Excessive Progression in Weekly Running Distance and Risk of Running-Related Injuries: An Association Which Varies According to Type of Injury

Running-related injuries are common, especially in novice runners. From a preventive perspective, study of the underlying mechanisms leading to such injuries is needed, as there is currently very limited knowledge about injury prevention. Interestingly, Hreljac pragmatically stated that all overuse injuries in runners are linked to training errors. This statement is supported by others who work with causality and injury in sport.

Training error is, unfortunately, a vague term because it covers a broad range of flaws in the running regimen. To name a few, these flaws may include excessive mileage, a rapid change in intensity, and a sudden increase in running distance. While difficult to define, it is a general belief that a sudden excessive increase in running distance may overwhelm the ability for adaptive changes and tissue repair, which ultimately leads to injury. To date, the scientific knowledge to support a link between sudden increases in weekly mileage and injury development is extremely limited. Yet, Jacobs and Berson reported that one third of runners with injuries described that they had changed their running routines just prior to their injury development.

The so-called “10% rule” is commonly used as a guideline for a maximum training progression by runners, coaches,
and clinicians. Although the 10% rule is widely accepted, a well-designed randomized controlled trial failed to identify an increased risk of injury in novice runners progressing their weekly running distance by 24% over an 8-week period compared to those progressing their weekly running distance by the recommended 10% over a 12-week period. Based on the results of this study, the 10% rule and its relationship to injury development should be reconsidered. Perhaps cumulative progressions over 8 and 12 weeks are not sudden enough. Possibly, changes in running routines over, for instance, a 2-week period may more likely lead to injuries. In addition, a higher progression rate may be needed to identify a difference in injury risk. In a recent case-control analysis, injured runners had an average progression in weekly distance prior to injury of 31%, whereas the noninjured controls had a progression of 22%. Unfortunately, the sample size in the study was small (n = 60), and only 13 runners sustained an injury. It was therefore concluded that the results from that study should be interpreted with extreme caution, and the need for more large-scale prospective studies was emphasized.

The inclusion of all types of running-related injuries into a statistical analysis may be problematic, as different running-related injuries may develop based on the types of errors in the running regime. It seems plausible that some injuries may more likely develop owing to sudden increases in running distance, while others may more likely develop owing to a sudden increase in running pace. A biomechanical rationale for the possible underlying mechanism for the development of some pace-related injuries has been suggested, and a number of studies have directly linked a fast pace or sprinting to the following injuries: Achilles tendinopathy, hamstring strains, tibial stress fractures, and iliotibial band syndrome.

Conversely, sudden increases in running distance may be linked to other types of running-related injuries, such as iliotibial band syndrome, patellofemoral pain, patellar tendinopathy, and medial tibial stress syndrome. A recent biomechanical study by Schache et al provides a rationale for the mechanisms that lead to injuries in the anterior part of the knee. During slow-speed running, the cumulative load at the knee joint is higher than the cumulative load during faster running. It is hypothesized that when running slower for longer distances (especially when fatigued), a sudden increase in mileage may be associated with an increased risk of running-related injuries in the anterior part of the knee. Similar assumptions could be made for other anatomical locations, such as the lateral part of the hip and the medial part of the lower leg. Accordingly, distance-related injuries could be hypothesized to be patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, gluteus medius injury, greater trochanteric bursitis, injury to the tensor fascia latae, and patellar tendinopathy.

To determine if a sudden increase in running distance may be associated with the development of running-related injuries, it would be possible, for instance, to follow a large cohort of runners prospectively and register their running routines using a valid method. Calculate the change in weekly running distance over a 2-week period, diagnose each injury by clinical examination, and divide the injuries into categories prior to analysis. Using this approach, it may be possible to determine whether the hazard of sustaining specific distance-related injuries increases in novice runners who progress their weekly running distance by more than 30% just prior to injury. The purpose of the present study was, therefore, to examine whether an association between a sudden change in weekly running distance and running-related injury varies according to the type of injury. We hypothesized that the injury rate would be significantly higher in novice runners who had a progression of weekly running distance of more than 30% than in novice runners with a progression of less than 10%, and that the increased injury rate would only be present for distance-related injuries, such as patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, gluteus medius injury, greater trochanteric bursitis, injury to the tensor fascia latae, and patellar tendinopathy.

