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## Overuse Injuries in Professional Road Cyclists



Master's Thesis in Sports Physiotherapy

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## Foreword

The theme of this project is close to my heart. I've spent a great deal of time over the past seven years treating injuries in cyclists of all levels, and have seen the dramatic effect that overuse injuries can have on their sporting careers.

When I first started planning my master's thesis in early 2008, my original ideas all consisted of investigating biomechanical risk factors that *I* felt to be particularly important to injuries that *I* considered to be a problem in cyclists. I then met my supervisors, Tron Krosshaug and Roald Bahr, who convinced me that if in my career I want to do any meaningful research into cycling injuries, I needed to take a more systematic approach. Given the paucity of research into professional cycling injuries, I had to take it right back to the descriptive epidemiology phase: in short, to define the problem I wanted one day to help to solve.

I then went on to make all the errors that we aspiring researchers are warned against: planning a large and difficult project, with a group of subjects very difficult to reach, and asking way too many research questions. Luckily, my supervisors were on hand to keep me on course, and have been an amazing help in coming up with what I hope is a good product in the end.

So firstly to Tron and Roald: Thank you both very much for your inspiration, wisdom, patience and availability. I have learned a great deal from you both.

This project was also made possible through the support of several friends and colleagues in the cycling milieu. Thank you to Peter Caine, Sofie Chavanel-Frenette and Karin Stephens for assistance with data collection, and to Gino Van Oudenhove, Christian Andersen, Rune Antonsen, Morten Hegreberg, Martial Gayant and Fabio Bartalucci for logistical help.

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Finally, this project was conducted during a very demanding, and sometimes difficult phase of my personal life. It would certainly not have been possible without the amazing support of my wife Stina, who has shouldered much more than her fair share of the burden at home.

I'm sure she will be very happy to get her husband back...

Ben Clarsen, Oslo 24<sup>th</sup> November 2009

## Abstract

**Background:** Very little epidemiological information exists on overuse injuries in elite road cyclists. Anecdotal reports and studies of recreational cyclists indicate anterior knee pain and lower back pain may be common problems.

**Objective:** To register overuse injuries amongst professional road cyclists with special focus on anterior knee and lower back pain.

**Design:** Cross-sectional study, retrospective interview.

**Methods:** We attended training camps of seven professional teams and interviewed 109 of 116 cyclists (94%) on overuse injuries they had experienced in the previous 12 month period. All injuries that required attention from medical personnel were registered. Additional information on anterior knee pain and lower back pain was collected using questionnaires based on a previous study that registered lower back pain in endurance athletes.

**Results:** We registered 94 injuries; 43 in the lower back (45%), 22 in the knee (23%) and 10 in the neck (11%). Only 23 of these injuries (23%) led to absence from training or competition; 13 knee injuries (57%), 3 in the lower leg or Achilles tendon (13%) and 5 in the lower back (22%), one of which caused the cyclist to end his career. Fifty-eight percent of all cyclists had experienced lower back pain in the previous 12 months, and 41% had sought medical attention for it. Thirty-six percent had experienced anterior knee pain and 19% had sought medical attention for it. Few cyclists had missed competitions due to pain in the lower back (6%) or anterior knee (9%).

**Conclusion:** Lower back pain and anterior knee pain were found to be the most prevalent overuse injuries, with knee injuries most likely to cause time-loss from cycling and lower back pain leading to the highest rates of functional impairment and medical attention. Future efforts to prevent overuse injuries in competitive cyclists should focus on these injuries.

**Key words:** Bicycling, Overuse injuries, Epidemiology

## Definition of Terms

<b>UCI</b>	Union Cycliste Internationale, the world governing body of cycling.
<b>NCF</b>	Norges Cykkelforbundet , the Norwegian Cycling Federation
<b>Road cycling</b>	Form of bicycle racing held on roads. Includes mass-start races, individual and team time-trials
<b>Professional road cyclist</b>	Any cyclist that is a member of a UCI classified road cycling team of any level. Does not include riders who have a trial period at the end of the season
<b>Cycling season</b>	Period from the first to the last race on the UCI calendar
<b>Overuse injury</b>	An injury caused by repeated micro-trauma without a single, identifiable event responsible for the injury
<b>Injury prevalence</b>	The proportion of a population with a given injury at a given time.
<b>Anecdotal evidence</b>	Information that is based on personal observations or opinions, not on rigorous scientific analysis
<b>Retrospective study</b>	Scientific study based on examination of existing data, or events that have already occurred.
<b>Prospective study</b>	Scientific study in which subjects are identified and then followed over a period of time to collect data and observe outcomes
<b>Cross sectional study</b>	Scientific study examining the frequency and characteristics of injury or disease in a certain population of subjects at one given point in time.

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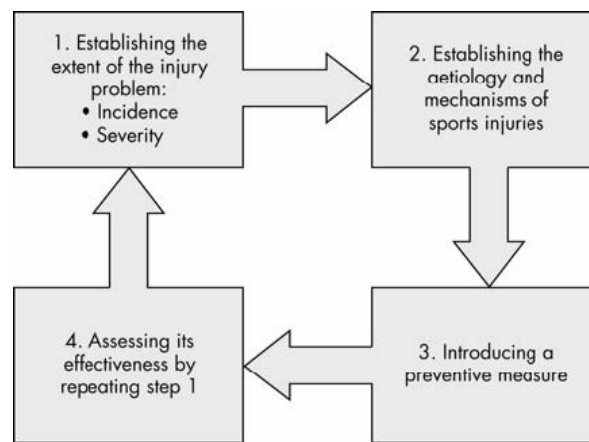
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# 1. Introduction

## 1.1 Background

Road cycling has been a part of the Olympic Games since their inception in 1896, and the sport's annual centrepiece race, the Tour de France, is currently one of the world's most popular sporting events.

Despite the history and popularity of the sport, little is known about the extent to which competitive road cyclists suffer from overuse injuries. Anecdotal and case reports suggest that certain conditions, such as patellofemoral pain (Holmes et al, 1994; Mellion, 1991) and lower back pain (Mellion 1994) may be particularly common problems, however support for these claims from systematic epidemiological investigations is lacking. Therefore it is currently not possible to know how many riders suffer from these and other overuse injuries, nor how serious a problem they represent. This information, according to a model proposed by van Mechelen and co-workers in 1992 (Fig.1), is essential to know if the ultimate aim is to prevent overuse injuries in competitive cyclists.



**Figure 1.** *The sequence of prevention of sports injuries (van Mechelen et al., 1992)*

According to this model, the identification and accurate measurement of a sports injury problem, which could also be called *descriptive epidemiology*, is the first of a four-step process of injury prevention. Subsequent steps are to identify the aetiology and mechanisms of the injury, otherwise known as *analytical epidemiology*, and then to develop and implement an idea for injury prevention. Re-measurement of the problem to test the effectiveness of the intervention is the final step in the model.



A majority of the existing research related to overuse injuries in cycling has focused on the second step in this model, for example specific investigations of the relationship between the patellofemoral pain and knee kinematics (Bailey et al., 2003), or the relationship between lower back pain and lumbar spine muscle function (Burnett et al 2004). Whilst the point of these studies is to generate methods to prevent overuse injury, insufficient information currently exists on the extent of the problems they are trying to prevent, and there is no way to test the effectiveness of implementing any of their recommendations.

This master's thesis will therefore focus on the first step of the model; descriptive epidemiology of the overuse injuries sustained by highly competitive road cyclists. The thesis is presented in the form of a scientific article, which has been submitted to the British Journal of Sports Medicine. A supplementary theory section precedes the article, containing a description of professional road cycling, a review of current knowledge on cycling-related overuse injuries, and a detailed description and discussion of the methods used to complete this project.

## **1.2 Aims**

Descriptive epidemiological information, a vital element in sports injury research, is currently lacking in the case of overuse injuries in competitive road cyclists. The primary research questions in this master's thesis are therefore:

- *What are the major overuse injury problems affecting professional road cyclists?*
- *What are the consequences of these injuries?*

### **1.2.1 Secondary aim**

As this study's cohort included two groups of similar size competing in either the UCI World Tour or the UCI Europe tour, we thought it was pertinent to investigate the question:

- *Are there differences in overuse injury prevalence between professional road cyclists on the highest and second-highest levels of international competition?*

### **1.3 Literature search**

The theoretical basis of this project was gathered primarily through searches of the PubMed database, although in some cases the search engine “Google Scholar” was also used. Initial searches included combinations of the terms “epidemiology”, “overuse injury,” and “bicycling” (MeSH terms). Extensive hand searches of article reference lists were also a major means of identifying relevant literature. Additional information on the organisation of professional cycling was gathered from the UCI website ([www.uci.ch](http://www.uci.ch)).

## **2. Theory**

### **2.1 Competitive road cycling**

#### **2.1.1 History and development of road cycling**

Since the invention of the modern bicycle in the mid 19<sup>th</sup> century, cycling has been used as a form of transport, rehabilitation, recreation and sport. Bicycle racing dates back to 1868, when riders competed over a 1200m course in the Parc de Saint Cloud in Paris, and by 1893, when the first road cycling world championship took place, the sport had evolved into the form it currently remains (McGurn, 1987).

Recent years has seen the internationalisation of what has been traditionally a western-European sport. Major races now exist on all continents, and many riders from non-traditional countries such as the USA, Australia, Great Britain, Denmark and Norway have enjoyed considerable success at the highest level. Correspondingly, local interest and participation in road cycling has grown in these countries.

This is particularly noticeable in Norway, where the number of licensed competitive racers has increased by over 400% during the past decade (NCF 2009, Appendix P). Norway now has three registered professional teams, and in 2009 was the 9<sup>th</sup> highest ranked nation in the UCI world rankings.

#### **2.1.2 Current forms of competitive and non-competitive cycling**

Organised cycling events can be broadly grouped into competitive races and non-competitive “recreational” events. The latter form of cycling has broad appeal, and may involve anything from an easy single-day event, to a physically demanding tour lasting several days. The participants of such events may also be highly variable in factors such as age, gender, cycling experience and equipment selection. Competitive bicycle races on the

other hand tend to involve a more homogenous population and a greater standardisation of equipment, however this varies significantly across the different forms of competition, such as road cycling, track cycling, mountain-biking, cyclocross, and BMX. Road cycling is the oldest and arguably the most prestigious discipline, and is also the discipline enjoying the greatest growth at the elite level in Norway (NCF, private communication, November 2009).

### **2.1.3 Organisation of professional road cycling**

#### **(1) Road races**

Professional road cycling races range from single-day events, to three-week long “grand-tours” such as the Tour de France, Giro d’Italia and Vuelta a Espana. Races may be held over flat or mountainous terrain, and on roads of variable quality. They may take the format of mass-start races or time-trials, which involve individual riders or teams in a staggered-start competing to achieve the fastest time over a given distance. Races are typically contested by eighteen to twenty-two teams of between six and nine riders. This means that each individual team, which may have up to thirty cyclists on its roster, will only send a proportion of them to any one race.

#### **(2) International Calendar and Team Classifications**

The world governing body of cycling is the Union Cycliste Internationale (UCI). Among its responsibilities are the licensing and ranking of professional teams and their riders, and the co-ordination of the international cycling calendar. The highest level of the men’s road cycling calendar is called the UCI World Tour, which lasts from January to October and includes all the major races in the world. Below the World-Tour level are the “UCI Continental Circuits,” including the Europe Tour, America Tour, Asia Tour, Africa Tour and Oceania Tours, which consist of races lasting from one to ten days.

There are currently three levels of teams registered under by the UCI: The top category is called the UCI Pro Tour, which in 2009 consists of eighteen teams. These teams have guaranteed entry into the most important races and they generally have the largest budgets. The second-category teams are called UCI Pro-Continental teams. There are currently twenty-one registered teams on this level, thirteen of which are granted “Wildcard” status, giving them the right to participate in the World Tour alongside the Pro-Tour level teams. The third-category teams are called UCI Continental teams. These teams consist of nine to sixteen riders and compete in races on the continental tours. In 2009 there are 132

continental teams registered with the UCI. Whilst these teams generally have a smaller budget, riders are typically full-time athletes and usually receive a salary from the team.

#### **2.1.4 Characteristics of professional road cyclists**

Road cycling has been described as “one of the most demanding of all sports, combining extremes of exercise duration, intensity and frequency” (Jeukendrup et al., 2001), and therefore successful cyclists display impressive maximal aerobic capacity measures, such as a high maximal power output (mean 6.4 W/kg) and maximal oxygen uptake (mean 78.8 ml/kg/min)(Mujika & Padilla, 2001). Due to the varied terrain over which they compete, the anthropometrical characteristics of road cyclists may be highly varied; from the extremely light-weight mountain-specialists who have an average weight of 62kg (SD±3) to larger more, powerful sprinters and flat-terrain specialists who have an average weight of 76kg (SD±3) (Mujika & Padilla, 2001).

There is also some evidence that experienced cyclists may undergo biomechanical adaptations as a result of cycling exposure. Elite cyclists display improved modulation of muscular activity (including reduced variance including reduced antagonist co-activation) in their leg muscles compared to novice level cyclists (Chapman et al., 2008), which could be interpreted as an example of enhanced neuromuscular efficiency, or “cycling skill.”

#### **2.1.5 Training and racing loads**

Professional cyclists have been reported to complete between 25000 and 35000km of cycling per year (Mujika & Padilla 2001), translating to approximately 1000 hours. UCI-ranked cyclists may compete in 50-110 days of racing per year, with one report of a professional team averaging 101 (SD±6) days (Jeukendrup et al., 2001). As the professional calendar lasts up to ten months a year, the opportunity for an “off-season” break from training and racing is limited. Instead, riders may tend to target races during which they want to be in peak physical condition, and use racing as a form of specific training in the periods preceding these races

## **2.2 Overuse injuries in cycling**

Lower limb joint forces are relatively low during cycling compared to other forms of exercise such as running, walking, stair climbing and weight lifting (Ericson et al., 1986), and because of this, cycling is often employed in the early phases of rehabilitation of musculoskeletal injuries or surgical procedures in the lower limb. Despite this, when cycling takes the form of a serious competitive sport, factors such as the repetitive and constrained motion pattern, large training and racing volumes, and the maintenance of a flexed spinal posture for sustained periods of time may lead to the development of overuse musculoskeletal injuries.

