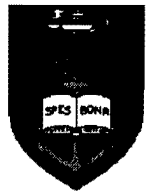

Upper Respiratory Tract Symptoms and allergies in Ironman triathletes

A dissertation prepared by Mamosilo Lichaba (LCHMAM001) in partial fulfilment of the requirements for the Master of Philosophy degree in Sports Medicine (MPhil Sports Medicine) from the University of Cape Town

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Declaration

I, Mamosilo Lichaba , hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

Signed by candidate

Signature Removed

22/11/2006 (Date)

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This thesis would not have been done if it were not for our professor, Martin Schwellnus. I would also like to thank my co-supervisor Dr Malcolm Collins. None of us in this course would be able to achieve anything without our Information Manager, Ms Yvonne Blomkamp.

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List of abbreviations

°C	Degrees Celsius
EIA	Exercise-Induced Anaphylaxis
EIB	Exercise-Induced Bronchospasm
GIT	Gastrointestinal Tract
IV	Intravenous
RTS	Respiratory Tract Symptoms
URTI	Upper Respiratory Tract Infection
VO_{2max}	Maximal Oxygen consumption

Abstract

Background: Triathletes, in particular Ironman triathletes, undergo intense training and compete in a very physically demanding race. Medical conditions in the pre-race period in these triathletes have not been well documented, but there is evidence form other endurance sports that symptoms of respiratory tract infection are particularly common. However, the prevalence, causes and consequences of these symptoms have not been studied in Ironman triathletes

Objective: The aims of this study were: 1) to determine the incidence of respiratory tract symptoms (RTS) in triathletes preparing for an Ironman Triathlon, 2) to establish the factors associated with the development of these RTS, and 3) to determine the effects of the RTS on pre-race training and race performance.

Methods: In this cross-sectional descriptive study, 304 triathletes entering the 2006 Ironman triathlon in South Africa were recruited as subjects. All the subjects completed a validated questionnaire in the 1-3 days before the race (during registration). The questionnaire contained sections on demographics, training and previous competitions, common general medical conditions that they may have experienced, and a detailed section pertaining to RTS and allergies, including use of medication. Data on race performance was collected after completion of the race. Subjects were divided into the following groups, based on their self-reported history of RTS in the 6 weeks period prior to the race: no RTS, all RTS, only upper respiratory tract symptoms (URTS), lower respiratory tract and/or systemic symptoms (LRT+SS).

Results: The main findings in this study were that, 1) 49% of the Ironman triathletes reported RTS in the 6-week period before competition, 2) there was a strong association between self reported RTS in Ironman triathletes and a history of self reported allergies rather than training volume (in the 15 weeks before the race), 3) self-reported LRT+SS but not URTS in triathletes were associated with decreased training in the 6 weeks before the race, 4) self-reported LRT+SS but not URTS in triathletes resulted in reduced pre-race training, predicted race performance, and actual race performance, and 5) there was no specific self-reported allergy that is associated with all RTS, URTS or LRT+SS in Ironman triathletes. Other findings of the study were that medical conditions other than RTS were also commonly reported by triathletes while preparing for an Ironman competition. Muscle cramping (52%), gastro-intestinal symptoms (44%), history of sunburn (40%), a history of tendon/ligament injuries (38%), allergies (36%) and genital injuries (24%) were the most common other reported medical problems in this group of triathletes.

Conclusion: Triathletes, in preparation for a race, report a high frequency of medical conditions. RTS are particularly common, and appear to be related to allergies rather than other factors including training volume or the calibre of the athlete. If RTS are accompanied by LRT or systemic symptoms, they decrease training and negatively affect performance on race day.

Keywords: respiratory tract symptoms, upper respiratory tract infections, triathletes, infections, allergies

Chapter 1

Introduction and scope of the thesis

The Ironman competition is an ultra-distance triathlon consisting of a 3.8 km swim, a 180 km cycle and a 42.2 km run. This event is held annually in South Africa during autumn at a coastal town, and attracts over 1000 local and international competitors. Following months of intensive training in three disciplines, the swim leg starts at 6 o'clock in the morning on race day. The fastest triathletes complete the race in about 8-9 hours. The race officially closes after 18 hours.

The Ironman triathlon is clearly a very long, intense and therefore physically demanding event. Prolonged intensive training in the weeks before the race, as well as the substantial physical challenges on race day are factors that can negatively affect the health of the triathletes [1]. Triathlete competitions can range in duration from 30 min to 36 hours of continuous exercise. Medical complications in Ironman triathletes can occur during the preparation phase, on race day, and in days to weeks after the event. The possible medical problems suffered by Ironman triathletes can affect many systems including the metabolic, cardiovascular, neuro-endocrine, gastrointestinal, musculoskeletal, uro-genital, and dermatological systems.

In this thesis, the focus will be on the respiratory system, in particular symptoms of respiratory tract infections, which can be affected by intense training and competition. The terminology that is used to describe symptoms of respiratory tract infections in ultra-endurance athletes varies in the

literature, and will be reviewed in Chapter 2 (Section 2.3.1.). However, for the purposes of this introduction, symptoms of infection of the respiratory tract will be referred to as RTS, symptoms of infection of the upper airways and nasal mucosa, will be referred to as upper respiratory tract symptoms (URTS), symptoms of infection of the lower respiratory tract will be referred to as LRT, and systemic symptoms that can accompany respiratory tract infections will be referred to as systemic symptoms (SS).

To date, the main focus of research, linking mainly URTS to athletes participating in ultra-endurance events, has been to study the risk of developing these symptoms in the few days or weeks following a competition [1-3]. The incidence, factors associated with RTI symptoms, and the possible negative consequences of RTI symptoms in the final 6-8 weeks of training before ultra-endurance events has not been well studied. Furthermore, these studies have only been conducted in ultra-distance runners, and not in triathletes.

Therefore the work presented in this thesis will focus on the rate of occurrence of medical complications, specifically RTS and systemic symptoms, suffered by triathletes in the preparatory phase for an Ironman competition. In this thesis 1) the occurrence of RTS in the 6 weeks before an Ironman triathlon, 2) factors that are associated with the development of these RTS, and 3) whether RTS that occur in triathletes during this period affect their training and performance on race day will be explored.

In Chapter 2 of this thesis, aspects related to the development of RTS in endurance athlete will be reviewed. In particular, the following will be discussed: medical conditions in endurance athletes in general, terminology and definitions related to RTS in endurance athletes, and the epidemiology, aetiology and consequences of RTS in endurance athletes.

In Chapter 3 the details of the research study methodology, results and discussion of the findings will be presented. In Chapter 4 the main findings of this thesis will be summarized. Practical clinical guidelines to sports physicians and triathletes on the prevention and management of these symptoms will be presented.

Chapter 2

Symptoms of respiratory tract infections (RTI) in Ironman triathletes: A review of causes and consequences

2.1. Introduction

It is well established that regular exercise training is beneficial in the primary and secondary prevention of chronic diseases of lifestyle [4-6] including, obesity [7], hypertension [8;9], coronary artery disease [10], cardiac failure [11;12], cerebrovascular disease [13], diabetes mellitus [14], peripheral vascular disease [15], osteopaenia, and some cancers [16;17]. There is thus a perception that athletes are generally healthy individuals, and that exercise training also protects against the risk of acquiring other acute medical illnesses such as infections [18;19]. However, there is also epidemiological evidence showing that increased exercise training (volume and intensity), particularly in endurance athletes, can be associated with an increased risk of developing infections [20-25].

Triathletes participate in three endurance sports - swimming, cycling and running. Furthermore, Ironman triathletes participate in a particularly strenuous ultra-endurance triathlon consisting of a 3.8 km swim, 180 km cycle, and a 42.2 km running event. Ironman triathletes therefore undergo a particularly intense and prolonged periods of training which peak in the 10-12

weeks prior to a competition. These triathletes are also exposed to a very intense and prolonged physical challenge on race day.

Medical conditions that can occur in triathletes have been studied, but it is interesting to note that the majority of studies have focused on medical complications that may occur during the event (on race day), or in the 1-3 week period following race day [1;26-29]. It appears that the medical conditions in triathletes that may occur during the period of intense training prior to a race have largely been ignored. This is in spite of the fact that this is the period when the intense and prolonged training may result in medical conditions for which a sports physician looking after triathletes is frequently consulted. It is for this reason that this thesis will focus on medical conditions that may occur in triathletes, specifically those conditions that may affect triathletes in the weeks as they prepare for competition.

There is some evidence to suggest that one of the most common medical conditions that endurance athletes experience during this period are respiratory tract symptoms ranging from those in the upper airways ('runny nose', blocked' nose, sore throat) to the lower respiratory tract (cough, wheeze, chest pain). These symptoms may also be accompanied by systemic symptoms such as fever, muscle aches, joint pain, and fatigue. Although these symptoms have been mostly attributed to an infection in the respiratory tract, the precise aetiology of these symptoms, whether they are indeed of infective nature, and their possible effect on training and competition is not well established. A better understanding of the cause of these symptoms

during this period will ultimately result in better clinical advice to triathletes preparing and competing in the Ironman triathlon.

This review will focus on respiratory tract symptoms (RTS) in triathletes and is divided into the following sections. In Section 2.2., medical conditions that can occur in endurance athletes, particularly triathletes, will be reviewed briefly. The terminology and the epidemiology of RTS in endurance athletes will be discussed in Section 2.3., while the current hypotheses to explain the aetiology of RTS in endurance athletes will be reviewed in Section 2.4. Current knowledge on the effects of RTS on training and performance (Section 2.5.), as well as current clinical guidelines for the management of athletes presenting with RTS (Section 2.6.) will also be reviewed.

2.2. Medical conditions in endurance athletes - with specific reference to triathletes

Medical conditions associated with endurance exercise can affect many organ systems, including the cardiovascular, dermatological, neuroendocrine, musculoskeletal, genitourinary, gastro-intestinal, metabolic, central and peripheral nervous systems [1;26-29]. Of particular interest in this thesis are the medical conditions in triathletes that affect the respiratory system, and more specifically RTS. Medical conditions in triathletes can occur at various stages of training and racing. These stages can be divided into the pre-race period (during the preparation training period), during the race (intra-competition), or

the post-race period recovery period (from immediately after the finish up to 2-6 weeks later).

2.2.1. Pre-race medical conditions in triathletes

Medical conditions that occur during this period of intense training in preparation for an event have not been well studied in triathletes and in other endurance sports such as running. Most of the studies that have examined medical conditions during endurance competitions such as marathon and triathlon, do not mention the pre-race medical status of the athletes. The prevalence of pre-race symptoms of medical conditions has often not been reported [1;2;28].

2.2.2. Medical conditions that occur in triathletes during racing

Medical conditions that can occur in triathletes during racing have recently been reviewed [1]. The following medical complications can occur in triathletes during competition: exhaustion, dehydration, muscle cramping, hypothermia, heat stroke, hyponatraemia, postural hypotension, excessive exposure to ultraviolet radiation, musculoskeletal injuries and minor trauma, infections, gastrointestinal tract problems, immunosuppression, sympathetic nervous system exhaustion and haemolysis [1;26]. An analysis of clinical records from the 1984 and 1985 Ironman races showed that the most common medical condition during racing is dehydration, accounting for 45% of the treatments in the medical care facility. Other commonly occurring problems were muscle cramps, exhaustion and musculoskeletal injuries. The risk of developing

medical conditions during racing increases with the duration of the race. It has been reported that there is a ten-fold increase in the risk of medical conditions in a 13-hour triathlon relative to a 3-hour triathlon [26]. Medical conditions in triathletes also occur mostly towards the end of the race [30], and in the Honolulu Triathlon between 1981-1984, 75% of medical visits occurred after 9 hours into the race with exhaustion, dehydration and heat injury being particularly common. Other common medical conditions in triathletes during the race were abdominal cramps with or without diarrhoea and muscular cramps [1;31;32].

2.2.3. Medical conditions that occur in triathletes during the recovery (2-6 weeks) following competition

Many medical conditions that present during a race may well persist for a few days into the recovery period. The most commonly reported post-race medical condition following endurance events is the presence of upper respiratory tract symptoms (URTS) in the first 10-14 days following intense competition. Post-race URTS have been mostly reported following endurance running events [2;3;33], but have not been well studied in triathletes.

It is generally accepted that these post-race URTS occur as a result of immunosupression following the high intensity and prolonged exercise associated with triathlon competitions [34-36]. Furthermore, it is generally assumed that these symptoms have an infective origin [3;20;21]. However, the 'infective' hypothesis for RTS has not been proven [37], and this will be reviewed in more detail (Section 2.4.).

2.3. Respiratory tract symptoms (RTS) in endurance athletes - with specific reference to triathletes

2.3.1. Terminology and definitions

As mentioned, endurance athletes can present with RTS ranging from 'blocked' nose, 'runny nose', sore throat, swollen glands, cough, wheeze, and chest pain. These symptoms may be accompanied by additional systemic symptoms such as fever, headache, muscle aches, joint pains and general fatigue. In some instance the term 'flu-like' illness has been used for the RTS, which are accompanied by systemic symptoms. In most studies where these RTS, or more specifically URTS, have been documented, these were self-reported by athletes, without any evidence of actual infection [37]. We are aware of only one study in which attempts have been made to obtain actual evidence of an infective agent by using bacterial and viral cultures to identify an infective agent [38] in distance runners presenting with post-race URTS. Therefore, the general use of the term Upper Respiratory Tract Infections (URTI), as has been used in many reports, without documenting actual evidence that these symptoms are due to an infection, may well be incorrect.

At present, it is well recognized that an athlete presenting with RTS that are localized to the upper airways (nose and orophraynx) is given different medical advice about exercise and training, when compared with an athlete presenting with RTS below the orophraynx (cough, wheeze, chest pain), or athletes presenting with accompanying systemic symptoms, such as fever,

muscle aches, joint pains, and general fatigue [21]. This clinical test has also referred to as the 'neck check' [39-41]. The use of the terms Upper Respiratory Tract Symptoms (URTS) ('blocked' nose, 'runny nose', sore throat, swollen glands), Lower Respiratory Tract Symptoms (LRTS) (cough, wheeze, chest pain) and systemic symptoms (fever, muscle aches, joint pains, general fatigue) to describe these clinical presentations is therefore more appropriate.

For the purposes of this thesis, the following terminology will be used:

- **Upper Respiratory Tract symptoms (URTS)** will refer to the presence of respiratory symptoms that are localized to the nose and pharynx ('blocked' nose, 'runny nose', sore throat)
- **Lower Respiratory Tract (LRT) symptoms** will refer to the presence of respiratory symptoms below the level of the pharynx (cough, wheeze, chest pain)
- **Systemic symptoms (SS)** symptoms of infection will refer to symptoms such as fever, muscle aches, joint pain, and general fatigue that may accompany infections

It should be pointed out that we are fully aware of the fact that RTS in athletes could also be due to many other cardiorespiratory conditions. In particular, we recognize that asthma is a very common respiratory condition in athletes that could give rise to RTS. However, in this thesis we wish to confine the discussions to RTS that have been related to infections, and the main focus is on URTS. We also acknowledge that systemic symptoms that are listed above can also occur as a result of many other infections (not only those affecting the respiratory tract) and other systemic conditions. Clinical decisions advising

athletes presenting with RTS are often made by distinguishing between URTS (above the neck) and either LRTS and/or SS (below the neck). This aspect will be discussed further in Section 2.6.

2.3.2. Epidemiology of RTS in endurance athletes

Respiratory tract infections (RTI), in particular URTI, are very common in the general population [42], and are more likely to affect individuals in the extremes of age and the immune-compromised individual [43]. It has been reported that 75-80% of all acute morbidities in the population of the United States of America are due to respiratory disease, 80% of which are due to viral infections of the respiratory tract, with an average of 3-6 respiratory tract illnesses per person per year [42;44]. URTI is the most common type of infection, and is mainly caused by viruses [42].

In athletes it has also been reported that upper respiratory infections (commonly caused by viruses) are by far the leading cause of infectious diseases in the training room [42]. A number of studies have documented URTS in endurance athletes, including runners [2;3;45-47], cross-country skiers [48], swimmers [49;50], rowers [51], and in other sports, such as tennis players [52], gymnastics [53], and even during military training [54]. It is very important to note that in all these studies, there is no verification that the symptoms are due to an infection. Hence, in all these studies it is correct to describe these as symptoms of URTI rather that actual documented URTI. The use of the terminology URTS, will therefore be used consistently in this thesis, when referring to these studies.

The risk of developing URTS in athletes has recently been reviewed [20]. In one of the first studies to document the relationship between URTS and endurance exercise, Peters and Bateman (1983) found that the incidence of URTS was twice as high in ultra-distance runners in the first 10-14 days following an endurance race, when compared with suitable sedentary controls followed up in the same time period [2]. These researchers also reported that the incidence of URTS was higher among the faster runners.

Following that first report, there have been at least three retrospective [25;55;56], and five prospective [3;33;45;57;58] studies documenting URTS in different groups of athletes. An in depth discussion of the findings of all these studies is beyond the scope of this review. However a summary of the main findings from these studies is as follows:

- Following endurance events (mainly ultra-marathon running) athletes experience an increased incidence of URTS compared with sedentary controls [2;3;55]
- Prospective studies and retrospective surveys in endurance athletes over months show that increased training is associated with an increased risk of URTS [25;45;57]
- Some studies report other factors that increase the risk of athletes to develop URTS including female gender [25;45], decreased Vitamin C intake [3], perceived stress [25], sleep deprivation [25], and nutritional unawareness [25].
- In two prospective studies, moderate intensity training resulted in increased natural killer cell function, increased T-cell function and reduced incidence of URTS [33;58]

Apart from studies in athletes, there are also epidemiological studies showing that moderate intensity recreational or occupational activity is associated with a decreased risk of URTS [59]. In animal studies, moderate intensity exercise has also been associated with a decreased risk of URTI [60].

Over the past decade, the results of studies in athletes and other populations have led to the commonly accepted hypothesis that the relationship between exercise training and risk of URTS is a 'J' shaped curve [25;39;61;62]. It appears that physical inactivity is associated with an increased risk of URTS [63], while moderate intensity and duration physical activity has been shown to be protective in some [24;64-67], but not in all studies [68;69]. However, high-intensity, prolonged exercise, such as during endurance training and competition, may increase the risk of developing URTS [25;45;57;70].

It is important to note that the risk of developing URTS has not been studied in Ironman triathletes, yet this sport is one of the most physically demanding endurance sports. Therefore the focus of the research presented in this thesis is on RTS in triathletes.

In the following section, the possible causes for the RTS in athletes will be briefly reviewed. In particular, the different hypotheses for the development of these RTS in athletes will be reviewed.

2.4. Aetiology and pathophysiology of RTS in endurance athletes

Until recently, it was generally assumed that the RTS in athletes were due to an infective cause, and that this increased risk of infection was because prolonged intense training or competition has been associated with a 'suppression' of a variety of parameters in the immune system. The 'suppression' of immune parameters in the 3-72 hours following intense and prolonged training has been termed the 'open window' period. During this period, it is hypothesized that infective agents entering the upper respiratory tract would cause URTI. Additional factors that may increase the risk of infection are the large volumes of air entering the respiratory tract particularly when mouth breathing is used by athletes during high intensity exercise [71] and nutritional deficiencies in particular carbohydrate [72] and Vitamin C deficiency [46;47;73-75].

