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Kinanthropometric differences between 1997 World championship junior elite and 2011 national junior elite triathletes

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ABSTRACT

Objectives: In 1997, anthropometry measures were made to determine the body size and shapes of both senior and junior elite triathletes. Since then, the junior event distance has changed and the optimal morphology of participants may have evolved. Thus the objective of this study was to compare the morphology of 1997 World championship junior elite triathlon competitors with junior elite competitors in 2011.
Design: Comparative study of junior elite triathlete kinanthropometry.
Methods: Twenty-nine males and 20 females junior elite competitors in the 1997 Triathlon World Championships underwent 26 anthropometric measurements. Results were compared with 28 male and 14 female junior elite triathletes who competed in the 2011 Australian National Junior Series, as qualifying for 2011 Triathlon World Championships. Comparisons were made on the raw scores, as well as somatotype, and body proportional scores.
Results: Both male and female junior elite triathletes in the 2011 group were significantly more ectomorphic than their 1997 counterparts. The 2011 triathletes were also proportionally lighter, with significantly smaller flexed arm and thigh girths, and femur breadths. The 2011 males recorded significantly longer segmental lengths and lower endomorphy values than the 1997 junior males.
Conclusions: Junior elite triathlete morphology has evolved during the past 14 years possibly as a result of changing race distance and race tactics, highlighting the importance of continually monitoring and updating such anthropometric data.

1. Introduction

The three disciplines of swimming, cycling and running, have remained consistent in the sport of triathlon since its inception. However, race distances have varied considerably, and 'drafting' is now legal in the cycle component. A standard triathlon race distance, comprising a 1.5 km swim, 40 km cycle and a 10 km run has been used to determine World champions since 1989 and Olympic champions from 2000.

The draft legal cycle leg was introduced to elite competition in 1996. Although gender differences have been reported with respect to the relative importance of each discipline,[1,2] draft legal cycling in triathlon has led to the increased importance of swimming and running[1,3,4] to the final outcome. This is in contrast to non-drafting events where final finishing position is highly correlated with cycling performance.[5] At the 1997 Triathlon World Championships (TWC) drafting was legalised for the junior elite competitors for the first time and in 2002 junior elite competitors competed for a world title over the shorter sprint distance (750 m swim, 20 km cycle and 5 km run) triathlon for the first time. Since the physiological demands vary according to the effect of drafting during the cycle[6,7] and the length of the triathlon[8] it is now timely to investigate if the morphological traits demanded in competition have altered since the change in junior elite race format.

Early research investigating the body shapes of triathletes conducted prior to draft legal triathlon made comparisons of the triathletes with athletes who competed in each of the individual disciplines.[9,10] It was suggested that both male and female triathletes were more like Olympic swimmers and runners with respect

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to body shape and composition.[9,10] Similarities in the anthropometry between elite males measured in the 1980s compared to those measured in the 1990s suggested that the physical characteristics may have stabilised 20 years after the introduction of the sport.[10] However, as drafting had not yet been legalised such morphological changes may have occurred since the change in race format. More recent research has indicated that important anthropometric characteristics of successful triathletes were low levels of adiposity and proportionately longer segmental lengths.[1,11] More recently, body height and running stride length were also suggested to influence triathlon performance.[12] The latter paper suggested that senior elite triathletes tended to record lower body mass than previously measured and that their body shapes could be continuing to evolve as the sport of triathlon develops beyond its infant stages as has occurred previously in other sports.[12–14]

Kinanthropometric differences and their relative importance to race outcome have been identified between junior and senior elite triathletes.[15] Senior elite females were less endomorphic and had lower sum of skinfolds than the junior elite females. While the junior elite males reported smaller segmental lengths, girths and breadths, they were not proportionately different from the senior elite male triathletes possibly indicating maturity differences between the two male groups.[15] Over time, one could possibly determine from this analysis that segmental lengths and adiposity may still be important to performance. Whether these variables have become less or more important is yet to be determined.

The importance of a high aerobic capacity has also been identified for successful triathlon performance.[16–18] However, it is interesting to note that physiological differences have been reported between genders,[17] juniors and seniors[16] and triathletes in various race distances.[5,18] Thus if differences exist between the physiological variables there may also be differences in morphological variables.

