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Weight Changes, Sodium Levels, and Performance in the South African Ironman Triathlon

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Objective: To establish relationships between body weight changes and serum sodium during and after an Ironman Triathlon, and postrace fluid status and rectal temperature, including the incidence of hyponatremia.

Design: Descriptive research.

Setting: The 2000 South African Ironman Triathlon, in which each athlete swam 3.8 km, cycled 180 km, and ran 42.2 km.

Participants: All entrants in the race were invited to participate in the study.

Methods: Athletes were weighed at registration, immediately prerace, immediately postrace, and 12 hours later. Blood samples were drawn at registration and immediately postrace. Rectal temperatures were measured postrace.

Results: Starting body weight was significantly related to total finishing time ($r = 0.27$) and to cycling ($r = 0.20$) and running ($r = 0.28$) time. Body weight decreased significantly ($p < 0.0001$) during the race and had not returned to prerace values 12 hours later ($p < 0.0001$). Percentage change in body weight was unrelated to postrace rectal temperatures and inversely related to the postrace serum sodium concentrations ($r = -0.45$). Postrace serum sodium concentrations fell within a normal distribution (141.8 ± 3.1 mmol.L^{-1}, mean ± SD) and were negatively correlated to overall triathlon time ($r = -0.22$). Three sodium values (0.6%) were below 135 mmol.L^{-1}. Percentage change in body weight was unrelated to time in the marathon leg.

Conclusions: Percentage change in body weight was linearly related to postrace serum sodium concentrations but unrelated to postrace rectal temperature or performance in the marathon. There was no evidence that in this study, more severe levels of weight loss or dehydration were related to either higher body temperatures or impaired performance.

Key Words: Body weight—Sodium—Rectal temperature.

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INTRODUCTION

Significant blood electrolyte disturbances are uncommon in competitive running races at distances of up to 42 km. However, an increasing proportion of athletes develops either hypernatremia or hyponatremia in ultradistance running and triathlon events, which last for 6 or more hours.[1] For example, serum sodium concentrations in 26% of the 2,384 blood samples drawn over 20 years in the medical facility at the finish of the 226-km world championship Hawaiian Ironman Triathlon were below 135 mmol.L^{-1}, while another 31% were above 145 mmol.L^{-1} (R. Laird and T. D. Noakes, Unpublished data, 1998). As a result, 57% (1,358 individuals) of triathletes who sought medical care at that event completed the race with serum sodium concentrations outside the normal range of 135 to 145 mmol.L^{-1}. Similarly, in the 1997 New Zealand Ironman Triathlon, 17% (112 individuals) of the total 660 triathletes completed the race with serum sodium concentrations outside the normal range.[2]

It remains unclear why serum sodium concentrations are so poorly regulated in such a large proportion of ultradistance triathletes. Factors that may contribute to this inappropriate regulation include 1) dehydration, or alternatively 2) overhydration if appropriate renal function fails to excrete a fluid excess secondary to sustained high rates of fluid ingestion,[3] or 3) an accumulated sodium deficit that is not corrected by the ingestion of sodium-free foodstuffs, water, or sports drinks, all of which have sodium concentrations that are lower than those measured in sweat.[4]

There have been only two previous studies in which changes in body weight and in serum electrolyte concentrations were measured in all the competitors in an ultradistance (triathlon) event.[2,5] The first Ironman distance triathlon held on the African continent provided the opportunity to repeat aspects of these studies. We wished specifically to study whether the frequency with which hyponatremia developed in those triathletes was similar

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to that reported in similar Ironman events. Furthermore, we wished to establish the relationship between changes in body weight and serum sodium concentrations during and after the race and the relationship of those variables to racing performance. In addition, by measuring postrace rectal temperatures, we aimed to examine the relationship between postrace fluid status and rectal temperature and to establish how those and other factors relate to endurance performance. It is generally believed that dehydration impairs performance, especially during ultradistance events, by impairing heat loss, thereby causing an elevation in the rectal temperature.[6]