Anecdotal reports of experts in the field (Mellion, 1991, 1994; Holmes et al., 1994), as well as clinical case-series studies (Holmes et al., 1991) suggest that certain overuse injuries may be common among competitive cyclists. Whilst these articles present a vast amount of information on the possible differential diagnoses of these injuries and their proposed aetiological factors, no accurate information can be gained from them on the magnitude of the problems they describe. In order to ascertain this, descriptive epidemiological investigations, investigating the type, location and severity of injuries sustained by competitive cyclists must be consulted.

Unfortunately the scientific literature currently contains very little information of this nature on overuse injuries in bicycling, particularly among elite competitive riders. Our literature review could only identify two articles reporting on the prevalence of overuse injuries in competitive cyclists; a retrospective review of the medical records of two professional teams over a thirteen year period (Barrios et al., 1997), and a cross-sectional survey of 71 members of British national cycling team members (Callaghan & Jarvis, 1996).

Several cross-sectional studies have reported the characteristics of injuries sustained by participants of non-competitive bicycle touring events, (Dannenberg, 1996; Kulund & Brubaker, 1978; Weiss, 1985; Wilber et al., 1995). The findings of these studies may only be of limited application to elite road cyclists, given that their subjects are reported to be significantly different in many factors, such as annual cycling exposure, training background and equipment selection. Nonetheless, given the paucity of research in competitive cycling, studies of recreational cyclists and anecdotal injury reports must be considered when determining the nature of competitive cycling injuries.

The following section will review the overuse injuries that are most commonly cited as a problem in cyclists. Information on possible diagnoses is included, as well as the reported prevalence and severity of each problem among recreational and competitive riders.

### **2.2.1 Knee injuries**

Anecdotal reports on overuse injuries in cycling suggest that the most commonly injured body region is the knee (Holmes et al 1994, Gregor and Wheeler 1994). According to these reports, specific knee diagnoses associated with cycling include chondromalacia patella, infrapatellar fat pad syndrome, medial plica irritations, patella-, quadriceps- and biceps femoris tendinopathy, iliotibial band friction syndrome, retropatellar-, prepatellar- and pes anserine bursitis, and strains of the medial collateral, lateral collateral and medial patello-femoral ligaments.

Sixty-two percent of the fifty-three overuse injuries in professional cyclists reported by Barrios and co-workers (1997) were located at the knee, including fifteen cases of chondromalacia patella, ten of patellar tendinopathy, four of quadriceps tendinopathy, two of iliotibial band friction syndrome, one of pre-patellar bursitis and one case of a degenerative meniscus tear. Severity information was not supplied for knee injuries in particular however 16% of all overuse injuries reported in the study led to less than one week absence from competition, 66% caused one to four weeks absence and 18% led to more than four weeks.

Callaghan and Jarvis (1996) administered a questionnaire on overuse injuries to seventy-one international-level cyclists, 33% of whom indicated having experienced problems with their knees related to cycling. Unfortunately no information on the nature or severity of knee injuries was supplied.

Studies of injuries in recreational cyclists also report a high prevalence of knee injuries, with 24-62% of subjects reporting knee pain. In an eight-day tour, 35% of participants reported some degree of knee pain with 21% reporting significant problems (Weiss, 1985). The most common diagnosis was patellofemoral pain, followed by iliotibial band friction syndrome and “non-localised” medial knee pain. One of the 113 subjects was unable to complete the ride due to a knee injury, which was diagnosed as iliotibial band friction syndrome.

Holmes and co-workers (1991) published a clinical case series of the cycling-related knee injuries treated in a sports medicine clinic between 1983 and 1990. During this period they treated 246 knee injuries in 148 patients whom they classified into very high level

competitive cyclists, state and local level competitive cyclists, non-competitive touring cyclists and individuals using cycling solely for “aerobic” purposes. The most common diagnosis was chondromalacia patella, which accounted for 38% of the injuries across all groups. Other prevalent diagnoses included iliotibial band friction syndrome, patellar tendinopathy and medial plica irritations, which accounted for 14% 13% and 13% of all knee injuries respectively. The authors suggest that whilst some injuries such as chondromalacia patella, patellar tendinitis and quadriceps tendinitis were common in all levels of cyclists, certain injuries such as medial plica irritations and medial retinacular thickening were only found in competitive racers.

It should be noted that the term “chondromalacia patella” is currently used to specifically refer to pathologic lesions of the patellar articular cartilage, whereas previously it has been used as an all-encompassing term for pain arising from the patellofemoral joint (Holmes & Clancy, 1998; Grelsamer, 2005). Articular cartilage degeneration is currently considered to be only one of several potential sources of patellofemoral joint problems, however the articles listing chondromalacia patella as a common cycling injury tend to use the term interchangeably with others such as anterior knee pain and patellofemoral pain, and do not mention the potential for alternative sources of pain. As a majority of these articles were published prior to those discussing patellofemoral nomenclature it may be assumed that in these instances chondromalacia patella has been used as an all-encompassing term for anterior knee pain.

### **2.2.2 Foot and Achilles tendon pain**

Anecdotal reports suggest that Achilles tendon pain, metatarsalgia, and plantar fasciitis are common overuse injuries in competitive cyclists (Baker, 2000; Holmes et al., 1994; Mellion, 1991). Callaghan and Jarvis (1996) report that 11% of seventy-one international-level cyclists had experienced foot or ankle injuries during their career, whilst Barrios and co-workers (1997) registered eight cases of Achilles tendonitis and one case of plantar fasciitis, representing 15% and 2% respectively of the overuse injuries sustained by the professional cyclists in their report. Neither study provided specific information on the severity of Achilles or foot injuries.

Studies of non-competitive cyclists reveal a prevalence of foot and ankle pain between 6% and 16.5% (Dannenburg, 1996; Kulund and Brubaker, 1978; Weiss, 1985; Wilber, 1996). Weiss (1985) reported that 7% of the participants in an eight-day recreational tour

experienced foot problems serious enough to make cycling extremely uncomfortable, mostly due to plantar pain or parasthesia, and in one case to Achilles tendon pain.

### **2.2.3 Neck pain**

Mellion (1994) anecdotally states that neck pain is an extremely common problem in competitive cyclists; however epidemiological reports of its prevalence in this group are variable. Nineteen percent of British national team cyclists reported having problems with neck pain (Callaghan & Jarvis, 1996), whereas Barrios and co-workers (1997) did not report any cases of neck pain in their cohort of professional cyclists, contending that neck discomfort in competitive cyclists is generally mild and not taken into consideration by the racers.

Studies in non-competitive touring cyclists are equally varying, with a reported prevalence of 3% to 66%. Wilber and co-workers (1995) describes neck pain as the most prevalent physical complaint in a cohort of 518 recreational cyclists, with 50% having experienced neck pain related to cycling. However only 4% reported pain significant enough to cause them to alter or stop riding their bicycle training for any length of time.

### **2.2.4 Lower back pain**

Anecdotal evidence suggests that lower back pain is a source of significant problems in competitive cyclists (Mellion, 1991, 1994) however reports of the prevalence of the problem among cyclists are mixed. Callaghan and Jarvis (1996) state that low back pain is the most common condition affecting competitive cyclists, reporting that 60% of British national team riders experienced problems in this region. This is similar to the prevalence of lower back pain in other sports thought to place high loads on the lumbar spine, such as 66% in cross-country skiing and 63% in rowing (Bahr et al., 2004). In contrast, Barrios and co-workers (1997) only reported seven cases of lumbar pain in their report of injuries in professional cyclists. This represents only 13% of the 53 reported injuries, affecting 11% of the riders.

In studies of recreational tour participants lower back pain prevalence has been reported to be between 3% and 30%. One study specifically investigated low back pain in recreational cyclists (Salai et al., 1999), reporting that 50% of an eighty-member cycling club experienced lower back pain after cycling. Unfortunately, few of these studies give detailed information on the severity or functional consequence of pain. Wilber and co-workers (1995) reported a lower back pain prevalence of 30% in 518 recreational cyclists. Eight



percent reported having experienced problems severe enough to cause them to reduce or cease bicycle training. Interestingly, subjects who reported greater volumes of weekly cycling had a significantly higher prevalence of lower back pain.

### **2.2.5 Upper limb injuries**

General epidemiological studies of recreational touring cyclists report the prevalence of wrist and hand injuries to be between 10-36% (Dettori & Norvell 2006), with the most frequently cited diagnosis being Ulnar nerve neuropathy, sometimes referred to as “cyclists palsy” or “handlebar palsy.” Median nerve palsy from cycling has also been documented (Braithwaite, 1992).

Compared to other cycling-related injuries, the epidemiology of cyclist’s palsy has been relatively well reported, with several specific cross-sectional and prospective studies investigating symptoms among long-distance tour participants (Andersen & Bovim, 1997; Patterson et al., 2003; Akuthota et al., 2005). Patterson and co-workers (2003) found that 92% of riders had either motor or sensory symptoms after a 600km ride, whilst other studies of sensory symptoms alone report a prevalence of between 30% and 50%.

Whilst one study found no relationship between riding experience and the prevalence of cyclist’s palsy (Patterson et al., 2003), little is known on the extent of the problem among highly competitive cyclists. It is possible that the problem is somewhat lower than the above studies suggest, as the review of cycling teams’ medical records by Barrios and co-workers (1997) did not record any cases, and only 7% of British national team members reported having ever suffered from wrist or hand problems (Callaghan & Jarvis, 1996).

### **2.2.6 Cycling-related iliac artery flow limitations**

One condition described in competitive cyclists is leg complaints related to flow limitations of the iliac arteries. This condition is characterised by claudication-type symptoms in one or both legs that appear with maximal effort, and disappear quickly with rest. It has been termed exercise-induced arterial endofibrosis by some authors (Abraham, 2004), although others contend that flow limitations may also be caused by anatomical kinking of the arteries and that endofibrotic changes are not always present (Bender et al., 2004). The condition appears to affect highly trained sportspeople, with a majority of cases described in the literature being cyclists (Abraham, 2004). For this reason it has also been referred to in the literature as cyclists’ iliac syndrome (Wijesinghe et al 2001).

As iliac artery flow limitations appears to be associated with high training load and may be progressive in nature they could be seen as a form of overuse injury. Although several high-profile cyclists have undergone surgery for the condition, there is scant data on the prevalence of the problem in cyclists. Of the 58 overuse injuries in professional cyclists reported by Barrios and co-workers (1997), one was described as iliac artery endofibrosis. This was one of only two overuse injuries rated as severe by the authors.

Schep and co-workers (2002) report that clinical examination of twenty-five Dutch Olympic athletes revealed five with symptoms of the condition. This led to claims that one in five endurance athletes may suffer from iliac artery flow limitations (Bender et al. 2004), however as no subject information was supplied, and it is unclear whether they were representative of any larger population, this statement appears to be premature.

### **2.2.7 Summary**

This section presented information on the type, location and severity of overuse injuries claimed to be common in cycling. This information played an important part in the planning phases of the current project, particularly in decisions about which injuries to collect specific information on during data collection. It is worth noting however that a majority of the epidemiological data in this section was based on the six aforementioned studies of recreational and competitive cyclists. A common feature of their data was the large variability, even between studies with remarkably similar cohorts. The most likely explanation for the variation in the results of these studies is differences in their methodology. The following section will therefore review the methodological quality of the previous epidemiological studies of overuse injuries in cyclists.

## **2.3 *Methodological critique of the previous epidemiological investigations of overuse injuries in cycling***

In order to assess the methodological quality of any body of research in an objective way, it is necessary to have a framework with which to rate or compare studies. A good example of this is the Physiotherapy Evidence Database (PEDro) score which can be used to rate the quality of randomised controlled trials on a scale of 1-11. Unfortunately in the case of sports epidemiology no such tools are available, thus objectively rating the quality of previous investigations of overuse injuries in cyclists is extremely difficult. However, recent consensus statements on injury-surveillance methods for various sports (Fuller et al., 2006,

2007; Pluim et al, 2009) and sports tournaments (Junge et al., 2008) may provide a methodological framework upon which qualitative assessments could be made. The structure of each of these consensus statements is similar, with sections on the recommended study design, injury definitions, and injury severity measures. The following section will therefore review these methodological aspects of the previous studies of overuse injuries in cycling.

### **2.3.1 Study design factors**

All previous studies of overuse injuries in cyclists have elements of their design that affect the validity of their results to a greater or lesser extent. Of the six studies, five had a cross sectional design (Kulund & Brubaker, 1978; Weiss, 1985; Dannenberg, 1996, Wilber et al., 1995, Callaghan & Jarvis, 1996). This design is limited by the degree to which the study's sample represents the population as a whole, with potential bias in the sample referred to as "selection bias."

One of the major factors in determining the representativeness of a sample in a cross-sectional design is the percentage of the targeted population from whom data is successfully collected, commonly referred to as the "response rate." Whilst there is no consensus on what is an "acceptable" response rate, a study with a rate of greater than 90% could be considered of high quality. No studies of cycling injuries have achieved this rate. Weiss (1985) and Callaghan and Jarvis (1996) report an acceptable rate of 86% and 81% respectively, whereas as Dannenburg and co-workers (1996) only achieved 70%, the validity of their results begin to become questionable. Wilber and co-workers (1995) had a response rate of 21%, which is a serious threat to the study's validity. Kulund and Brubaker (1978) fail to define their target population, which makes calculation of their response rate impossible.

Systematic factors related to the location of data collection may also be a form of selection bias. Three studies collected injury data with the participants at a recreational cycling event (Dannenburg 1996, Kulund & Brubaker 1978, Weiss 1985). This may expose these studies to selection bias as it is reasonable to assume that participants at such an event are reasonably healthy and injury free. Any potential riders with significant injury problems, on the other hand, may not have been present at the event in the first place. An underestimation of the true injury rate could therefore be expected in these studies.

The retrospective review of the medical records of two professional cycling teams by Barrios and co-workers (1998) may be a design of questionable validity, as the study was based on preexisting medical records with no standardised system of injury recording defined *a priori*. Furthermore, the likelihood that all injuries sustained by this study's subjects were treated, and thereby recorded, by their team medical staff may be considered unlikely, given that members of professional cycling teams are typically based over a very large geographical area and riders tend to have their own local medical support for periods between races. The injuries presented in this study may therefore only represent a small percentage of the true injury rate among the subjects.