Due to the changes in race distance and draft-legal cycling for junior elite triathlon competitors, the morphological data collected of junior elite triathletes in 1997 could be outdated and may no longer be valid.[3,19] Therefore, this paper compared kinanthropometric variables of the 2011 junior elite triathletes competing in the 2011 Australian National Junior Series (AJTS) with data collected from the 1997 TWC junior elite competitors. The project sought to identify any morphological characteristics that may have changed over the 14 year time period, and examine whether any such characteristics may provide a performance advantage in the modern junior triathlon. Such findings could lead to improved training practices, talent identification and a greater understanding of the body shape of triathletes. As previous research has indicated that there may be a trend for reduced body mass at the elite level,[12] and that low levels of adiposity and longer lever lengths may be advantageous to performance[1,11] it may be possible that current 2011 junior triathletes would be lighter, more ectomorphic and have longer lever lengths than their 1997 counterparts. Thus it was hypothesised that 2011 junior elite triathletes would record significantly different anthropometric measurements with reduced body mass, lower levels of adiposity and proportionately longer lever lengths, when compared with their 1997 junior elite counterparts.

2. Methods

The sample comprised junior elite triathletes competing in the 1997 TWC in Perth, Australia and those competing in the 2011 AJTS. The 1997 TWC junior sample ($n = 49$) were male and female competitors from nine nations. The junior elite male sample consisted of 29 triathletes (18.6 ± 1.1 y), three of whom finished in the top 20. The junior elite female sample comprised 20 triathletes (18.5 ± 1.5 y), of whom eight placed in the top 10. Of note, in the 1997 Triathlon World Championships, the junior elite field was limited to 80 triathletes, allowing a maximum of six competitors to represent each country.

Forty-two junior elite triathletes were measured during the 2011 AJTS. In all, data were recorded from 28 male (18.1 ± 1.0 y) and 14 female (17.7 ± 1.0 y) junior elite competitors. This sample included the three male (5th, 12th, 31st) and three female (2nd, 18th, 20th) Australian 2011 world championship representatives (in 2011 countries were permitted a maximum of three male and female representatives at the TWC). In order to compete in the 2011 AJTS, athletes must be age 16–19 years, have cycling skills to ride safely in a group, and achieve benchmark 1000 m swim (male = 13 min:30 s; female = 14 min:30 s) and 5 km run times (male = 17 min:30 s; female = 19 min:30 s).

All participants and coaches were briefed as to the purpose, requirements and risks of involvement in the project. Written consent was obtained in accordance with the requirements of the Human Ethics Committee of The University of Western Australia prior to measurement and all ethical guidelines for human investigation were followed.

For the 1997 triathletes, a mobile laboratory was transported to accommodation and training venues for each of the teams. Hence, the triathletes could be measured in a single session during a resttime within their training schedule. Most athletes were measured in the seven day period prior to the championships with only four measured after the completion of the event. The 2011 AJTS testing was conducted at the race venue in a single session 48 h post event.

All participants in the 2011 AJTS underwent 26 anthropometric dimensions previously reported by for the collection of the 1997 TWC data.[1] After land marking by a criterion anthropometrist, participants moved sequentially to each of five stations for the measurement of eight skinfolds, six limb lengths, five segment girths, four segment breadths, plus body mass and stretch stature. All variables were measured on the right side of the body and measured twice. If a difference of greater than 0.2 mm for skinfolds, or 0.5 cm for other variables, was recorded, a third measure was taken. The final score used in the data analysis was the mean of the two scores or the median of three. The standard procedures for each measurement followed those of the International Society for the Advancement of Kinanthropometry.[20] All measurements were made by trained anthropometrists whose technical errors of measurement were determined from a sub set of 10 participants (skinfolds = 2.3%; lengths 0.4%; girths = 1.6%; breadths = 0.6%). These values were within the recommended target values.[21]

Data were entered onto a spread sheet, from which means and standard deviations for each characteristic were calculated. Somatotype was determined via somatotype formulae[13] and the phantom stratagem was used to determine triathlete proportionality for all measurements.[22] Standard formulae were employed to determine brachial and crural indices (BI & CI respectively) and relative lower limb length (RLLL). Comparisons via a Student's *t*-test were made between the 1997 and the 2011 competitors based on gender. All statistical analyses were conducted using SPSS Statistics 18 (2009), and alpha was set at $p < 0.05$.

3. Results

The mean chronological ages for the 1997 and 2011 females and males were not significantly different. No measures of biological maturity were recorded but the data are representative of triathletes who actually compete against each other. The elite juniors ranged from 16 to 20 years and therefore could include several athletes who had not reached full maturity.