METHODOLOGY

All entrants in the first official South African Ironman Triathlon, held on February 5, 2000, at Gordons Bay, situated 55 km from Cape Town, were invited to participate in the study. Each athlete was contacted before the race and was sent a complete explanation of the study and an informed consent form. Athletes were requested to bring the consent forms to the race registration that was held for the 3 days prior to the race. During this time, each entrant in the race underwent an interview to ensure a complete understanding of the aims and methods of the study. Athletes who had not been previously informed of the study were also invited to participate in the study after having given informed consent. Approval for this study was obtained from the Research and Ethics Committee of the Faculty of Health Sciences, University of Cape Town. The South African Weather Bureau provided details of the environmental conditions on race day.

Measurement of Body Weights and Rectal Temperatures

Two hundred seventy-one of the total 356 entrants were weighed during registration. Subjects were weighed using calibrated Adamlab JPS electronic scales (Scales, Brackenfell, South Africa) that were placed on a hard, flat surface. All subjects were weighed in standardized clothing. Body weight was then corrected for this clothing (250 g) and calculated as net body weight.

On the morning of the race, 307 triathletes were weighed before the start of the swimming leg. Subjects were weighed on the same scales, without shoes and in their swimming costumes, to record their net starting body weight.

All athletes finishing the race were asked to enter the medical tent for further testing and a medical evaluation before being discharged. Immediately on entering the medical tent, subjects were weighed without shoes. If athletes were too fatigued to remove their shoes, their body weight was corrected for the extra weight of the shoes. A sample of 20 pairs of running shoes was weighed to obtain an average running shoe weight, which was determined as 750 g for both running shoes. Body weight was also corrected for the weight of the running clothes (200 g). The total number of athletes weighed in the medical tent after the race was 293. Immediately after they had been weighed, subjects were directed to the nearest vacant treatment cot, where they lay supine. As soon as possible after the subject had entered the tent, rectal temperature was obtained using calibrated electronic clinical thermometers (Microlife, Berneck, Switzerland) inserted 5 cm into the rectum and left until the thermometer recorded a stable reading, usually within 30 seconds. Following this measurement, a 4.5-mL venous blood sample was drawn from the athletes for the measurement of postrace serum electrolytes.

The following day, 138 triathletes were reweighed at the prize ceremony, using the same scales. Body weight was again corrected for standardized clothing (250 g) and calculated as net body weight.

On each occasion that measurements were taken or body weight measured, an attempt was made to collect data from all subjects competing in the event. Because these measurements were not compulsory, however, and on some occasions not possible due to time constraints, not every athlete participating in the trial could be included in all of the measurements. Accordingly, the number of subjects in the different sample groups for each measured variable has been indicated, where applicable, in the results.

Biochemical Analysis

Subjects willing to participate in the study had a 4.5-mL venous blood specimen drawn by venipuncture in the supine position into lithium heparin vacutainer tubes. Blood was sampled at race registration and within 10 minutes of finishing the race for the analysis of prerace and postrace serum electrolyte concentrations. The blood samples were centrifuged at 3000 × g for 10 minutes at 4°C, and the plasma sodium, potassium, and chloride concentrations were analyzed using an EasyLyte PLUS Na/K/Cl analyzer (Medica Corp., Bedford, MA).

Calculation of Results

Body mass was corrected for standardized clothing by subtracting the mass of the clothes from the measured mass of the athlete. Percent of body mass lost or gained was calculated as the difference between the initial and final masses divided by the initial mass and expressed as a percentage. Although we were unable to calculate the exact levels of dehydration incurred during this study, we made the assumption that the percentage body weight change would approximate postrace hydration status.

Statistical Analysis

Data were analyzed using a computer based statistical program. A Student's dependent *t*-test was used to analyze differences between values obtained before and after the race, and correlation analysis was used to determine relationships between all variables measured during the study. Multiple regression analysis techniques were used to determine the effects of starting body weight and percent change in body weight on performance parameters. An ANOVA was used to determine differences between athletes grouped according to percentage change in body weight and starting body weight. Statistical significance was accepted when $p < 0.05$.