However, it is also well established that RTS are not always due to an infection and that there may be other causes for these symptoms such as allergies or inflammation caused by other physical or chemical irritants [76]. It is only more recently that other possible causes of URTS in athletes during training or competition have been proposed. The possible hypotheses for the cause of RTS in endurance athletes will be discussed under the following headings: Infective hypothesis, allergic hypothesis, and other causes. Scientific evidence for each of these will now be briefly reviewed.

2.4.1. Infective hypothesis for RTS in athletes

Since 1990, the relationship between an acute exercise bout and immune parameters, as well as the relationship between exercise training and changes in the immune parameters has received more and more attention. Over the past 10-15 years, the number of publications in this field have increased by more than 10 fold [77]. There is now an extensive body of knowledge documenting the relationship between exercise and the immune system and this has recently been reviewed in a number of publications [19;22,37,77;78;79-82]. The main focus of the research in this thesis is not on exercise immunology, and hence an in-depth review of the interaction between exercise and the immune system is beyond the scope of this chapter. However, the main current findings relating changes in the immune system as a result of exercise, and how these may relate to RTS in athletes will be reviewed.

It is well established that an acute bout of exercise as well as exercise training can alter a variety of immune parameters. Changes in systemic immunity [19], mucosal immunity, and cytokine [79] in response to exercise have been reviewed. To date, there have been numerous studies that were conducted to relate these changes in immune parameters to URTS in athletes. However, in most of these studies, no direct relationship between changes in immune parameters and the presence of URTS could be documented. This lack of association between measures in immune function and URTS was first pointed out by Shephard in 2000 [37], and more recently by Malm in 2004 [77], and Gleeson et al. 2004 [80]. The evidence for a direct link between observed

changes in immune parameters, and the development of URTS can be summarized as follows:

- An acute bout of exercise as well as regular exercise training can alter systemic [22;33;35;51;58;83-87] and mucosal immunity [52-54;59;64;88-95] by enhancing some parameters and suppressing others
- The biological significance of these alterations in the immune system are not well established, and will require further investigation
- The association between changes in immune parameters and the development of RTS in athletes has been examined [49;52-54;59;86;89;93;96], but to date, no consistent cause-effect relationship has been documented
- Nutritional interventions to change immune system parameters and decrease the risk of URTS in athletes have been studied.
- Although the effect of nutritional supplements such as carbohydrates [72], glutamine [97], and Vitamin C [46;47;73-75] on immune parameters have been studied [98-101], with the exception of Vitamin C supplementation [3], none of the other supplements have been shown to decrease URTS in athletes [72 99]

It is therefore clear that the relationship between exercise-induced changes in immune parameters and the development of RTS in athletes is not well established. Furthermore, there are no studies confirming the diagnosis of an infection in athletes presenting with URTS where either serological criteria have been used, or where actual pathogens have been cultured. In conclusion, scientific evidence supporting the infective hypothesis as the cause of URTS in athletes undergoing training or competition is lacking.

Alternative hypotheses, perhaps linking changes in the immune system parameters during intense exercise, and the development of RTS have to be considered. It has been suggested that allergic disorders, which are also mediated through the immune system, may account for the development of at least some RTS in athletes. This hypothesis will now be explored.

2.4.2. Allergic hypothesis for RTS in athletes

It is well established that allergies are very common worldwide and that the prevalence of allergies has increased over the decades [102;103]. The prevalence of allergic diseases in the population of industrialized countries has been estimated at 10-25%. As mentioned, allergies have increased significantly over the last 50 years in developed countries probably due to air pollution [104]. There is a very wide spectrum of clinical presentations of allergic conditions, ranging from a benign rash to exercise-induced anaphylaxis [105]. Allergic conditions of the respiratory tract in athletes can vary from allergic sinusitis, allergic rhinitis, allergic rhinoconjunctivitis, to allergic asthma [103;106-108]. The prevalence of asthma amongst elite athletes ranges between 3.7% and 28.8%, with evidence that this prevalence has almost doubled between 1976 and 1996. A similar increase in prevalence has been reported for allergic rhinitis. The focus of this thesis is mainly on URTS; hence allergic asthma in athletes will not be discussed further. However, the possibility that URTS in athletes may be related to allergies of the upper respiratory tract will be explored.

It has been suggested that allergic rhiritis [71] and allergic rhinoconjunctivitis [108] are more common in athletes than currently thought, and these conditions are probably under-diagnosed and under-treated in athletes [103]. In one study, 16.8% of Swiss athletes from different sports were reported to suffer from hay fever, with 59% of the athletes requiring medication during the pollen season to control symptoms [109]. In this study, it was also reported that the athletes with hay fever also had significantly more exercise-related RTS. In a study among elite athletes preparing for the Olympic Games in 2000, 56% of athletes gave a history consistent with allergic rhinoconjunctivitis, 41% had a positive skin test response to any one allergen and 29% reported seasonal allergic conjunctivitis [110]. In a retrospective analysis of medical records of the 1976 and 1980 Australian Olympic teams the prevalence of allergic disorders in athletes was reported as 20% [111].

There also appears to be a difference in the prevalence of allergic conditions amongst the different sports with aquatic sports (swimming, rowing and diving) with a higher risk of allergic rhinitis than non-aquatic sports. Paradoxically, equestrians have the lowest atopic tendencies, probably due to natural selection [108].

The prevalence of allergic conditions in triathletes has to our knowledge not been studied. However, the prevalence of allergies, in particular allergic rhinitis in endurance athletes, was recently reported in two studies. In one study among elite athletes preparing for the Olympic Games, 18.3% of the athletes reported allergies, with 14.5% reporting allergic rhinitis. In this study, there were no gender differences, but endurance athletes reported a higher

prevalence of allergies than other subgroups [112]. In a recently published survey among 261 male and 185 female athletes participating in different sports, the prevalence of a 'disturbing' allergy was 32.1%, with the highest prevalence in endurance sports (43.5% of athletes) [71]. This prevalence of allergies in athletes was higher than that reported for the normal population (20%). Furthermore, 26.5% of all athletes, and 36.1% of endurance athletes reported allergic rhinitis [71]. In this survey, the prevalence of all allergies, and allergic rhinitis was similar in male and female athletes [71].

In summary, there is evidence that allergies are common in elite athletes with the prevalence of any allergy varying between 16 and 32%. Allergic rhinitis (or allergic rhinoconjunctivitis as it is also referred to if conjunctival symptoms occur) appears to be one of the most common allergic conditions in athletes (26-56% of athletes). Finally, recent data indicates that endurance athletes in particular have a high prevalence of allergic conditions in general (32% of athletes), and more specifically allergic rhinitis (44% of athletes).

The clinical presentation of allergic conditions that affect the respiratory tract may mimic those of an URTI. Common URTS that could be due to either infections or allergies are blocked nose and runny nose, while more systemic symptoms, such as headache, malaise and fatigue, can also occur due to allergies [103]. Associated symptoms, such as itchy nose, sneezing and itchy, runny eyes, are more likely due to allergic than infective causes [71;108;113]. However, chronic allergies can, similar to infections, also result in impaired sports performance [103;110] (Section 2.5.2.).

It can be therefore be hypothesized that URTS in endurance athletes may be related to allergies rather than infective nature, or there may be an interaction between these two mechanisms for the following reasons:

- There is a high prevalence of reported allergies, particularly in endurance athletes
- The most common reported allergy in endurance athletes appears to be allergic rhinitis (rhinoconjunctivitis)
- There is an overlap of symptomatology between allergic rhinitis and URTS due to an infective cause
- Both allergies and infective conditions have an immunological basis, and acute exercise, as well as regular training, can result in changes in immune parameters
- The relationship between observed changes in the immune system with exercise and the development of allergies has not been systematically investigated [103]
- Chronic nasal allergies cause swelling which decreases drainage and can predispose to the development of infections [108]
- There may well be a continuum of URT disease with an overlap between respiratory tract allergies and infections, which has to date not been explored.

In the research component of this thesis, some aspects of the relationship between RTS in triathletes and history of allergies will therefore be investigated.

2.4.3. Other hypotheses for RTS in athletes (physical factors)

Any discussion of the possible causes of RTS in athletes will not be complete unless it is mentioned that many other irritants can also cause an inflammatory response in the respiratory tract. A non-allergic, non-infective rhinitis can be caused by physical factors. Physical factors that may cause RTS in athletes include high ventilatory rate, cold, dry air, increased air turbulence, mouth-breathing, and inhaled irritants (physical, chemical and allergens). When the ventilatory rate exceeds 30L/min there is a tendency towards both mouth breathing and nasal breathing and this causes deposition of airborne allergens and irritants into the upper and lower respiratory tract [71]. Pollutant irritants are classified as primary or secondary. Primary pollutants are directly from the source such as inorganic gases. Secondary pollutants result from chemical reactions of emitted and natural precursors. Pollutants of major concern to respiratory health are sulphur dioxide (SO_2), photochemical smog (ozone and nitrogen dioxide - NO_2) and airborne particulates [104]. Recently, it has been documented that there is an increase in airway inflammatory cells, possibly related to increased ventilation of cold and dry air [114;115]. The precise relationship between these observed inflammatory cells and respiratory tract pathology in athletes requires further investigation [114]. It is important to point out that other hypotheses relating physical and chemical factors to RTS in athletes may require further study.

2.4.4. Summary: Hypotheses for RTS in athletes

In summary, the precise aetiology and pathogenesis of RTS in athletes during training, and immediately after intense competition is not clear. Until recently, the prevailing hypothesis for the high incidence of mainly URTS in endurance athletes following competition was that alterations in the immune system post-exercise cause infections. However, actual infection has never been documented either clinically, by serological means, or through culture of the organisms. Furthermore, despite numerous attempts, no clear relationship between altered immune parameters and URTS has been documented. Therefore the infective hypothesis for RTS in athletes requires further study, or alternative hypotheses have to be considered.

Concomitantly, it has been documented that respiratory tract allergies, in particular allergic rhinitis, is common in athletes, especially in endurance athletes. The symptoms of allergic conditions of the URT and the symptoms of URTI overlap, and the possibility that RTS in endurance athletes is related to allergies has to be considered. Finally, other physical factors causing RTS in athletes must not be disregarded.

2.5. Effects of RTS on training and competition in endurance athletes

The effect of RTS on training and performance has not been well investigated. This is probably because the aetiology of RTS in athletes is not established. The effects of both RTI and allergic conditions of the respiratory tract on training and athletic performance will now be discussed.

2.5.1. The effects of RTI in athletes on training and performance

There are only a few studies where the effects of RTI on training and performance have been examined. The main reason for this is that although very rare, some infective agents can cause an associated myocarditis [42;116-118]. Viral myocarditis has been the cause of sudden death in athletes [117;118]. Therefore, the current guidelines for athletes with documented RTS is to avoid training if there are any symptoms of possible concomitant myocarditis, such as chest pain, shortness of breath at rest, resting tachycardia, or systemic symptoms, such as fever, myalgia or joint pain. If any of these symptoms are present, athletes are advised not to train at all based on clinical advice [42]. For obvious ethical reasons the validity of this advice has not been studied systematically [21]. If symptoms are localized to the URT, athletes frequently do not seek medical assistance and, based on anecdotal evidence, many continue training. However, the effects of these localized URTS on training and performance have not been well investigated.

The effects of febrile illness on muscle function in humans have been investigated in a few studies. In one study where a fever was induced in 7 volunteers by inoculation with the sandfly fever virus, it was documented that there is a transient decrease in muscle function which correlated with myalgia, rather than the presence of fever [119]. In this study, it was not possible to distinguish between inactivity (bed rest) or the febrile illness as the main cause of loss of muscle strength. In another study by the same investigators, isometric muscle strength and isometric muscle endurance were recorded

serially (during fever, after fever, at 1 and 4 months after the infection) at the time of an acute infectious disease of viral or mycoplasmal aetiology in over 30 young men. In this study, the febrile illness resulted in a 5-15% decrease in isometric muscle strength and a 13-18% decrease in isometric muscle endurance as compared to control subjects undergoing bed rest for the same time period as the infected subjects [120;121]. It is important to point out that in these studies the infection was clearly documented, and that it was associated with systemic symptoms (fever). The effects of a localized URTI on exercise performance and training has to our knowledge not been studied, other than in a report where URTI was the main medical reason for absence from training in elite skiers [48].

Therefore in this thesis the relationship between RTS in triathletes and pre-competition training, as well as actual performance on race day will be explored. Furthermore, a distinction will be made between localized URT symptoms, and those accompanied by lower respiratory tract or systemic symptoms.

2.5.2. The effects of allergies in athletes on training and performance

The potential negative effects of allergies on training and performance in athletes have not been well studied. To our knowledge, there are no studies that have used established physiological performance variables to measure the effects of allergies conditions on exercise performance. There are anecdotal reports, which are not confirmed by physiological measures, that Olympic athletes with severe exacerbations of allergic conditions have sub-

optimal exercise performance [110]. It is also known that rhinitis often causes changes in sleep patterns due to nasal obstruction, rhinorrhoea and sinus pressure [113], and the resultant tiredness and fatigue could impair athletic performance [71].

Short bouts of sprinting depend on nasal breathing for optimal performance, and nasal obstruction that is associated with allergic rhinitis may inhibit this mechanism [71]. Allergic rhinitis has also been associated with alterations in the central nervous system function, which also may significantly impair athletic performance. Reaction time, attention and vigilance were decreased during cognitive processing tests, when subjects suffering from allergic rhinitis were exposed to pollen [102].

2.5.3. Summary: RTS and exercise performance

The effects of RTS in athletes, whether due to infections or allergies, on their exercise performance and training have not been well studied. It appears that if an infective episode is accompanied by systemic symptoms, such as fever and myalgia, muscle function is impaired for a time period following recovery. There are no data to determine the effect of localized URTS on training and exercise performance. Allergies could, based on general clinical effects, affect training and performance, but this has not been systematically evaluated.

2.6. Clinical advice to athletes presenting with RTS

The clinical advice that is currently given to athletes presenting with RTS is largely based on whether the RTS are confined to the upper airways (above the neck), or whether there are LRT or systemic symptoms (below the neck). This clinical test has been termed the 'neck check' [39-42]. The main reasons for adopting this clinical approach are twofold. Firstly, LRT or systemic symptoms may indicate a generalized (systemic) infection, and systemic viral or bacterial infections may be associated with myocarditis, and this is a potential cause of sudden death in an exercising athlete [42;116;117]. Secondly, as has been discussed (Section 2.5.1.), there are indications that exercise performance is impaired significantly when LRT or systemic symptoms are present.

Therefore the current clinical approach when athletes present with RTS is to document localized ('runny nose', 'blocked nose', sore throat) or additional LRT (cough, chest pain, wheeze) or systemic symptoms (muscle aches, joint pain, fever, fatigue). If only localized symptoms are present, moderate intensity exercise is allowed for a short duration, and depending on how the athlete feels, this can be continued. In the presence of any LRT or systemic symptoms exercise is not allowed and follow-up clinical assessment is advocated [39-42].

However, in this current clinical approach, the presence or absence of allergic symptoms and their management, which is different to that of URTI [103;108;113], is largely ignored. If a closer association between RTS in athletes undergoing intense training and allergies is documented, this current clinical approach may have to be reconsidered.

2.7. Summary and conclusions

- Medical conditions associated with the Ironman Triathlon and other ultra-endurance physical activities are common
- RTS is one of the more common medical conditions that is encountered in endurance athletes, particularly during intense training and immediately after races
- There are many studies documenting alterations in immune parameters in athletes undergoing intense training and competition

- It is a common assumption that RTS in endurance athletes are as a result of infections during periods where there are known alterations in immune parameters
- There are no studies directly linking alterations in immune parameters in response to training and documented evidence of infections in athletes
- Allergic conditions, in particular allergic rhinitis, are common in endurance athletes
- There is some overlap in the symptomatology of URTI and allergic rhinitis
- Chronic allergic rhinitis may predispose to the development of URT infections
- The infective hypothesis, the allergic hypothesis and alternate hypotheses to explain the high prevalence of RTS in endurance athletes require further investigation
- Current clinical guidelines for the management of RTS in athletes are mainly based on the assumption that RTS in athletes are only as a result of an infective cause
- If other causes for RTS in athletes are documented, these guidelines may require modification

Chapter 3

Respiratory tract symptoms (RTS) in triathletes participating in an Ironman Triathlon: An investigation of causes and consequences

3.1. Introduction

The Ironman Triathlon is an ultra-endurance event comprising of a 3.8 km swim, 180 km cycle and a 42.2 km run. Ironman triathletes can suffer from a variety of pre-race, intra-competition, and post-race medical conditions [1;26-29]. One of the most common medical complaints in endurance athletes is URTS [2;3;33], and these occur mostly in the 1-2 weeks after an event. However, URTS have also been reported to occur in endurance athletes at times of increased training volume and intensity [25;45;57]. Therefore RTS, in particular URTS, are likely to be common in Ironman triathletes in the 6 weeks before a competition, when training volume and intensity is likely to be very high. However, the incidence of RTS in triathletes during this time has not been investigated.

The most common hypothesis for the development of URTS in endurance athletes during periods of intense training or immediately following competition is that immunosupression occurs, resulting in an infection. Although intense training has been shown to alter both systemic [22;33;35;51;58;83-87] and mucosal immunity [52-54;59;64;88-95] in endurance athletes, an exact cause-effect

relationship of these changes to the development of URTI has not been documented, despite many attempts [49;52-54;59;86;89;93;96]. Furthermore, there is no study showing that URTS in endurance athletes is due to an infection, and in only one study to date, no positive viral or bacterial cultures could be obtained in runners presenting with post-race URTS [38]. Therefore the 'infective' hypothesis for RTS in endurance athletes requires further study, and alternative hypotheses may have to be considered.

There is a growing body of evidence that allergies are common in elite athletes, including endurance athletes, and that these are under-recognized [71;103;108]. It has been documented that between 26-56% of athletes suffer from allergic rhinitis, and in endurance athletes specifically, the prevalence of allergic rhinitis has been reported as 44% [71]. Because the symptoms of allergic rhinitis overlap with those reported as URTS in endurance athletes, it is possible that allergies may account for at least some of the athletes presenting with URTS. This 'allergic' hypothesis for RTS in endurance athletes requires further investigation.

The effect of RTS, in particular URTS, in endurance athletes on training and performance during races is not well documented. There are studies indicating that RTS associated with a febrile illness or myalgia can decrease muscle strength and endurance [119-121]. However, there is anecdotal evidence suggesting that most athletes with localized URTS often continue training. The effects of these URTS on training and performance are not documented. Clinical advice to athletes presenting with RTS is based to a large extent on a distinction between localized URTS (above the neck) and associated lower

respiratory tract (LRT) or systemic symptoms (below the neck) – known as the 'neck check' [39-42]. The main reason for this distinction is that LRT and systemic symptoms may be associated with viral myocarditis, a condition that is very serious and can cause sudden death in athletes [116-118]. However, this current clinical advice is based on the assumption that RTS in athletes are of an infective origin, and this requires further study.

RTS in elite triathletes, in particular Ironman triathletes, has to date not been investigated. The purpose of this investigation is to answer some of the questions related to RTS in endurance athletes, and triathletes in particular. More specifically, the aims of this study are: 1) to determine the incidence of RTS in triathletes preparing for an Ironman Triathlon, 2) to establish the factors associated with the development of these RTS, and 3) to determine the effects of the RTS on pre-race training and race performance.

3.2. Methods

3.2.1. Type of study

Descriptive cross-sectional study.