### **2.3.2 Injury definitions**

The definition of what constitutes a recordable sporting injury greatly influences the outcome of sports epidemiology investigations (Brooks and Fuller 2006, Junge and Dvorak 2000, van Mechelen 1992).

The studies by Callaghan and Jarvis (1996), and Weiss (1985) both failed to define what constituted a recordable injury. This omission seriously hinders the interpretation of their results, as it is unclear whether minor complaints such as muscle pain, which could be considered a normal part of cycling, are regarded as overuse injuries. Scarcely better than this, and causing the same interpretational problems, was the vague and highly subjective definition; “any physical complaint that made some portion of the tour unpleasant” used by Kulund & Brubaker (1978).

Wilber et al (1995) defined an overuse injury as “discomfort, pain, swelling, or bruising that occurs before, during or after cycling.” This definition is not only extremely complicated, but also confusing, given that injury symptoms that occur *before* cycling are unlikely to be due to cycling participation.

Barrios and co-workers (1998) defined an overuse injury as complaints “clearly related to an overuse condition while cycling, without previous trauma.” This too is a subjective decision, as the phrase “clearly related” remains undefined.

All previous studies of overuse injuries in cycling therefore suffer from problems related to injury definitions. And, as definitions vary between every study, direct comparison of results is not possible.

### **2.3.3 Injury severity measurement**

The reporting of injury severity in studies of overuse injuries in cycling is particularly variable. Several do not include any rating of injury severity at all (Dannenburg et al., 1996; Callaghan & Jarvis, 1996; Kulund & Brubaker, 1978), whilst others utilise overly subjective or cycling-specific rating systems. Weiss (1985) categorised injuries sustained during a six-day tour into five categories, including (1) “there was no problem at all,” (2) the body part bothered the rider but “not enough to make any difference,” (3) it bothered the rider “quite a bit – enough to make them really uncomfortable,” (4) “it bothered them so much that they had to make a change in their riding style,” and (5) “it bothered them so much they had to stop riding at some point, either temporarily or permanently.” This scale is highly subjective and open to individual interpretation, and though perhaps relevant to the specific situation of recreational cycling tours, it is unusable in comparisons to injuries in other sports or situations.

Wilber and co-workers (1995) rated injuries based on the effects they had on bicycle training. Injuries were classified as “mild” if the subject could continue training despite symptoms, “moderate” if the subject had to reduce training due to symptoms, and “severe” if training had to be temporarily ceased due to symptoms. Several difficulties also arise in such a scale, for example an injury that may have reduced training for months would be scored lower than an injury that prevented training for one day.

The report by Barrios and co-workers (1998) was the only study to utilise standardised injury severity measures, rating all overuse injuries using two different scales: the Abbreviated Injury Scale and the Ekstrand 3-Point Scale. The Abbreviated Injury Scale classifies injuries into minor, moderate, severe but not life-threatening, severe and life-threatening, and severe with uncertain survival. It is normally a tool used to rate traumatic injuries, used for example in hospital casualty departments, and it was presumably included as the study also reported on acute injuries. The application of such a scale to overuse injuries however is of questionable validity, as it is difficult to imagine a scenario in which an overuse injury would ever score in the top two classifications. The Ekstrand 3-point scale rates injury severity based on time lost from sports activity. Injuries are classified as minor if they lead to less than seven days absence from sports, moderate if they lead to between seven and twenty-eight days absence, and severe if they cause more than 28 days absence from sport. This is a relatively common form of measuring overuse injury severity, similar

for example to the scale recommended in the UEFA model of football injury surveillance methodology (Hägglund et al., 2005).

#### **2.3.4 Conclusions**

Having been published between twelve and thirty-one years ago, all of the previous investigations of overuse injuries in cycling would be judged by today's standards as being of poor methodological quality. Attempts to standardise sports-epidemiological methods and reporting standards have been made in the past decade (Hagglund et al 2005, Fuller et al., 2006, 2007; Junge et al. 2008., Pluim et al., 2009) however as all cycling studies were published prior to this, they are characterised by a marked variation in the way injuries are defined, rated and reported. Factors related to study design such as selection bias may also affect the validity of several of these studies.

These factors help to explain the wide variation in the results seen in the previous section of this paper and seriously limit the extent to which the results of individual studies can be directly compared. In certain cases, methodological flaws are sufficient to render the entire study to be of very limited value. The need for new epidemiological studies of overuse injuries in cycling, using currently accepted methods to register injuries, is therefore clear.

## 3 Methods

The following section describes the methods used in this study in greater detail than was possible in the article, with discussion of our choice of methods where appropriate.

### 3.1 Study design

The design of this project was a cross-sectional study, with 12-month retrospective injury registration conducted during athlete interviews.

A prospective design is considered the best for sports injury epidemiology studies (Fuller et al., 2006), primarily due to concerns over the accuracy of retrospectively collected information, often referred to as *recall bias* due to subjects' inability to recall exact information. In this case however, the difficulty of accessing the targeted cohort, as well as the limited time-frame of the project, limited us to the use of a cross-sectional, retrospective design.

Whilst prospective studies may represent the “gold standard” of epidemiological research, recent evidence suggests there are times when their theoretical benefits may be outweighed by practical difficulties in their implementation. Flørenes and colleagues (in press) conducted a study of injuries during the 2006-07 FIS alpine skiing and snowboarding world cups using both prospective and retrospective injury registration methods. They found that prospective registration performed by team medical staff was only successful in recording 52% of the injuries identified during retrospective athlete interviews. This finding contrasts with previous studies comparing prospective and retrospective injury registration methods in football players (Junge & Dvorak, 2000) and physical education students (Twelaar et al., 1996). However the authors comment that in the case of elite skiers, factors such as the busy travel and competition schedule of the athletes, as well as having medical staff with shared responsibility for the team and who do not always travel to competitions, may have contributed to the poor capture rate of the prospective registration methods. They also speculate that injury recall may be particularly good in their cohort, as highly committed athletes may be expected to have good recall of injuries that affected their performance during the season. As these factors are all very similar for professional cyclists, the results of this study lend credence to the methods used in the current project.

Despite this, the threat of recall bias cannot be discounted, as it may potentially have a significant effect on a study's results. For example, in a group of 70 Australian-rules football players only 61% could accurately recall the number, body location and diagnosis of injuries they had sustained in the previous 12 months, with 21% unable to recall either the number or location of injuries they had sustained (Gabbe et al., 2003). Junge and Dvorak (2000) demonstrated a similar trend in footballers, with only 73% concurrence in prospective and retrospective methods of recording severe injuries over a one year period, with even some very severe injuries such as fractures missed during retrospective injury registration. We therefore attempted to maximise subjects' injury recollection through the use of interview forms that required subjects to go through their training and competition schedules on a week by week basis over the retrospective period. This method is described in further detail in section 3.5.2.

A common criticism of cross-sectional sports injury studies, especially those conducted at sporting events, are that they may end up with a biased sample, given more seriously injured athletes may not be in attendance. We felt that this may be a particular risk in professional cycling, given that as only a small percentage of each participating team are in attendance at any given race, teams are likely to send riders in good physical condition. We therefore chose to target fewer, complete teams, and to conduct interviews at a time when all riders are expected to be in attendance regardless of their fitness or injury status; at their pre-season training camps. In order to avoid missing any career-ending injuries, we also elected to include all cyclists who were members of the participating teams in 2008, but who retired prior to the 2009 season for any reason.

### **3.2 Team inclusion and recruitment procedures**

As the goal of this study was to collect data on top-level road cyclists, only teams registered as UCI Pro-Tour, UCI Pro-Continental or UCI Continental were considered for inclusion. Whilst, for the purpose of ensuring sample representativeness, it would have been ideal to include a random selection of UCI-registered teams, this was practically impossible due to difficulties in gaining access to top-level teams and the fact that we were limited to including only teams we shared a common language with. Subsequently, a selection-bias in our sample of teams cannot be ruled out. For example, as fifty-two subjects were from Nordic countries, these riders may have different pre-season training habits such as indoor cycling or cross-country skiing, and this may affect their injury rates. However no evidence



exists in the literature that training or racing habits of professional cyclists vary from team to team, and we therefore operated on the assumption that all UCI-registered teams were, for the purposes of this study, generic. We therefore do not consider selection-bias to be a major limitation of this study.

As the primary author had previously worked as physiotherapist for several professional cycling teams, all those within which he had personal contacts were approached for participation. In addition, all Pro-Tour teams with an official language of either English or French (languages spoken by the author) were invited to participate. Altogether, 11 teams were targeted for potential inclusion in the study (n=218).

All targeted teams were sent an official letter of invitation in either English (Appendix A) or French (Appendix B), which was followed up with telephone calls and emails. In total, seven teams agreed to participate in the study (n=116).

### **3.3 Team and subject characteristics**

The seven teams included originated from five different countries (Australia, Denmark, France, Norway and Switzerland) and contained riders from 23 different nationalities. There was one UCI Pro-Tour team, one UCI Pro-Continental team (with wildcard status) and five UCI Continental-level teams. Therefore, 49 subjects were cyclists in the UCI World Tour in 2009, with the remainder competing in the UCI Europe Tour.

The cohort contained many riders of a particularly high level, including one rider who had won the Tour de France, a winner of the green sprinter's jersey at the Tour de France, one Olympic champion, five UCI world champions, ten grand-tour stage winners and twelve national road cycling champions.

### **3.4 Data collection procedures**

Data were collected at training camps located in Norway, Portugal, France, Spain and Australia. The author personally travelled to six of the seven camps, with data collection at the remaining camp being conducted by the team physiotherapist, who had previously been closely instructed on data collection procedures.

In all but one case, the entire team was expected to be in attendance at the training camp, however one was with an incomplete team as some members were away competing in early-

season racing. In this case a local physiotherapist with experience working in elite cycling visited the riders at the race to conduct the interviews.

Seven riders in total were missing from training camps for personal reasons. Attempts were made to contact each missing rider by telephone, and interviews were successfully conducted with three of the missing riders.

By comparing the 2008 and 2009 team rosters as well as questioning team management, we were able to identify 11 former members of teams participating in the study who retired during or following the 2008 season. These riders were also contacted by telephone, and successful interviews were conducted with eight of them.

### **3.5 Athlete interviews**

On arrival at a training camp the researcher was introduced to the team members by the team management and information letters about the project, written in either English (Appendix C) or French (Appendix D) were distributed to each rider. The researcher then visited each rider individually at a convenient time during the camp to conduct the interviews. Interviews were conducted in either English or French, except in two cases when a team physiotherapist was called upon to translate the questions into Spanish. The interviews were conducted within the following structure: Background information and exposure data was collected from the subject, followed by registration of all overuse injuries they experienced during the previous 12-month period. Finally, specific lower back pain and anterior knee pain questionnaires were completed.

#### **3.5.1 Part 1: Subject information**

Subjects were questioned about their age, height and weight, the number of years they had been riding in a UCI registered team. To estimate their cycling exposure they were asked how many days of racing they had completed in the 2008 season, and how many hours of training they had completed in the preceding twelve months. They were asked to use training records to assist in providing accurate information.

Subjects were then asked about several of their training habits, including their stretching frequency and whether or not they performed weight training, specific low-cadence strength training on the bicycle or specific “injury-prevention” training” such as core-conditioning exercises. If they performed any of these training forms, they were also asked which periods

of the season they performed them. Season periods were defined as (a) the period in which they are not riding their bicycle (off-season), (b) the period in which they are training on the bicycle but not yet racing (pre-season), (c) the period in which they have commenced racing but not in peak condition or competing in their most important races (early season), and (d) the period during which they are in peak condition and during which they compete in their major races of the season (peak season). This information was collected for the purposes of future-hypothesis generation, as these factors may have a potential association with overuse injury, yet the training habits of professional cyclists is unreported in the scientific literature. The eventual data were however left out of the final article, owing largely to the fact that in retrospect we felt it lacked sufficient detail to be of extra value to the study.

During this section of the interview subjects were also asked whether they used pedals that allowed a small degree of axial rotation, known as “floating pedals,” or whether they preferred pedals with a completely fixed connection to the shoe. Floating pedals have been widely promoted as being good for cyclists’ knees since a study by Wheeler and co-workers (1995) demonstrated that with their use, axial-rotation moments at the knee joint were reduced. This, according to the authors, had potential implications in the prevention of patellofemoral joint injuries. The percentage of top-level cyclists who use floating pedals is however unreported.

Finally, subjects were asked whether they had ever been assessed a vascular specialist for leg pains related to bicycling, and if so whether they had subsequently received surgical treatment for iliac artery flow limitations.

### **3.5.2 Part 2: Injury registration**

The first part of the injury registration process was designed to maximise injury recall, and was based on a technique used in previous retrospective injury-registration studies in beach volleyball (Bahr & Reeser, 2003) and alpine sports (Flørenes et al., *in press*). Subjects were shown a graphical illustration of the retrospective period divided into 52 weeks, with all major races marked upon it. They were asked to indicate their season periods according to the definitions described above, and to mark any episodes of overuse injury or pain that they experienced during the year, including the duration of symptoms. This form was different for the World Tour and Europe Tour riders to reflect their different race schedules (Appendices G & H), and was modified slightly along the way to update the retrospective period, as data were gathered over a four-month period. In a further effort to combat recall

bias, interviews were conducted with a somewhat flexible structure such that injury registration could be returned to at any time. This led to extra injuries being registered, for example in some cases the knee or lower back questionnaires prompted the subject to remember a previously unrecalled injury.

Each injury that a subject recalled was registered by the interviewer, using a separate injury recording form (Appendix I). An “overuse injury” was explained to the subject as being “any pain or discomfort that was not directly associated with a traumatic event (such as a bicycle crash), and was different from the normal aches and pains associated with competitive cycling.” We elected to use this broad terminology in order to capture as many potential injuries as possible, however only injuries that required attention from qualified medical personnel were subsequently recorded. “Medical attention” did not include the normal massages that are a common form of preparation and recovery in competitive cycling. Injuries were further classified as “time-loss” injuries if they caused the subject to miss one or more days of training or competition. In this way, the definition and sub-classification system of injuries used in this study was consistent with the system proposed by Fuller and colleagues for injury surveillance studies in football (Fuller et al., 2006). The classification system of the anatomical location injuries was also based on this system.