**METHODS**

The Danish Novice Running project (DANO-RUN) was a prospective, observational cohort study with a 1-year follow-up. The study protocol was presented to the Ethics Committee of Central Denmark Region, which waived the request for approval because observational studies do not need ethics approval according to Danish law. Recruitment procedures and inclusion and exclusion criteria have been presented in previously published work. Of the 1530 individuals who volunteered for the study, 579 were excluded prior to baseline evaluation. At baseline investigation, an additional 18 individuals were excluded due to a variety of reasons. A detailed description of the reasons for excluding these 597 individuals is presented elsewhere. Finally, 933 participants (464 female, 469 male) were enrolled in the study after signing an informed-consent form.

**Baseline Investigation**

At baseline, the body mass index (BMI) of all participants was calculated. Subsequently, the participants were provided with a pair of neutral running shoes (Super nova Glide 3; adidas Group, Herzogenaurach, Germany) and were asked to use this shoe in all running sessions during the following year. In addition, each participant was provided with a global-positioning-system (GPS) watch (Forerunner 110 M; Garmin Ltd, Schaffhausen, Switzerland), which has previously been shown to accurately measure the distance covered by runners. Participants were instructed to upload every training session (running only) they completed during the year to an internet-
based training diary (http://www.vilober.dk/). In case of missing GPS data, they were told to upload the time and distance manually. After the baseline evaluation, the participants initiated their running program, which was self-structured. Each participant decided when and where to run, with no restrictions with regard to time, duration, and intensity of each training session. Similarly, each participant decided on the change in weekly running distance. Participants were told that they would receive the shoes and GPS watch for free if they completed a minimum of 52 running sessions during the 1-year follow-up.

**Running-Related Injuries**

The primary outcome was the first running-related injury to occur during the 1-year period. A running-related injury was defined as "any musculoskeletal complaint of the lower extremity or back caused by running that restricted the amount of running (distance, duration, pace, or frequency) for at least 1 week." This definition was a modified version of the definition used by Buist et al.\(^1\) If the participants sustained a running-related injury during the study period, they were instructed to contact the medical team via their personal training diary. Then, the participant was contacted by telephone, and an appointment for a clinical examination was made during which he or she was examined by a physiotherapist, preferably no later than 1 week after the telephone conversation. A standardized examination procedure and non-validated guidelines for the diagnostic criteria were used to classify each injury. If the physiotherapist was unable to diagnose the injury at the clinical examination, an additional examination including diagnostic imaging was performed at a nearby hospital, which was needed for 25% of all injury cases.

At each clinical examination, the running-related injury was classified as being based on overuse or on trauma. Injuries occurring during the first 2 weeks of the running program \((n = 34)\) were excluded because (1) these injuries were hypothesized to have occurred because the initial running distance during the first week was too long, and (2) it was not possible to calculate the progression in running distance during the first 2 weeks. A total of 873 of the 933 individuals originally included in the DANO-RUN study were included in the present analyses, after exclusion of those who sustained injuries in the first 2 weeks and the 23 uninjured individuals who left the study for reasons other than injury in the first 2 weeks. A flow chart of the exclusions prior to the analyses is provided in Figure 1.

Injured participants were asked to report the specific day or training session at which the symptoms started. Patellofemoral pain, iliobibial band syndrome, and patellar tendinopathy have previously been linked to excessive running distance.\(^2\) Additionally, we hypothesized that the development of medial tibial stress syndrome, gluteus medius injury, greater trochanteric bursitis, and injury to the tensor fascia latae would be linked to excessive progression in running distance. The assumption that these injuries are likely to be distance re-

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**Figure 1.** Flow chart of the exclusions prior to analyses. When investigating the cause-specific injury probability (Table 2: all subanalyses), the uninjured, the 76 sustaining distance-related injuries, the 58 sustaining pace-related injuries, the 52 sustaining other overuse injuries, and the 16 sustaining traumatic injuries are included. Abbreviation: DANO-RUN, Danish Novice Running project.

