INTRODUCTION

A recent report on sports participation in the Netherlands revealed that in 2012, around 12% of the Dutch population was involved in running [1]. This makes running, after fitness, the most popular sporting activity in the Netherlands [1]. Running is one of the most accessible sports - all you need is a pair of shoes - which probably explains the preference for running as sporting activity. Running is often practiced for its positive effects on health, ironically it is also one of the most injurious sports activities [2].

It is well known that the risk of chronic and life style related diseases like obesity and heart failure is reduced by regular physical activity [3, 4]. In addition, regular physical activity can increase life expectancy by more than 5 years while the occurrence of ageing related diseases can be delayed and quality of life can be increased by physical activity [5, 6]. Recently the statement, “sitting is the new smoking”, was used to highlight the problem of inactivity to modern society [7]. For this reason, promotion of physical activity is seen as today’s priority for enhancing public health [8].

During the last years, several initiatives have been undertaken to promote running in Dutch society. These initiatives often encompass a short supervised running program with a training schedule at beginner level to assist the start of a running career. These programs encourage participants to run regularly. Premature dropout from these programs, however, hinders a shift towards becoming a regular runner. An important reason for drop out from a running program is the occurrence of an injury [9]. It is therefore important to prevent injuries, in particular for novice runners, because dropout prevents a more active lifestyle.

A model that is often used to guide research aimed at injury prevention is shown in Figure 1 [10]. The first step in this model is to determine the extent of the problem (i.e. reporting the injury incidence). After identification of the extent of the problem, factors that might increase injury risk (risk factors) can be examined. When modifiable risk factors are identified, preventive measures that target these risk factors can then be introduced. The final step of the model is to examine the effect of the preventive measures, leading again to the first step.

Many studies have examined the extent of injury related problems. In running, injuries are often the result of repetitive micro-traumas which lead to an injury without an identifiable event responsible for the injury [11, 12]. These so called overuse injuries often have a slow
appearance of pain and a repetitive character [13]. A systematic literature review showed that most running injuries were located in the knee and lower leg and that the reported injury incidence in runners varies greatly between 19% and 79% [14]. Factors as injury definition, method of injury assessment, study design and duration of follow-up may be the reason for this large variance [15]. Likewise, differences in the population of runners studied might explain the lack of consensus on injury incidence. Identification of injury incidence in different populations of runners is important to get more insight into high risk populations. Consequently, future studies can focus on preventive measures specifically aimed at these populations of runners by identification of risk factors.

Several studies have tried to identify factors that increase the risk of sustaining an injury [16]. As these studies have shown conflicting results, not much is known about possible risk factors for running injuries yet. A recent literature review concluded that, although many risk factors were studied, the only risk factor consistently related to the occurrence of a running injury was having had a previous injury [16]. Besides differences in running populations and study designs, the lack of consensus might also be explained by the statistical methods used. Development of an injury is caused by a complex interaction of risk factors as shown in Figure 2 [17, 18]. For the identification of risk factors the complex relations between these different risk factors should be taken into account. Therefore, all these risk factors should be analyzed simultaneously in a multifactorial model [17, 19]. This form of analysis, however, requires a large number of injured participants [20]. Because of small sample sizes, previous studies could only examine a limited number of risk factors that were selected on forehand. To overcome the pre-selection of potential risk factors and create a multifactorial model, a prospective cohort study with a large sample size is required.

![Figure 2: A dynamic, multifactorial model of sports injury etiology (adapted from Bahr and Holme, 2003 [18]).](image-url)
The main aim of the research described in this thesis is to increase our knowledge regarding the incidence and etiology of running injuries. To gain more insight into the incidence of running injuries, we conducted a systematic review to provide an overview of injury reports in different populations of runners. In another study the impact of different injury definitions on injury incidence reports was studied. To increase our knowledge about the etiology of running injuries, we designed the NLstart2run study. In this study the association between both personal characteristics and training behavior with running injuries is examined. This thesis describes the design and results of the nationwide NLstart2run study, which was a prospective cohort study among novice runners participating in a “Start to Run” program. The above mentioned limitations in previous research and the lack of consistent risk factors for running injuries constituted the base of the NLstart2run study.

Outline of the thesis

The aim of chapter 2 is to give an overview of the literature on injury incidence in runners and describe differences in injury incidence and injury locations between different populations of runners. Chapter 3 describes the design and the different objectives of the NLstart2run study, a multicenter prospective cohort study among novice runners. The incidence of running injuries during the NLstart2run study will be described in chapter 4, as well as the personal characteristics that were associated with an increased injury risk. In addition to these personal characteristics, chapter 5 focuses on the association between training characteristics and injury occurrence. The injury definition used in a study has always been subject of discussion. The aim of chapter 6 is to describe the impact of different injury definitions on injury incidence, injury characteristics and its consequences for future research. Chapter 7 discusses the most important findings of the studies included in this thesis as well as the limitations and implications. A discussion on opportunities and directions for future research will conclude this thesis.

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