The severity of medical attention injuries was assessed by classifying them into (a) injuries that did not disrupt normal training and racing performance, (b) those during which the athlete could continue to train and compete, but with either a reduced intensity or volume, and (c) those during which the subject could not ride at all. This system is not widely used in sports epidemiology studies, but was included due to concerns that time-loss based injury severity systems may fail to adequately assess the impact of overuse injuries (discussed below). The classifications were based on the final section of a questionnaire originally designed to assess the severity of patellar tendinosis (Visentini et al., 1998).

The severity of time-loss injuries was assessed by using the absolute number of days of time-lost from training or competition (Fuller et al., 2006), and grouped according to the UEFA model (Hägglund et al 2005) into slight (1-3 days), mild (4-7 days), moderate (8-28 days) and severe (>28 days).

The methods used to register overuse injuries in this section of the interview were based on a consensus statement of sports epidemiology experts on the recommended methodology for injury surveillance studies in football (Fuller et al., 2006). This framework was chosen as

since its publication it has served as the methodological basis for almost every injury surveillance system or study across several sports, including rugby union (Fuller et al., 2007), athletics (Alonso et al., 2009), tennis (Pluim et al 2009) and alpine skiing/snowboarding (Flørenes et al., *in press*), as well as at large multi-sports events such as the Olympic Games (Junge et al., 2008). We recognised that the use of a common methodology in this study would facilitate comparison with other studies, and therefore the recommendations from the football consensus statement were an obvious starting point. Recent arguments have been made however, that this system, which was designed primarily for the study of acute sporting injuries, may not be ideal for the study of overuse injuries, as it relies too heavily on the use of time-loss as an injury definition and severity measure (Bahr, *in press*). Several examples exist in the literature of athletes continuing to train and compete despite suffering from symptoms of overuse injury, for example in a prospective study of injuries in professional beach volleyball (Bahr & Reeser, 2003), 40% of all players had overuse “medical attention” injuries that represented a significant source of disability and impaired performance, however only 23.5% of these injuries led to time loss from training or competition. Similarly, in a cross-sectional study of injuries at a national-level team gymnastics competition (Harringe et al., 2004) 58% of athletes reported competing despite symptoms of an injury.

For this reason we used additional measures to those described in the football consensus statement, including the abovementioned scale measuring the functional impact of medical attention injuries, as well as specific questionnaires on injuries that we thought may be a particular problem in this cohort; lower back pain and anterior knee pain. Whilst we expect these efforts will help to present a more complete picture of the injury load experienced by this study’s subjects, we recognise that this is an imperfect system and the need for new methodologies to measure overuse injuries.

### **3.5.3 Part 3: Lower back pain questionnaire**

The interviewer went through a questionnaire specifically asking about lower-back pain symptoms (Appendices J & K). Lower back pain was defined as “pain, ache or soreness in the low-back with or without radiating pain to the gluteal area or lower extremities.” This definition, as well as all questions, were based on a survey used in a previous study of lower back problems in cross-country skiing, rowing and orienteering (Bahr et al, 2004), which has also recently been used to study these problems in beach volleyball players (Bahr, *in*

*press*). The original survey was itself based on validated questionnaires for the study of occupational injuries (Andersson et al 1984, Kuorinka et al 1987).

Our goal in including this questionnaire was twofold. Firstly, we wanted to gain extra information on the impact of lower back pain on cyclists' function, beyond the information gained from the general injury registration. Secondly, we wanted to be able to compare the results with the cohorts from cross-country skiing and rowing, which are both sports thought to have place a high load on the lumbar spine (Bahr et al, 2004), and orienteering, which was considered in the original study to be a sport with relatively low lumbar loading.

#### **3.5.4 Part 4: Anterior knee pain questionnaire**

The final section of the questionnaire was a questionnaire on anterior knee pain symptoms (Appendices L & M). The definition of anterior knee pain was "pain, ache or soreness on the front of the knee." Questions were exactly the same as those in the lower back pain questionnaire, such that the responses to each could be compared.

This same questionnaire format has recently also been used for the study of overuse knee injuries in beach volleyball players (Bahr, *in press*). The extent to which these results can be directly compared to the present study may however be limited, given that volleyball players are far more likely to be suffering from patellar tendon injuries than cyclists (Lian et al., 2005) whose knee pain is more likely of patellofemoral joint origin (Holmes et al., 1991). Whilst the beach volleyball study specifically tried to include only pain coming from the patellar tendon, we made no attempt to differentiate between potential anterior knee pain diagnoses.

### **3.6 Ethics and treatment of sensitive personal information**

The study was approved by the South-Eastern Norway Regional Committee for Research Ethics (Appendix N) and the Norwegian Data Inspectorate (Appendix O). All subjects gave their informed consent to participation in the study, and each was assigned a code which was used to identify all their personal and injury information. Once data collection was completed, the list linking codes to subject names was deleted.

### **3.7 Data analysis and statistical methods**

All data were manually entered into a computer database and checked twice for accuracy. Data were processed using Excel and SPSS (SPSS Inc., Chicago, Illinois). Analyses used included descriptive statistics, frequencies, and cross-tabulations. Differences between riders competing in the UCI World Tour and those competing in the UCI Europe Tour were investigated using Chi square tests (Pearson's Chi square and Fishers exact tests where appropriate) for non-parametric variables and unpaired t-tests for parametric variables. Differences were considered statistically significant if the p-value was less than 0.05.

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## 5. Article

### Overuse injuries in Professional Road Cyclists

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## INTRODUCTION

Road cycling has been a part of the Olympic Games since their inception in 1896, and the sport's annual centerpiece race, the Tour de France, is currently one of the world's most popular sporting events. Despite the history and popularity of the sport, surprisingly little attention has been paid to the epidemiological study of overuse musculoskeletal injuries among competitive cyclists, although anecdotal reports suggest that certain injuries such as patellofemoral pain<sup>1-3</sup> and lower back pain<sup>4</sup> may be prevalent.

Several studies have investigated overuse injuries among participants of non-competitive recreational cycling events.<sup>5-8</sup> These investigations have unanimously found knee injuries to be prevalent, affecting between 24% and 62% of subjects, whereas reports of other injuries such as lower back pain and neck pain, are more variable, with prevalence rates of 3-31% and 3-66%, respectively, for the two conditions. Whilst they may give a general idea of the types of overuse injuries that cyclists experience, the results of these studies may not be directly applicable to competitive cyclists, largely due to vast differences in cycling exposure between non-competitive "recreational" cyclists, and elite professionals. One study of recreational touring cyclists reported an average annual training volume of 7114km, and an average participation rate of 2.9 non-competitive events per year.<sup>8</sup> Professional cyclists, on the other hand, have been reported to ride between 25000 and 35000 km, and complete 50-110 days of intense racing each year.<sup>9, 10</sup> It would therefore be reasonable to assume that the overuse injury load experienced by these two cohorts may be substantially different.

There is only one in-depth report on overuse injuries in professional cyclists, a retrospective review of the patient records of two professional teams over a 13-year period.<sup>11</sup> The likelihood that all injuries sustained by this study's subjects were treated, and thereby recorded, by their team medical staff may be questionable, given that members of professional cycling teams are typically based over a very large geographical area and riders tend to have their own local medical support, outside of the official team structure. Although the validity of the results may be questioned, the results of this study are of interest, especially given the paucity of research in this field. Whilst knee injuries were found to clearly be the most common problem, representing 62% of all overuse injuries, few cases of lower back pain and no cases of neck pain were reported. This contrasts significantly with the findings of a brief survey on overuse injuries amongst members of the British national cycling team,<sup>12</sup> which reported a lower back pain prevalence of 60% and a neck pain

prevalence of 19%. Unfortunately, a lack of detail in this report prevents any analysis of the potential reasons for such differing results. The need for further investigation of the general pattern of overuse injury amongst competitive cyclists is therefore clear.

There is also some evidence that competitive cyclists may be particularly predisposed to a range of leg symptoms including pain, numbness and loss of power caused by flow limitations of their external iliac arteries.<sup>13, 14</sup> This has been referred to by several names in the literature, including sports-related flow-limitations of the iliac arteries,<sup>14</sup> exercise-induced arterial endofibrosis,<sup>13</sup> and cyclists' iliac syndrome.<sup>15</sup> Whilst several high-profile cyclists have undergone surgery for this condition, very little is known as to the magnitude of the problem amongst elite cyclists.

The primary aim of the present cross-sectional study was to investigate the patterns of overuse musculoskeletal injuries in a cohort of professional road cyclists. As lower back pain and anterior knee pain may be particular problems in this cohort, the secondary aim was to collect additional information on each of these problems through the use of specific questionnaires. Finally, questions on iliac artery flow limitations were also included in an attempt to improve knowledge of the prevalence of this condition in professional cycling.

## **METHODS**

### **Recruitment methods and data collection procedures**

Eleven road cycling teams, certified to take part in international competitions by the Union Cycliste Internationale (UCI), were invited to participate in this study. These teams were targeted either because we had prior contact with members of the medical staff or management, or because they were based in a convenient geographical location. Seven teams responded positively and were included in the study (n=116). These were based in Australia, Denmark, France, Norway and Switzerland, and included riders from 23 different nationalities. Two teams (n=49) were from the highest level of professional cycling (one UCI Pro-Tour team and one UCI Pro-Continental team with wildcard status), competing in all major races including the UCI World Tour and the Tour de France, whilst the remaining five were UCI Continental-level teams, competing in the UCI Europe tour (n=67).

We visited team training camps during the period between October 2008 and February 2009 and invited all cyclists in attendance to complete a 10-20 min interview on overuse injuries. Attempts were then made to conduct interviews by telephone with all team members who were not present at the camps (n=7), as well as all riders who were listed in the 2008 team rosters and who retired from international competition during or following the 2008 season for any reason (n=11). All cyclists were informed that participation in the study was voluntary and the information they provided could not be traced back to them or their team. The study was approved by the South-Eastern-Norway Regional Committee for Research Ethics and the Norwegian Data Inspectorate, and all subjects gave their informed consent prior to participation in the study.

### **Athlete Interviews**

All athlete interviews were conducted by physical therapists with experience working within professional cycling. The interviewer went through a standardised questionnaire verbally with each subject, providing further explanation or translation of the questions where necessary. All participating teams had an official language of either English or French, and interviews were conducted in one of these languages. Written material was also available in both languages. In two cases it was necessary to call upon a team staff member to assist in translation of the interview questions into Spanish. The interview was divided into the following sections:

### 1. Subject Characteristics

Subjects were questioned about their age, height and weight, the number of years they had been riding in a UCI registered team, the number of days of racing they had completed in the 2008 season, and the number of hours of training they had completed in the preceding twelve months. They were encouraged to use training records to assist in estimation of training and racing exposure.

### 2. Overuse Injury Registration

Subjects were asked to give information about all overuse injuries they had experienced in the preceding 12-month period. A schematic representation of the time period, including all major competitions, was shown to the subjects to assist them to recall injuries as best possible. The definition of an overuse injury was any pain or discomfort that was not directly associated with a traumatic event and was different from the normal aches and pains associated with competitive cycling. We elected to use this broad definition in order to capture as many potential injuries as possible; however, only injuries that required attention from qualified medical personnel were subsequently recorded. They were further classified as “time-loss” injuries if they caused the subject to miss one or more days of training or competition.

The anatomical location of the injury was recorded using the system proposed by Fuller et al for injury surveillance studies in football (soccer).<sup>16</sup> The severity of medical attention injuries was assessed by classifying them into (a) injuries that did not disrupt normal training and racing performance, (b) those during which the athlete could continue to train and compete, but with either a reduced intensity or volume, and (c) those during which the subject could not ride at all. Time-loss injury severity was assessed by using the absolute number of days of time lost from training or competition, and grouped according to the UEFA model,<sup>17</sup> into slight (1-3 days), mild (4-7 days), moderate (8-28 days) or severe (>28 days).

### 3. Low Back Pain and Anterior Knee Pain Questionnaires

The interviewer went through two questionnaires specifically asking about lower back pain and anterior knee pain. All questions and injury definitions were based on a questionnaire from a previous study analysing lower back problems in cross-country skiing, rowing and orienteering<sup>18</sup> that had been developed and validated for the study of occupational injuries.<sup>19,</sup>

<sup>20</sup> Lower back pain was defined as “pain, ache or soreness in the low-back with or without



radiating pain to the gluteal area or lower extremities” and anterior knee pain was defined as “pain, ache or soreness on the front of the knee.” We chose to use the broad term “anterior knee pain” as the retrospective design made it difficult to distinguish between individual diagnoses. The standard questions in each questionnaire included the following:

- Have you ever experienced low back/anterior knee pain?
- Have you experienced low back/anterior knee pain in the previous 12 months?
- How many days in total have you had low back/anterior knee pain over the past 12 months? (none, 1-7 days, 7-30 days, >30 days but not daily, daily)
- Have you been examined or treated for low back pain/anterior knee pain by a physician, physical therapist, chiropractor or other medical personnel in the previous 12 months? (not including regular post-race massages)
- Have you taken pain-killers or non-steroidal anti-inflammatory medications for low-back/anterior knee pain in the past 12 months?
- Have you ever been hospitalised for low back/anterior knee pain?
- Have you ever had surgery for low back/anterior knee pain?
- How many days of training have you missed due to low back/anterior knee pain in the past 12 months? (none, 1-7, 8-30, >30 but not daily, daily)
- How many races have you missed due to low back/anterior knee pain in the past 12 months? (none, 1-3, 4-10, >10)

Subjects were also asked whether they had had low back or anterior knee pain symptoms during each of four season periods; (a) the period in which they are not riding their bicycle (off-season), (b) the period in which they are training on the bicycle but not yet racing (pre-season), (c) the period in which they have commenced racing but not in peak condition or competing in their most important races (early season), and (d) the period during which they are in peak condition and during which they compete in their major races of the season (peak season).

The low back pain questionnaire contained an additional question asking subjects to indicate whether they had experienced pain radiating into their gluteal area, thigh, knee, lower leg or foot. The knee pain questionnaire contained an additional question asking whether riders used pedals that allowed a degree of rotation, commonly referred to as “float,” or if they preferred completely fixed pedals.

