The NLstart2run study: running related injuries in novice runners
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SUMMARY

Running is a popular sports activity. In the Netherlands, 12% of the population is running on a regular basis, which makes running the second most popular sports activity. Given the positive health effects associated with regular physical activity, the growing popularity of running is a positive trend. The high injury incidence in runners however is a downside, in particular novices are susceptible. Structural sports participation is important for maximizing the health effects associated with sports. For this reason it is important to prevent running related injuries, because occurrence of an injury often leads to drop-out from running or sports.

Although much research has been conducted, evidence based knowledge on running related injuries is scarce. We know that most running related injuries are the result of overuse and are located around the knee and lower leg. The exact incidence remains unclear due to large variances in incidence reports (19% to 79%). Also not much is known on factors that increase injury risk in running. Many studies tried to identify risk factors for injury occurrence, but results were inconsistent. A running related injury is caused by multiple risk factors which together determine the injury risk. These risk factors should therefore be entered simultaneously in a statistical model. In previous studies it was not always possible to account for multiple risk factors simultaneously, which might explain the inconsistent results.

This thesis describes the NLstart2run study, a study in which a large cohort of novice runners is followed. The main purpose of this thesis was to increase knowledge regarding the incidence and etiology of running related injuries in novice runners (Chapter 1).

Chapter 2 describes a systematic literature review that included all available literature in which injury incidences were reported. We tried to clarify the large variance in incidence reports by categorizing these reports on population of runners and type of injury definition used. Incidence proportions varied greatly between different populations of runners. Sprinting athletes and ultra marathon runners reported the highest incidence of time loss injuries. Only a small number of studies expressed the injury incidence in relation to the time spent running (e.g. the number of injuries per 1,000 hours of running). This makes it difficult to compare incidence reports from different studies. Future studies are therefore advised to express the injury incidence per 1,000 hours of running.

The design and aims of the NLstart2run study were described extensively in chapter 3. Runners who participated in a 6-week Start to Run program which is organized biannually by the Dutch Athletics Federation, were asked to also participate in the study. Study participants completed a questionnaire before the start of the running program. This questionnaire was used to collect data on personal characteristics, sports and injury history, perceived health and physical activity during daily life. The same questionnaire was sent after 6, 12, 24 and 52 weeks, to monitor changes over time. During the running program a weekly online run-
ning log was sent to the participants to collect data on training behavior like duration and intensity of each training session. We also asked for the presence of complaints during the training session and whether or not these complaints were the result of running and if the complaints impacted the training session. Based on this information, injuries were registered. An injury was registered when running ability was hampered for three consecutive training sessions as a result of running related pain. In which hampering could either be absence from running or a reduction in volume or intensity.

The first results of the NLstart2run study were presented in chapter 4. A quarter of all Start to Run participants (N=7,660) also participated in the NLstart2run study. Some participants were excluded from the analyses, because of age restrictions or incomplete questionnaires, leaving 1,696 runners in the analyses. During the 6-week running program, 185 participants (10.9%) sustained an injury. The incidence density was 27.5 injuries per 1,000 hours of running. Most injuries were located around the knee (38.4%), followed by the calf (20.0%), Achilles tendon (13.0%) and shin (13.0%). Participants without previous running experience, with previous musculoskeletal complaints, a higher age and a higher BMI had an increased injury risk. Unfortunately most of these characteristics are non-modifiable, therefore it is important to identify training behavior that is associated with an increased injury risk.

The association between training characteristics and injury occurrence was examined in chapter 5. Running frequency, total running volume (minutes) and mean intensity of all training sessions in the week prior to the injury were determined. Running with a higher intensity increased injury risk. Training frequency, on the other hand, was not significantly associated with injury occurrence. There was, however, a trend towards running three times per week being more hazardous than running twice a week. Finally, running more than 60 minutes per week turned out to be protective for sustaining an injury. This last finding is surprising and is caused by other factors. Future research should tell which factors caused this finding and how these factors are related to training load and injuries.

An important aspect of sports injury research is the injury definition used. Many different definitions are used, but not much is known about the impact of these different injury definitions. Therefore, the NLstart2run dataset was used to describe the effect of different injury definitions on the incidence and nature of the registered injuries (Chapter 6). Six different definitions were compared and the results showed large differences in injury incidence. The incidences varied between 7.5% to 58.0% or 18.7 to 239.6 injuries per 1,000 hours of running. Besides differences in incidence, also duration of complaints, maximum amount of pain and affected body locations differed between injury definitions. These results stress the need for uniform methods of injury registration.

Chapter 7 discusses the most important findings of the studies included in this thesis as well as the implications and opportunities for future research. The incidence of running related
injuries is high and varies between 1.4% and 94.4%. Populations of runners and duration of follow-up partly explain this high variance. The injury definition also has a large impact on the reported injury incidence. It is advised to register injuries with a standardized condition-al questionnaire to get a more complete overview of the injury complaints.

The surprising results regarding training related risk factors showed that other factors modify the association with injury occurrence. It is important to realize that in the end an injury is caused by too much load in relation to the load capacity. Load is caused by training characteristics while load capacity mainly is the result of personal characteristics. In future studies we should realize that the association between training and injury will depend on personal characteristics. More insight into these relations should result in person specific training programs. In this perspective, a digital coaching app offers great opportunities for research and implementation.
Samenvatting