3.2.2. Subjects

All 1136 triathletes (970 male, 85.4% and 166 female, 14.6%) who registered for the 2006 "Spec-savers" Port Elizabeth South African Ironman Triathlon (3.8 km swim, 180 km cycle and 42.2 km run), which was held during March

2006, were considered as potential subjects for this study. In the 2 months prior to the event, information about the study was posted on to the official race website (Appendix 1). This information included details about the study procedures (Appendix 2), the informed consent form (Appendix 3) and copies of the questionnaires to be completed (Appendix 4) and a service for triathletes to ask questions about the research by telephone or email. Prior to the study, the protocol was approved by the Research Ethics Committee of the University of Cape Town (REC ref no. 425/2005) (Appendix 5), as well as the general organizing committee and the medical sub-committee of the 2006 "Spec-savers" Port Elizabeth South African Ironman Triathlon.

Recruitment for the study took place at the registration area in the 3 days prior to the event. A research area was established in close proximity to the registration desk. As triathletes reported at the registration desk, they were informed about the nature of the study, and could then volunteer to take part in the study. Triathletes then reported to the research staff, where further information was given, and any questions were answered. Once triathletes gave informed written consent to be part of the study, they continued with the completion of a pre-race questionnaire. Of the 1136 triathletes who registered for the event, 992 (87.2%) started the race and 304 (26.8%) triathletes agreed to complete the pre-race questionnaire.

Triathletes were encouraged to complete the questionnaire whilst remaining in the research area and the majority complied. Alternatively, triathletes were allowed to take the questionnaire with them and return it the next day or on the morning of the race (< 10% of questionnaires were returned this way).

3.2.3. Pre-race questionnaire

For the purposes of this study, a previously validated pre-race questionnaire was modified and then used [32] [122] [31]. The content of the medical section of the questionnaire was based on common medical problems that were previously reported in triathletes [1]. The modified questionnaire was further validated by testing it on a sample of triathletes that were not part of the research study. These triathletes were asked to read the questionnaire and assess its ease of administration, relevance and ease of understanding. The athletes then gave independent comments which were used to review the format and content of the questionnaire.

The pre-race questionnaire consisted of various sections and included details of each triathlete's medical, racing and training history (Appendix 4). The information obtained from this questionnaire was used in a number of studies that were conducted at this event. In this particular study, information from the following sections was used: (1) demographic details (including age, height, weight and gender); (2) a history of previous participation in distance running (5 km, 10 km, 21.1 km and 42.2 km) and Ironman (sprint, standard swim, run, cycle, half Ironman, Ironman) events (including personal best times), training details in the last 15 weeks before the event (training distances and hours spent training); and (3) personal general medical history. In the general medical history section of the questionnaire, triathletes were asked to report a history of any medical problems in 14 specific areas. These included the presence of RTS (in the questionnaire these were termed 'flu-like' symptoms

to avoid medical terminology that triathletes may not understand) in the 6 weeks or 1 week before the race,

If the triathlete had a positive response to any of the abovementioned general medical sections, they were requested to complete a further detailed section of the questionnaire where more information about the specific medical problem was obtained. For the purposes of this study, the detailed sections of the questionnaire pertaining to RTS ('flu-like' symptoms) and allergies are relevant. As mentioned, in the questionnaires, the term 'flu-like symptoms' rather than RTS was used so that athletes have a clear understanding of the symptoms.

In the detailed section on RTS, triathletes were asked to report the presence of URTS (sore throat, 'blocked', or 'runny' nose), LRTS (cough, chest pain) or systemic symptoms (SS) (fever, joint pain, muscle aches), and a category of 'other' symptoms in the period 6 weeks before the race, and in the period 1 week before the race.

For the purposes of this thesis the following categories of symptoms are therefore defined:

- URTS – upper respiratory tract symptoms
- LRTS – lower respiratory tract symptoms
- LRT+SS – lower respiratory tract symptoms and systemic symptoms
- RTS - all respiratory tract symptoms and systemic symptoms (URTS, LRT, and SS)

In the detailed section on allergy history, triathletes were asked to report on the duration of allergies, current or past type of allergy (hay fever, sinusitis, skin allergies, eye allergies, allergies to plant material, allergies to foods, allergies to animals, and other allergies). In addition, triathletes were asked to report on medication used for allergies (cortisone nose spray/inhaler, anti-histamine tablets, cortisone cream, anti-histamine cream, and other inhalers tablets or cream). Information about specific current allergy symptoms (sneezing, itchy runny nose, headaches, itchy palate, streaming eyes, itchy eyes, blocked nose, post-nasal drip, coughing, fatigue, wheezing and poor sleep), as well as information about the seasonal nature of the allergies (by calendar month) was also obtained.

Finally, triathletes were requested to complete a detailed section on family history. For the purposes of this study, a positive family history for asthma and allergies will be reported.

3.2.4. Environmental conditions on race day

Data on the weather conditions on race day were obtained from the South African Weather Service. The average temperature during the race was 20°C (maximum temperature of 21°C, minimum temperature of 19°C). The average relative humidity during the race was 70%, and the average wind speed was 37 km/h. The sea temperature during the swim component was recorded as 19.2°C.

3.2.5. Statistical analysis of data

All the data from the questionnaires were entered on to an Excel spreadsheet (Microsoft 2003). Data were analysed using the Statistica 7.0 (Stat-soft Inc, Tulsa, Oklahoma, USA) and GraphPad InStat 2.05a (GraphPad Software, San Diego, California, USA) statistical programs. All numerical data are represented by the mean ± standard deviation, with the number of subjects in parenthesis. A one-way analysis of variance (ANOVA) was used to determine any significant differences between groups. Where the overall F value was significant, a Turkey's honest significant difference post hoc test was used to identify where the differences were. Categorical data are expressed as frequencies, and significant differences between groups were analyzed using the Pearson's chi-square or Fisher's exact tests. The numbers of subjects or observations (n) are usually in parenthesis. Statistical significance was accepted when $p<0.05$.

3.3. Results

3.3.1. General medical conditions in Ironman triathletes

The general medical conditions reported by the triathletes (male and female) in this sample are depicted in Table 3.1.

Table 3.1. The general medical conditions of a sample of triathletes (male and female) who entered the 2006 South African Ironman Triathlon

	All (n=304)	Male (n=253)	Female (n=51)	p-value [a]
Respiratory tract symptoms (%) [b]	49.2 (299)	48.4 (248)	52.9 (51)	0.661
Muscle Cramping (%)	52.2 (301)	56.0 (250)	33.3 (51)	0.005
Tendon / Ligament injuries (%)	38.3 (300)	39.4 (249)	33.3 (51)	0.517
Medicines (%) [c]	28.9 (301)	26.8 (250)	39.2 (51)	0.107
Gastrointestinal Symptoms (%) [d]	44.2 (301)	42.0 (250)	54.9 (51)	0.125
Nervous system Symptoms (%)	17.0 (300)	14.8 (250)	28.0 (50)	0.039
Genital area injuries (%)	23.9 (301)	22.8 (250)	29.4 (51)	0.407
Allergies (%)	36.3 (300)	37.0 (249)	33.3 (51)	0.742
Asthma (%)	9.6 (301)	9.6 (250)	9.8 (51)	0.829
Exercise-associated Collapse (%)	6.6 (301)	6.0 (250)	9.8 (51)	0.493
Current injuries (%)	26.3 (297)	26.3 (247)	26.0 (50)	0.897
Sunburn (%)	40.2 (291)	40.1 (242)	40.8 (49)	0.949
Skin cancer (%)	2.5 (278)	2.5 (236)	2.4 (42)	0.636
Other skin damage (%)	3.7 (267)	3.0 (230)	8.1 (37)	0.299

Values are expressed as a frequency (%) with the number of subjects (n) in parentheses.
[a] Male vs. female triathletes
[b] Six weeks before the race.
[c] Used medicines to treat injuries in the week before or during a race.
[d] During exercise.

The most commonly reported medical complaint in this group of triathletes was muscle cramping (52%) followed by respiratory tract symptoms (RTS) (49%), gastrointestinal symptoms (44%), a history of sunburn (40%) and allergies (36%). A history of tendon or ligament injuries was reported in 38% of triathletes, while 26% reported a current injury.

3.3.2. Respiratory tract symptoms (RTS) in Ironman triathletes

In this sample, 147 triathletes reported having RTS during either the 6-weeks or 1-week period before the race. The age, height, self-reported body weight, BMI, gender, country of origin, country of residence, performance in the triathlon (swim, cycle, run and overall), in the triathletes who reported RTS and those who did not report any RTS in the 6 weeks before the race is depicted in Table 3.2. Triathletes who reported RTS in the 6 weeks before the race were significantly younger, and reported a higher frequency of being born in South Africa compared with those who did not report RTS. There was, however, no significant difference in the RTS of the triathletes based on their country of present residence (p=0.151). The performance time in the swim, cycle and run legs, as well as the overall time, was not affected by RTS. A similar number of triathletes (>93%) successfully completed the event in each group (p=0.124).

Table 3.2. The physical characteristics and performance parameters of the triathletes who reported RTS during the 6 weeks before the race

	No RTS (n=152)	RTS (n=147)	p-value	Co-varied p-value [a]
Age (years)	39.7 ± 9.4 (142)	36.7 ± 7.6 (135)	0.004	n.d.
Height (cm)	178.2 ± 8.8 (134)	177.9 ± 7.9 (133)	0.782	n.d.
Weight (kg) [b]	74.0 ± 10.5 (144)	75.3 ± 11.5 (142)	0.338	n.d.
BMI (kg/m^2) [c]	23.5 ± 2.4 (132)	23.7 ± 2.5 (133)	0.325	n.d.
Gender (% male)	84.2 (152)	81.6 (147)	0.661	n.d.
Country of Birth (% South Africa) [d]	66.0 (141)	81.2 (138)	0.006	n.d.
Country of Residence (% South Africa)	80.3 (152)	87.1 (147)	0.151	n.d.
Swim Time (min)	89 ± 16 (146)	89 ± 15 (144)	0.717	0.439
Cycle Time (min)	407 ± 40 (143)	409 ± 41 (142)	0.774	0.365
Run Time (min)	295 ± 51 (141)	296 ± 53 (143)	0.871	0.483
Overall Time (min)	789 ± 94 (142)	793 ± 95 (144)	0.711	0.262
Finished Ironman Triathlon (%) [e]	93.4 (152)	98.0 (147)	0.124	n.d.

Values are expressed as either an average ± standard deviation or a frequency (%). The number of subjects (n) is in parentheses.
n.d., not determined.
[a] Co-varied for age.
[b] Weight is the athletes self-reported normal body weight.
[c] Body mass index (BMI) is calculated as weight (kg) divided by height (m) squared.
[d] 22 Africa, 1 Asia, 4 Central and North America, 42 Europe, 2 Middle East, 2 New Zealand and 1 Mauritius.
[e] 7 did not start and 6 did not finish the Ironman Triathlon.

The history of smoking, allergies, family history of allergies and asthma in the triathletes who reported RTS and those who did not report RTS is depicted in Table 3.3.

Table 3.3. The history of smoking, allergies, and family history of allergies and asthma of the triathletes who reported RTS during the 6 weeks before the race

	No RTS (n=152)	RTS (n=147)	p-value
Current and Ex-smokers (%) [a]	30.9 (152)	26.9 (145)	0.525
Allergies (%)	25.8 (151)	46.9 (147)	<0.001
Asthma (%)	9.9 (152)	9.5 (147)	0.924
Family History of Allergies (%)	35.6 (146)	45.0 (140)	0.134
Family History of Asthma (%)	29.1 (148)	39.4 (142)	0.082

Values are expressed as either an average ± standard deviation or a frequency (%). The number of subjects (n) is in parentheses.
[a] 6 triathletes are current smokers. The current and ex-smokers smoked on average 16 ± 11 cigarettes per day for 10.1 ± 6.1 years, and the ex-smokers stopped smoking on average 10.4 ± 8.4 years ago.

There were also no significant difference in RTS (26.9%) and no RTS (30.9%) amongst current and past smokers (p=0.525). Triathletes who reported RTS in the 6 weeks before the race had a significantly greater reported frequency of allergies (47%), compared to triathletes who did not report RTS in the 6 weeks before the race (26%) (p<0.001). A self-reported history of asthma was not associated with RTS (p=0.924), and neither was a family history of allergies (p=0.134). However, there was a trend observed between a family history of asthma and RTS in the 6 weeks before the race (p=0.082). Similar results for the physical characteristics, performance parameters, and history of smoking and allergies, as well as the family history for allergies and asthma, were obtained when only the South African-born triathletes or only those resident in South Africa were analyzed (data not shown). The mean numbers of years that triathletes suffered from allergies was 19.7 ± 13.3 years

(n=66), and there was no significant difference in the number of years between subgroups of triathletes reported suffering from allergies (p=0.124).

3.3.3. Upper respiratory tract symptoms (URTS) and lower respiratory tract and/or systemic symptoms (LRT+SS) in triathletes

Triathletes who reported RTS before the race were further subdivided into those with only upper respiratory tract symptoms (URTS), which included blocked or runny nose, and those with either systemic lower respiratory tract or systemic symptoms or both (LRT+SS) (fever, cough, chest pain, wheeze, muscle aches and pains). Sixty-seven triathletes had symptoms during both the 6-week and during the one-week pre-race period. Four triathletes only had symptoms during 1 week before the race (not the 6 weeks), and 68 had symptoms during the 6-weeks period, but none during the week before the event.

The physical characteristics and performance parameters of triathletes who reported no RTS and either URTS or LRT+SS during the 6 weeks before the race are presented in Table 3.4.

Table 3.4. The physical characteristics and performance parameters of the triathletes who reported no RTS, and either URTS or LRT+SS during the 6 weeks before the race

	No RTS (n=154)	URTS (n=44)	LRT+SS (n=70)	p-value	Co-varied p-value [a]
Age (years)	39.8 ± 9.3 (144) [d,e]	35.7 ± 7.7 (41) [d,f]	36.3 ± 8.2 (65) [e,f]	[d] 0.020 [e] 0.019 [f] 0.930	n.d.
Height (cm)	178.3 ± 8.8 (135)	179.0 ± 8.9 (41)	177.2 ± 7.6 (64)	0.522	n.d.
Weight (kg) [b]	74.0 ± 10.7 (146)	76.3 ± 12.3 (43)	75.9 ± 11.6 (68)	0.342	n.d.
BMI (kg/m^2) [c]	23.4 ± 2.4 (133)	23.8 ± 2.5 (41)	24.0 ± 2.6 (64)	0.312	n.d.
Gender (% male)	83.8 (154)	84.1 (44)	82.9 (70)	0.981	n.d.
Allergies (%)	25.5 (153)	52.3 (44)	44.9 (69)	<0.001	n.d.
Swim Time (min)	89 ±16 (148)	87 ±14 (44)	92 ± 17 (68)	0.284	0.168
Cycle Time (min)	407 ± 39 (145) [d,e]	402 ± 36 (44) [d,f]	420 ± 47 (66) [e,f]	[d] 0.777 [e] 0.088 [f] 0.070	[d] 0.922 [e] 0.014 [f] 0.083
Run Time (min)	295 ± 50 (143) [d,e]	286 ± 46 (44) [d,f]	312 ± 59 (67) [e,f]	[d] 0.609 [e] 0.066 [f] 0.029	[d] 0.571 [e] 0.010 [f] 0.019
Overall Time (min)	789 ± 92 (144) [d,e]	775 ±76 (44) [d,f]	823 ± 109 (67) [e,f]	[c] 0.686 [e] 0.039 [f] 0.026	[d] 0.851 [e] 0.004 [f] 0.022

With the exception of gender and allergies, which are expressed as frequencies (%), the remaining values are expressed as an average ± standard deviation. The number of subjects (n) is in parentheses.
n.d., not determined.
[a] Co-varied for age.
[b] Weight is the athletes self-reported normal body weight.
[c] Body mass index (BMI) is calculated as weight (kg) divided by height (m) squared.
[d, e, and f] p values as depicted in the column "p-value"

The triathletes that reported either URTS (p=0.020) or (p=0.019) LRT+SS were on average significantly younger than those who did not report any RTS. There was no significant difference in the ages of subgroups of triathletes who reported URTS or LRT+SS (p=0.930). When co-varied for age differences, the triathletes with LRT+SS completed on average the cycle, run and overall event slower than the triathletes with no RTS or URTS. URTS did not appear to affect the athletes' performance during the triathlon. However, both

subgroups of triathletes with either URTS (52%) or LRT+SS (45%) reported a significantly higher prevalence of allergies compared with triathletes reporting no RTS during the 6 weeks before the race ($p<0.001$).

Triathletes who reported no RTS, and either URTS or LRT+SS during the 1 week before the race are presented in Table 3.5. In these groups, there were no significant differences in the average age of the triathletes. Those with URTS or LRT+SS were, however, significantly heavier than those with no RTS. As before, the triathletes with either URTS or LRT+SS in the period 1 week before the race reported significantly greater prevalence of allergies compared to the triathletes reporting no RTS ($p<0.001$). Triathletes reporting LRT+SS in the 1 week period before the race were also slower in all three legs and the in the overall time for the triathlon when compared to triathletes with either no RTS or only URTS. The presence of URTS 1 week before the event also did not affect the performance of the triathletes.

Table 3.5. The physical characteristics and performance parameters of the triathletes who reported no RTS, URTS, or LRT+SS 1 week period before the race

	No RTS (n=218)	URTS (n=35)	LRT+SS (n=29)	p-value	Co-varied p-value [a]
Age (years)	38.8 ± 8.9 (207)	36.2 ± 7.2 (29)	36.2 ± 9.1 (27)	0.145	n.d.
Height (cm)	177.6 ± 8.8 (193)	179.5 ± 7.8 (33)	180.4 ± 6.6 (28)	0.187	n.d.
Weight (kg) [b]	74.3 ± 11.1 (209)	77.2 ± 11.4 (33)	78.9 ± 9.4 (28)	0.065	n.d.
BMI (kg/m^2) [c]	23.6 ± 2.5 (191)	23.9 ± 2.6 (33)	24.2 ± 1.9 (28)	0.446	n.d.
Gender (% male)	83.9 (218)	80.0 (35)	86.2 (29)	0.781	n.d.
Allergies (%)	30.1 (216)	65.7 (35)	48.3 (29)	<0.001	n.d.
Swim Time (min)	89 ±16 (210) [d,e]	84 ± 13 (35) [d,f]	95 ± 16 (29) [e,f]	[d] 0.195 [e] 0.147 [f] 0.017	[d] 0.089 [e] 0.053 [f] 0.002
Cycle Time (min)	407 ± 42 (207) [d,e]	401 ± 40 (35) [d,f]	426 ± 39 (27) [e,f]	[d] 0.768 [e] 0.051 [f] 0.048	[d] 0.419 [e] 0.028 [f] 0.014
Run Time (min)	293 ± 52 (206) [d,e]	293 ± 56 (35) [d,f]	323 ± 49 (27) [e,f]	[d] 1.000 [e] 0.016 [f] 0.074	[d] 0.596 [e] 0.038 [f] 0.063
Overall Time (min)	787 ± 97 (207) [d,e]	779 ± 91 (35) [d,f]	844 ± 90 (27) [e,f]	[d] 0.883 [e] 0.011 [f] 0.022	[d] 0.381 [e] 0.014 [f] 0.007

With the exception of gender and allergies, which are expressed as frequencies (%), the remaining values are expressed as an average ± standard deviation. The number of subjects (n) is in parentheses.
n.d., not determined.
[a] Co-varied for age, gender and self-reported normal body weight.
[b] Weight is the athletes self-reported normal body weight.
[c] Body mass index (BMI) is calculated as weight (kg) divided by height (m) squared.
[d, e, and f] p values as depicted in the column "p-value"

The triathlon (sprint, standard, half Ironman and Ironman) and road running (5 km, 10 km, 21.1 km and 42.2 km) personal best times (PB), as well as the best times achieved over the last 12 months in triathlons or 15 weeks in road running races in the no RTS, URTS and LRT+SS groups during the 6 weeks and 1 week before the race are presented in Tables 3.6. and 3.7. respectively. There were no significant differences in the life-long personal best times of the three groups of athletes in any of the triathlon or road running events (Tables 3.6. and 3.7.). Similarly, there was also no significant difference in the best

times achieved by the triathletes in any of the 4 triathlon disciplines during the 12 months before the 2006 South African Ironman Triathlon. With the exception of a significant difference in the 21.1 km best time achieved by the 6 weeks URTS and the LRT+SS groups during the 15 weeks before the Ironman (Table 3.6.), there were no other significant performance difference in the road running disciplines between the groups (Tables 3.6. and 3.7.). All the groups of triathletes competed in a similar number of standard Ironman triathlons during the last 2 years (data not shown).