#### 4. Sports-related iliac artery flow limitations

Subjects were asked whether they had ever been assessed a vascular specialist for leg pains related to bicycling, and if so whether they had subsequently received surgical treatment for iliac artery flow limitations.

#### **Data Analysis and Statistical Methods**

It is unknown whether subject characteristics, cycling exposure or overuse injury prevalence differs between riders in racing at the UCI World Tour/Tour de France level and the UCI Europe Tour level and therefore all data were compared between groups. Chi square tests (Pearson's chi square and Fisher's exact tests where appropriate) were used to detect differences between non-parametric categorical variables and unpaired t-tests were used to detect differences in parametric variables. Differences were considered statistically significant if the p-value was less than 0.05.

## RESULTS

### Response Rate

The seven teams included in the study included 105 active cyclists, as well as eleven former team members who had retired during or following the 2008 season. We were able to complete questionnaires with 101 of the active riders and seven of the retired riders, giving us a total response rate of 94%. Through interviews with team medical staff we were able to confirm that the three retired riders whom we were unable to contact did not end their careers due to overuse injuries. Similarly, we were able to confirm that the four active riders whom we were unable to contact were not unavailable due to overuse injury.

### Subject Characteristics

Subject characteristics are shown in Table 1. Significant differences existed between the World Tour level and the Europe Tour level riders in age ( $p<0.001$ ), the number years spent riding for UCI teams ( $p<0.001$ ), the number of annual race days ( $p<0.001$ ) and in annual training hours ( $p<0.001$ ). The proportion of riders able to give exact exposure information based on their training records was 46% for the number of race days and 40% for the number of training hours, whilst the remainder provided an estimate. No significant differences were found however, between accurate and estimated exposure data.

**Table 1** Subject Characteristics

	Europe Tour (n=60)	World Tour (n=49)	Total (n=109)
Age	25 (4)	28 (5)	26 (4)
Height	182 (6)	181 (6)	181 (6)
Weight	71 (6)	69 (6)	70 (6)
Years Professional	3.2 (2.5)	6.0 (3.9)	4.5 (4.0)
Annual Racing Days	53 (19)	77 (16)	64 (21)
Annual Training Hours	869 (134)	952 (99)	904 (127)

Values shown are mean (SD)

### Retrospective Injury Registration

No significant differences were observed between the World Tour and Europe Tour riders for any injury data, therefore these data are presented as for a single cohort.

During the athlete interview 63 subjects recorded a total of 94 overuse injuries for which they had received medical attention, details of which are shown in Table 2. Thirty-nine percent of medical attention injuries did not affect the subject's ability to complete normal

training and racing, 36% led to a reduction in either racing performance or training volume, and 24% caused the subject to miss one or more days of training or competition. The most common medical attention injuries were lower back pain (46% of all medical attention injuries), knee pain (23%) and neck pain (10%). Time-loss injuries (Table 3) had a slightly different pattern, with knee pain the most common (57% of all time loss injuries), followed by lower back pain (17%) and lower leg or Achilles tendon injuries (13%). Seventeen percent of time-loss injuries were classified as slight, 17% as mild, 43% as moderate, and 17% as severe, whilst one case of lower back pain was sufficiently severe to end the competitive career of the subject. The average duration of time loss was 13.5 days (SD 10.1), not including the career-ending injury.

**Table 2** Location and Severity of Medical Attention Injuries

	Normal training and racing	Reduced performance	Could not ride bicycle	Career ending	Total
Lower Leg / Achilles Tendon	2	1	3	0	6
Knee	4	5	13	0	22
Thigh	1	4	1	0	6
Hip / Groin	0	1	0	0	1
Lower back / Pelvis / Sacrum	20	19	3	1	43
Abdomen	1	1	0	0	2
Sternum / Ribs / Upper back	0	1	0	0	1
Hand/ Finger / Thumb	1	0	0	0	1
Forearm	1	0	0	0	1
Shoulder / Clavicle	1	0	0	0	1
Neck / Cervical spine	6	2	2	0	10
Total	37	34	22	1	94

**Table 3** Location and Severity of Time Loss Injuries

	Slight (1-3 days)	Mild (4-7 days)	Moderate (8-28 days)	Severe (>28 days)	Career Ending	Total
Lower Leg / Achilles Tendon	1	1	1	0	0	3
Knee	1	3	7	2	0	13
Thigh	0	0	1	0	0	1
Lower back / Pelvis / Sacrum	1	0	1	1	1	4
Neck / Cervical spine	1	0	0	1	0	2
Total	4	4	10	4	1	23

### Low Back Pain Questionnaire

No significant differences were observed between groups in low back pain data and therefore these data are presented for a single cohort. There was a high prevalence of low back pain (Table 4), with 58% of subjects reporting symptoms in the past twelve months and 41% having sought outpatient medical assistance; however, relatively few had missed racing

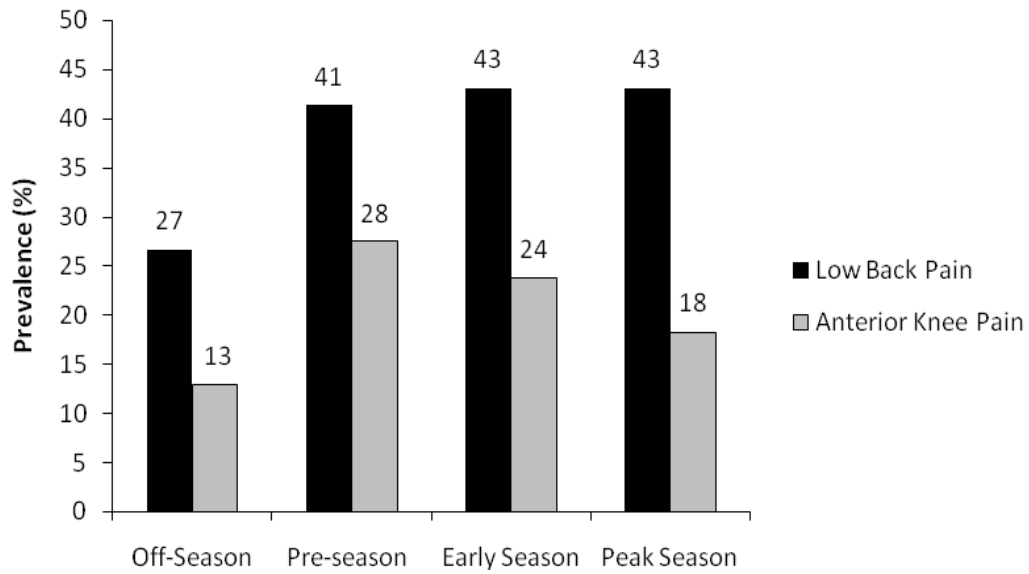
due to pain (6%). Symptoms were more prevalent during the pre-season preparation periods and competitive season than the off-season (Fig 1).

### Anterior Knee Pain Questionnaire

No significant differences were observed between groups in anterior knee pain data and therefore these data are presented for a single cohort. The 12-month prevalence of anterior knee pain (36%) was lower than low back pain (Table 4). Fewer subjects sought medical assistance (19%) but more missed training (27%) and competition (9%) due to knee pain. The prevalence of anterior knee pain also fluctuated throughout the year, peaking during the pre-season (Fig 1). Twenty-eight percent of subjects reported using fixed pedals, and 72% using floating pedals.

**Table 4.** Responses (number of riders) to low back pain/anterior knee pain questionnaires (n=109)

	Lower Back Pain	Anterior Knee Pain
Symptoms ever	71	61
Symptoms in previous 12 months	63	39
Total symptom duration		
1-7 days	21	11
8-30 days	23	21
>30 days but not daily	16	7
Daily	3	0
Outpatient medical assistance	45	21
NSAIDs in previous 12 months	15	20
Hospitalisation	8	7
Surgery	2	3
Missed training in previous 12 months	12	29
Number of days of missed training		
1-7 days	9	21
8-30 days	2	8
>30 days	2	0
Missed races in previous 12 months	6	10
Number of missed competitions		
1-3 races	3	7
4-10 races	0	2
>10 races	3	1
Referral of symptoms		
Gluteal region	5	-
Thigh	7	-
Knee	7	-
Lower leg or foot	13	-



**Figure 1.** Prevalence of anterior knee pain and lower back pain throughout the season

### **Iliac artery flow limitations**

Six subjects (5.5%) had been investigated by a vascular specialist at some stage during their professional career for exercise-related leg pains. Two of these (1.8%) had been diagnosed with unilateral sports-related flow-limitations of their external iliac artery and had undergone surgery for the condition.

## DISCUSSION

We found that symptoms of both lower back pain and anterior knee pain were common among elite cyclists, with an annual prevalence of 58% and 36%, respectively. More than half of all time-loss injuries were located at the knee, whereas cyclists were unlikely to miss training or competition due to lower back pain. Despite this, a large percentage suffered from performance-limiting lower back pain symptoms and sought medical attention for it. Other injuries previously reported to be common in recreational cyclists, such as neck pain and hand numbness, were generally mild or non-existent in this group with only four cases of neck pain affecting cycling performance and only one leading to significant time-loss from cycling participation.

To our knowledge, this is only the second epidemiological study investigating overuse injuries in elite competitive cyclists. Whilst we consider this to be a methodological improvement on the one existing study, it does have some limitations which much be taken into consideration when interpreting the results. Instead of using a prospective design, currently considered the gold standard in injury surveillance research,<sup>16</sup> we conducted a cross-sectional study with retrospective data collection. This was primarily due to doubts over the quality of the prospective data we were likely to be able to collect from a large group of professional cyclists, each of whom compete in a highly variable international race program. Recent evidence suggests that in such logistically difficult situations, retrospective athlete interviews may be a preferable alternative to prospective studies.<sup>21</sup> However, the major problem with retrospective studies is that they are subject to the threat of recall bias. Previous studies investigating the effects of recall bias show a general under-reporting of injury occurrence, particularly for milder injuries,<sup>22</sup> and an over-estimation of exposure data.<sup>23</sup> Interestingly, in this study no significant differences were found between exposure estimates and data from accurate subject training records. We attempted to minimise recall bias during the general injury registration by presenting a graphical representation of the previous competitive season and asking subjects to link specific dates and races with any periods of injury. This technique has been used before in a study of beach volleyball injuries with apparent success;<sup>24</sup> however, the recall period of that study was only eight weeks. We also conducted interviews with a flexible structure so that injury registration could be returned to at any time, for example if the knee or lower back questionnaires prompted the subject to remember an injury. Despite this, it remains likely that there is an element of injury underreporting in the current study due to recall bias. For example, whilst 27% of

riders reported having missed training due to knee pain in the anterior knee pain questionnaire, only 13 time-loss knee injuries were identified during the retrospective injury registration. This discrepancy is most likely explained by a number of time-loss injuries being forgotten during injury registration, and then recalled when subjects were prompted by specific questions within the knee questionnaire. The question of whether location-specific questionnaires may be more accurate than general retrospective injury registration in dealing with recall bias could therefore be asked.

Cross-sectional studies are also subject to the threat of sampling bias, for example data collected at a competitive event may underestimate true injury levels, as more seriously injured subjects may be absent. We expected this to be a particular problem in professional cycling, as only a small percentage of each team may be present at any given race. For this reason we chose to collect data when entire teams were gathered together, regardless of riders' fitness or injury status, and made a substantial attempt to contact any missing or recently retired riders by telephone. As we were able to include a high percentage of targeted riders, and given the geographic diversity of this study's sample, there is good reason to believe that this study's subjects are a representative sample of road cyclists competing on an equivalent level.

The high prevalence of anterior knee pain in this study is consistent with previous epidemiological investigations of professional<sup>11</sup> and recreational cyclists,<sup>5-8</sup> and appears to confirm anecdotal reports that knee pain is a common injury affecting competitive cyclists.<sup>1-</sup>  
<sup>3</sup> If, in accordance with currently recommended sports epidemiology methods,<sup>16, 25, 26</sup> time loss is used as the sole measurement of injury severity, then it would seem that knee injuries are clearly the most significant problem affecting professional cyclists. Lower back pain on the other hand, would according to these methods seem to be a far milder complaint, given the comparatively low number of time-loss injuries it caused. The injury load posed by lower back pain should however not be so easily dismissed. Whilst time-loss was a relatively rare consequence, more than one in five riders reported back pain causing reduced performance, which could in itself be considered a serious injury outcome in a cohort such as this for whom career and financial success is so dependent on optimum physical performance. Furthermore, a significantly greater percentage of cyclists reported long-term (>1 month) symptoms from lower back pain than knee pain and a far greater number of riders sought medical attention for lower back pain. In fact, results from the low back pain



questionnaire were highly comparable with results from other sports where lower back pain is considered to be a significant problem, such as cross-country skiing and rowing.<sup>18</sup> Clearly, lower back pain represents a significant injury load on competitive cyclists, yet current recommended injury-surveillance methodology, developed primarily for the study of acute injuries, is unequipped to adequately measure it. The development of novel methods to quantify overuse injury problems, with focus on prospective measurement of functional impairment and exercise exposure, is needed.<sup>27</sup>

In analysing the prevalence of symptoms throughout the year, lower back pain is relatively even during periods of racing or training, and markedly lower during the off-season. This indicates a strong relationship between cycling and lower back pain. For knee pain, symptoms were also lowest during the off-season and most prevalent during the pre-season preparation period. This could perhaps be explained by rapid increases in training load over this period, or perhaps other factors such as cold weather conditions, as this season period occurs during winter for a vast majority of subjects. Prospective investigations including risk factor analysis and accurate exposure measurement would be necessary to ascertain this with more certainty.

There was generally a low prevalence of upper-body complaints, and with the exception of one serious case of neck pain, almost all those reported were without functional consequence. This finding is in contrast to several studies of recreational cyclists, among which neck pain prevalence has been reported to be as high as 66%.<sup>7</sup> Parasthesia of the ulnar nerve, sometimes known as “handlebar palsy” has also been reported to be highly prevalent in cyclists,<sup>6, 28, 29</sup> however no cases were recorded in this study. One explanation for this, favoured by Barrios et al,<sup>11</sup> is that to elite cyclists these conditions are familiar and of such little consequence that they are regarded as a normal part of the sport. Alternatively it could be speculated that these athletes have, by this stage in their cycling career, either adjusted their bicycle position to minimise discomfort on upper body structures, or physically adapted to the ergonomic demands of the sport.

