the completion of the 3-month period, or at the time of an injury, volunteers were asked to complete a compliance form estimating their adherence to their assigned study group.

During enrollment and follow-up, a fully Bayesian interim monitoring plan was implemented [Fayer *et al* 1997 and Vail *et al* 2001] to constantly evaluate whether there was a detectable increase or decrease in the risk of injury in either study group unadjusted by other covariates. The final primary analysis was multiple logistic regression adjusted for the covariates listed in the Table 1. All tests were 2-sided and performed using an alpha of 0.05. All analyses were conducted on a per-protocol cohort defined as those individuals who provided consent, submitted a completed baseline report, completed either an injury report or a study wrap-up (compliance) report and indicated compliance of at least 75% with the assigned study group.

Results

Between mid-summer 2007 and late-summer 2009, 2729 volunteers consented to participate in the study with 1366 randomized to the stretch group and 1363 randomized to the no stretch group. For all enrolled volunteers, the raw injury rate was approximately 10% (274 / 2729) with raw rates of 9% (119/ 1366) and 11% (155 / 1363) in the stretch and no-stretch groups respectively.

Just over half of the enrolled subjects, 51% (1398 / 2729) sufficiently complied with the randomized stretching assignments and completed the study. This per-protocol cohort included 43% (600) of subjects randomized to the stretch group and 57% (798) of subjects randomized to the no stretch group. Obviously it is easier to comply with doing nothing than with performing the stretching routine. The raw injury rates in the per-protocol cohort are 16% overall and in both the stretch and no-stretch groups (p-value = 0.93).

Table 2 provides the raw percentages and adjusted and unadjusted p-values for comparison of the stretch and no-stretch groups using various definitions of injury. Note that the injury definitions are not necessarily mutually exclusive (eg: injury preventing running ≥ 2 weeks may or may not have been diagnosed by a healthcare professional). There were a total of 220 injuries in the per-protocol group. As mentioned above, the unadjusted rates in the two stretch groups were 16% and there is no statistically significant difference. When adjusting for all potential risk factors (Table 1), there remained no significant difference between the two stretching groups.

Of the 220 injuries, 115 (52%) were diagnosed by a healthcare professional. There is a small difference in the unadjusted injury rate between the two groups with 7% of runners in the stretch group and 9% in the no stretch group reporting injury (p-value = 0.15). However, when adjusting for other risk factors, those in the stretch group experienced a 40% reduction in risk (p-value = 0.005), implying that all other things being equal, individuals who stretched prior to running were less likely to report an injury diagnosed by a medical professional. However, when comparing injuries which prevented running in excess of 1 or 2 weeks, there is no significant difference between the stretch and no stretch groups whether adjusting for other risk factors or not.

The difference in the rate of injuries diagnosed by a medical professional seems incongruous with the lack of injuries of higher severity; preventing running for ≥1 or ≥2 weeks. This incongruity exists not necessarily because of a difference in the severity of injuries between the two groups, but by a difference in the chances an injury is diagnosed by a medical professional. In fact, the rate of diagnosed injuries is driven almost entirely by individuals who typically perform a pre-run stretch, but were randomized to and complied with the no-stretching regimen. These particular individuals were almost twice as likely to have an injury diagnosed by a medical professional (22.3%) compared to those who normally didn't stretch, and were randomized to the non-stretch group (11.8%).

Knee injuries accounted for 41/220 (19%), foot/ankle injuries accounted for 56/220 (25%), hip injuries accounted for 6/220 (3%), back injuries accounted for 10/220 (5%) and all other injuries which include stress fractures, muscle tears of all types, and groin pulls 105/220 (48%) of total injuries. There was no statistically significant difference in injury rates between the stretch and no stretch groups for any specific injury location or diagnosis.

In addition to evaluating the various injury rates, volunteer compliance with the assigned group and completion of the study were also evaluated for differences between the two randomized stretch groups and both were significantly associated with whether the randomized group was consistent with the subject's usual habits. (ie: if the subject switched pre-run stretching routines, they were unlikely to be compliant).