Table 3.6. The triathlon (sprint, standard, half Ironman and Ironman) and road running (5 km, 10 km, 21.1 km and 42.2 km) personal best times (PB) and best times achieved over the last 12 months or 15 weeks of the triathletes who reported no RTS, URTS, or LRT+SS during the 6 weeks before the race

	No RTS (n=154)	URTS (n=44)	LRT+SS (n=70)	p-value	Co-varied p-value [a]
Sprint PB (min)	73 ± 17 (76)	72 ± 9 (28)	75 ± 16 (38)	0.712	n.d.
Standard PB (min)	147 ± 27 (84)	140 ± 22 (23)	150 ± 27 (32)	0.340	n.d.
Half Ironman PB (min)	333 ± 49 (88)	328 ± 32 (21)	336 ± 43 (37)	0.830	n.d.
Ironman PB (min)	737 ± 102 (68)	748 ± 56 (14)	770 ± 110 (28)	0.350	n.d.
Sprint 12 Months (min)	78 ± 20 (51)	78 ± 17 (18)	78 ± 18 (21)	0.999	0.944
Standard12 Months (min)	153 ± 30 (60)	143 ± 25 (18)	156 ± 27 (25)	0.321	0.199
Half Ironman 12 Months (min)	339 ± 47 (61)	329 ± 36 (15)	348 ± 39 (27)	0.411	0.573
Ironman 12 Months (min)	764 ± 104 (53)	755 ± 64 (10)	780 ± 112 (21)	0.775	0.290
5 km PB (min)	20 ± 4 (84)	20 ± 3 (23)	21 ± 3 (30)	0.373	n.d.
10 km PB (min)	41 ± 6 (116)	42 ± 7 (30)	43 ± 7 (51)	0.124	n.d.
21.1 km PB (min)	95 ± 14 (129)	94 ± 15 (27)	98 ± 15 (55)	0.431	n.d.
42.2 km PB (min)	210 ± 30 (113)	209 ± 25 (23)	217 ± 31 (42)	0.761	n.d.
5 km 15 weeks (min)	22 ± 5 (39)	22 ± 3 (9)	21 ± 4 (11)	0.923	0.965
10 km 15 weeks (min)	45 ± 6 (56)	47 ± 6 (18)	46 ± 6 (17)	0.561	0.359
21.1 km 15 weeks (min)	104 ± 15 (70)	100 ± 11 (16)	111 ± 16 (28)	0.036	0.033
42.2 km 15 weeks (min)	230 ± 42 (49)	207 ± 28 (9)	228 ± 20 (14)	0.316	0.486

Values are expressed as average ± standard deviation, with the number of subjects (n) in parentheses.
PB, personal best time; n.d., not determined.
[a] Co-varied for age and gender.

Table 3.7. The triathlon (sprint, standard, half Ironman and Ironman) and road running (5 km, 10 km, 21.1 km and 42.2 km) personal best times (PB) and best times achieved over the last 12 months or 15 weeks of the triathletes who reported no RTS, URTS, or LRT+SS during the 1 week before the race

	No RTS (n=218)	URTS (n=35)	LRT+SS (n=29)	p-value	Co-varied p-value
Sprint PB (min)	74 ± 17 (107)	71 ± 10 (24)	75 ± 13 (18)	0.660	0.412 [b]
Standard PB (min)	146 ± 28 (112)	140 ± 20 (22)	155 ± 22 (15)	0.237	0.137 [b]
Half Ironman PB (min)	332 ± 47 (121)	320 ± 34 (21)	351 ± 40 (16)	0.099	0.068 [b]
Ironman PB (min)	739 ± 105 (94)	745 ± 97 (15)	786 ± 85 (8)	0.455	0.483 [b]
Sprint 12 Months (min)	79 ± 21 (72)	74 ± 8 (14)	76 ± 14 (9)	0.558	0.330 [a]
Standard 12 Months (min)	153 ± 31 (81)	146 ± 21 (16)	154 ± 21 (14)	0.669	0.064 [a]
Half Ironman 12 Months (min)	341 ± 47 (86)	325 ± 42 (18)	367 ± 35 (10)	0.069	0.116 [a]
Ironman 12 Months (min)	765 ± 103 (72)	759 ± 116 (12)	778 ± 117 (6)	0.936	0.665 [a]
5 km PB (min)	20 ± 3 (119)	20 ± 3 (20)	20 ± 3 (12)	0.873	0.298 [b]
10 km PB (min)	42 ± 6 (170)	42 ± 6 (23)	45 ± 6 (18)	0.082	0.212 [b]
21.1 km PB (min)	95 ± 15 (179)	94 ± 12 (23)	100 ± 14 (22)	0.314	0.197 [b]
42.2 km PB (min)	208 ± 29 (154) [c,d]	221 ± 32 (20) [c,e]	227 ± 26 (17) [d,e]	[c] 0.122 [d] 0.026 [e] 0.825	0.109 [b]
5 km 15 weeks (min)	22 ± 4 (54)	20 ± 3 (9)	22 ± 7 (3)	0.579	0.296 [a]
10 km 15 weeks (min)	45 ± 6 (76) [c,d]	45 ± 5 (17) [c,d]	51 ± 7 (8) [c,d]	[c] 0.834 [d] 0.039 [e] 0.036	0.093 [a]
21.1 km 15 weeks (min)	105 ± 16 (102)	103 ± 12 (17)	116 ± 11 (7)	0.136	0.240 [a]
42.2 km 15 weeks (min)	230 ± 46 (52)	218 ± 29 (11)	242 ± 28 (4)	0.563	0.445 [a]

Values are expressed as average ± standard deviation, with the number of subjects (n) in parentheses.
PB, personal best time.
[a] Co-varied for age, gender and self-reported normal body weight.
[b] Co-varied for gender and self-reported normal body weight.
[d, e, and f] p values as depicted in the column "p-value"

3.3.4. RTS and training in triathletes preparing for the Ironman

The training frequencies, times and distances during the 15 weeks and 1 week prior to the Ironman for the no RTS, URTS and LRT+SS groups during the 6 weeks and 1 week before the triathlon are depicted in Tables 3.8. and 3.9., respectively. Athletes with LRT+SS during the 6 weeks prior to the event trained significantly less than those with either no RTS or only URTS (Table 3.8.). Training frequency was, however, not significantly different between the groups of triathletes reporting RTS 1 week before the event (Table 3.9.). In addition, triathletes reporting LRT+SS during the 6 weeks (Table 3.8.) and 1 week (Table 3.9.) before the race completed significantly less running, but not cycling or swim distances per week than the triathletes with no RTS or only URTS. The time per week spent training for each component of the triathlon during this period was similar between the various groups of triathletes. Except for significant differences in the running time and distance per week by the triathletes reporting RTS during the week before the triathlon (Table 3.8.), the groups of triathletes trained for similar durations and times during the 7 days prior to the triathlon (Tables 3.8. and 3.9.).

Table 3.8. The training distances and durations (swimming, cycling, running and total) for the period 1 week and 15 weeks before the Ironman of the triathletes groups with no RTS, URTS and LRT+SS during the 6 weeks before the triathlon

	No RTS (n=154)	URTS (n=44)	LRT+SS (n=70)	p-value
Training Frequency (days/wk)	5.8 ± 0.9 (140) [a,b]	6.0 ± 0.7 (41) [a,c]	5.4 ± 1.1 (65) [b,c]	[a] 0.271 [b] 0.037 [c] 0.004
Swim Time 15 wk (min/wk)	185 ± 95 (147)	200 ± 76 (41)	184 ± 106 (62)	0.641
Cycle Time 15 wk (min/wk)	489 ± 182 (147)	528 ± 174 (41)	473 ± 199 (63)	0.321
Run Time 15 wk (min/wk)	293 ±109 (141)	306 ± 112 (38)	261± 93 (54)	0.093
Total Time 15 wk (min/wk)	962 ± 274 (138)	1044 ± 287 (38)	907 ± 267 (54)	0.065
Swim Dist 15 wk (km/wk)	6.3 ± 3.3 (149)	7.4 ± 2.9 (41)	6.3 ± 3.2 (63)	0.130
Cycle Dist 15 wk (km/wk)	218 ± 82 (146)	239 ± 89 (41)	214 ± 86 (62)	0.289
Run Dist 15 wk (km/wk)	49 ± 17 (144) [a,b]	48 ±14 (41) [a,c]	41 ± 13 (60) [b,c]	[a] 0.945 [b] 0.003 [c] 0.070
Total Dist 15 wk (km/wk)	275 ± 89 (143)	295 ± 97 (41)	261 ± 92 (58)	0.191
Swim Time 1 wk (min/wk)	69 ± 63 (145)	61 ± 38 (41)	71 ± 74 (67)	0.709
Cycle Time 1 wk (min/wk)	155 ± 144 (143)	155 ± 85 (38)	133 ± 110 (65)	0.479
Run Time 1 wk (min/wk)	76 ± 62 (145)	82 ± 60 (37)	73 ± 66 (65)	0.800
Total Time 1 wk (min/wk)	305 ± 213 (140)	299 ± 149 (36)	283 ± 216 (61)	0.780
Swim Dist 1 wk (km/wk)	2.4 ± 2.3 (147)	2.4 ± 1.5 (42)	2.4 ± 1.8 (65)	0.993
Cycle Dist 1 wk (km/wk)	69 ± 57 (146)	69 ± 47 (42)	55 ± 47 (64)	0.198
Run Dist 1 wk (km/wk)	13 ± 12 (138)	16 ± 11 (40)	12 ± 11 (62)	0.322
Total Dist 1 wk (km/wk)	83 ± 61 (135)	89 ± 54 (40)	69 ± 56 (61)	0.176

Values are expressed as average ± standard deviation, with the number of subjects (n) In parentheses.
[a, b, and c] p values as depicted in the column "p-value"

Table 3.9. The training distances and durations (swimming, cycling, running and total) for the period 1 week and 15 weeks before the Ironman of the triathletes groups reporting no RTS, URTS and LRT+SS during the 1 week before the triathlon

	No RTS (n=218)	URTS (n=35)	LRT+SS (n=29)	p-value
Training Frequency (days/wk)	5.7 ± 0.9 (201)	5.7 ± 0.9 (32)	5.7 ± 0.6 (26)	0.902
Swim Time 15 wk (min/wk)	187 ± 90 (205)	184 ± 93 (34)	188 ± 108 (24)	0.980
Cycle Time 15 wk (min/wk)	499 ± 192 (204)	494 ± 150 (33)	444 ± 180 (25)	0.385
Run Time 15 wk (min/wk)	289 ± 104 (193)	319 ± 107 (31)	254 ± 111 (22)	0.085
Total Time 15 wk (min/wk)	968 ± 276 (190)	1003 ± 258 (30)	880 ± 261 (22)	0.256
Swim Dist 15 wk (km/wk)	6.5 ± 3.2 (206)	7.3 ± 4.1 (33)	6.5 ± 3.1 (27)	0.430
Cycle Dist 15 wk (km/wk)	222 ± 88 (202)	246 ± 104 (33)	215 ± 78 (27)	0.313
Run Dist 15 wk (km/wk)	48 ± 17 (200) [a,b]	51 ± 16 (32) [a,c]	104 ± 11 (26) [b,c]	[a] 0.456 [b] 0.083 [c] 0.029
Total Dist 15 wk (km/wk)	278 ± 96 (198)	306 ± 118 (32)	259 ± 74 (24)	0.173
Swim Time 1 wk (min/wk)	71 ±58 (208)	69 ±60 (34)	61 ±93 (26)	0.765
Cycle Time 1 wk (min/wk)	158 ±133 (205)	171 ±108 (31)	107 ±99 (25)	0.124
Run Time 1 wk (min/wk)	79 ±61 (207) [a,b]	99 ±74 (30) [a,c]	50 ±50 (25) [b,c]	[a] 0.351 [b] 0.069 [c] 0.011
Total Time 1 wk (min/wk)	312 ± 203 (201)	346 ± 218 (29)	216 ± 206 (22)	0.064
Swim Dist 1 wk (km/wk)	2.5 ±2.2 (205)	2.5 ±1.9 (34)	2.1 ±2.1 (28)	0.620
Cycle Dist 1 wk (km/wk)	68 ±55 (203)	72 ±51 (34)	53 ±49 (28)	0.309
Run Dist 1 wk (km/wk)	13 ±11 (192) [a,b]	18 ±12 (33) [a,c]	10 ±11 (28) [b,c]	[a] 0.044 [b] 0.345 [c] 0.012
Total Dist 1 wk (km/wk)	83 ± 59 (188)	95 ± 59 (33)	65 ± 58 (28)	0.146

Values are expressed as average ± standard deviation, with the number of subjects (n) in parentheses.
[a, b, and c] p values as depicted in the column "p-value"

Triathletes who reported LRT+SS during the 6 weeks prior to the event predicted that they would run (296 ± 58 min, n=66, p≤0.017), but not swim (p=0.355) or cycle (p=0.515), significantly slower than triathletes reporting no RTS (275 ± 45 min, n=147) or only URTS (271 ± 40 min, n=44) during the 6

week period. There was also no significant differences in the overall predicted times between these groups of triathletes (p=0.170) (data not shown). Similarly, the triathletes reporting LRT+SS during the 7 days prior to the event predicted that they would run significantly slower (301 ± 57 min, n=27) than triathletes with no RTS (276 ± 47 min, n=209) during this period (p=0.032) (data not shown). Those reporting URTS during this 1 week period predicted that they would run on average for 277 ± 54 min (n=35). There were no significant differences in the triathlete's relative overall or split times when their actual times were expressed relative to there predicted times (data not shown).

3.3.5. Different types of self-reported allergies and RTS in triathletes

The different types of self-reported allergies in triathletes who reported URTS or LRT+SS in the 6 weeks or 1 week before the Ironman are reported in Tables 3.10. and 3.11. respectively.

Table 3.10. The types of self-reported allergies in the triathletes groups with no RTS, all RTS, and either URTS or LRT+SS during the 6 weeks before the Ironman

	No RTS (n=33)	URTS (n=22)	LRT+SS (n=32)	p-value [a]	All RTS (n=54)	p-value [b]
Nose (Hay Fever) %	25 (75.8)	13 (59.1)	22 (68.8)	0.424	35 (64.8)	0.406
Sinusitis (%)	18 (54.6)	14 (63.6)	18 (56.3)	0.788	32 (59.3)	0.835
Asthma (Allergy) (%)	26 (78.8)	19 (86.4)	26 (81.3)	0.775	45 (83.3)	0.806
Skin Allergies (%)	6 (18.2)	1 (4.6)	9 (28.1)	0.089	10 (18.5)	0.806
Eye Allergies (%)	4 (12.1)	3 (13.6)	8 (25.0)	0.340	11 (20.4)	0.487
Allergy to Plant Material (%)	3 (9.1)	5 (22.7)	3 (9.4)	0.258	8 (14.8)	0.655
Allergy to Food (%)	29 (87.9)	20 (90.9)	28 (87.5)	0.919	48 (88.9)	0.839
Allergy to Animals (%)	11 (33.3)	3 (13.6)	6 (18.8)	0.182	9 (16.7)	0.126
Other Allergies (%)	31 (93.9)	20 (90.9)	31 (96.9)	0.561	51 (94.4)	0.707

Values are expressed as the number of observations (n), with the frequency (%) in parentheses.
[a] No RTS vs. URTS vs. LRT+SS.
[b] No RTS vs. All RTS.

There were no significant differences in the reported occurrence of no RTS, URTS, LRT+SS and all RTS for all types of reported allergies in triathletes 6 weeks before the triathlon. At 1 week before the triathlon, triathletes with sinusitis reported significantly more URTS rather than LRT+SS (p=0.038). Allergy to animals was more common in triathletes who reported no RTS in the 1 week period before the race (p=0.025) (Table 3.11.)

Table 3.11. The types of self-reported allergies in the triathletes groups with no RTS, all RTS, and either URTS or LRT+SS in the 1 week before the Ironman

	No RTS (n=56)	URTS (n=23)	LRT+SS (n=16)	p-value [a]	All RTS (n=39)	p-value [b]
Nose (Hay Fever) %	42 (75.0)	15 (65.2)	11 (68.8)	0.656	26 (66.7)	0.513
Sinusitis (%)	30 (53.6)	19 (82.6)	8 (50.0)	0.038	27 (69.2)	0.187
Asthma (Allergy) (%)	46 (82.1)	22 (95.7)	11 (68.8)	0.083	33 (84.6)	0.970
Skin Allergies (%)	10 (17.9)	4 (17.4)	3 (18.8)	0.994	7 (17.9)	0.794
Eye Allergies (%)	11 (19.6)	4 (17.4)	3 (18.8)	0.973	7 (17.9)	0.953
Allergy to Plant Material (%)	7 (12.5)	5 (21.7)	2 (12.5)	0.553	7 (17.9)	0.658
Allergy to Food (%)	49 (87.5)	20 (87.0)	15 (93.8)	0.764	35 (89.7)	0.992
Allergy to Animals (%)	19 (33.9)	6 (26.1)	0 (0.0)	0.025	6 (15.4)	0.075
Other Allergies (%)	54 (96.4)	21 (91.3)	16 (100.0)	0.627	37 (94.9)	0.883

Values are expressed as the number of observations (n), with the frequency (%) in parentheses.
[a] No RTS vs. URTS vs. LRT+SS.
[b] No RTS vs. All RTS.

3.4. Discussion

The main findings in this study are that, 1) RTS are commonly reported by Ironman triathletes in the 6 week period before competition (49% of triathletes), 2) there is a strong association between self-reported RTS in Ironman triathletes (reported in the period 6 weeks and 1 week before the race) and a history of self-reported allergies rather than training volume (in the 15 weeks before the race), 3) self-reported LRT+SS but not URTS in triathletes are associated with decreased training in the 6 weeks before the

race, 4) self-reported LRT+SS but not URTS in triathletes result in reduced pre-race training, predicted race performance, and actual race performance, and 5) there is no specific self-reported allergy that is associated with all RTS, URTS or LRT+SS in Ironman triathletes.