Arterial claudication problems would perhaps not normally fall under the umbrella of overuse sports injuries; however, we felt the inclusion of iliac artery flow limitations in this study was indicated, as the condition has been linked to cycling exposure and has frequently been reported to be a common problem in elite cyclists. Despite this, the only information available on the magnitude of the problem amongst cyclists is a suggestion that 20% of all

top-level cyclists may suffer from the condition.<sup>14</sup> However, as this was based on a study by a group of surgeons that regularly treat the condition,<sup>30</sup> it may be subject to sampling bias. Having only identified two athletes who had received surgery for flow limitations, our results suggest a far lower prevalence than this. Investigations involving greater numbers of cyclists would be necessary before more definitive conclusions could be made.

## **CONCLUSION**

This article provides new information on the pattern of overuse injuries sustained by professional road cyclists. Lower back pain and anterior knee pain were found to be the most prevalent overuse injuries, with knee injuries most likely to cause time-loss from cycling and lower back pain leading to the highest rates of functional impairment and medical attention. Future efforts to prevent overuse injuries in competitive cyclists should focus on these injuries.

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## Appendix A



[name]  
[title]  
[team]

Dear [name],

The Oslo Sports Trauma Research Center is conducting new research to gain more information about overuse injuries in professional cycling.

We are aiming to survey a number of professional cycling teams between the 2008 and 2009 seasons to gain information on injuries that riders have sustained during training and competition over the previous year. We will also be collecting other information that may relate to these injuries such as the amount of training and racing each rider has completed, whether they perform stretching or weight training throughout the year, and the type of pedal and cleat systems they use.

This information is important to get a better picture of injuries that professional cyclists sustain and to enable us to develop measures to prevent these injuries. Further information about this project is available at <http://www.ostrc.no/en/Project/159---Non-traumatic-injuries-in-professional-road-cycling/>

We would very much like the opportunity for one of our researchers to visit your team at a time when all the riders are gathered together, for example at a winter training camp. Each rider would be asked to complete a short questionnaire that would take approximately ten minutes, during which the researcher would be present to help explain each question. This could be done at a convenient time, for example whilst the massages are being performed. We would therefore only need our researcher to be present for one or two days at the camp.

All information obtained during this research project would be treated with strict confidentiality, as would the team's involvement in the study. No specific information about any of the teams or individuals involved in the study will be published or passed on to any other party, and no permanent records will be kept that link the information gained in the questionnaire to rider or team names.

You will however receive statistics on the overuse injuries sustained by your riders, as well as their average training and racing volume, and their stretching, weight training and injury-prevention training habits. .

This study is funded by the Oslo Sports Trauma Research Centre. Participation would be free of any costs to your team.

We hope that you will be interested in participation in this study, and can suggest a time when it is convenient for a researcher to visit your team.

Best Regards

Roald Bahr  
Professor, MD

Tron Krosshaug  
PhD, Senior Researcher

Benjamin Clarsen  
Physiotherapist, Researcher

Contact: Benjamin Clarsen - +4798481204 – [ben\\_clarsen@yahoo.com.au](mailto:ben_clarsen@yahoo.com.au)

## Appendix B



[name]  
[title]  
[team]

Cher Monsieur,

Le Centre de Recherche des Blessures Traumatiques du Sport d'Oslo effectue de nouvelles recherches dans le domaine des blessures des coureurs cyclistes.

Notre but est de recueillir des informations spécifiques sur les coureurs de plusieurs équipes du Pro-Tour. Nous aimerions nous entretenir avec les coureurs qui auraient subi des blessures (lors d'entraînements ou de compétitions) durant la saison 2008.

Cette collecte d'information se fera sous forme de questionnaire abordant des sujets qui, nous pensons, peuvent être en relation avec les blessures tel que : entraînements, compétitions, programmes d'étirements, musculations, choix des pédales et des clips.

Ces informations importantes nous permettront de mieux comprendre les causes des blessures des cyclistes professionnels et de, par la suite, développer des méthodes préventives.

Pour mener à bien ce projet, nous souhaiterions idéalement rencontrer l'équipe au complet (durant un stage d'hivers par exemple). Chaque sportif, s'il le souhaite, nous accordera quelques minutes de son temps (lors des massages peut être commode).

Toutes informations personnelles et médicales données durant l'entretien resteront strictement confidentielles ainsi que toutes informations sur l'équipe.

Bien entendu le directeur sportif recevra un compte rendu général de cette étude (statistiques sportives et médicales) ainsi qu'une étude comparative des diverses équipes qui auront participé à ce projet.

Cette recherche est entièrement financée par le Centre de Recherche des Blessures Traumatiques du Sport d'Oslo. Ainsi que tous les frais qui s'y rattachent.

Nous espérons que ce projet vous intéressera, et nous vous contacterons dans les prochaines semaines pour en discuter plus en détail.

Veuillez recevoir, Monsieur, l'expression de nos salutations distinguées.

Roald Bahr  
Professor  
OSTRC

Tron Krosshaug  
PhD, Senior Researcher  
OSTRC

Benjamin Clarsen  
Physiotherapist  
Norwegian School of Sports Sciences

Contact :  
ben\_clarsen@yahoo.com.au  
+4799481204



## Appendix C

### **Request for participation in a research project**

#### *“An Investigation of Non-Traumatic Injuries in Professional Road Cycling”*

##### **Background and purpose**

This is a request for you to participate in a research study that aims to collect information regarding non-traumatic injuries in professional road cycling. At this stage there is very little scientific information on the different types of overuse injuries that professional cyclists experience, nor of the impact of those injuries. This would be valuable information in allowing us to develop strategies to prevent these injuries in the future.

##### **What does the study entail?**

This study entails the completion of a questionnaire relating to any pain or injuries that you have suffered over the past 12 months whilst training or racing on your bicycle. We will also be asking some questions about your training program and your pedal cleat selection as we would like to know if there are any relationships between these factors and overuse injury. There are also two short questionnaires that specifically ask about lower-back pain and knee pain. We have already conducted these on a number of groups of athletes from other sports and are interested to compare these sports to road cycling. The whole process should only take about ten minutes.

##### **What are the potential advantages and disadvantages of participation in this project?**

The information gained from this study will help in the development of effective strategies to prevent overuse injuries in professional cycling. As a professional cyclist, this may be of direct benefit to you in the future.

Apart from giving some minutes of your time to fill out the questionnaires, there are no disadvantages of participating in this project.

##### **What will happen to the information about you?**

The data that are registered about you will only be used in accordance with the purpose of the study as described above. All the data will be processed without name or other directly recognisable type of information. A code number links you to your data through a list of names. The list that can link your name to the code number will be stored at the university only, and only the project staff will have access to it. This list will be destroyed and the data material anonymised once all data is collected, within May 2009. All data in relation to this project will be deleted at the latest seven years after its completion.

It will not be possible to identify you or your team in the results of the study when these are published.

##### **Voluntary participation and withdrawal**

Participation in the study is voluntary. You can withdraw your consent to use your data in the study at any time up until the completion of the project in May 2009 without stating any

particular reason and without consequence. If you have any questions concerning the study, you may contact Benjamin Clarsen on +47 98 48 12 04.

If you wish to participate, please sign the declaration of consent below.

### **Consent for participation in the study**

I am willing to participate in the study.

---

(Signed by the project participant, date)

I confirm that I have given information about the study.

---

(Signed, role in the study, date)

Norwegian School of Sports Sciences  
Sports Medicine Department  
Postboks 4014 Ullevål Stadion  
0806 Oslo

## Appendix D



### DEMANDE DE PARTICIPATION DANS UNE ETUDE

#### *“Etudes des blessures ‘non-traumatique’ dans le cyclisme professionnel”*

##### **Informations Générales et Objectif**

Nous vous proposons de participer à une nouvelle recherche qui a pour but de collecter des informations spécifiques sur les blessures dans le milieu du cyclisme professionnel.

A l'heure actuelle il existe très peu de données scientifiques sur les différents types de blessures récurrentes que subissent les cyclistes ainsi que leurs conséquences. Ces informations nous seraient très utiles afin de développer des stratégies pour prévenir ces blessures.

##### **En quoi consiste l'étude ?**

Cette étude se présente sous forme de plusieurs questionnaires.

Nous vous demanderons de remplir un questionnaire en rapport avec toutes douleurs ou blessures que vous auriez subit durant les 12 derniers mois pendant d'entraînement ou en compétition. Nous vous demanderons aussi quelques questions sur votre programme d'entraînement et les choix de vos pédales et clips, car nous aimerions savoir s'il existe un rapport entre les blessures et ces choix.

L'étude comporte aussi deux courts questionnaires qui se concentrent spécifiquement sur les douleurs dorsales (en particulier le bas du dos) et celles du genou.

Nous avons déjà effectué cette étude auprès d'autres milieu sportif et serions maintenant intéressé de comparer ces résultats avec ceux des cyclistes professionnels.

Dix minutes vous suffiront pour remplir les questionnaires.

##### **Quelles sont les avantages et inconvénients à participer à ce type de projet ?**

Les informations recueillit par cette étude permettront de développer des stratégies efficaces pour prévenir les blessures récurrentes des cyclistes professionnels. En tant que cycliste professionnel ceci pourrait vous être utiles pour votre futur.

Mis à part le temps nécessaire pour remplir les questionnaires, il n'y a pas d'inconvénients à participer a ce projet.

##### **Où vont vos informations personnelles ?**

Vos données personnelles ne seront utilisées que dans le cadre du projet décrit ci-dessus.

Toutes les informations seront traitées anonymement et sans autre moyen de reconnaissance par un tiers. Un numéro de code vous lie à vos données personnelles à

travers une liste de noms. La liste qui permet de mettre en lien votre nom et vos données

est entreposée à l'Université d'Oslo ou seuls les membres du projet peuvent y avoir accès.

Cette liste sera détruite une fois que toutes les données auront été collectées puis toutes les informations en rapport avec ce projet seront effacées au plus tard sept ans après la fin du projet.

Il ne sera pas possible de vous identifier, ou d'identifier votre équipe, dans les conclusions de cette recherche lors de sa publication.

**Participation Volontaire et Désistement**

Votre participation est volontaire, mais il vous est possible de vous désister à tout moment avant la fin du projet en mai 2009, ceci sans justifications et sans conséquences.

Si vous avez des questions concernant cette étude, merci de contacter Benjamin Clarsen sur +4798481204.

Si vous souhaitez participer à cette étude, veuillez signer l'Accord de participation ci-dessous.

**Accord de participation**

Je certifie vouloir participer à cette étude.

---

(Signature du participant et date)

Je certifie avoir transmis des informations concernant l'étude

---

(Signature et date)

Norwegian School of Sports Sciences  
Sports Medicine Department  
Postboks 4014 Ullevål Stadion  
0806 Oslo

# Appendix E

Subject Code \_\_\_\_\_

1. What year were you born 19\_\_\_\_\_
2. How tall are you? \_\_\_\_\_ cm
3. How much do you weigh? \_\_\_\_\_ kg
4. How many years have you been a professional cyclist? \_\_\_\_\_
5. How many days of racing did you have in the 2008 season?  
5.1 Is this based on a training log?  Yes  
 No, this is an estimate
6. How many hours of racing and training have you completed in total over the past 12 months?  
6.1 Is this based on a training log?  Yes  
 No, this is an estimate
7. How often do you perform stretching during the season?  Never  
 Now and then  
 Regularly but not daily  
 Daily
8. Do you perform weight training at any time during the season?  Yes (*answer question 8.1*)  
 No  
8.1 What periods of the season do you perform weight training?  Off-season  
 Pre-Competition  
 Early Competitive  
 Peak Competitive
9. Do you perform strength training *on the bicycle* at any time during the season?  Yes (*answer questions 9.1 and 9.2*)  
 No  
9.1 What periods of the season do you perform strength training *on the bicycle*?  Off-season  
 Pre-Competition  
 Early Competitive  
 Peak Competitive

Subject Code \_\_\_\_\_

- 9.2 What cadence do you use in this type of training
- <40  
 40-50  
 50-60  
 >60
10. Do you perform an individualised program of exercises designed specifically to prevent injuries at any time during the season?
- Yes (*answer question 10.1*)  
 No
- 10.1 What periods of the season do you perform this program?
- Off-season  
 Pre-Competition  
 Early Competitive  
 Peak Competitive
11. What type of pedals do you use?
- \_\_\_\_\_
- Floating cleats  
 Fixed cleats
12. Have you ever been assessed by a surgeon for any problem related to your iliac arteries (on your lower abdomen near the front of your hips)?
- No  
 Yes (*answer question 13*)
13. Have you had surgery on your Iliac arteries?
- No  
 Yes

# Appendix F

Subject Code \_\_\_\_\_

1. Quelle année étiez-vous né 19\_\_\_\_
2. Combien grand êtes-vous ? \_\_\_\_\_ cm
3. Combien pesez-vous ? \_\_\_\_\_ kg
4. Combien d'années avez-vous été un cycliste professionnel ? \_\_\_\_\_
5. Combien de jours de course avez-vous dans la saison 2008 ? \_\_\_\_\_  
\_\_\_\_\_
- 5.1 Est-ce que ce basé est sur une notation de l'entraînement ?  
 Oui  
 Pas, c'est une évaluation
6. Combien d'heures de course et de l'entraînement avez-vous finies au total au cours des 12 mois derniers ? \_\_\_\_\_  
\_\_\_\_\_
- 6.1 Est-ce que ce basé est sur une notation de l'entraînement ?  
 Oui  
 Pas, c'est une évaluation
7. Combien de fois exécutez-vous l'étirement pendant la saison ?  
 Jamais  
 De temps en temps  
 Régulièrement  
 Quotidiennement
8. Exécutez vous la musculation pendant la saison ?  
 Oui  
 Pas
- 8.1 Quelles périodes de la saison vous font la musculation ?  
 période de repos  
 période de préparation  
 saison tôt  
 saison maximale
9. Exécutez vous l'entraînement spécifique du force sur le vélo pendant la saison ?  
 Oui (répondre 9.1 est 9.2)  
 Pas
- 9.1 Quelles périodes de la saison font-vous l'entraînement spécifique du force sur le vélo  
 période de repos  
 période de préparation  
 saison tôt  
 saison maximale