TABLE 1. *Body weights (kg) and changes in body weight (kg) of triathletes competing in the 2000 South African Ironman triathlon*

	Mean ± SD	Range	N
Registration	75.8 ± 10.4	49.3–103.2	271
Race start	76.7 ± 10.1	49.7–104.5	307
Race finish	72.8 ± 9.5	48.6–101.0	293
Prize giving	73.9 ± 10.7	49.2–102.9	138

	Mean ± SD	Range (N)	Change (%)
Registration to race start	0.9 ± 0.9***	−1.8–3.9 (262)	1.1 ± 1.2
Race start to race finish	−3.7 ± 1.6***	−12.8–0.1 (283)	5.2 ± 2.2
Race start to prize giving	−2.2 ± 1.3***	−5.7– −1.1 (137)	3.1 ± 1.8
Race finish to prize giving	1.4 ± 1.4***	−7.2– −3.8 (134)	1.9 ± 1.9

*** P < 0.0001.

RESULTS

Three hundred fifty-six triathletes (311 males and 45 females) registered for this race. Three hundred seven of these athletes (278 males and 29 females) were weighed immediately prior to the start of the race. Average age, height, and starting mass of these triathletes were 34.8 ± 7.8 years, 179.0 ± 9.9 cm, and 76.7 ± 10.1 kg, respectively. On race day, the average temperature was 20.5°C, ranging from 17.0 to 23.9°C. At midday, the temperature was 21.7°C with a relative humidity of 55%. This humidity averaged 68% for the day, with a range of 46 to 87%. Sea temperature was 16°C. Average wind speed was 4.6 m.sec^{-1}, ranging from 0 m.sec^{-1} at 7:00 am to 7.1 m.sec^{-1} at 11:00 pm

The mean race finishing time for the triathletes who participated in the trial was 757.1 ± 99.8 minutes, ranging from 534.6 minutes to 998.1 minutes. Their average swimming time was 70.1 ± 12.0 minutes (range, 46.2–117.0 minutes), their average cycling time was 395.3 ± 44.4 minutes (range, 296.4–540.6 minutes), and their average running time was 286.7 ± 55.9 minutes (range, 171.6–638.4 minutes).

Changes in body weight for triathletes are listed in Table 1. The body weight of the triathletes increased significantly by 0.9 ± 0.9 kg (p < 0.001) from 75.8 ± 10.4 kg at registration to 76.7 ± 10.1 kg at the start of the race, representing a 1.1% increase in body weight. Body weight decreased significantly (p < 0.001) to 72.8 ± 9.5 kg at the end of the race (range, 48.6–101.0 kg), representing a mean decrease in body weight of 3.7 ± 1.6 kg (5.2%) during the race. Only one subject gained weight during the race, and this was by 0.1 kg. Average weight of the triathletes weighed the following day at the prize ceremony was 73.9 ± 10.7 kg, 2.2 ± 1.3 kg (3%) (p < 0.0001) less than the weight recorded at the start of the race and 1.4 ± 1.4 kg (1.9%) more than weight recorded at the end of the race (Table 1). Data were then analyzed for that subgroup of competitors who were measured at registration, before the race, after the race, and the following day. These data showed the same patterns of weight change (data not shown).

Starting body weight was linearly related to total finishing time (N = 297, r = 0.27, p < 0.0001) (Fig. 1A)