Medical conditions other than RTS are also commonly reported by triathletes while preparing for an Ironman competition. Muscle cramping (52%), gastro-intestinal symptoms (44%), history of sunburn (40%), a history of tendon/ligament injuries (38%), allergies (36%) and genital injuries (24%) were the most common other reported medical problems in this group of triathletes.

In our study we documented that almost 50% of the triathletes reported RTS in the 6 week period before the race. In the 6 week period before the race, 44/268 (16%) of these triathletes reported URTS, while 70/268 (26%) reported LRT+SS. In the last week before the race, 35/282 (12.4%) reported URTS, while 29/282 (10.3%) reported LRT+SS. This is a very high incidence and clearly indicates that RTS are very common in these athletes, particularly during the intense pre-race training period. Yet, despite previous data showing that increased training volume is associated with an increased risk of RTS, triathletes presenting with RTS in our sample did not have higher training volumes in the 15 weeks before the race, compared to those triathletes who did not present with RTS. Rather, RTS in triathletes was associated with a younger age, being born in South Africa, and a self-reported history of allergies. Smoking history, a history of allergies, a history of asthma, a family history of allergies, calibre of the triathlete (personal best times in components

of the triathlon) and a family history of asthma were not related to RTS. It is important to note that country of residence was not related to a RTS, and this is perhaps a more important parameter than country of origin, because exposure to different environmental conditions (temperature, humidity, altitude and aero-allergens) is more likely to affect risk of developing RTS. In our subsequent analysis, the younger the age of the triathletes with RTS was taken into account (co-varied). In this analysis, the history of self-reported allergies still remained the most significant factor that was associated with RTS (URTS, and LRT+SS) in this group of triathletes. However, we could not identify a specific type of allergy that was associated with any RTS, or URTS and LRT+SS subgroups.

There are no studies in triathletes that we can directly compare our findings to. However, the frequency of RTS in the pre-race period in our study is comparable to that reported for the post-race period in marathon runners (33-68%) [2;3]. However, we could not confirm the previously documented association between RTS and faster runners [2], nor did we show an association between increased training and the development of RTS [25;45;57].

Our data that 36% of all the triathletes reported allergies, is similar to that recently documented for endurance athletes (44%)[71]. A novel finding, not previously reported elsewhere, is that this prevalence of allergies is twice as high in triathletes experiencing RTS in the 6-week period before a race (47%), compared to triathletes with no RTS in the period 6 weeks before the race (26%). It is also of interest to note that the prevalence of allergies was highest in the URTS subgroup (66%), compared with the LRT+SS group (48%) and

the no RTS group (30%). Therefore allergies are associated with RTS in the 6 weeks prior to a race, and this is not affected by calibre of the athletes, nor the training volume. The hypothesis that RTS in endurance athletes could be, at least in part, due to an allergic origin clearly requires further investigation.

We acknowledge that one of the main limitations of our study is the fact that all our data on RTS, training and allergies are self-reported, and is also based on recall over a period of weeks. We were also not able to conduct any special tests to verify the presence of allergies, or to exclude infections as a cause of RTS in these athletes. Therefore our data have to be interpreted with these limitations in mind. However, the strengths of our study are 1) that we have a large sample size, 2) we used questionnaires that were previously validated, and 3) that our methodology (questionnaire survey) did not differ from studies that were previously conducted in similar groups of athletes to document either URTS [2;3;25;55;56] or allergies [71;107;110].

One of the other main findings in our study is that RTS affects training in the pre-race period, as well as performance on race day. We showed that triathletes reporting LRT+SS trained less, reported a slower predicted race time, and performed slower on race day. The relationship between pre-race RTS in endurance athletes and training or performance has, to our knowledge, not been previously reported. Therefore there are no studies that we can compare our results to. However, it is of interest to note that triathletes in the LRT+SS group, had symptoms which were 'below the neck' (LRT symptoms or systemic symptoms). This may well indicate a more systemic illness rather than a localized illness. It is tempting to speculate that perhaps

this was a sub-group of athletes where an allergy resulted in a subsequent infection, giving rise to systemic symptoms. The presence of an infective episode that is associated with systemic symptoms has been shown to reduce muscle strength and endurance [119-121]. This could explain the reduced training, the predicted slower race time, and the actual slower race time that we documented for this sub-group. It is, however, of concern, that the athletes in the LRT+SS subgroup appeared to continue with training, despite the presence of LRT or systemic symptoms.

In summary, this is the first study, to our knowledge, that related pre-race symptoms to training and performance on race-day. These data show that, when triathletes experience LRT or systemic symptoms, training and performance is negatively affected. This would support that current clinical recommendation that RTS 'below the neck' indicates a more severe condition, and the advice that training should not be conducted until symptoms resolve is correct [39-42]. However, further studies are required to fully document the nature of these symptoms, and what is the interaction between allergies, infections and the development of systemic symptoms.

Finally, in our study, we did include a section on the general medical conditions that triathletes report during the intense training period prior to a race. In this component of our study we showed that the most common medical condition reported by triathletes in this period is muscle cramping (52%), followed by RTS (49%), gastro-intestinal symptoms (44%), sunburn (40%), tendon/ligament injuries (38%), and allergies (36%). A detailed discussion of these conditions is beyond the scope of this research study, and

will be the focus of a subsequent analysis and report. However, we do note that these findings are, in general, consistent with the profile of medical conditions in triathletes, which was recently reviewed [1].

In summary, the results of this study show that triathletes, in preparation for a race, report a high frequency of medical conditions. RTS are particularly common, and appear to be related to allergies rather other factors including training volume or the calibre of the athlete. If RTS are accompanied by LRT or systemic symptoms, they decrease training and negatively affect performance on race-day.

Chapter 4

Summary and conclusion

Respiratory tract symptoms (RTS) are common amongst triathletes in the 6 weeks preparation period before an Ironman Triathlon, being second only to muscle cramping. There is a strong association between any RTS, URTS, and LRT+SS and self-reported allergies but no association between RTS and training volume, calibre of the athlete, smoking history, or family history (allergies or asthma). LRT+SS were associated with a reduction in training volume during the preparatory phase as well as performance during the competition. It was interesting to note that triathletes continued to train and participate in such an intense competition (though at a slightly reduced performance level), despite LRT or systemic symptoms.

The results of this study can be applied to the current clinical recommendations for athletes presenting with RTS during training as follows:

1. Sports physicians should be aware of the high incidence of general medical conditions in triathletes in the preparatory phase before an Ironman event
2. Triathletes presenting with RTS should be assessed for the presence of allergic conditions, particularly those affecting the respiratory tract
3. We recommend that an assessment to document allergies should be included in the current 'neck check' guideline to assess athletes presenting with RTS

4. This assessment for allergies should take the form of a clinical assessment, but also include special investigations to document the allergies
5. The current clinical advice that athletes presenting with LRT symptoms or systemic symptoms should not train is supported by the results of this study
6. Apart from the danger of viral myocarditis, the results of this study show that LRT and systemic symptoms are associated with a decrease in training and impairment of performance

Finally, the results of this study clearly show that further research studies are needed to fully understand the relationship between RTS, allergies and immune parameters in athletes undergoing intense training.

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Appendix 1: Website Information

Welcome to the Spec-Savers Ironman South Africa Research programmme - 2006

Dear Triathlete

We have the privilege to inform you that scientific and medical research at the Port Elizabeth Spec-Savers Ironman South Africa Triathlon has been planned in collaboration with the UCT/MRC Research Unit for Exercise Science and Sports Medicine based at the Sports Science Institute of South Africa, and Tswane University in Pretoria. This will provide a unique opportunity for a research programme to address important medical and physiological problems that are associated with participation in the Spec-Savers Ironman South Africa triathlon.

The research study will concentrate on the following 6 main components that will ultimately assist you to **improve your performance** and **improve the standard of your medical treatment** at future triathlons and other endurance events:

- Management of the collapsed triathlete
- Causes and treatment of Exercise-Associated Muscle Cramping
- Preventing post-exercise decreases in immune function and upper respiratory tract (URT) symptoms
- Genetic basis for performance and physiological responses during an Ironman Triathlon
- Identifying causes of chronic Achilles tendon injuries in triathletes
- Identifying the relationship between training history, perception of effort (RPE) during the race and the subsequent recovery after the race.

How can I volunteer to participate in the research study?

As a participant in the Port Elizabeth Spec-Savers Ironman South Africa triathlon, you will be given the unique opportunity to participate in this research effort. Please understand that your participation is entirely voluntary. Please read through the details of the following six components of the study. You will be given the opportunity to participate in any number, or all the components of the study. The details of each component are summarized below and a detailed explanation of each component can be downloaded as a PDF file. If you wish to participate in the study, please **download** the information related to each component of the study (PDF file), and read through it carefully. Please bring the INFORMED CONSENT FORM of the study with you to Port Elizabeth, and then visit our RESEARCH area at the registration venue. Here we will discuss any questions you may have, and then sign the INFORMED CONSENT FORM with you. In addition please download and complete the QUESTIONNAIRES. We will let you know once the questionnaires are available. Printed copies of all the documentation will also be available at the REGISTRATION research area.

Will my participation in the research affect my preparation, race participation, or recovery after the race?

All the components of this study have been carefully designed NOT to 1) interfere with your preparation or participation in the Ironman, 2) affect your performance on race day, and 3) your recovery after the event. All the tests are not painful and non-invasive (apart from a small blood sample taken at registration and after the race).

Will I have access to the results of the study?

Once the study results are known, you will be able to access a summary of the findings of the study on the website and you can also request, this be sent to you by email. You will also be given the opportunity to attend a feedback meeting where the results of the study will be discussed. The results will only be that of the whole group, and no individual results will be made public.

Who can I contact for more information?

In the next few weeks, please feel free to contact members of the research team should you have any questions related to the study (or any component of the study). Contact details of the research team are as follows: ironman@sports.uct.ac.za or (021) 650 4572.

The following documents can be downloaded:-

1. Subject information sheets (PDF File)
2. Consent form (PDF File)
3. Questionnaires (MS Word document)
4. Summary of the study (This web page) (PDF File)
5. Adobe Acrobat Reader

Summary of each component of the research study:-

1. Management of the collapsed triathlete

The precise causes and best treatment of collapsed endurance athletes is still widely debated. We would like to see if collapsed athletes have a greater incidence of serum sodium and plasma volume abnormalities than athletes who do not collapse at the end of the race. Accordingly, if these abnormalities do exist in collapsed athletes, are intravenous fluids superior to oral fluids in the treatment and restoration of sodium and plasma volume levels? Close monitoring of sodium levels, heart rate and blood pressure and time to discharge will help our team answer these questions.

2. Exercise-associated muscle cramping

The precise causes of Exercise-Associated Muscle Cramping (EAMC) are still widely debated. Contrary to popular belief, heat, dehydration and electrolyte (salt) abnormalities may NOT be the cause of EAMC. In this component of the study we would like to measure these changes in triathletes who cramp, and then follow what happens once we treat these athletes. We also want to measure the muscle "twitchiness" during the recovery period, once again trying to see if these related

to changes in serum electrolyte concentrations (salt). Triathletes who are prone to EAMC may well be interested in this component of the study.

3. **Post-exercise upper respiratory tract (URT) symptoms**

It is well documented that intense training, as well as participation in a prolonged strenuous endurance events (such as the Ironman) can cause changes in the immune system, and may increase the risk of infections (mainly of the upper respiratory tract). In this component of the study we want to examine the immune changes, as well as find out what causes the upper respiratory tract symptoms in endurance athletes after participation in the Ironman. Triathletes that are prone to developing symptoms such as sore throat, runny or blocked nose or cough after a race may well be specifically interested in participating in this component of the study.

4. **Genetic basis for performance and physiological responses during an Ironman Triathlon**

Athletic ability is partly determined by an intervals genetic make-up. Various gene (DNA material) have been shown to be associated with endurance performance, including the South African Ironman Triathlons. In addition it has also been suggested that the inter-individual physiological responses, such as blood salt and water imbalance, as well as the development of tendon overuse injuries, during endurance activities is partially determined by ones genes. The aim of this component of the study is to identify genes associated with performance and susceptibility to salt and water imbalances and indicators of underlying tendon pathology during the Ironman Triathlon. Volunteers for this component of the study will be asked to complete a questionnaire. At registration they will be asked to donate a small blood sample from which your genetic material (DNA) will be extracted and your blood salt levels measured. You will also be weighed before the swim and again immediately after the race. A second blood sample will also be taken after the measure to measure your blood salt levels. Some volunteers will also have there Achilles tendons scanned at registration.

5. **Chronic Achilles tendon injuries in triathletes**

Chronic Achilles tendon injuries are common in athletes participating in weight-bearing sports. It is well established that repetitive forces that are applied to the Achilles tendon (such as during running) may cause microscopic damage to the tendon. In the initial phases this may not cause any symptoms (pain or swelling). However, these changes can be observed using a technique known as soft tissue diagnostic ultrasound (non painful scan of the tendon). In this component of the study we wish to assess the changes in the Achilles tendon before and then after (immediately and 6 weeks later) the Ironman. In particular we wish to find out what damage (if any) takes place in the tendon as a result of the race, and how does this recover after 6 weeks. The findings of this study will also be linked to the genetic basis component (described in 4 above). Here we will be able to determine if your genetic make up determines how your tendons respond to a race such as the Ironman.

6. **The relationship between training history, perception of effort during the race and the subsequent recovery after the race.**

   The relationship between training history, perception of effort during the race and the subsequent recovery after the race is poorly understood. Knowing more about this relationship is important as it will have practical implications for the preparation for the race and minimise any health risks associated with too much physical stress which may occur after the race. Volunteers for this study will be asked to complete a short questionnaire on their training habits in preparation for the Ironman. During the race subjects will be asked to shout out a "perception of effort" score at they go past one of the 8 stations along the route. A researcher at the station will record the race number and the score. Volunteers will be sent emails on a daily basis for a week after the race with a short questionnaire on their recovery. Thereafter, they will be sent an email on a weekly basis for 12 weeks. Volunteers living near a big centre will be asked to donate a small blood sample at 1, 3, 5, 7 and 9 days after the race for the measurement of creatine kinase, a marker of muscle damage (however, blood donations are not essential for entry into the study)

If I decide to participate in the research study, what will be required of me?

The following table summarises the details of your participation in the study:-

	Details of Your Participation in the Study
Before Race	1. Download information sheets, questionnaires and consent forms from web page 2. Complete questionnaires using Microsoft Word 3. E-mail completed questionnaires to researchers at ironman@sports.uct.ac.za
At Registration	1. Hand in and sign the informed consent forms 2. Donate a sample of blood Ultrasound scan of both Achilles tendons in some athletes (Achilles Tendon component - No 5) Donate a saliva sample and have a throat swab (URT component - No 3)
Before Swim (Race Day)	1. Have yourself weighed near the start of the swim before donning your wetsuit in your costume
During Race	1. Shout out a "perception of effort" score at they go past one of the 8 stations along the route (RPE component - No 6)

Immediately After Race (Medical Tent)	1. Have yourself weighed in your running gear, without shoes, at the medical tent 2. Donate a sample of blood Ultrasound scan of both Achilles tendons in those athletes who had a scan during registration (Achilles Tendon component - No 5) Donate saliva samples and have throat swabs (URT component - No 3) Treatment of athletes with cramps and testing of unaffected volunteers (cramps component- No 2) Treatment of the collapsed athletes (collapsed athlete component - No 1)
Continuing Follow-up	**At 6 Weeks:** Ultrasound scan of both Achilles tendons (Achilles Tendon component - No 5) **Daily for 2 Weeks:** Complete symptoms questionnaire, available for telephonic surveillance calls every second day, **and only if required,** visit a designated centre for a clinical examination, donation of saliva and blood samples and have a throat swab taken (URT component - No 3) **For 12 weeks after the race:** Complete a short electronic questionnaire on your recovery daily for a week after the race, thereafter, on a weekly basis for 12 weeks. Volunteers living near a big centre will be asked to donate a blood sample at 1, 3, 5, 7 and 9 days after the race (however, blood donations are not essential for entry into this component of the study) (RPE component - No 6)

We look forward to meeting you at the Spec-Savers Ironman South Africa Registration area, and wish you well in your race preparation and participation.

Prof Martin Schwellnus, Dr Malcolm Collins, Prof Tim Noakes, and the rest of the Ironman Research Team

Appendix 2: Subject Information Sheet

SUBJECT INFORMATION SHEET

Dear Triathlete

We have the privilege to inform you that scientific research at the Port Elizabeth IRONMAN triathlon has been planned in collaboration with the UCT/MRC Research Unit for Exercise Science and Sports Medicine based at the Sports Science Institute of South Africa. This will provide a unique opportunity for a research programme to address important medical and physiological problems associated with the IRONMAN triathlon. Each participant will be able to access a summary of the findings of the study by email, and the website, once it has been completed. You will also be given the opportunity to attend a feedback meeting where the results of the study will be discussed. The results will only be that of the whole group, and no individual results will be made public.

The research study will concentrate on the following 6 main components that will ultimately improve your performance and improve the standard of your medical treatment at future triathlons and other endurance events:

- Management of the collapsed triathlete
- Exercise-associated muscle cramping
- Post-exercise upper respiratory tract symptoms
- Genetic basis for performance and physiological responses during an Ironman Triathlon
- Chronic Achilles tendon injuries in triathletes
- The relationship between training history, perception of effort during the race and the subsequent recovery after the race.

As a participant in the Port Elizabeth IRONMAN Triathlon, you will be given the choice to participate in this research effort. Your participation is entirely voluntary. Please read through the details of the following six components of the study. You will be given the opportunity to participate in one or more components of the study. The details of each component are explained in this document, and if you wish to participate in one or more components of the study, please read through and sign the INFORMED CONSENT FORMS that relate to each component of the study. Please feel free to contact members of the research team should you have any questions related to the study (or any component of the study). Contact details of the research team are as follows: ironman@sports.uct.ac.za or (021) 650 4572.

SUBJECT INFORMATION SHEET:

COMPONENTS OF THE RESEARCH STUDY TO BE CONDUCTED AT THE 2006 IRONMAN TRIATHLON IN PART ELIZABETH

The research study at the 2006 Ironman Triathlon, comprise of six components. The detailed information on each of these components of the study is as follows:

Component 1: A study on the management of the collapsed triathlete

General information:

The aim of this study is to evaluate the optimum treatment strategies for which to treat collapsed triathletes, after an Ironman race. Although intravenous (IV) fluid replacement is a common practice in the treatment of collapsed triathletes, medical personnel need to be advised of a treatment method that will prevent possible fluid overload (hyponatraemia) which can be a very severe condition. Your participation in this trial will aid in the understanding and management of how best to correct any fluid imbalance following this race.

If you collapse during or after the Ironman Triathlon and are brought into the medical tent, you will be evaluated and treated according to the current best standard of care principles. Your legs will be elevated and your heart rate, blood pressure, mental status and serum sodium concentration will be measured. If you are confused and your sodium level is normal, other laboratory tests will be performed such as an evaluation of your body temperature and blood sugar levels. If your body temperature is normal and do not have evidence for another treatable medical condition, an IV line will be placed in your arm and the appropriate fluid will be administered - IV or oral fluid (ad libitum – you choose how much you wish to drink) - until you recover and can leave the medical tent without assistance. Your discharge will be at the discretion of the supervising medical officer. If your condition deteriorates at any time, you will be immediately removed from the trial, treated appropriately and transported to the nearest hospital.