Subject Code \_\_\_\_\_

- 9.2 Quelle cadence employez vous dans cette type d'entrainement ?
- <40
  - 40-50
  - 50-60
  - >60
10. *Exécutez-vous un programme individualisé conçu spécifiquement pour la prévention des blessures ?*
- Oui (répondre 10.1)
  - Pas
- 10.1 Quelles périodes de la saison exécutez-vous cette type d'entrainement ?
- période de repos
  - période de préparation
  - saison tôt
  - saison maximale
11. Quel type de pédales employez vous ?
- 
- Floating cleats
  - Fixed cleats
12. Avez vous jamais été chez un chirurgien pour un problème connexe aux artères Iliacs (dedans l'abdomen qui donne le sang aux cuisses)
- No
  - Yes (answer question 13)
13. Avez vous eu la chirurgie sur les artères Iliacs ?
- No
  - Yes



# Appendix G



		Part of Season	Injuries
2008	January	Tour Down Under (22.1-27.1)	
	February	Tour of Qatar (27.01-01.02)	
		Tour Mediteraneen	
		Ruta del Sol (17.02-21.02)	
	March	Het Volk (01.03)	
		Paris Nice (9-16.03)	
		Tirreno-Adriatico (12-18.03)	
	April	Milan-San Remo (22-03)	
		Tour of Flanders (06.04)	
		Paris Roubaix (13.04), Pais Vasco (07-12)	
	May	Amstel Gold Race (20.04)	
		Liege-Bastogne-Liege (27.04)	
Tour Romandie (29.04-04.05)			
June	Giro d'Italia (10.05-01.06)		
	Volta Ciclista a Catalunya		
	Dauphine Libere (08-15.06)		
July	Tour de Suisse (14.06-22.06)		
	Tour de France (05-27.07)		
	Tour of Austria		
August	Brixia Tour		
	Classica San Sebastian		
	Olympic Games (09.08,13.08)		
September	Eneco Tour (20.08-27.08)		
	Deutschland Tour (29.08-06.09)		
	Vuelta a Espana (30.08-21.09)		
October	Tour de Pologne (14-20.09)		
	World Championships (28.09)		
	Paris-Tours (12.10)		
November	Giro de Lombardia 18.10		
December			
2009	January	Tour Down Under (22.01-27.01)	

Instructions: Fill in the "Part of season" box using the following code: (1) Off Season (2) Pre-season preparation (3) Early season (using racing to find peak form) (4) Peak season (5) Late season (major goals are completed but you continue racing due to contract with team)

Fill in the "Injuries Sustained" box using a brief description of each overuse injury. Shade the approximate amount of time that each injury was a problem

# Appendix H



		Part of Season	Injuries
2007	October	NC Jesheim	
	November		
	December		
2008	January		
	February		
	March	Istrian Spring trophy, Croatia Grenland GP Tour de Normandy	
	April	Rhone Alps Isere Tour de Bretagne	
	May	Skanis Open Eidsvollrittet Olympias Tour	
	June	Ringerike GP	
	July	NM Lag Tempo, Gøteritt NM Tempo, Landevei Tour de France (03-27.07)	
	August	Sperkasse Giro Bochum Paris Correze Regio Tour Tour of Ireland	
	September	NC Etappelgp Oslo Sykkelfestivale VM Varese	
	October	NM Jessheim	

Instructions: Fill in the "Part of season" box using the following code: (1) Off Season (2) Pre-season preparation (3) Early season (4) Peak season (5) Late season

Fill in the "Injuries Sustained" box using a brief description of each overuse injury. Shade the approximate amount of time that each injury was a problem

# Appendix I

## Overuse Injury Recording Schema

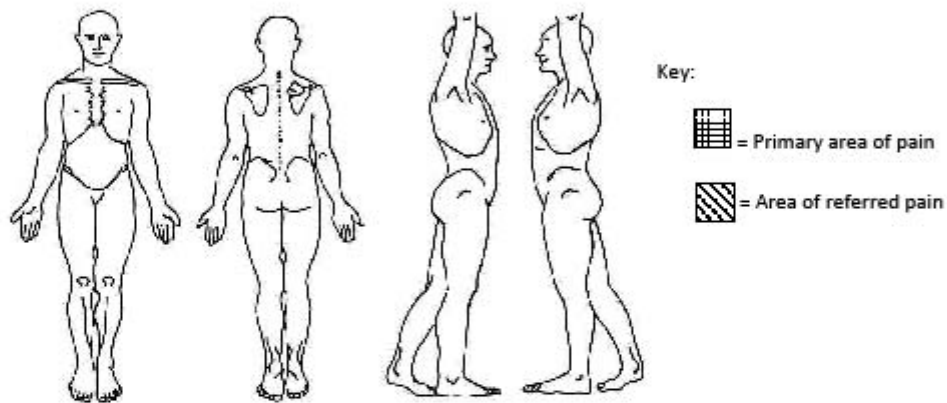
Subject Code \_\_\_\_\_

Injury Number \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_

*An overuse injury is any pain or discomfort that is not directly associated with a traumatic event and different from the normal aches and pains associated with competitive cycling. This pain or discomfort affects your ability to perform racing or training OR causes you to seek medical attention from a qualified medical doctor*

*Please complete a separate form for each overuse injury that you have experienced in the past 12 months*

### 1. Indicate all areas of pain involved with THIS injury, including areas of referred pain



### 2. Briefly describe the nature of this injury (e.g. pain on the outside of the knee, lower back pain)

---



---

### 3. Injury Location

- |                           |                          |                     |                          |
|---------------------------|--------------------------|---------------------|--------------------------|
| Foot/Toe                  | <input type="checkbox"/> | Hand/Finger/Thumb   | <input type="checkbox"/> |
| Ankle                     | <input type="checkbox"/> | Wrist               | <input type="checkbox"/> |
| Lower leg/Achilles Tendon | <input type="checkbox"/> | Forearm             | <input type="checkbox"/> |
| Knee                      | <input type="checkbox"/> | Elbow               | <input type="checkbox"/> |
| Thigh                     | <input type="checkbox"/> | Upper Arm           | <input type="checkbox"/> |
| Hip/Groin                 | <input type="checkbox"/> | Shoulder/Clavicle   | <input type="checkbox"/> |
| Lower back/Pelvis/Sacrum  | <input type="checkbox"/> | Neck/Cervical Spine | <input type="checkbox"/> |
| Abdomen                   | <input type="checkbox"/> | Head/Face           | <input type="checkbox"/> |
| Sternum/Ribs/Upper Back   | <input type="checkbox"/> |                     |                          |

4. When did this injury occur: for the first time? \_\_\_\_\_

In the past 12 months? \_\_\_\_\_

4. How long have you had symptoms in the past 12 months? \_\_\_\_\_

5. Have you received medical treatment for this injury in the past 12 months?

- |                        |                          |                         |                          |
|------------------------|--------------------------|-------------------------|--------------------------|
| No                     | <input type="checkbox"/> |                         |                          |
| By a doctor            | <input type="checkbox"/> | By a physiotherapist    | <input type="checkbox"/> |
| By a chiropractor      | <input type="checkbox"/> | By an osteopath         | <input type="checkbox"/> |
| By a massage therapist | <input type="checkbox"/> | Unsure of qualification | <input type="checkbox"/> |

6. How did this injury affect your cycling performance?

Select one option that best describes the *WORST* this injury has been in the past 12 months:

- a. You were able to complete normal training and racing
- b. You were able to complete your normal training and racing schedule however your *performance was reduced*  For how long \_\_\_\_\_
- c. You had to reduce your training and/or racing load  For how long \_\_\_\_\_
- d. You could not ride a bicycle at all  For how long \_\_\_\_\_
- e. You were not able to continue as a professional cyclist

7. What factors do you attribute to the development of your overuse injury?

- Too much training/racing
- Too little training
- Off-Bike Training  \_\_\_\_\_
- Equipment  \_\_\_\_\_
- Bicycle position  \_\_\_\_\_
- Specific muscle weakness  \_\_\_\_\_
- Other \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

## Appendix J

### QUESTIONS ABOUT LOWER BACK PAIN

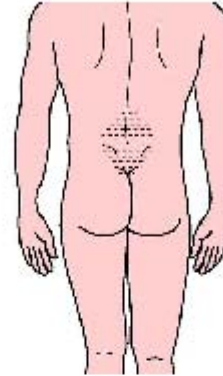
Subject Code \_\_\_\_\_

*Instructions for completing the questions:*

- By LOWER BACK PAIN we mean pain, ache or soreness in the hatched area on the figure, with or without radiating pain to the gluteal area or the lower extremity.

- Please complete the questions whether you have had low back pain or not.

- Please complete the questions by selecting the most appropriate response. **Note! Just one answer per question.** Please try to respond as well as you can even if you find it difficult.



1. Have you ever had low back pain?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
2. Have you been examined or treated for low back pain by a doctor, physical therapist, chiropractor or other health personnel outside hospital during the previous 12 months?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
3. Have you ever had been to hospital because of lower back pain?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
4. Have you ever had surgery because of low back pain?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
5. Have you had low back pain during the past 2 months?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
6. Have you had lower back pain during the past 7 days?	<input type="checkbox"/> YES	<input type="checkbox"/> NO

7. Have you ever had low back pain radiating to the lower extremities?	<input type="checkbox"/> No <input type="checkbox"/> Yes, into the gluteal region <input type="checkbox"/> Yes, into the thigh <input type="checkbox"/> Yes, into the knee <input type="checkbox"/> Yes, into the lower-leg or foot						
8. How many days have you had lower back pain during the past 12 months?	<input type="checkbox"/> None <input type="checkbox"/> 1-7 Days <input type="checkbox"/> 8-30 Days <input type="checkbox"/> More than 30 days, but not daily <input type="checkbox"/> Daily						
19. Have you had lower back pain in the following periods of the past year (training periods):	<p style="text-align: center;">Off-Season</p> <input type="checkbox"/> Never <input type="checkbox"/> Now and Then <input type="checkbox"/> Weekly <input type="checkbox"/> Daily						
	<p style="text-align: center;">Pre-season Preparation</p> <input type="checkbox"/> Never <input type="checkbox"/> Now and Then <input type="checkbox"/> Weekly <input type="checkbox"/> Daily						
	<p style="text-align: center;">Early Season</p> <input type="checkbox"/> Never <input type="checkbox"/> Now and Then <input type="checkbox"/> Weekly <input type="checkbox"/> Daily						
	<p style="text-align: center;">Peak competitive Season</p> <input type="checkbox"/> Never <input type="checkbox"/> Now and Then <input type="checkbox"/> Weekly <input type="checkbox"/> Daily						
10. How many days have you had to miss training or racing because of lower back pain during the previous 12 months?	<input type="checkbox"/> None <input type="checkbox"/> 1-7 Days <input type="checkbox"/> 8-30 Days <input type="checkbox"/> More than 30 days						
11. How many races have you had to miss because of lower back pain during the previous 12 months?	<input type="checkbox"/> None <input type="checkbox"/> 1-4 Races <input type="checkbox"/> 4-10 Races <input type="checkbox"/> More than 10 Races						
12. Do take pain killers or anti-inflammatory medication when you ride because of lower back pain?	<table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">Currently</td> <td style="width: 20%;"><input type="checkbox"/> YES</td> <td style="width: 20%;"><input type="checkbox"/> NO</td> </tr> <tr> <td>In the past 12 months</td> <td><input type="checkbox"/> YES</td> <td><input type="checkbox"/> NO</td> </tr> </table>	Currently	<input type="checkbox"/> YES	<input type="checkbox"/> NO	In the past 12 months	<input type="checkbox"/> YES	<input type="checkbox"/> NO
Currently	<input type="checkbox"/> YES	<input type="checkbox"/> NO					
In the past 12 months	<input type="checkbox"/> YES	<input type="checkbox"/> NO					

## Appendix K

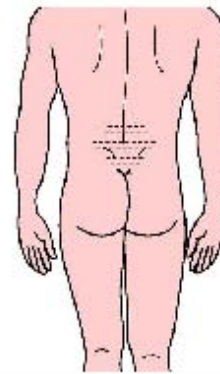
### QUESTIONS AU SUJET DE LOMBALGIE

*Instructions pour accomplir les questions:*

LA LOMBALGIE signifie douleur, mal ou malaise dans le secteur haché sur l'image, avec ou sans rayonnement de la douleur à la région fessière ou à la jambe

Veillez accomplir les questions, que vous ayez eu la douleur lombo-sacrée ou pas

Veillez accomplir les questions en choisissant la réponse la plus appropriée. **Note ! Juste une réponse par question.** Essayez svp de répondre comme vous pouvez même si vous le trouvez difficile



1. Avez-vous jamais eu la lombalgie ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
2. Avez-vous été examiné ou traité- pour la lombalgie par un médecin, un kinésithérapeute, un chiropracteur ou tout autre personnel de santé en dehors d'hôpital pendant les 12 mois précédents ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
3. Avez-vous jamais eu été à l'hôpital en raison de la lombalgie ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
4. Avez-vous jamais eu la chirurgie en raison de la douleur lombo-sacrée ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
5. Avez-vous eu la douleur lombo-sacrée pendant les 2 mois derniers ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
6. Avez-vous eu la lombalgie pendant les 7 jours derniers?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
7. Avez-vous jamais eu la douleur lombo-sacrée rayonner aux extrémités inférieures ?	<input type="checkbox"/> Pas <input type="checkbox"/> Oui, jusqu'aux fesses <input type="checkbox"/> Oui, jusqu'au cuisse <input type="checkbox"/> Oui, jusqu-au genou <input type="checkbox"/> Oui, jusqu'à la jambe inférieure ou pied