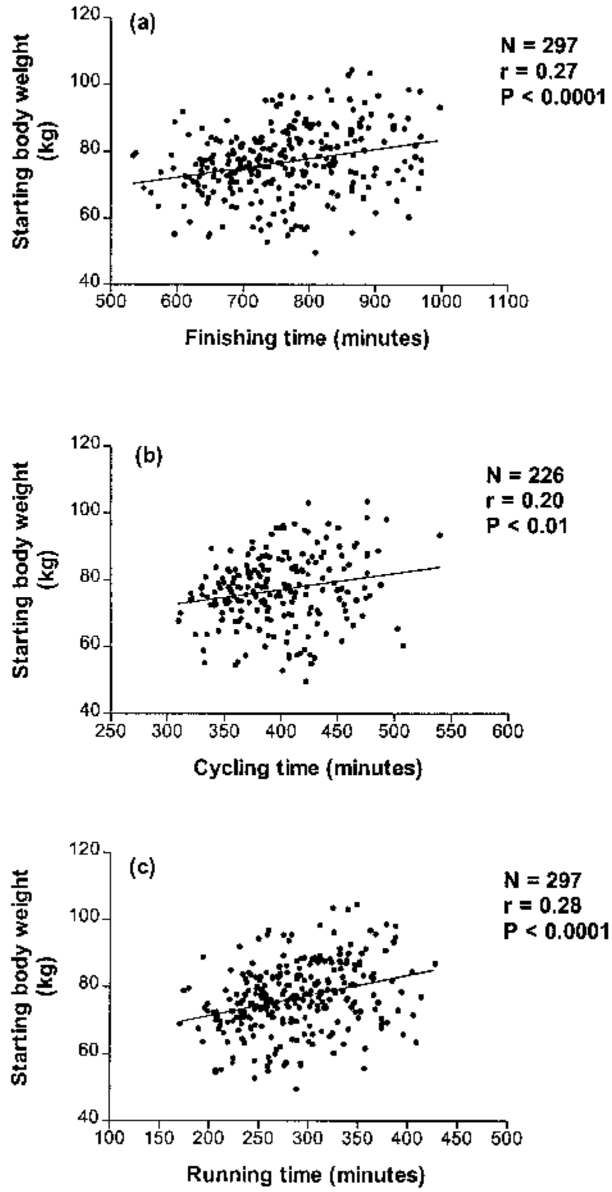

FIG. 1. Relationship between starting body weight and (**A**) total finishing time, (**B**) cycling time, and (**C**) running time in triathletes. The sample size was smaller during the cycle leg, as performance time was not captured for 71 of the 297 subjects.

as it was in the cycling leg (N = 226, r = 0.20, $p < 0.01$) (Fig. 1B) and the running leg (N = 297, r = 0.28, $p < 0.0001$) (Fig. 1C). There was no relationship between body weight and finishing time in the swimming leg (data not shown).

The distribution of prerace and postrace serum sodium concentrations measured in the individual triathletes are shown in Figure 2. Average prerace serum sodium (Na^+) concentration measured in 198 athletes was 141.2 ± 2.7 mmol.L^{-1} (range, 136.7–146.6 mmol.L^{-1}) (Fig. 2A). Serum Na^+ concentrations increased significantly ($p < 0.01$) by 2% to 145.1 ± 3.2 mmol.L^{-1} (range, 132.2–152.0 mmol.L^{-1}) during the triathlon, with a mean difference of 0.6 ± 3.5 mmol.L^{-1}. Seventy-two (30%) triathletes showed a decrease in Na^+ concentration, three (1%) athletes maintained the same Na^+ concentration, and 126 (53%) athletes showed an increase in postrace Na^+ concentration. The change in Na^+ concentrations ranged from −9.8 to 10.2 mmol.L^{-1}. Only three triathletes had postrace sodium concentrations of less than 135 mmol.L^{-1} (range, 132–134 mmol.L^{-1}) (Fig. 2B), and all were asymptomatic.

Correlation analysis revealed significant correlations between postrace Na^+ concentrations and changes in body weight (r = −0.46, $p < 0.0001$) (Fig. 3A), percentage dehydration (r = −0.45, $p < 0.0001$) (Fig. 3B), rectal temperature (r = 0.2, $p < 0.05$) (Fig. 3C), and finishing time (r = −0.22, $p < 0.0001$) (Fig. 3D).

Average postrace rectal temperature for the triathletes was 37.9 ± 0.6°C, with values ranging from 34.2 to 40.5°C. There was no relationship between the postrace rectal temperature and the change in body weight (kg) during the race in triathletes (Fig. 4), even though percentage change in body weight ranged from 0 to −12%, equivalent to weight losses of 0 to 8 kg, the widest distribution in athletes in whom rectal temperatures have also been measured.