The risk of adverse affects of placement of an intravenous line include: infection, delayed healing, bruising, physical pain, mental discomfort and possible injury to a nerve or vessel. The risk of these adverse effects are rare and every attempt to minimize these risks will be undertaken by the use of sterile technique and use of disposable, single use, material. Your blood will be used for evaluation of serum sodium or blood glucose concentration only. No other tests will be performed on your blood and your blood samples will be appropriately discarded after these tests are performed.

We will obey the strict practices of confidentiality and anonymity. Each subject's identity will be known only to the researchers and numbers will be assigned to each sample in lieu of names. No results will be publicly available and the scientific publication of results will never disclose subject identity.

Potential risks of this component of the study

- The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.
- The potential risks to subjects of blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 15ml prior to the race.
- Body weight will be measured using a standard electronic scale, and there is no risk associated with this procedure.
- The risks associated with participation in this component of the study do not exceed the risks associated with competing in the Ironman competition. The administration of IV fluids will involve an invasive placement of an intravenous line. The risks associated with the placement of an intravenous line include: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or vessel. These risks will be minimized by the use of trained phlebotomists, sterile technique and disposable, single use materials. If at any time the condition of a collapsed triathlete deteriorates, the most appropriate treatment will be initiated, the trial terminated and the patient will be transported to the local hospital if necessary. The support form the local hospital is part of the normal standard medical care associated with this event.

Potential benefits of this component of the study

- The data collected in this component of the study will aid in the development of optimal treatment strategies for collapsed triathletes. Although intravenous fluid replacement is a common practice in the treatment of collapsed triathletes, medical personnel need to be advised of a more judicious approach to treatment as to avoid the deleterious effects of fluid overload (hyponatraemia). This information will aid in the understanding and management of serum sodium disorders in collapsed triathletes by scientifically 1)

evaluating the efficacy of intravenous versus oral rehydration and 2) assessing if the normalization of serum sodium levels are important in the recovery of collapsed triathletes.

Component 2: A study to determine the cause of Exercise-Associated Muscle Cramping (EAMC)

General information

The purpose of this component of the study is to determine the possible cause of exercise-associated muscle cramping (EAMC) in endurance athletes. At registration, triathletes will be given the opportunity to volunteer to participate in this component of the study.

Details of the study are as follows:

- Prior to or at registration, a questionnaire detailing personal particulars, medical information, training information, and history of muscle cramping will be completed.
- At registration, a blood sample (5ml – 1 teaspoon) will be collected from the vein in the arm using standard procedures.
- Body weight will be determined at the time of registration, and on the morning before the race starts by stepping onto an electronic scale
- Should you develop muscle cramping during or immediately after the race, and if you agree to participate, you will be admitted to a designated area of the medical facility at the finish of the race.
- At the finish your core body temperature will be measured using a rectal thermometer. This procedure will take place in privacy, and entails placing a thermometer in the rectum (backside) for about 3 minutes. This procedure may be associated with mild discomfort but no pain. Normal precautions will be taken to ensure that the thermometer is clean and properly lubricated. Trained medical staff will perform this procedure.
- Disposable surface patches (electrodes) will be attached to your cramping muscle/s and also to your arm (back of the arm on the triceps muscle) to record the electrical activity of the muscles. This procedure is not associated with any pain or discomfort.
- During the time of your admission to the medial facility you will be treated for cramping using standard accepted medical procedures.
- You will be asked to stand and walk periodically (every 15min), unless you are still actively cramping. Once you are able to stand and walk with no cramping, you will be discharged from the medical facility.
- Should you develop any medical complications or if your condition deteriorates, you will be treated according to normal accepted medical practices, and this can include admission to hospital if required.

Potential risks of this component of the study

- The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.
- The potential risks to subjects of blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 15ml prior to the race.
- Body weight will be measured using a standard electronic scale, and there is no risk associated with this procedure.
- All medical conditions, including EAMC, will be treated appropriately, based on the current standard of care or evidenced based paradigms. If at any time the condition of a triathlete with EAMC deteriorates, the most appropriate treatment will be initiated, the trial terminated and the patient will be transported to the local hospital if necessary. The support form the local hospital is part of the normal standard medical care associated with this event. Surface electrode placement and measurement of EMG activity is not associated with any known risk to the subject.

Potential benefits of this component of the study

- The anticipated benefits of this component of the study are that the results will further our understanding of the possible cause/s of EAMC in endurance athletes. In particular, once the aetiology of EAMC is better understood, this will improve our ability to prevent this condition, and to treat it effectively if it does occur.

Component 3. A study to determine the cause of post-exercise upper respiratory tract symptoms

General information

Upper respiratory tract (URT) symptoms such as a sore throat, runny or blocked nose, and throat irritation are particularly common in ultra distance athletes including triathletes. These symptoms occur mostly in the 2 weeks after a race. It has been shown to occur in 30-50% of all athletes after endurance events. It is important to understanding the relationship between

exercise and URT symptoms as it is known that infections have potential negative effects for the athlete. Having an infection or not may mean the difference between being able to compete safely, performing at a sub-optimum level at risk, or missing the event altogether because of illness. In recent years we have become aware that the symptoms of URT infections that endurance athletes suffer from after a race may NOT be caused by an infection. Instead this may reflect an irritation of the inner cell lining of the nose and throat due to allergy or perhaps pollution. However, we still need more evidence to prove this.

The aim of this component of our research is to determine if the symptoms experienced by athletes after an Ironman race are due to an infective cause (microbial agent such as a virus or a bacteria) or due to a non-infective inflammatory process in the upper respiratory tract.

The study will involve recruiting in excess of 120 triathletes who participate in the Port Elizabeth IRONMAN endurance race. You will be requested to report to a specific area at the registration desks in the 3 days prior to the event. At this time you will be asked to complete a questionnaire, and have a blood sample taken from your vein in the forearm. In addition nasal and throat swabs will be taken and you will be required give a specimen of your saliva (spit).

Immediately after you finished the race, you will be asked to report to a specific section of the medial tent at the finish, where a further blood sample and saliva sample will be taken.

You will then be asked to be available for a follow up in the 14 days after the race. Follow-up will take place in four cities (Cape Town, Port Elizabeth, Durban and Gauteng).You will be required to complete a short symptom chart every day, and you will be contact regularly (every 2 days) by a member of the research team to obtain this information. Should you develop any symptoms of upper respiratory tract irritation (such as blocked nose, runny nose, sore throat, cough) you will be asked to report to a research centre in the city (as mentioned above). There will be no financial compensation to attend this centre, but the medical consultation will be free of charge. During that visit you will be seen by a doctor, who will take a medical history, and conduct a medical examination of your upper respiratory tract (ears, nose throat and chest). In addition a blood and saliva samples will be taken. You will receive treatment and advice for the management of these symptoms.

Potential risks of this component of the study

- The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.
- The potential risks to you during blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the

potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 15ml prior to the race.

- The potential risks associated with the collection of saliva and throat swabs are minimal. Local minimal and transient discomfort in the upper respiratory tract is the only anticipated risk. The collection procedure will be conducted by trained staff.

Potential benefits of this component of the study

- The anticipated benefits to subjects participating in this component of the study are firstly that the knowledge of the cause of the symptoms of the URT after an endurance event will be known, secondly that the treatment of these symptoms will be based on sound scientific and clinical evidence and finally, that triathletes can be given accurate and safe advice on training during the recovery period.

Component 4: A study to determine the genetic basis for performance and physiological responses during an Ironman Triathlon

General information

A study to determine the genetic basis for performance and physiological responses during an Ironman Triathlon will be conducted by the UCT/MRC Research Unit for Exercise Science and Sports Medicine at the University of Cape Town in Cape Town, South Africa, in conjunction with the Molecular Genetics Department B and Laboratory of Forensic Genetics of the Cyprus Institute of Neurology and Genetics in Nicosia, Cyprus.

The study involves donate ten millilitres (2 teaspoons) of venous blood and this will be done at race registration and after the race (five millilitres - 1 teaspoon). Five millilitres of the sample will be used for the extraction and analysis of genetic material (DNA), while the remainder of the sample will be used to measure serum electrolyte (salt) levels. In addition, body weight will be measured prior to the start of the race and again in the medical tent on completion of the race.

The DNA will only be used for scientific research purposes relating to the genetic basis of (1) athletic ability, (2) tendon and ligament overuse injuries and (3) dysnatraemia during ultra-endurance events. Personal particulars and sporting and medical questionnaires will have to be completed and this information will be treated with the strictest confidentiality and will only

be used for scientific research purposes. All data will be analysed anonymously and DNA samples will be destroyed on completion of the study.

Part of the DNA extracted form the donated blood sample will be sent to the Cyprus Institute of Neurology and Genetics in Cyprus for analysis. DNA samples will be shipped to and analysed in Cyprus anonymously. DNA will be genotyped (analysed) for variations (polymorphisms) within genes relating to the genetic basis of athletic ability, tendon and ligament overuse injuries as well as water and salt imbalance during ultra-endurance events only.

Potential risks of this component of the study

- The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.
- The potential risks to you during blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 15ml prior to the race.

Potential benefits of this component of the study

The anticipated benefits of this component of the research study are to identify genetic factors that may predispose to 1) improved performance or 2) increased risk of medical consequences (such as abnormal electrolyte imbalances). This information will eventually assist triathletes in predicting and improving their performance, and decrease their risk of medical complications during participation in triathlon.

Component 5. A study to determine the genetic risk/s associated with chronic Achilles tendon injuries in triathletes

General information

The purpose of this component of the research study is to determine if there are specific genetic factors (refer to the details for component 4) that are associated with the development

of chronic tendon injuries. In addition, we want to determine what the effect of an endurance event (such as the Ironman) is on the structure of the Achilles tendon.

At registration you will be required to complete a questionnaire with personal details, training details, past injury details, and details about family history. In addition, a 5ml (1 teaspoon) blood sample will be taken from a vein in your arm. Finally, a qualified radiologist will examine both you Achilles tendons using a soft tissue diagnostic ultrasound machine. This procedure entails putting a clear jelly on your skin, and then using a probe to examine the tendon by passing it over the skin. This is not associated with any discomfort.

After you complete the race, you will be asked to undergo the same procedure (blood collection and ultrasound examination) in the medical facility at the finish. If possible, you will be asked to report to a medical centre close to your home for a final ultrasound examination approximately 6 weeks after the race. The cost of this will be free, but you will not receive any financial compensation to attend this centre.

Potential risks of this component of the study

- The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.
- The potential risks to you during blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 15ml prior to the race.
- Soft tissue diagnostic ultrasound is a well described and common clinical diagnostic procedure that is associated with no known risk. This procedure will be undertaken by a trained radiologist.

Potential benefits of this component of the study

- The anticipated benefits of this component of the study are that the results will clarify why certain triathletes may be more or less prone to chronic tendon injuries, based on their genetic make-up. In future, this work may lead to the screening and early identification of an increased risk for tendon injuries, so that preventative measures can be undertaken.

Component 6: A study to determine the relationship between training history, perception of effort during the race and the subsequent recovery after the race

General information

The purpose of this component of the study is to investigate whether the strain experienced in the recovery period after an Ironman is directly proportional to the perception of effort and racing intensity in a group of similarly trained triathletes. The answer to this question has a practical application for training and also contributes to a better understanding of the physiological responses of ultra-endurance events.

The research project will involve the following:

- About 1 week before the race you will be asked to complete a questionnaire on your training habits for swimming, cycling and running in preparation for the Ironman and your personal best times for the 3 disciplines. This will take about 30 minutes.
- You will be familiarised with the subjective scores for "perception of effort rating" and "pain assessment" before the race.
- During the race researchers will be allocated to about 12 stages throughout the race. As you swim, run or cycle past these researchers they will hold up two boards with the scores for "perception of effort rating" and "pain assessment". You will be asked to shout out your respective scores as you go past them and they will record these scores against your race number.
- You will be sent an email on a daily basis for a week after the race with a short questionnaire on your subjective perception of recovery. This questionnaire will take about 2 minutes to complete. Thereafter, you will be sent an email on a weekly basis for 12 weeks with the same short questionnaire.
- Blood samples after the race will be obtained 1, 3, 5, 7 and 9 days later for the measurement of creatine kinase.

Potential risks of this component of the study

- The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.
- The potential risks to you during blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These

risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 15ml prior to the race.

- Data for this component of the study will involve contact with subjects during the race. There is a potential risk that in the process of data collection, the performance of subjects in the race will be interfered with. This risk will be minimal, as the nature of the data collection is such that subjects will only be asked to shout out two numbers as they pass members of the research team at designated points in the race. However, should triathletes feel that this affects their performance during the race, they will be free to withdraw from this component of the study. There will be no interference with other race participants during this data collection process.

Potential benefits of this component of the study

- The anticipated benefits of this component of the study are firstly that subjects will receive a full summary of their individual results, as well as the overall findings from this component of the study. Secondly, and more specifically, the individual results will include information about their training and development of fatigue during the race which will be of interest. Finally, these results may assist triathletes in modifying their training to improve their performance.

Appendix 3: Informed Consent Form

THE PORT ELIZABETH IRONMAN TRIATHLON 2006: MEDICAL CONSEQUENCES FOLLOWING ENDURANCE SPORTS RESEARCH PROJECT

I, _____, agree voluntarily to participate in the UCT/MRC Research Unit for Exercise Science and Sports Medicine's research project with the following components titled:-

- "A study on the management of the collapsed triathlete",
- "A study to determine the cause of Exercise-Associated Muscle Cramping (EAMC)",
- "A study to determine the cause of post-exercise upper respiratory tract symptoms",
- "A study to determine the genetic basis for performance and physiological responses during an Ironman Triathlon",
- "A study to determine the genetic risk/s associated with chronic Achilles tendon injuries in triathletes",
- "A study to determine the relationship between training history, perception of effort (RPE) during the race and the subsequent recovery after the race",

performed by the University of Cape Town and the Sports Science Institute of South Africa. I have read the subject information sheets and the following procedures and concepts have been explained to me in full:

1. Completion of a questionnaire: The completion of a questionnaire is not associated with any risk. Questionnaire and other clinical data (paper and electronic) will be kept confidential, will be kept secure, and will not be made available to any party other than the research team without the consent of the individual subjects.

2. Blood sample collection at registration, immediately after the race, and if required in the 14 days after the race: The potential risks to subjects of blood collection are minimal and are related to 1) blood sample collection technique, and 2) the volume of blood collected prior to racing and the potential risk of a decreased performance in the race. The potential risks associated with blood collection technique from the ante-cubital veins are: infection, delayed healing, haematoma, physical pain, mental discomfort and injury to a nerve or a vessel. These risks are small and will be minimized by the use of trained phlebotomists, use of sterile techniques and the use of disposable, single use materials. The risk of decreased performance as a result of blood collection will be reduced by not subjecting any participant to the collection of a blood volume exceeding 25ml prior to the race.

3. Measurement of body weight before and after the race: Body weight will be measured using a standard electronic scale, and there is no risk associated with this procedure.

4. Treatment if I collapse after the race: **(only for the collapsed athlete component)** If I collapse during or after the race I might receive either IV (drip into arm vein) or oral fluids ad libitum (as much fluid as I want). I will be attended to in a separate section of the medical tent under the supervision of a qualified doctor. I will be assessed regularly (every 15 minutes) and I understand that

optimum care will be provided to me according to the current standard of care. Treatment will cease when I am alert, oriented, able to walk and when my laboratory tests are normal. I will be transported to the local hospital if my condition requires more urgent medical attention.

5. Treatment if I develop muscle cramps during or after the race: **(only for the cramps component)** If I develop muscle cramps during after the race I will receive treatment in a designated area of the medical facility. Optimum care will be provided to me according to the current standard of care. I will be required to have a rectal temperature measurement taken, blood samples will be collected, body weight will be measured, and I will have surface electrodes attached to my muscle to measure electrical activity. Treatment will cease when my cramps have stopped and I am able to stand up and walk. I will be transported to the local hospital if my condition requires more urgent medical attention.

6. Saliva sample collection at registration, immediately after the race, and if required in the 14 days after the race: **(only for the URT component)** The potential risks associated with saliva sample collection are very small. I may experience transient discomfort as the inner lining of my throat is swabbed with a soft swab. I understand that all the normal precautions will be taken during this procedure, and that it will be undertaken by trained staff.

7. Assessment and treatment of symptoms of the upper respiratory tract in the two weeks after the race: **(only for the URT component)** I understand that should I develop any symptoms of the upper respiratory tract in the 14 days after the race, I will be required to report to a research centre in my home town, to be examined by a doctor, give a blood sample and have a throat swab as well a saliva sample taken. I understand that I will then be treated for my symptoms according to standard medical practice. I understand that I will not receive any financial compensation to attend the centre.

8. Soft tissue diagnostic ultrasound examination: **(only for the Achilles tendon component)** I understand that I will be subjected to a soft tissue diagnostic ultrasound examination of my Achilles tendons during the registration period, on completion of the race, and if possible 6 weeks after the race at a medical facility close to my home. I understand that I will not receive any direct financial compensation to attend this centre for the ultrasound, but that the investigation will be free of charge. I understand that these investigations are not associated with any risk, and will be performed by a trained radiologist.

9. The genetic basis for performance and physiological responses during an Ironman Triathlon as well as to determine the genetic risk/s associated with chronic Achilles tendon injuries in triathletes: **(only for the genetics components)** These components of the study are been performed in conjunction with the Molecular Genetics Department B and Laboratory of Forensic Genetics of the Cyprus Institute of Neurology and Genetics in Nicosia, Cyprus. At race registration, I have agreed to donate ten ml (2 teaspoon) of venous blood. Half the sample will be used for the extraction and analysis of genetic material (DNA), while the remainder of the sample will be used to measure serum electrolyte (salt) levels. I also agree to donate an additional five ml (1 teaspoon) of venous blood after the race in the medical tent which will be used to measure post-race serum electrolyte (salt) levels.

   The DNA will only be used for scientific research purposes relating to the genetic basis of (1) athletic ability, (2) tendon and ligament overuse injuries and (3) dysnatraemia during ultra-endurance events. I also understand that all data will be analysed anonymously and my DNA sample will be destroyed on completion

of the study. I understand that some of the DNA extracted form the donated blood sample will be sent to the Cyprus Institute of Neurology and Genetics in Cyprus for analysis. I understand that the DNA samples will be shipped to and analysed in Cyprus anonymously. I understand that the DNA will be genotyped (analysed) for variations (polymorphisms) within genes relating to the genetic basis of athletic ability, tendon and ligament overuse injuries and dysnatraemia during ultra-endurance events only.

I understand that whilst there is no direct benefit to myself, if a genetic predisposition for (1) athletic ability, (2) tendon and ligament overuse injuries and (3) dysnatraemia during ultra-endurance events can be established, then future generations will be able to establish their risk for this condition. This may allow better prevention and treatment options in the future. I understand that I will receive the overall results of the study.

I have read (or, where appropriate, have had read to me) and understood the information about this study, and any questions I have asked have been answered to my satisfaction. I agree to participate in the study, realising that I have the right to request that my DNA sample be destroyed at anytime. I agree that research data provided by me or with my permission during the project may be included in a thesis, presented at conferences and published in journals on the condition that neither my name nor any other identifying information is used.

10. Providing information on my rating of effort and fatigue status during the race: **(only for the RPE component)** I understand that I will be required to study and familiarize myself with two scales of perceived effort and fatigue before the race starts. I understand that during the race, at designated stages, I will be required to report (by shouting) my perception of effort and fatigue to members of the research team.