<p>8. Combien de jours avez-vous eu la lombalgie pendant les 12 mois derniers ?</p>	<p><input type="checkbox"/> Aucun  <input type="checkbox"/> 1-7 Jours  <input type="checkbox"/> 8-30 Jours  <input type="checkbox"/> plus de 30 jours, men pas quotidiennement  <input type="checkbox"/> Quotidiennement</p>
<p>9. Avez-vous eu la lombalgie dans les périodes suivantes de la dernière année (périodes de l'entraînement) ?</p>	<p><b>période de repos (aucun velo)</b>  <input type="checkbox"/> Jamais <input type="checkbox"/> hebdomadaire  <input type="checkbox"/> De temps en temps <input type="checkbox"/> Quotidiennement</p> <p><b>période de préparation d'avant-saison</b>  <input type="checkbox"/> Jamais <input type="checkbox"/> hebdomadaire  <input type="checkbox"/> De temps en temps <input type="checkbox"/> Quotidiennement</p> <p><b>saison tôt</b>  <input type="checkbox"/> Jamais <input type="checkbox"/> hebdomadaire  <input type="checkbox"/> De temps en temps <input type="checkbox"/> Quotidiennement</p> <p><b>saison concurrentielle maximale</b>  <input type="checkbox"/> Jamais <input type="checkbox"/> hebdomadaire  <input type="checkbox"/> De temps en temps <input type="checkbox"/> Quotidiennement</p>
<p>10. Combien de jours ont vous avez dû ne pas faire l'entraînement ou la concurrence en raison de la lombalgie pendant les 12 mois précédents ?</p>	<p><input type="checkbox"/> Aucun  <input type="checkbox"/> 1-7 jours  <input type="checkbox"/> 8-30 jours  <input type="checkbox"/> Plus de 30 jours</p>
<p>11. Combien des courses ont vous avez manqué en raison de la lombalgie pendant les 12 mois précédents ?</p>	<p><input type="checkbox"/> Aucun  <input type="checkbox"/> 1-4 courses  <input type="checkbox"/> 4-10 courses  <input type="checkbox"/> Plus de 10 courses</p>
<p>12. Prenez-vous les médicaments antidouleurs ou anti-inflammatoires quand vous faites le vélo en raison de la lombalgie ?</p>	<p>Maintenant ? <input type="checkbox"/> Oui <input type="checkbox"/> Pas  Pendent les 12 mois précédents ? <input type="checkbox"/> Oui <input type="checkbox"/> Pas</p>



# Appendix L

## QUESTIONS ABOUT KNEE PAIN

Subject Code \_\_\_\_\_

	LEFT KNEE:	RIGHT KNEE:
1. Do you currently suffer from anterior knee pain (pain, ache or soreness on the front of the knee)?	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
2. If yes, how long have you had symptoms (number of months)		
3. If no, have you previously had anterior knee pain?	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
4. Have you been examined or treated for anterior knee pain by a doctor, physical therapist, chiropractor or other health personnel outside hospital during the previous 12 months?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
5. Have you ever been hospitalized because of anterior knee pain?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
6. Have you ever had surgery because of anterior knee pain?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
7. Have you had anterior knee pain during the past 2 months?	<input type="checkbox"/> YES	<input type="checkbox"/> NO
8. Have you had anterior knee pain during the past 7 days?	<input type="checkbox"/> YES	<input type="checkbox"/> NO

<p>9. How many days have you had symptoms from anterior knee pain during the past 12 months?</p>	<input type="checkbox"/> None <input type="checkbox"/> 1-7 Days <input type="checkbox"/> 8-30 Days <input type="checkbox"/> More than 30 days, but not daily <input type="checkbox"/> Daily																																
<p>10. Have you had anterior knee pain in the following periods of the past year (training periods):</p>	<table border="0"> <tr> <td colspan="4" style="text-align: center;"><b>Off-Season</b></td> </tr> <tr> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Now and Then</td> <td><input type="checkbox"/> Weekly</td> <td><input type="checkbox"/> Daily</td> </tr> <tr> <td colspan="4" style="text-align: center;"><b>Pre-season Preparation</b></td> </tr> <tr> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Now and Then</td> <td><input type="checkbox"/> Weekly</td> <td><input type="checkbox"/> Daily</td> </tr> <tr> <td colspan="4" style="text-align: center;"><b>Early Season</b></td> </tr> <tr> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Now and Then</td> <td><input type="checkbox"/> Weekly</td> <td><input type="checkbox"/> Daily</td> </tr> <tr> <td colspan="4" style="text-align: center;"><b>Peak competitive Season</b></td> </tr> <tr> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Now and Then</td> <td><input type="checkbox"/> Weekly</td> <td><input type="checkbox"/> Daily</td> </tr> </table>	<b>Off-Season</b>				<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily	<b>Pre-season Preparation</b>				<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily	<b>Early Season</b>				<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily	<b>Peak competitive Season</b>				<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily
<b>Off-Season</b>																																	
<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily																														
<b>Pre-season Preparation</b>																																	
<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily																														
<b>Early Season</b>																																	
<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily																														
<b>Peak competitive Season</b>																																	
<input type="checkbox"/> Never	<input type="checkbox"/> Now and Then	<input type="checkbox"/> Weekly	<input type="checkbox"/> Daily																														
<p>11. How many days have you had to miss training or racing because of anterior knee pain during the previous 12 months?</p>	<input type="checkbox"/> None <input type="checkbox"/> 1-7 Days <input type="checkbox"/> 8-30 Days <input type="checkbox"/> More than 30 days																																
<p>12. How many races have you had to miss because of anterior knee pain during the previous 12 months?</p>	<input type="checkbox"/> None <input type="checkbox"/> 1-4 Races <input type="checkbox"/> 4-10 Races <input type="checkbox"/> More than 10 Races																																
<p>13. Do you currently take pain killers or anti-inflammatory medication when you ride because of anterior knee pain?</p>	<input type="checkbox"/> YES <input type="checkbox"/> NO																																
<p>13. Have you taken pain killers or anti-inflammatory medication when you ride because of anterior knee pain in the past 12 months?</p>	<input type="checkbox"/> YES <input type="checkbox"/> NO																																

## Appendix M



### QUESTIONS AU SUJET DE DOULEUR DE GENOU

	Genou gauche	Genou droit
1. Faites-vous ont actuellement la douleur de genou antérieure?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
2. Si oui, combien de mois ont vous avez eu vos symptômes		
3. Si pas, avez-vous jamais eu la douleur de genou antérieure?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas	<input type="checkbox"/> Oui <input type="checkbox"/> Pas

2. Avez-vous été examiné ou traité- pour la douleur de genou antérieure par un médecin, un kinésithérapeute, un chiroprakteur ou tout autre personnel de santé en dehors d'hôpital pendant les 12 mois précédents ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
3. Avez-vous jamais eu été à l'hôpital en raison de la douleur de genou antérieure?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
4. Avez-vous jamais eu la chirurgie en raison de la douleur de genou antérieure?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
5. Avez-vous eu la douleur de genou antérieure pendant les 2 mois derniers ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
6. Avez-vous eu la douleur de genou antérieure pendant les 7 jours derniers?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
7. Combien de jours avez-vous eu la douleur de genou antérieure pendant les 12 mois derniers ?	<input type="checkbox"/> Aucun <input type="checkbox"/> 1-7 Jours <input type="checkbox"/> 8-30 Jours <input type="checkbox"/> plus de 30 jours, men pas quotidiennement <input type="checkbox"/> Quotidiennement

9. Avez-vous eu la douleur de genou antérieure dans les périodes suivantes de la dernière année (périodes de l'entraînement) ?	période de repos (aucun vélo)	
	<input type="checkbox"/> Jamais	<input type="checkbox"/> hebdomadaire
	<input type="checkbox"/> De temps en temps	<input type="checkbox"/> Quotidiennement
	période de préparation d'avant-saison	
	<input type="checkbox"/> Jamais	<input type="checkbox"/> hebdomadaire
	<input type="checkbox"/> De temps en temps	<input type="checkbox"/> Quotidiennement
	saison tôt	
	<input type="checkbox"/> Jamais	<input type="checkbox"/> hebdomadaire
	<input type="checkbox"/> De temps en temps	<input type="checkbox"/> Quotidiennement
saison concurrentielle maximale		
<input type="checkbox"/> Jamais	<input type="checkbox"/> hebdomadaire	
	<input type="checkbox"/> De temps en temps	<input type="checkbox"/> Quotidiennement
10. Combien de jours ont vous avez dû ne pas faire l'entraînement ou la concurrence en raison de la douleur de genou antérieure pendant les 12 mois précédents ?	<input type="checkbox"/> Aucun <input type="checkbox"/> 1-7 jours <input type="checkbox"/> 8-30 jours <input type="checkbox"/> Plus de 30 jours	
11. Combien des courses ont vous avez manqué en raison de la douleur de genou antérieure pendant les 12 mois précédents ?	<input type="checkbox"/> Aucun <input type="checkbox"/> 1-4 courses <input type="checkbox"/> 4-10 courses <input type="checkbox"/> Plus de 10 courses	
12. Prenez-vous les médicaments antidouleurs ou anti-inflammatoires quand vous faites le vélo en raison de la douleur de genou antérieure ?	Maintenant ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas
	Pendant les 12 mois précédents ?	<input type="checkbox"/> Oui <input type="checkbox"/> Pas

## Appendix N



### UNIVERSITETET I OSLO DET MEDISINSKE FAKULTET

Tron Krosshaug  
Seksjon for idrettsmedisinske fag  
Norges idrettshøgskole  
Pb. 4014 Ullevål stadio  
0806 Oslo

Regional komité for medisinsk og helsefaglig  
forskningsetikk Sør-Øst A (REK Sør-Øst A)  
Postboks 1130 Blindern  
NO-0318 Oslo

Telefon: 22 84 46 66

Telefaks: 22 85 05 90

E-post: : jorgen.hardang@medisin.uio.no

Nettadresse: www.etikkom.no

Dato: 8.12.08

Deres ref.:

Vår ref.: S-08710a 2008/18185

**S-08710a An Investigation of Non-Traumatic Injuries in Professional Road Cycling  
[6.2008.1773]**

Vi viser til brev mottatt 24.11.08 med svar på komiteens merknader vedlagt revidert informasjonsskriv på fransk og engelsk samt signert søknad (utkast).

Komiteen tar svar på merknader til etterretning.

Komiteen har ingen merknader til reviderte informasjonsskriv.

Komiteen godkjenner at prosjektet gjennomføres.

Med vennlig hilsen

Kristian Hagestad  
Fylkeslege cand.med., spes. i samf.med  
leder

Sverre Engelschion  
sekretariatsleder

Kopi: Benjamin Clarsen, ben\_clarsen@yahoo.com.au

# Appendix O

Norsk samfunnsvitenskapelig datatjeneste AS  
NORWEGIAN SOCIAL SCIENCE DATA SERVICES



Harald Hårfagres gate 29  
N-5007 Bergen  
Norway  
Tel: +47-55 58 21 17  
Fax: +47-55 58 96 50  
nsd@nsd.uib.no  
www.nsd.uib.no  
Org.nr. 985 321 884

Tron Krosshaug  
Seksjon for idrettsmedisinske fag  
Norges idrettshøgskole  
Postboks 4014 Ullevål Stadion  
0806 OSLO

Vår dato: 19.11.2008

Vår ref: 20053 / 2 / KH

Deres dato:

Deres ref:

## TILRÅDING AV BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 24.09.2008. All nødvendig informasjon om prosjektet forelå i sin helhet 19.11.2008. Meldingen gjelder prosjektet:

20053	<i>An Investigation of Non-Traumatic Injuries in Professional Road Cycling</i>
Behandlingsansvarlig	<i>Norges idrettshøgskole, ved institusjonens overste leder</i>
Daglig ansvarlig	<i>Tron Krosshaug</i>
Student	<i>Benjamin Clarsen</i>

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, [http://www.nsd.uib.no/personvern/forsk\\_stud/skjema.html](http://www.nsd.uib.no/personvern/forsk_stud/skjema.html). Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, <http://www.nsd.uib.no/personvern/prosjektoversikt.jsp>.

Personvernombudet vil ved prosjektets avslutning, 30.05.2009, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

  
Bjørn Henrichsen

  
Kjersti Håvardstun

Kontaktperson: Kjersti Håvardstun tlf: 55 58 29 53

Vedlegg: Prosjektvurdering

Kopi: Benjamin Clarsen, Myklegardgata 1 A, 0656 OSLO

Avdelingskontorer / District Offices:

OSLO: NSD, Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. nsd@uio.no  
TRONDHEIM: NSD, Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. kyrre.svarva@svt.ntnu.no  
TROMSØ: NSD, SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. nsdmaa@svt.uit.no

# Appendix P



## NCF Lisenshistorikk 2000-2009

KLASSE	5-9 år		10-12 år		13-16 år		Junior M		Junior K		Senior M		Senior K		Veteran M		Veteran K		Sum	Engangs- tur	Heltur	SUM LISENSER
	M	K	M	K	M	K	M	K	M	K	M	K	M	K	M	K						
2009 (PR. 30/10)	299	97	562	108	788	157	356	44	1 085	179	5 487	638	9 800	42 600	-	-	-	-	9 800	42 600	-	52 400
2008 (pr. 31/12)	235	49	565	117	810	157	291	33	1 027	147	4 585	518	8 534	36 494	-	-	-	-	8 534	36 494	-	45 028
2007 (pr. 31/12)			471	84	753	137	289	38	793	107	3 667	390	6 709	28 718	-	-	-	-	6 709	28 718	-	35 427
2006 (pr. 31/12)			435	95	428	93	180	54	469	85	1 725	131	3 695	25 903	856				3 695	25 903	856	30 454
2005 (pr. 31/12)			392	77	455	81	166	33	453	73	1 554	111	3 395	22 129	924				3 395	22 129	924	26 448
2004 (pr. 31/12)			319	46	406	60	164	43	439	57	1 477	91	3 102	18 258	870				3 102	18 258	870	22 230
2003 (pr. 31/12)			323	44	444	61	109	15	321	38	1 360	82	2 797	17 221	780				2 797	17 221	780	20 798
2002 (pr. 31/12)			248	39	351	55	100	10	329	56	1 239	78	2 505	17 549	760				2 505	17 549	760	20 814
2001 (pr. 31/12)			207	36	329	37	129	11	348	56	1 096	72	2 321	15 317	738				2 321	15 317	738	18 376
2000 (pr. 31/12)			180	23	333	33	155	16	356	56	912	47	2 111	14 038	630				2 111	14 038	630	16 779
% Økning 2000-2009			312	470	237	476	230	275	305	320	601	1357	464	303					464	303		312

Norges Celloforbund  
 Brevadresse: Hemneveien 55, 5336 Senkalla  
 Postadresse: PB 170, 5309 Rud  
 Tel: 67 80 49 20 - Fax: 67 80 49 21 - E-post: cjk@nclfibret.no