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**Table 2**

<table>
<thead>
<tr>
<th>Sustained</th>
<th>Excluded</th>
<th>Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury</td>
<td>n = 3</td>
<td>n = 873</td>
</tr>
<tr>
<td>Injuries</td>
<td>n = 34</td>
<td>n = 896</td>
</tr>
<tr>
<td>Injuries</td>
<td>n = 23</td>
<td>n = 930</td>
</tr>
<tr>
<td>Injuries</td>
<td>n = 202</td>
<td></td>
</tr>
</tbody>
</table>

**Sustained**

- Distance-related injuries, n = 76
- Pace-related injuries, n = 58
- Other overuse injuries, n = 52
- Traumatic injury types, n = 16

**Excluded**

- Sustained injuries prior to baseline
- Sustained injuries in the first 2 weeks
- Uninjured, left the study in the first 2 weeks

**Included**

- Remained uninjured, n = 671
- Sustained a running-related injury, n = 202
lated and not pace related remains to be further validated, and, as a consequence, the analyses presented in this article should be considered as explorative.

**Change in Weekly Running Distance**

The primary exposure of interest was the ratio between 2 weekly distances expressed as a percentage of change. The ratio was calculated in the following manner. After each running session during the study period, the sum of kilometers from that session was added to the sum of kilometers covered in a 6-day period prior to that session. Accordingly, the cumulative number of kilometers over a 1-week period (week 1) was determined. Then, the cumulative running distance from days 7 to 13 prior to the training session of interest (week 0) was calculated. Based on these 2 absolute distances from week 1 and week 0, the progression or regression (%) between these 2 periods was calculated by dividing the 2 absolute distances and then multiplying the result by 100 \[ \text{ratio between weekly distances} = \left( \frac{\text{total running distance week 1}}{\text{total running distance week 0}} \right) \times 100 \].

The ratio between weekly distances was a covariate that was time dependent, in the sense that progression (a positive ratio) or regression (a negative ratio) could change many times during the study period (effectively, after each running session). This enabled data analysis of a time-dependent exposure variable that allowed the participants to move into other exposure groups (or stay in the same exposure group) each time they ran. Importantly, this approach is much different from the average change in running distance, which is not time dependent and has been used as the exposure of interest in many previously published studies.

After calculating the ratio after each running session, the change in weekly distance (progression or regression) was categorized into 1 of the following 3 exposure groups (in statistical terms, exposure states): progression less than 10% or regression, progression between 10% and 30%, and progression greater than 30%. The 10% cutoff was chosen based on the general belief that a graded training program could become injurious at a progression in weekly distance of more than 10%. The 30% cutoff was chosen based on the findings from a pilot study. Because most participants varied in their running routine, each runner was able to move between the 3 exposure groups (less than 10% or regression, 10% to 30%, or greater than 30%) every time that runner completed a new running session during the study period. Statistically, such movement between exposure groups is known as multistate transition. Importantly, when a hazard ratio (HR) was calculated in the present study, it was based solely on the 3 exposure groups, with the goal of answering the following question: “Is it hazardous to progress by more than 30% over a 2-week period?”

If a runner did not run in week 0, it was not possible to calculate a ratio between the weekly distances in week 1 and week 0, because the denominator was zero. In such cases, participants were categorized into a “not available” group. To summarize, after each running session, participants were continuously categorized into 1 of the 4 groups (less than 10% progression or regression [reference group], 10% to 30% progression, greater than 30% progression, or not available).

**Statistical Analysis**

The HRs between exposure groups and running-related injury were estimated using Cox regression, with the number of kilometers during the training sessions as the time scale. In statistics, an exposure that can change over time is known as a time-dependent covariate. This concept enables each participant to move between exposure states continuously (after each running session) using delayed entry in the Cox regression model. In the analyses, cause-specific hazards of the instantaneous risk of injury from a specific injury category (distance-related injuries, pace-related injuries, other overuse injuries, and traumatic injuries) were calculated using competing risks. The HRs were compared across injury categories, with the less than 10% group as the reference group. The unit of analysis was each runner. Participants were censored in case of pregnancy.