I have read the preceding subject information sheet and understand the testing procedures outlined therein. I understand any accompanying risks and discomforts. Knowing these risks and discomforts and having had the opportunity to pose questions answered to my satisfaction, I hereby consent to participate in this study. I understand that I may withdraw from this study at any time without further question. I have been informed that the individual data derived from my participation in these protocols will remain confidential. I understand that the medical staff and the research team have professional medical insurance.

Name of the triathlete: _____
Signature of triathlete _____

Date: _____
Name of investigator: ___Prof Martin Schwellnus_____
Signature of Investigator: _____
Date: _____ _____

Appendix 4: 2006 Ironman Medical and Training Questionnaire

Department of Human Biology

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2006 IRONMAN – MEDICAL AND TRAINING QUESTIONNAIRES

These questionnaires have been constructed by the Medical Research team, in conjunction with the Medical Director of the Ironman 2006. The information obtained from these questionnaires is essential for the planning of medical care during events such as the Ironman 2006. We acknowledge that the questionnaires are long, but we are asking about 20 minutes of your valuable time to complete them. The completion of the questionnaires is voluntary, all the information will be kept confidential and will only be used for research and medical care planning purposes. We suggest that you consider completing this before the event, or at the time of registration.

Prof Martin Schwellnus (Chairman, Research Team)
Dr Peter Schwartz (Medical Director, Ironman 2006)

Instructions

You can either complete the questionnaires electronically using Microsoft word or print the questionnaires and complete them manually. Please answer each question by filling in the details in the allocated space or checking one or more of the option boxes.

If you complete the questionnaire electronically using Microsoft word, please e-mail the completed forms to ironman@sports.uct.ac.za and bring the signed consent form to the research table at race registration.

If you complete the questionnaire manually, please bring the completed forms together with the signed consent form to the research table at race registration.

Please complete sections A, B, C, D and E

Please complete only the relevant questions in the following section

Section A: Personal details			
2006 Ironman Race Number			
Surname			
First Name			
Postal Address		Postal/ Zip Code	
E-mail address		Phone (day time)	code number
Date of birth	yyyy-mm-dd	Cell	
Height	cm	Gender	Male ☐ Female ☐
Weight	kg	Age	
Ethnic group (Only Required and Used for Research Purposes)	Black/African ☐ White ☐ Indian ☐ Mixed Ancestry (Coloured) ☐ Asian ☐ Other ☐		
Ancestry: Tribal or national background (eg Xhosa, Dutch, Zulu, German, Italian)	Father: Unknown ☐ Mother: Unknown ☐		
Country of Birth			
Dominant Hand	Left ☐ Right ☐ Both ☐	Dominant Leg	Left ☐ Right ☐ Both ☐
Occupation			
What **percentage** of your **working** day is spent in the following activities?	Sitting: ____ % Standing: ____ % Walking (Lower body activity) ____ % Manual Labour (upper and body activity) ____ %		

Section B. Racing and training history				
Type of triathlon	**Sprint**	**Standard (1.6, 40, 10)**	**½ Ironman**	**Ironman**
Which triathlons have you **ever** participated in?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Year of first event				
How many events have you **ever** participated in?				
How many Olympic (or above) triathlon races have you completed over the **past 2 years**?				
Personal best time **ever**	_____ hrs:min	_____ hrs:min	_____ hrs:min	_____ hrs:min
What was your time for your last triathlon race during the **past 12 months**?	_____ hrs:min	_____ hrs:min	_____ hrs:min	_____ hrs:min
Type of running event	**5 km**	**10 km**	**21.1 km**	**42.2 km**
Which races have you **ever** participated in?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Year of first event				
How many events have you **ever** participated in?				
Personal best time **ever**	_____ hrs:min	_____ hrs:min	_____ hrs:min	_____ hrs:min
What is your best time, in a running race, in the **last 15 weeks**?	_____ hrs:min	_____ hrs:min	_____ hrs:min	_____ hrs:min
Type of event	**Two Oceans Marathon**	**Comrades Marathon**		
Which races have you **ever** participated in?	Yes ☐ No ☐	Yes ☐ No ☐		
Year of first event				
How many events have you **ever** participated in?				
Personal best time	_____ hrs:min	_____ hrs:min		

What is your best average cycling speed (km/h) in a race over 80 km in the **last 15 weeks**?	Average speed: _____ Distance: _____	km/h; km
What is your best swimming performance in the **last 15 weeks**?	Time: _____ Distance: _____	min m
What is your predicted time for the entire 2006 Ironman event and each of the three splits?	Entire event: _____ Swim: _____ Cycle: _____ Run: _____	min min min min

Please answer the following questions, with your answers reflecting your average in the **most recent 15 weeks i.e. beginning December 2005 to 18th March, 2006.**	
How many days a week did you train during the **last 15 weeks**?	days/week
What distances did you train in an average week during the **last 15 weeks**?	Swim: ____ km/week Cycle: ____ km/week Run: ____ km/week
How many hours a week did you train in an average week during the **last 15 weeks**?	Swim: ____ hrs/week Cycle: ____ hrs/week Run: ____ hrs/week
What **distances** did you train in the week before the race?	Swim: ____ km Cycle: ____ km Run: ____ km
How many **hours** did you train in the **week before** the race?	Swim: ____ hours Cycle: ____ hours Run: ____ hours

Flexibility training history	
Do you perform flexibility training (stretching exercises)?	Yes ☐ No ☐
If YES, please complete the rest of the flexibility training history section below:- If NO, continue completing the questionnaire from the top of page 5 (Equipment use history)	
On average, how many days a week do you perform a stretching session?	days/week
On average, how times a day do you perform a stretching session?	times/day
Please tick which muscle groups do you include in your stretching session?	☐ Hamstrings ☐ Quadriceps ☐ Calf (gastrocnemius) ☐ Calf (soleus) ☐ Groin (inner thigh) ☐ Upper body limbs ☐ Other:
Please tick when you stretch? (before, during and/or after exercising. You can tick more than one box)	☐ Before Exercise ☐ During Exercise ☐ After Exercise
When you stretch an individual muscle group, on average, **how long do you hold the stretch** for?	seconds
When you stretch an individual muscle group, on average, **how many times do you stretch the muscle for**?	☐ Once ☐ Twice ☐ 3 times ☐ 4 times ☐ 5 times ☐ 6 or more times

Equipment use history

Please indicate which type of **bicycle** you use?	☐ Kuota	☐ Kestrel	☐ Trek
	☐ Aegis	☐ Litespeed	☐ Softride
	☐ Felt	☐ Quintana Roo	☐ Javelin
	☐ Cervelo	☐ Argon 18	☐ Scott
	☐ Elite	☐ Specialized	☐ Guru
	☐ Giant	☐ Other: _____	
Please indicate which type of **handle bars** you use?	☐ Bontrager	☐ HED	☐ Zipp
	☐ Profile Design	☐ Vision Tech	☐ Oval Concepts
	☐ Deda	☐ Easton	☐ Syntace
	☐ Pedalsoft	☐ Kestrel	
	☐ Other: _____		
Please indicate which type of **saddle** (Brand - model) you use?	☐ Selle San Marco- Azoto TriathGel		
	☐ Profile Design- Tri Stryke (with a groove)		
	☐ Selle San Marco- Rever Profil		
	☐ Fizik- Arione Tri		
	☐ Terry		
	☐ Koobi		
	☐ Other: _____		
Please indicate which brand of **helmet** you use?	☐ Trek	☐ Bell	☐ Giro
	☐ MET	☐ Other: _____	
Please indicate which type of **cycling shorts** you use?	☐ Thin lycra (no padding)		☐ Padded cycling shorts
	☐ Triathlon shorts with some padding		☐ Swimming costume
	☐ Other:		
Do you normally wear **underwear** together with cycling shorts?	☐ Yes	☐ No	
Please indicate which type of **cycling shoes** you use?	☐ Olympic	☐ Nike	☐ Diadora
	☐ Shimano	☐ Carnac	☐ Sidi
	☐ Other: _____		
Please indicate which type of **kit** you use?	☐ Anatomic	☐ Nike	☐ Velo
	☐ Howzit	☐ Adidas	☐ Orca
	☐ De Soto	☐ Louis Garneau	☐ Quintana Roo
	☐ Zoot	☐ Other: _____	
Please indicate which **brand of running shoe** you use?	☐ Adidas	☐ Asics	☐ Brooks
	☐ New Balance	☐ Nike	☐ Mizuno
	☐ Puma	☐ Reebok	☐ Saucony
	☐ Other: _____		
Please indicate which **type of running shoe** you use?	☐ Soft neutral shoe		
	☐ Mild anti-pronation shoe		
	☐ Motion control shoe		
	☐ Light racing shoe		
	☐ Unknown or not sure		
	☐ Other: _____		

Section C. History of medication and supplement use

What medication, if any, are you currently using? (please list)	Name of medication	Years taken

Do you use protective skin sunscreen during training session or when competing?	Yes ☐ No ☐	☐ Every session	☐ Most sessions
		☐ Some sessions	☐ Very occasionally

Are you currently taking dietary supplements/vitamins?	Yes ☐ No ☐

If **yes** to the above question, please list names of dietary, sports or vitamin supplements.	Name of supplement	Years taken
	☐ Multi-vitamins	____
	☐ Anti-oxidants	____
	☐ Immune boosters	____
	☐ Protein powders/supplements, Protein bars, BCAAs	____
	☐ Creatine	____
	☐ Caffeine	____
	☐ Fat cutters	____
	☐ Carbohydrate drinks/powders/gels	____
	☐ Other: _____	____

Have you ever used oral corticosteroids (cortisone tablets)? (If **yes**, how long ago?)	Yes ☐ No ☐	☐ 3 months	☐ 6 months
		☐ 12 months	☐ 24 or more months
Have you ever been given an injection with corticosteroids? (If **yes**, how long ago?)	Yes ☐ No ☐	☐ 3 months	☐ 6 months
		☐ 12 months	☐ 24 or more months
Have you ever been given an injection of corticosteroids in or around the **Achilles** tendon? (If **yes**, how many times?)	Yes ☐ No ☐	☐ Once	☐ Twice
		☐ 3 times	☐ >3 times
Have you ever used fluoroquinoline antibiotics? (refer to the following list)	Yes ☐ No ☐	☐ 3 months	☐ 6 months
		☐ 12 months	☐ 24 or more months

List of some fluoroquinoline antibiotics:

ADCO-CIPRIN	CIPROBAY	SANDOZ CIPROFLOXACIN
AVELON	CIPROGEN	TAFLOC
BACTIDRON	CPL ALLIANCE CIPROFLOXACIN	TARIVID
CIFLOC	DYNAFLOC	TAVANIC
CIFRAN	FACTIVE	TEQUIN
CIPLA-CIPROFLOXACIN	FLOXIN	UNIQUIN
CIPLOXX	MAXAQUIN	UTIN-400
CIPRO-HEXAL	NOROXIN	ZANOCIN
	ORPIC	

Lifestyle and habits history			
Please indicate your smoking status	Current smoker ☐	Ex smoker ☐	Never smoked ☐
If you answered yes, (past or current smoker) please complete the section on the right	Number of years of smoking:	If stopped, how many years ago:	
	What is (was) the average number of cigarettes per day:		
On average, how much alcohol do you drink per week (tots, glasses) of spirits, wine or beer?	_____ glasses beer/cider per week _____ glasses wine per week _____ tots of spirits per week		

Fluid Intake		
How do you best describe your fluid intake during an Ironman triathlon race?	(a) I drink to thirst ☐ (b) I drink as much as tolerable ☐ (c) I drink according to a predetermined fluid intake schedule ☐ (d) I drink to prevent any weight loss during exercise ☐ (e) I combine (a) with (c) ☐ (f) I combine (b) with (c) ☐ (g) Other: _____ ☐	
What percentage of your fluid intake will consist of these beverages?	Water: ☐ 0-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% Sports drink: ☐ 0-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% Coke: ☐ 0-25% ☐ 26-51% ☐ 51-75% ☐ 76-100% Other: ☐ 0-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% Specify other: _____	
What will be your estimated **total** fluid intake be **(if at all)** during the **swim**?		ml
What will be your estimated **total** fluid intake be during the **cycle**?		ml
What will be your estimated **total** fluid intake be during the **run**?		ml
Rank the following sources of information on their importance in formulating your drinking strategy (1 being most influential and the lowest number being least influential)	_____ Fellow triathletes _____ Coach / trainer _____ Magazines / books _____ Website (please specify: _____) _____ Drinking guidelines from sports associations _____ Adverts _____ Self-experimentation _____ Other: _____	

Section D. Family medical history

Have any of your blood (biological) relatives ever had the following?

Please tick yes or no. If yes, please tick the relationship of that person to you (You may tick more than one of the relationship blocks).

Description		If Yes, please indicate the relationship
Exercise-associated muscle cramps	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Night muscle cramps	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Chronic Achilles tendon injury	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Achilles tendon rupture	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Any ligament injury	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Asthma	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Allergies (in general)	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Heart Disease	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother
Diabetes	Yes ☐ No ☐	☐ Father ☐ Mother ☐ Brother ☐ Sister ☐ Child ☐ Grandfather ☐ Grandmother

Section E. Personal general medical history

In this section, you are asked to read through 14 questions about your personal general medical history. If you answer "yes" to any of questions 1 to 12, please complete the additional questions at the end of the section (section F on page 11).

1. In the **6 weeks before this race** (from 1st February) did you suffer from any **symptoms of flu** (fever, sore throat, blocked or runny nose, cough, wheeze, muscle aches and pains)?	Yes ☐ No ☐
2. Have you **ever** in triathlon career suffered from **muscle cramping** during or immediately (within 6 hours) after exercise (in training or competition)?	Yes ☐ No ☐
3. Have you **ever** in your triathlon career suffered from **a tendon or ligament injury** (pain, swelling, stiffness) in any tendon (including Achilles tendon, knee tendons, and shoulder tendons) or ligaments (partial or complete tear)?	Yes ☐ No ☐
4. Have you **ever** in your triathlon career **used medicines to treat injuries** in the week **before or during a race** – including anti-inflammatory drugs, cortisone (pills, or injection), or pain killers?	Yes ☐ No ☐
5. Have you **ever** in your triathlon career suffered **gastrointestinal** symptoms **during exercise** including heartburn, nausea, vomiting, abdominal pain, urge to defecate (pass a stool), diarrhoea, or blood in the stools?	Yes ☐ No ☐
6. Have you **ever** in your triathlon career suffered from symptoms of the **nervous system** including exercise induced headaches, nerve tingling or loss of sensation?	Yes ☐ No ☐
7. Have you **ever** in your triathlon or cycling career (in particular with **cycling**) suffered from **injury to the genital area** including genital numbness after cycling, genital pain after cycling, genital swelling or altered sexual function after cycling?	Yes ☐ No ☐
8. Have you **ever** in your triathlon career suffered from **symptoms of allergies** including nose allergies (hay fever), allergic sinusitis, allergic asthma, skin allergies, a past history of allergies to medication, plant material or animal material?	Yes ☐ No ☐
9. Do you **currently suffer from asthma** including exercise induced asthma, or symptoms of asthma such as shortness of breath, wheezing, or chronic coughing?	Yes ☐ No ☐
10. Have you ever **collapsed** (fell down **not because of an accident**, needing medical attention) during, at the finish or after a race or training session?	Yes ☐ No ☐
11. Do you **currently** suffer from any **symptoms of injury** in the muscles, tendons, bones, ligaments or joints?	Yes ☐ No ☐
12. Do you **currently**, or did you **in the last year**, suffer from any symptoms of **exercise related skin disease**?	Sunburn: Yes ☐ No ☐ Skin cancer: Yes ☐ No ☐ Other skin damage resulting sun exposure: Yes ☐ No ☐

13. Please tick in which anatomical area you ever had **surgery** performed	☐ Head ☐ Neck ☐ Face ☐ Front chest ☐ Back chest ☐ Shoulder ☐ Upper arm ☐ Elbow ☐ Forearm ☐ Wrist ☐ Finger ☐ Lower back ☐ Hip ☐ Thigh ☐ Knee ☐ Lower leg ☐ Achilles ☐ Ankle ☐ Foot ☐ Abdomen ☐ Other (Specify: _____)
14. **Female athletes only:** Please complete the following questions (14a. to 14g.) related to your menstrual cycle and other gynaecological history	
14a. At what age did you start your periods (menstruating)?	(years)
14b. In the last 12 months, how many menstrual cycles did you have?	
14c. Have you ever had irregular menstrual periods in the past? (excluding pregnancy)?	Yes ☐ No ☐
14d. Have you had a hysterectomy/ovarectomy?	Yes ☐ No ☐
14e. How many times have you been pregnant?	(times)
14f. What form of contraception are you currently using?	☐ None ☐ Oral contraceptive pill ☐ Injection ☐ Intra-uterine device ☐ Sterilization (tubes tied) ☐ Other: _____
14g. If yes to question 14f. above, for oral contraceptive pill, for what reason was the pill prescribed?	☐ Not applicable ☐ Dermatological ☐ Contraception ☐ Regulate period ☐ Other: _____

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

If you have answered **YES** to any of the first 11 questions of the Personal General Medical History questionnaollow in section F.

If you have completed the questionnaire manually, please bring the completed forms together with the signed consent form to the research table at race registration.

If you have completed the questionnaire electronically using Microsoft word, please e-mail the completed forms to ironman@sports.uct.ac.za and bring the signed consent form to the research table at race registration.

Section F. Additional detailed medical history

(Please complete all the sections to which you answered "Yes" in the Personal general medical history)

1. Flu symptoms in the last 6 weeks

If you answered **YES** to **question 1** in section E, please complete the following two questions related to flu symptoms in the last 6 weeks.

(1a) Please tick which of these flu symptoms you suffered from **in the last 6 weeks**	☐ Fever ☐ Cough ☐ Joint pains ☐ Blocked nose ☐ Wheezing ☐ Runny nose ☐ Muscle aches ☐ Any other flu symptoms (Specify: _____)
(1b) Please tick which of these flu symptoms you suffered from **in the last 7 days**	☐ Fever ☐ Cough ☐ Joint pains ☐ Blocked nose ☐ Wheezing ☐ Runny nose ☐ Muscle aches ☐ Any other flu symptoms (Specify: _____)

2. Muscle cramping

If you answered **YES** to **question 2** in section E, please complete the following questions (2a. to 2m.) related to your cramping.

