Summary
Patellar tendinopathy (also called jumper’s knee) is a common injury in sports that involve jump actions such as volleyball and basketball. In elite and recreational basketball players the prevalence is 32% and 12% respectively and in elite and recreational volleyball players it is 45% and 14% respectively. This high prevalence together with the observation that this injury often causes long lasting symptoms stresses the importance of finding effective ways to prevent this injury and, for cases where prevention fails, to develop effective treatments. These two subjects, prevention and treatment of patellar tendinopathy (PT), are the focus of this thesis (Chapter 1).

The aim of the first part (Chapter 2 – Chapter 5) of this thesis, that addresses prevention, is to increase knowledge about the etiology of PT. Understanding the etiology of an injury is one of the steps towards developing effective preventive measures. This first part starts out with giving an overview of the literature (Chapters 2 & 3). In Chapter 2 a systematic review of literature concerning risk factors for PT is performed. The systematic search resulted in the inclusion of 11 studies that addressed risk factors for PT in athletes. The methodological quality of these studies was assessed and based on this assessment a strength of evidence criterion was applied to identify risk factors. The overall methodological quality of the included studies was low. Therefore the level of evidence for the identified risk factors was also so low. Nine risk factors were identified for which there is some evidence that they are related to PT. These are weight, body mass index, waist-to-hip ratio, leg-length difference, arch height of the foot, quadriceps flexibility, hamstring flexibility, quadriceps strength and vertical jump performance. Based on this literature review, recommendations are given as to what may be options for prevention and treatment of PT. These are reducing body weight, increasing upper-leg flexibility and quadriceps strength and the use of orthotics. A biomechanical approach is taken in Chapter 3. Biomechanical risk factors are identified by a systematic review of literature that addresses the relation between PT and jumping. Nine articles were identified from the literature. A synthesis of these studies suggests that risk factors for PT are flexion angles (small ankle plantar flexion angle, large knee flexion angle) at touchdown that reduce the available range of motion, a small range of motion and high angular velocities. Furthermore, landing seems to pose a greater threat for developing PT than take-off. This suggests that employing a flexible landing strategy may help prevent PT, although there is a need for prospective studies on this topic.

The results of a survey to identify risk factors among basketball and volleyball play-
ers are presented in Chapters 4 and 5. The aim was to identify risk factors in a large representative sample of basketball and volleyball players since most research in the past has been done on specific groups (e.g. only elite players) and has used small sample sizes. An online survey was sent to the playing members of the Dutch Basketball Association (NBB) and the Dutch Volleyball Association (NEVOBO). The survey consisted of questions concerning 1) subject characteristics, 2) knee injuries and PT, 3) sports participation and 4) occupation. The survey was send to approximately 12000 subjects. The response rate was around 20%. Based on 2224 subjects it was found that risk for PT decreased with age, was higher in subjects who play at the national level, was higher in men compared to women and was higher in volleyball players compared to basketball players (Chapter 4). In volleyball players, playing as outside hitter or middle blocker was found to increase the chance of developing PT compared to playing as setter. For basketball players no playing positions with an increased risk were identified. These findings should be taken into account for prevention and rehabilitation. After excluding students, occupational risk factors for PT were assessed in 1505 subjects (Chapter 5). Heavy physically demanding work was found to be a risk factor for PT. The odds in subjects with heavy physically demanding work was twice as high as in subjects with mentally demanding work (e.g. an office job). Especially food and beverage workers and professional basketball and volleyball players showed a high risk. It was also found that PT can have a considerable impact on work productivity and can cause work limitations. These findings suggest that PT is not only a sports injury, but to a certain extent also an occupational disease. Work load should be taken into account when treating PT.

The second aim of this thesis is to gain knowledge about Extracorporeal Shockwave Therapy (ESWT) as a treatment for PT and more specifically about the differences between focused and radial ESWT. The second part of this thesis (Chapter 6 – Chapter 8) is about this second aim. There are a number of differences between these two ESWT technologies (Chapter 6); focused ESWT (FSWT) and radial ESWT (RSWT). One difference is the technology that is used to generate the therapeutic waves. This difference in technology leads to differences in the characteristics of the therapeutic waves that are generated with both methods. It is even argued in the literature that waves that are generated with RSWT are not real shockwaves because these waves lack the typical characteristics of shockwaves. There are also differences between technologies in the location where the waves
reach their maximal intensity. Whereas focused shockwaves reach their maximal intensity (and theoretically their maximal therapeutic effect) in the focus that is located deeper in the tissue, radial shockwaves reach their maximal intensity at the contact surface at the skin. However, it is not clear what these differences mean for therapeutic efficacy. This, together with the observation that most clinicians and physical therapists in the Netherlands, who use ESWT to treat PT, use a radial shockwave device, while on the other hand most research that has been conducted on this subject used focused shockwave devices, was the motive to design a study that directly compares both methods. In Chapter 7 the design of this study, the TOPSHOCK study, that directly compares FSWT and RSWT is described. The TOPSHOCK study is a randomized controlled trial with two groups. One group received 3 treatments with FSWT while the other group received 3 treatments with RSWT. Subjects as well as outcome assessors were blinded to the allocation of the treatment. Both groups also executed an eccentric exercise program that started two weeks after the final treatment. The main outcome measure was the VISA-P questionnaire that measures pain, function and sports participation in subjects with PT. Measurements took place before the treatment and 1, 4, 7 and 12 weeks after the final treatment.

The results of the TOPSHOCK study are presented in Chapter 8. No differences were found between the FSWT group and the RSWT group on the VISA-P questionnaire (15.0 vs. 9.6 points) after 12 weeks. Both groups did improve significantly over time, but it is debatable whether this represents a clinical relevant change. There were also no differences between groups on the other outcome measures. Based on these results it is not possible to recommend one of the two types of ESWT over the other.

The general discussion in Chapter 9 starts out with an overview of the findings presented in this thesis. Next, these findings are discussed in relation to the two main topics of this thesis: prevention and treatment. At the end of this chapter some practical suggestions for trainers, coaches and clinicians are extracted from the findings that are presented in this thesis.