### Table 1: Characteristics of the 873 Participants, Stratified by Injury Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (n = 873)</th>
<th>Injury Free (n = 671)</th>
<th>Injured (n = 202)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, n‡</td>
<td></td>
<td></td>
<td></td>
<td>.59</td>
</tr>
<tr>
<td>Male</td>
<td>441</td>
<td>335</td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>432</td>
<td>336</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Age, y§</td>
<td>37.2 ± 10.3</td>
<td>36.7 ± 10.2</td>
<td>39.0 ± 10.3</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>26.1 ± 4.2</td>
<td>25.9 ± 4.3</td>
<td>26.6 ± 4.2</td>
<td>.05</td>
</tr>
<tr>
<td>Fat percentage*</td>
<td>28.1 ± 9.3</td>
<td>276 ± 9.4</td>
<td>295 ± 9.3</td>
<td>.01</td>
</tr>
<tr>
<td>Previous RRI, n</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Yes</td>
<td>156</td>
<td>105</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>717</td>
<td>566</td>
<td>151</td>
<td></td>
</tr>
<tr>
<td>Previous non-RRI, n</td>
<td></td>
<td></td>
<td></td>
<td>.13</td>
</tr>
<tr>
<td>Yes</td>
<td>327</td>
<td>242</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>546</td>
<td>429</td>
<td>117</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; RRI, running-related injury.

*Values are mean ± SD unless otherwise indicated. All variables were measured or reported prior to or at the baseline investigation.

†The P values correspond to the tests for difference between injured and injury free.

‡Chi-square test used to compare injured and injury free.

§Unpaired t test used to compare injured and injury free.

*Measured by bioelectrical impedance.
TABLE 2

<table>
<thead>
<tr>
<th>Exposure State</th>
<th>Hazard Ratio*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All injuries (n = 202)†</td>
<td>1 (reference)</td>
<td>.99</td>
</tr>
<tr>
<td>&lt;10%</td>
<td>0.99 (0.55, 1.82)</td>
<td>.99</td>
</tr>
<tr>
<td>10%-30%</td>
<td>1.07 (0.54, 2.13)</td>
<td>.86</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>1.17 (0.84, 1.63)</td>
<td>.36</td>
</tr>
<tr>
<td>Distance-related injuries (n = 76)‡</td>
<td>1 (reference)</td>
<td>.96</td>
</tr>
<tr>
<td>&lt;10%</td>
<td>1.00 (0.57, 1.78)</td>
<td>.96</td>
</tr>
<tr>
<td>10%-30%</td>
<td>1.03 (0.37, 2.90)</td>
<td>.96</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>1.59 (0.96, 2.68)</td>
<td>.07</td>
</tr>
<tr>
<td>Pace-related injuries (n = 58)§</td>
<td>1 (reference)</td>
<td>.65</td>
</tr>
<tr>
<td>&lt;10%</td>
<td>0.91 (0.32, 2.63)</td>
<td>.86</td>
</tr>
<tr>
<td>10%-30%</td>
<td>0.83 (0.44, 1.57)</td>
<td>.56</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>1.00 (0.51, 1.99)</td>
<td>.96</td>
</tr>
<tr>
<td>Other overuse injuries (n = 52)¶</td>
<td>1 (reference)</td>
<td>.53</td>
</tr>
<tr>
<td>&lt;10%</td>
<td>0.63 (0.15, 2.70)</td>
<td>.36</td>
</tr>
<tr>
<td>10%-30%</td>
<td>0.84 (0.40, 1.77)</td>
<td>.56</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>1.00 (0.51, 1.99)</td>
<td>.96</td>
</tr>
<tr>
<td>Traumatic injuries (n = 16)‖</td>
<td>1 (reference)</td>
<td>.24</td>
</tr>
<tr>
<td>&lt;10%</td>
<td>3.00 (0.61, 15.20)</td>
<td>.17</td>
</tr>
<tr>
<td>10%-30%</td>
<td>3.16 (0.62, 16.25)</td>
<td>.17</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>2.09 (0.61, 12.00)</td>
<td>.24</td>
</tr>
</tbody>
</table>

*Values in parentheses are 95% confidence interval. Due to the low number of injuries in the 10% to 30% progression exposure group (n = 2-4), TABLE 3, the hazard ratios between this group and the reference group should be interpreted with caution.