(2a) For how many years have you suffered from cramping?	(years)
(2b) Did you suffer from cramping during or after exercise in the **last 12 months**?	Yes ☐ No ☐
(2c) With what **type of exercise** is your cramping associated (You can tick more than one form of exercise)?	☐ Swimming ☐ Cycling ☐ Running
(2d) In the **last 10 races or training sessions**, how many times have you experienced cramping?	Races: ____/10 Training sessions: ____/10
(2e) What treatment/s have you had that **successfully relieved** an acute cramp? (can tick more than one)	☐ Stretching ☐ Resting ☐ Drinking fluid ☐ Ice application ☐ Massage ☐ Magnesium ☐ Salt (tablets or solution) ☐ Other (Specify: _____)
(2f) At **what point in the race or training run** do you usually first experience cramping?	☐ First quarter ☐ Second quarter ☐ Third quarter ☐ Fourth quarter ☐ After the race ☐ No pattern
(2g) In which **muscles** do you usually cramp (please list the muscle by the one which cramps most frequently (as 1) and the others after that (2-4)?	☐ Calves ☐ Hamstrings ☐ Quadriceps (thigh) ☐ Foot muscles ☐ Other (Specify: _____)
(2h) Have you **ever** suffered from cramping in your **whole body** (arms and legs)?	Yes ☐ No ☐
(2i) Have you **ever** been **admitted to hospital** following cramping?	Yes ☐ No ☐

(2j) Have you **ever** been **confused or in a coma** during or after a cramping episode?	Yes ☐ No ☐
(2k) Have you ever had **"dark urine"** in the 3 days following a cramping episode?	Yes ☐ No ☐
(2l) If you cramp, **how long** does the cramp usually last for (min)?	(minutes)
(2m) If you cramp, how **severe** is the cramp usually? (please tick)	☐ Mild: < 5 minutes and you are able to continue exercising ☐ Moderate: 5-15 minutes and you are able to continue exercising ☐ Severe: >15 minutes or if you have to STOP exercising

3. Past Tendon and Ligament Injury History

If you answered **YES** to **question 3** in section E, please complete the following questions (3a. to 3d.) related to your past history of tendon/ligament injury/ies.

(3a) Please tick which **tendon/s** you have injured? (next column on the tright)

Also indicate (tick) if your injured tendon was longstanding pain (tendinopathy) or an acute tear/rupture

Tendon		Longstanding Pain (Tendinopathy)	Acute Tear/ Rupture
Foot and ankle:	☐ Achilles tendon	☐	☐
	☐ Tibialis posterior	☐	☐
	☐ Plantar fascia	☐	☐
Knee	☐ Patellar tendon	☐	☐
Elbow and wrist:	☐ Wrist extensor tendon	☐	☐
Shoulder:	☐ Rotator cuff	☐	☐
Other: _____		☐	☐

(3b) Please tick which **ligament/s** you have injured? (next column on the tright)

Also indicate if your sprained or completely tore the ligamant

Ligament	Sprain	Complete Tear
☐ Shoulder ligaments	☐	☐
☐ Elbow ligaments	☐	☐
☐ Wrist ligaments	☐	☐
☐ Finger ligaments	☐	☐
☐ Knee (ACL)	☐	☐
☐ Knee (MCL)	☐	☐
☐ Knee (PCL)	☐	☐
☐ Knee (LCL)	☐	☐
☐ Ankle lateral ligaments	☐	☐
☐ Ankle medial ligaments	☐	☐
☐ Spinal ligaments	☐	☐
☐ Other: _____	☐	☐

(3c) Please tick if you have you ever suffered from any of the following **joint capsule** injuries?	☐ Acute shoulder dislocation ☐ Chronic shoulder instability ☐ Other: _____
(3d) Do you suffer from any other **connective tissue or rheumatological diseases** or disorders? (If yes, please specify which one)	Yes ☐ No ☐ (refer to the list on the next page) (If yes, specify: _____)

List of some Connective Tissue and/or Rheumatic Diseases and Disorders		
Ankylosing Spondylitis	Lipid Storage Diseases	Pseudogout
Aspartylglycosaminuria (AGU)	Marfan Syndrome	Reactive Arthritis
Behcet's Syndrome	Menkes Kinky Hair Syndrome	Reiter's Syndrome
Crohn's Disease	Mucopolysaccharidoses	Relapsing Polychrondritis
Discoid Lupus Erythematosus	Myopathies and Dystrophies	Scleroderma
Ehlers-Danlos syndrome (EDS)	Ochronosis (Homocystinuria)	Sjogren's Syndrome
Eosinophilic Fascitis	Osteogenesis imperfecta (OI)	Systemic Lupus Erythematosus (SLE)
Giant Cell (Temporal) Arthritis	Polyarteritis Nodosa	Systemic Sclerosis
Gout	Polymyalgia Rheumatica	Wegener's Granulomatosis
Hypersentive Vasulatis	Polymyositis & Dermatomyositis	

4. Use of medicines to treat an injury before or during participation

If you answered **YES** to **question 4** in section E, please complete the following two questions related to medicine use for injuries before or during races

(4a) Which of the following medicines have you used in the past to treat an injury **in the week just before** a race?	☐ Paracetamol (e.g. Panado, Tylenol) ☐ Non-steroidal anti-inflammatories (e.g. Voltaren, Cataflam) ☐ Cortisone (pills) ☐ Cortisone injection ☐ Codeine ☐ Anti-inflammatory gels/creams/patches ☐ Any other pain killers (Specify: _____)
(4b) Which of the following medicines have you used in the past to treat an injury **during a race**?	☐ Paracetamol (e.g. Panado, Tylenol) ☐ Non-steroidal anti-inflammatories (e.g. Voltaren, Cataflam) ☐ Cortisone (pills) ☐ Cortisone injection ☐ Codeine ☐ Anti-inflammatory gels/creams/patches ☐ Any other pain killers (Specify: _____)

5. Gastrointestinal symptoms during exercise

If you answered **YES** to **question 5** in section E, please indicate which gastrointestinal symptoms you have ever suffered from **during exercise** and, how frequently (in the last 12 months and in the last 10 races), and in which type of exercise.

Symptom	Number of times in the last 12 months **(during exercise)**	Number of times in last 10 races **(during races)**	Tick type of exercise
Nausea			☐ Swimming, ☐ Cycling, ☐ Running
Vomiting			☐ Swimming, ☐ Cycling, ☐ Running
Heartburn			☐ Swimming, ☐ Cycling, ☐ Running
Abdominal pain			☐ Swimming, ☐ Cycling, ☐ Running
Urge to pass a stool (defecate)			☐ Swimming, ☐ Cycling, ☐ Running
Diarrhoea			☐ Swimming, ☐ Cycling, ☐ Running
Passing blood in the stool			☐ Swimming, ☐ Cycling, ☐ Running

6. Diseases of the nervous system

If you answered **YES** to **question 6** in section E, please indicate which nervous disease symptoms you have ever suffered from **during exercise** and, how frequently (in the last 12 months and in the last 10 races), and in which type of exercise

Symptom	Number of times in the last 12 months **(during exercise)**	Number of times in last 10 races **(during races)**	Tick type of exercise
Headaches			☐ Swimming, ☐ Cycling, ☐ Running
Nerve tingling in the hands			☐ Swimming, ☐ Cycling, ☐ Running
Loss of sensation in the hands			☐ Swimming, ☐ Cycling, ☐ Running

7. Genital tract injury during cycling

If you answered **YES** to **question 7** in section E, please indicate which symptoms of genital tract injury have you suffered from **during or after cycling**, how frequently (in the last 10 sessions), how long symptoms last, and what factors prevent or relieve symptoms?

Symptom	Number of times in the last 10 cycling sessions	Please indicate when the symptoms occur	Please indicate if any of the following reduce or prevent the symptoms (can tick more than one)
Genital numbness		☐ Only during cycling ☐ During and up to 1 hour after cycling ☐ During and 1-24 hours after cycling ☐ During and > 24 hours after cycling	☐ Changing the saddle type ☐ Changing the saddle position ☐ Using padded cycling shorts ☐ Wearing no underwear ☐ Wearing additional underwear ☐ Other (Specify: _____)
Genital pain		☐ Only during cycling ☐ During and up to 1 hour after cycling ☐ During and 1-24 hours after cycling ☐ During and > 24 hours after cycling	☐ Changing the saddle type ☐ Changing the saddle position ☐ Using padded cycling shorts ☐ Wearing no underwear ☐ Wearing additional underwear ☐ Other (Specify: _____)
Genital bruising		☐ Only during cycling ☐ During and up to 1 hour after cycling ☐ During and 1-24 hours after cycling ☐ During and > 24 hours after cycling	☐ Changing the saddle type ☐ Changing the saddle position ☐ Using padded cycling shorts ☐ Wearing no underwear ☐ Wearing additional underwear ☐ Other (Specify: _____)
Altered sexual function following a cycling session		☐ Up to 1 hour after cycling ☐ 1-24 hours after cycling ☐ > 24 hours after cycling	☐ Changing the saddle type ☐ Changing the saddle position ☐ Using padded cycling shorts ☐ Wearing no underwear ☐ Wearing additional underwear ☐ Other (Specify: _____)

8. Allergy history

If you answered **YES** to **question 8** in section E, please complete the following questions (8a. to 8e.) related to your current and past history of allergies

(8a) Please indicate how long (years) have you been suffering from allergies?					years
(8b) Please tick which <u>type of allergy</u> do you currently suffer from					
Nose (hay fever)	Yes ☐ No ☐	Sinusitis	Yes ☐ No ☐	Asthma (allergic)	Yes ☐ No ☐
Skin allergies	Yes ☐ No ☐	Eye allergies	Yes ☐ No ☐	Allergy to plant material	Yes ☐ No ☐
Allergy to foods	Yes ☐ No ☐	Allergy to animals	Yes ☐ No ☐	Other	
(8c) Please tick which <u>type of allergy</u> do you <u>currently take medication</u> for					
Nose (hay fever)	Yes ☐ No ☐	Sinusitis	Yes ☐ No ☐	Asthma (allergic)	Yes ☐ No ☐
Skin allergies	Yes ☐ No ☐	Eye allergies	Yes ☐ No ☐	Allergy to plant material	Yes ☐ No ☐
Allergy to foods	Yes ☐ No ☐	Allergy to animals	Yes ☐ No ☐	Other	
(8d) Please tick which <u>type of medication</u> do you <u>currently take</u>					
Cortisone nose spray	Yes ☐ No ☐	Cortisone nose inhaler	Yes ☐ No ☐	Anti-histamine tablets	Yes ☐ No ☐
Cortisone cream	Yes ☐ No ☐	Anti-histamine cream	Yes ☐ No ☐	Other inhaler / tablets or cream	Yes ☐ No ☐
(8e) Please tick which <u>symptoms of allergy</u> do you <u>currently suffer</u> from					
Sneezing	Yes ☐ No ☐	Itchy runny nose	Yes ☐ No ☐	Headache	Yes ☐ No ☐
Itchy palate	Yes ☐ No ☐	Streaming eyes	Yes ☐ No ☐	Fatigue	Yes ☐ No ☐
Itchy eyes	Yes ☐ No ☐	Blocked nose	Yes ☐ No ☐	Poor sleep	Yes ☐ No ☐
Post nasal drip	Yes ☐ No ☐	Coughing	Yes ☐ No ☐	Wheezing	Yes ☐ No ☐
In which months of the year do you <u>currently</u> have symptoms of allergies? (You tick more than one)	☐ Jan ☐ Feb ☐ March ☐ April ☐ May ☐ June ☐ July ☐ Aug ☐ Sept ☐ Oct ☐ Nov ☐ Dec				
(8f) Please tick which <u>type of allergy</u> did you suffer from in the past (NOT currently)					
Nose (hay fever)	Yes ☐ No ☐	Sinusitis	Yes ☐ No ☐	Asthma (allergic)	Yes ☐ No ☐
Skin allergies	Yes ☐ No ☐	Eye allergies	Yes ☐ No ☐	Allergy to plant material	Yes ☐ No ☐
Allergy to foods	Yes ☐ No ☐	Allergy to animals	Yes ☐ No ☐	Other	

9. Asthma history

If you answered **YES** to **question 9** in section E, please complete the following questions (9a. to 9k.) related to your current history of asthma

(9a) Do you currently suffer from asthma?	Yes ☐ No ☐
(9b) How many years have you suffered from asthma?	(years)
(9c) How was your asthma diagnosed?	☐ A doctor taking a history and performing an examination ☐ Lung function test (blow test) but no exercise ☐ Lung function test (blow test) before and after exercise ☐ Metacholine challenge test ☐ Eucapnic hyperventilation test (rebreathing test) ☐ Other test (Specify: _____)
(9d) Which **type of asthma** do you currently suffer from?	☐ Asthma that occurs at any time but not during exercise ☐ Asthma that occurs at any time including during exercise ☐ Asthma that only occurs during exercise
(9e) Please indicate **how frequently do you currently experience the symptoms** of asthma (shortness of breath, wheezing, coughing or coughing after exercise)?	**Daytime symptoms (per week)** ☐ < 2 / week ☐ 2-4 / week ☐ >4 / week ☐ All the time **Night time symptoms (per month)** ☐ < 1 / month ☐ 2-3 / month ☐ ≥4 / month ☐ All the time **Exercise related symptoms (per 10 exercise sessions)** ☐ <1 per 10 sessions ☐ 2-3 per 10 sessions ☐ ≥4 per 10 sessions
(9f) Please indicate if you had symptoms of asthma that were severe enough to necessitate **hospital admission in the last 12 months**	☐ No hospital admission for asthma in the last 12 months ☐ 1-2 hospital admissions for asthma in the last 12 months ☐ 3-4 hospital admissions for asthma in the last 12 months ☐ >4 hospital admissions for asthma in the last 12 months
(9g) Which **symptoms of asthma** do you currently suffer from?	☐ Wheezing ☐ Dry cough ☐ Shortness of breath ☐ Tight chest ☐ Chest pain ☐ Other (Specify: _____)

(9h) What **medication do you currently use** for your asthma? (you may tick more than one option)	☐ Cortisone inhaler (e.g. Beclate, Becloforte, Becodisks, Becotide, Budeflam, Flixotide, Inflammide, Pulmicort, Qvar, etc) ☐ Salbutamol (bronchodilator) inhaler (e.g. Ventolin, Venteze, Vomax, Airomir, Asthavent etc.) ☐ Salmeterol (bronchodilator) inhaler (Serevent) ☐ Fenoterol (bronchodilator) inhaler (Berotec) ☐ Terbutaline (bronchodilator) inhaler (Bricanyl) ☐ Formoterol (bronchodilator) inhaler (e.g. Foradil, Foratec, Oxis) ☐ Ipratropium (bronchodilator) inhaler (Atrovent) ☐ Tiotropium (bronchodilator) inhaler (Spiriva) ☐ Combined cortisone and bronchodilator inhaler (e.g. Atrovent, Berodual, Combivent, Duolin, Duovent, Seretide, Symbicord) ☐ Cortisone tablets ☐ Bronchodilator tablets ☐ Leukotriene receptor antagonist tablets (e.g. Accolate, Singulair) ☐ Other inhaler ☐ Other medication (Specify: _____)
(9i) **When do you use your medication** for your asthma?	☐ Daily (irrespective of exercise) ☐ Only before exercise ☐ Other (Specify: _____)
(9j) **How long before an exercise session** do you use your medication for asthma?	min
(9k) Have you obtained **TUE (therapeutic use exemption forms)** for your asthma medication?	Yes ☐ No ☐

10. History of previous collapse If you answered **YES** to **question 10** in section E, please complete the following questions (10a. to 10d.) related to your current history of asthma	
(10a) Have you collapsed during training or racing?	☐ Training ☐ Racing ☐ Training and racing
(10b) How many times have you collapsed in training session or races during the last **five years**?	_____ training session _____ races
(10c) When you collapse, does it mostly occur before of after the finish line / completion of the training session?	☐ Before the finish ☐ After the finish
(10d) What is the cause of you collapse?	☐ Dehydration ☐ Heat illness ☐ Hyponatremia ☐ Low blood pressure ☐ Low blood sugar ☐ Other condition (Specify: _____)

11. History of any current injury that you suffer from

If you answered **YES** to **question 11** in section E please complete the following questions (11a. to 11g.) related to each of your current injury/ies (Space is provided for two injuries)

Injury 1			
(11a) What was the approximate date when you first became aware of the injury?	Month	Year	
(11b) Please indicate which side of your body is injured (if applicable)	☐ Right	☐ Left	
(11c) Please indicate which anatomical area is currently injured	☐ Head ☐ Neck ☐ Face ☐ Front chest ☐ Back chest ☐ Shoulder ☐ Upper arm	☐ Elbow ☐ Forearm ☐ Wrist ☐ Finger ☐ Lower back ☐ Hip ☐ Thigh	☐ Hamstring ☐ Quadriceps ☐ Knee ☐ Shin ☐ Achilles ☐ Ankle ☐ Foot
	Other (Specify: _____)		
(11d) Please indicate the type of structure that was injured	☐ Muscle ☐ Tendon ☐ Bone	☐ Ligament ☐ Joint	
	Other (Specify: _____)		
(11e) Please indicate in which sport (discipline) the injury occurred	☐ Running ☐ Swimming	☐ Cycling	
	Other (Specify: _____)		
(11f) Please indicate the severity of the injury (tick one box please)	☐ I only experience symptoms after exercise - Grade 1 ☐ I experience symptoms during exercise, but it does not interfere with exercise - Grade 2 ☐ I experience symptoms during exercise that may interfere with my training/ competition - Grade 3 ☐ I am so painful that I may not be able to train or compete - Grade 4		
(11g) Please indicate how your injury was treated to date (you can tick more than one)?	☐ Rest ☐ Stretches ☐ Physiotherapy ☐ Surgery ☐ Strengthening exercises ☐ Equipment change	☐ Tablets ☐ Cortisone injection ☐ Other injection ☐ Orthotics	
	Other (Specify: _____)		

Injury 2			
(11a) What was the approximate date when you first became aware of the injury?	Month		Year
(11b) Please indicate which side of your body is injured (if applicable)	☐ Right	☐ Left	
(11c) Please indicate which anatomical area is currently injured	☐ Head ☐ Neck ☐ Face ☐ Front chest ☐ Back chest ☐ Shoulder ☐ Upper arm	☐ Elbow ☐ Forearm ☐ Wrist ☐ Finger ☐ Lower back ☐ Hip ☐ Thigh	☐ Hamstring ☐ Quadriceps ☐ Knee ☐ Shin ☐ Achilles ☐ Ankle ☐ Foot
	Other (Specify: _____)		
(11d) Please indicate the type of structure that was injured	☐ Muscle ☐ Tendon ☐ Bone	☐ Ligament ☐ Joint	
	Other (Specify: _____)		
(11e) Please indicate in which sport (discipline) the injury occurred	☐ Running ☐ Swimming	☐ Cycling	
	Other (Specify: _____)		
(11f) Please indicate the severity of the injury (tick one box please)	☐ I only experience symptoms after exercise - Grade 1 ☐ I experience symptoms during exercise, but it does not interfere with exercise - Grade 2 ☐ I experience symptoms during exercise that may interfere with my training/ competition - Grade 3 ☐ I am so painful that I may not be able to train or compete - Grade 4		
(11g) Please indicate how your injury was treated to date (you can tick more than one)?	☐ Rest ☐ Stretches ☐ Physiotherapy ☐ Surgery ☐ Strengthening exercises ☐ Equipment change	☐ Tablets ☐ Cortisone injection ☐ Other injection ☐ Orthotics	
	Other (Specify: _____)		

Appendix 5: Research Ethics letter of approval

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
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Observatory 7925
Telephone (021) 406 6338 • Facsimile (021) 406 6411
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13 January 2006

REC REF: 425/2005

Assoc Prof MP Schwellnus
Department of Human Biology
UCT/MRC Research Unit for Exercise Science and Sports Medicine
Medical School

Dear Prof Schwellnu

THE PORT ELIZAB IRONMAN TRIATHLON 2006: MEDICAL CONSEQUENCES FOLLOWING E DURANC PORTS

Thank you for your letter to the Research Ethics Committee dated 14 December 2005, addressing the issues raised by the committee. It is a pleasure to inform you that the Ethics Committee has formally approved the above mentioned study.

Please quote the REC. ll your correspondence

Yours sincerely

Signed by candidate

Signature Removed

PROF.T ZABOW
CHAIRPERSON