Discussion

Over a three-month period there was no statistically significant difference in injury risk between the pre-run stretching and non-stretching groups. Stretching neither prevented nor induced injury when compared to not stretching before running. Important risk factors for injury during the 3 month study were: BMI (the heavier the subject, the more likely the risk

of injury), age (increasing age increases injury risk), average miles per week (increasing miles increases injury risk), and history of chronic injury or injury within 4 months of initiating the study. The risk of all injury types (any, diagnosed, long/short term, knee, hip, foot/ankle, back or other) was the same for men and women. For the increased injury risk for age and for mileage, the difference existed only for those who had professional diagnosis.

Subjects who typically stretched as part of their pre-run routine, but were randomized to the no-stretching group were far more likely to have an injury diagnosed by a medical professional. Although, all subjects switching routines were more likely to experience an injury than those who did not switch, the group that stopped stretching had by far the higher number of reported injuries, implying that an immediate shift in a regimen may be more important than the regimen itself.

As an entirely volunteer study with no oversight for compliance, volunteers randomized to a group they did not want (ie: someone who normally stretches randomized to the non-stretch group) could decline participation and potentially re-enroll to obtain a more preferred assignment. Because there was no in-person oversight as in a typical clinical trial, all drop-outs are excluded from analysis – giving the best opportunity to measure an effect, and none was detected.

References

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Table 1: Counts, percentages, and p-values for unadjusted and adjusted comparisons of stretch and no-stretch groups

Injury Definition	Raw Percentages	P-Values for Difference between Stretch and No-Stretch Groups		Other Significant Predictors / Confounders
		Unadjusted (raw %s for each group)	Adjusted	
Self-Diagnosed (any injury preventing running > 3 days)	220/ 1398 (16% of subjects)	0.93 (S = 16%, NS = 16%)	0.86 No Diff	Recent Injury (0.02) Chronic Injury (0.03) Switching Routine (0.006) BMI (<0.0001)
Any Injury Diagnosed by Health Professional	115 / 220 (52% of injuries)	0.15 (S = 7%, NS = 9%)	0.005* Stretching Protective (OR = 0.60)	Prior Illness (0.003) Chronic Injury (0.0005) Age (0.03) High Average Mileage (0.007) BMI (<0.0001)
Any Injury Preventing running ≥1 week	106 / 220 (48% of injuries)	0.93 (S = 8%, NS = 8%)	0.8 No Diff	Recent Injury (0.004) Switching Routine (0.01) BMI (0.0003)
Any Injury Preventing running ≥ 2 weeks	64 / 220 (29% of injuries)	0.89 (S = 5%, NS = 5%)	0.9 No Diff	Recent Injury (0.02) Switching Routine (0.02) BMI (<0.0001)
Knee Injuries	41 / 220 (19% of injuries)	0.25 (S = 3%, NS = 2%)	0.2 No Diff	Chronic Injury (0.04)
Foot / Ankle Injuries	56 / 220 (25% of injuries)	0.41 (S = 4%, NS = 5%)	0.46 No Diff	High Average Mileage (0.02) BMI (<0.0001)
Hip Injuries	6 / 220 (3% of injuries)	0.94 (S = 0%, NS = 0.8%)	0.9 No Diff	Chronic Injury (0.03)
Back Injuries	10 / 220 (5% of injuries)	0.65 (S = 0.8%, NS = 0.6%)	0.7 No Diff	BMI (0.007)
All Other*	105 / 220 (48% of injuries)	0.48 (S = 8%, NS = 7%)	0.9 No Diff	Amount of time-off due to injury (0.003) Recent Illness (0.006) Switching Routine (0.006)

RED = Factors increasing risk of injury; BLUE = Factors reducing the risk of injury

* - included in this category are the following diagnoses: stress fracture, muscle tear (calf, quad, hamstring), or groin pull