†All 202 injured novice runners (all injuries) were included in the analyses.

‡Included the 76 runners sustaining distance-related injuries (patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, patellar tendinosis, and injury to the tensor fascia latae).

§Included the 58 runners who sustained pace-related injuries (plantar fasciitis, Achilles tendinopathy, tibial stress fracture, hamstring injuries, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, patellar tendinosis, and injury to the tensor fascia latae).

‖Included the 52 runners who sustained pace-related injuries (plantar fasciitis, Achilles tendinopathy, tibial stress fracture, hamstring injuries, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, and injury to the tensor fascia latae).

TOTAL OF 202 OF THE 873 NOVICE runners included in the study sustained a running-related injury. Demographic characteristics of the runners, divided by injury status, are presented in TABLE 1. During the study period, the participants ran a total of 148,491 km in 35,410 training sessions. After participants completed each running session, it was possible to calculate the exposure group to which the participant belonged at that given time point: for 16,253 sessions (46%) the progression (or regression) was less than 10%, for 19,393 sessions (55%) the progression was between 10% and 30%, and for 7,507 sessions (21%) the progression was greater than 30%. Finally, it was not possible to calculate a progression for 9,711 running sessions (27.5%).

The primary result revealed that the injury rate was modified by injury diagnoses in the greater than 30% progression group, based on the results from the analysis of pace-related injuries (TABLE 2, third analysis) and distance-related injuries (TABLE 2, second analysis) being significantly different (P < .05). In the analysis that included all injuries, no significant differences in injury rates were found across exposure groups (TABLE 2, first analysis). However, if injuries were restricted to patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, and injury to the tensor fascia latae (TABLE 2, second analysis), an increased rate of sustaining an injury was observed in those runners who progressed their weekly running distance by greater than 30% compared with those who progressed less than 10% (HR = 1.59; 95% confidence interval: 0.96, 2.66; P = .07). The estimate changed minimally after adjusting for age, BMI, fat percentage, and previous history of running-related injury (HR = 1.59; 95% confidence interval: 0.96, 2.66; P = .07).

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DISCUSSION

The present study revealed that novice runners who progressed their weekly running distance by greater than 30% were more vulnerable to distance-related injuries, such as patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, gluteus medius injury, greater trochanteric bursitis, and injury to the tensor fascia latae, than runners who progressed their running distance less than 10% (Table 2, second analysis). Such a relationship was not present for other injury types like traumatic injuries (Table 2, fifth analysis) or pace-related injuries like Achilles tendinopathy, plantar fasciitis, tibial stress fracture, hamstring injuries, iliopsoas injuries, and injuries to the triceps surae muscles. The red line is the cause-specific injury probability of traumatic injuries, such as ankle inversion injuries.

The observed and expected numbers of injuries in each exposure group are presented in Table 3.

Injury rate decreased in relation to increasing progression in running distance (Table 2, third analysis). A plot of the cause-specific injury probability is presented in Figure 2. The observed and expected numbers of injuries in each exposure group are presented in Table 3.

Clinical knowledge must be used with caution when designing a running program, because multiple changes between groups (multistate transitions) over time may affect injury risk considerably. In the present study, we examined 1 change in group over a 2-week period (from week 0 to week 1) in relation to injury risk. We did not take into account the cumulative distance in the week prior to week 0 (week –1) and the change in progression/regression from week –1 to week 0, or the change in progression from week –2 to week –1. In the present study, the 30% cutoff was found to be associated with an increased injury rate. Therefore, a runner increased his or her weekly distance by 36%, there was an increased injury rate for distance-related injuries. If the increase remained less than 30%, the injury rate was lower, which could have led the runner to assume that just keeping the increase to less than 30% would keep the injury rate low, no matter how the runner scheduled his or her running. Such an assumption must, however, be made with extreme caution. The injury rate may be low when increasing the weekly distance by, for instance, 5%, then by 7%, and finally by 3%. But the injury rate may be high when progressing from 25% to 25% and finally to 25% over a 4-week period, even though the progression did not exceed 30%. Clinicians should, therefore, be cautious about advising runners to increase their running distance at a high progression level, even though our results suggest that runners may be at low risk if the progression does not exceed 30%. Clinicians should, therefore, be cautious about advising runners to increase their running distance at a high progression level, even though our results suggest that runners may be at low risk if the progression does not exceed 30%. For now, it seems plausible to assume that continuous changes over time between high progression states (eg, 25%) may ultimately lead to an injury. But more work is needed to validate this assumption.
The biomechanical rationale that explains the mechanisms leading to injury development owing to a sudden increase in weekly distance remains unknown. Yet, it seems plausible to assume that running longer distances than usual may force runners to decrease running speed, especially if they are fatigued. If running speed is decreased for a given running distance, the cumulative number of steps increases considerably. This is important, because the cumulative load at the knee joint seems to be significantly increased during slow-speed running compared with faster running. A similar finding may be present at the lateral part of the hip and at the medial part of the lower leg. In contrast, another biomechanical rationale suggests a sudden increase in running speed to be linked with injuries like Achilles tendinopathy, plantar fasciitis, tibial stress fracture, hamstring injuries, iliopsoas injuries, and calf injuries. This may be the reason for the difference in the results across distance-related and pace-related injuries. We strongly underline the importance of this assumption because it seems crucial to make such a categorization if the influence of training errors on injury development is to be investigated properly.

The strengths of the present study are the number of individuals included and the method used to gather information about running exposure. Also, the statistical approach used, allowing for delayed entry/time-dependent exposures and competing risks, is a major strength. A comprehensive tutorial of the strengths and validity of time-to-event analysis, including a description of time-dependent exposures in observational studies, is provided by Bull and Spiegelhalter. But important limitations should be taken into account when interpreting the results. First, nearly all novice runners included in the study utilized a rearfoot strike. The results from the present study cannot be generalized to runners utilizing other foot-strike patterns, as other mechanisms leading to injury may exist for those with a midfoot- or forefoot-strike pattern. Second, it must be emphasized that the present study is an observational study. Because of this study design, the results presented are vulnerable to confounding, and the results must therefore be interpreted with caution. In Table 1, age, BMI, race, and previous running-related injuries were found to be risk factors for developing an injury. These risk factors were included in an adjusted analysis, but the adjustment had little influence on the estimates. Still, various unknown risk factors may confound the results of the present study. To take into account the risk of confounding, more randomized controlled trials are needed. In such studies, it is of great importance to perform clinical examination of the injured participants because different training approaches (sudden change in running distance versus sudden change in running pace) are associated with development of different types of injuries. Third, the results of the present study revealed that sudden progression of weekly running distance was a risk factor for the development of only 76 of 202 injuries (37.6%). Therefore, work must be devoted to identifying the training errors linked to the development of the remaining 126 injuries. For now, it seems plausible that excessive pace may be somehow associated with Achilles tendinopathy, plantar fasciitis, tibial stress fracture, hamstring injuries, iliopsoas injuries, and injuries to the triceps surae muscles. It would therefore be of great interest to perform an analysis to investigate whether progression in running pace may be associated with development of these injuries. Unfortunately, the measurement errors provided by the nondifferential GPS watches used to quantify the running pace were too severe to perform such analysis based on the DANO-RUN data set.

CONCLUSION

Novice runners increasing their weekly running distance by greater than 30% were more vulnerable to distance-related injuries, such as patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, gluteus medius injury, greater trochanteric bursitis, and injury to the tensor fascia latae, than runners who kept their progressions in running distance to less than 10%. These differences were not present for what we would consider “pace-related” or “other overuse” injuries. Due to the exploratory nature of the present study, randomized controlled trials are needed to confirm these findings, and more experimental studies are needed to validate the assumption that some structures are relatively more exposed to stress than other structures in relation to an increase in running distance. Yet, novice runners may be well advised to increase their weekly running distance at a slower pace to keep the time at a similar percentage of their total weekly distance.
distance by less than 30% over a 2-week period.

**KEY POINTS**

**FINDINGS:** A sudden increase in weekly running distance of greater than 30% over a 2-week period may lead to the development of patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, gluteus medius injury, greater trochanteric bursitis, and injury to the tensor fascia latae.

**IMPLICATIONS:** Novice runners may be well advised to increase their weekly distance by less than 30% over a 2-week period. Clinicians should pay particular attention to a runner’s progression in weekly distance if they have patellofemoral pain, iliotibial band syndrome, medial tibial stress syndrome, patellar tendinopathy, gluteus medius injury, greater trochanteric bursitis, or injury to the tensor fascia latae.

**CAUTION:** Other training-related factors, such as progression over several weeks and intensity, should be taken into account when designing a program for runners.

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- Suomen Ortopedisen Manuaalisen Terapian Yhdistys ry (SOMTY)
- Orthopaedic Manipulative Therapy-Canada (OMT-Canada)
- German Federal Association of Manual Therapists (DFAMT)
- Association of Manipulative Physiotherapists of Greece (AMPG)
- Hellenic Scientific Society of Physiotherapy (HSSPT) Sports Injury Section
- Chartered Physiotherapists in Sports and Exercise Medicine (CPSEM) of the Irish Society of Chartered Physiotherapists (ISCP)
- Israeli Physiotherapy Society (IPTS)
- Gruppo di Terapi Manuale (GTM), a special interest group of Associazione Italiana Fisioterapisti (AIFI)
- Italian Sports Physical Therapy Association (GIS Sport-AIFI)
- Nederlandse Associatie Orthopedische Manuele Therapie (NAOMT)
- Sports Physiotherapy New Zealand (SPNZ)
- Norwegian Sport Physiotherapy Group of the Norwegian Physiotherapist Association
- Portuguese Sports Physiotherapy Group (PSPG) of the Portuguese Association of Physiotherapists
- Singapore Physiotherapy Association (SPA)
- Singapore Physiotherapy Association Singapore (SMAS)
- Orthopaedic Manipulative Physiotherapy Group (OMPTG) of the South African Society of Physiotherapy (SASP)
- Swiss Sports Physiotherapy Association (SSPA)
- Association of Turkish Sports Physiotherapists (ATSP)

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Running
How to Safely Increase Your Mileage

Do you want to start a running program? Are you already a runner and want to increase your miles? Are you recovering from an injury and trying to return to running? If you are working to accomplish any of these goals, you have probably wondered how to increase your running miles safely so that you are not hurt. Running-related injuries are very common, and training errors are the leading cause of preventable injuries. Most training injuries are the result of “too much, too soon, too fast, too quick.” Although preventing running injuries is complicated and scientists still have a lot to discover, one rule familiar to many runners is the 10% rule, which states that you should not increase running mileage more than 10% each week. A study published in the October 2014 issue of JOSPT puts the 10% rule to the test.

NEW INSIGHTS
Although runners, coaches, and health care providers commonly use the 10% rule, more science is needed to understand its role in injury prevention. Researchers followed 873 new runners for 1 year; during this period, 202 runners had a running-related injury. The researchers compared runner injuries based on each participant’s weekly increase in running distance: less than 10%, 10% to 30%, and more than 30% in the 2 weeks prior to injury. Runners who increased their mileage by more than 30% had a higher injury rate than those who increased their mileage by less than 10%. Runners who ran farther faster were at higher risk for patellofemoral pain (runner’s knee), iliotibial band syndrome, medial tibial stress syndrome (shin splints), patellar tendinopathy (jumper’s knee), greater trochanteric bursitis, and injury to the gluteus medius or tensor fascia latae (see illustration). However, other types of injuries were not linked to the 10% rule, such as plantar fasciitis, Achilles tendinopathy, calf injuries, hamstring injuries, tibial stress fractures, and hip flexor strains. The authors suggest that these injuries may be related to other training errors.

PRACTICAL ADVICE
A sudden increase in weekly running distance by more than 30% over a 2-week period may put runners at increased risk for developing running-related injuries. The lowest injury rates were found in new runners who increased their weekly mileage by less than 10% over 2 weeks. However, other running injuries may be linked to running pace, increasing running speed, sprint training, or other training errors. If you are starting a running program, your physical therapist can help customize a safe running progression to meet your needs. For more information on a personalized running program, contact your physical therapist specializing in musculoskeletal disorders and running-related injuries.
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