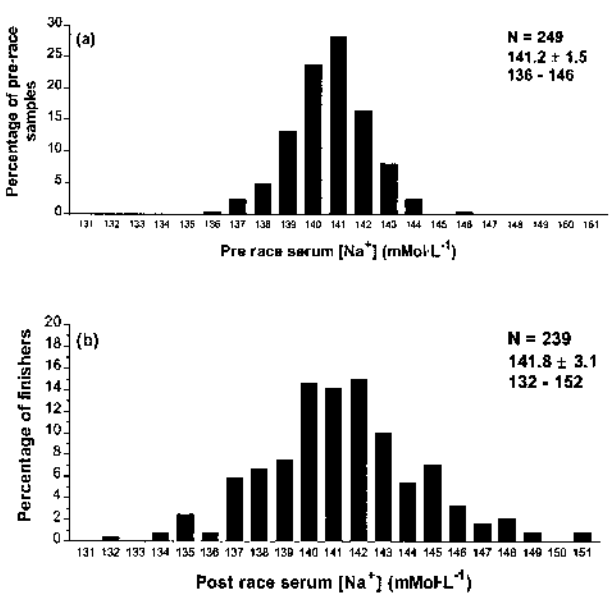

FIG. 2. Distribution of serum sodium concentrations in (**A**) triathletes before the race and (**B**) triathletes after the race.

To assess any possible effect of levels of weight loss and, thus, assumed dehydration developed during the race, we compared marathon finishing times of the triathletes in groups matched for starting body weight (< 70 kg, 70–80 kg and > 80 kg), since marathon time was related to body weight (Fig. 1). Figures 5A, B, and C show that there was no relationship between the levels of weight loss developed during the Ironman and finishing time in the marathon leg. When this relationship was analyzed for the entire cohort of triathletes, there was again no correlation between the percentage change in body weight and total finishing time (Fig. 5D) or time in the marathon leg (data not shown).

A similar analysis was then performed to evaluate any interaction between the postrace serum sodium concentrations and percentage change in body weight on finishing times, since the post-ace serum sodium concentration was inversely related to total race time (Fig. 3D). The marathon finishing times of triathletes with different levels of percentage weight change were grouped according to the postrace serum sodium concentration (<140 mmol.L^{-1}, 140–145 mmol.L^{-1}, > 145 mmol.L^{-1}). Figures 6A and B show that there was no relationship between performance time and postrace serum sodium concentrations of less than 145 mmol.L^{-1}. Figure 6C, however, shows a significant negative relationship (r = −0.38, $p < 0.05$) between running performance time and percentage body weight change in those triathletes whose postrace serum sodium concentrations were greater than 145 mmol.L^{-1}.

Five percent of the total starting athletes sought medical care in the medical tent at the end of the race. The most common specific diagnoses were exercise-associated collapse, experienced by nine athletes, and muscle cramping, experienced by six athletes. Hyponatremia was diagnosed biochemically in three asymptomatic triathletes (0.6% of total entrants), while hypothermia developed during the 3.8-km swim in one triathlete who was unaccustomed to sea water swimming and who wore an inappropriate wet suit. There were seven athletes who were diagnosed with other medical conditions, including skin lacerations and asthma.

DISCUSSION

The first important finding of this study was the low incidence of hyponatremia during the race (0.6% of all race entrants) (Fig. 2B). This finding compares to reported incidences of up to 29%[7] in the Hawaiian Ironman Triathlon and of 22% in the 1997 New Zealand Ironman Triathlon.[2] Speedy et al.[2] reported that the incidence of hyponatremia in the New Zealand Ironman Triathlon fell from 22% in the 1997 race to 3% the following year, when race participants were encouraged to drink more conservatively, and watering stations were provided less frequently on both the cycling and running legs. As a result, fewer triathletes either gained weight or lost little weight (<2 kg) during the 1998 New Zealand triathlon.

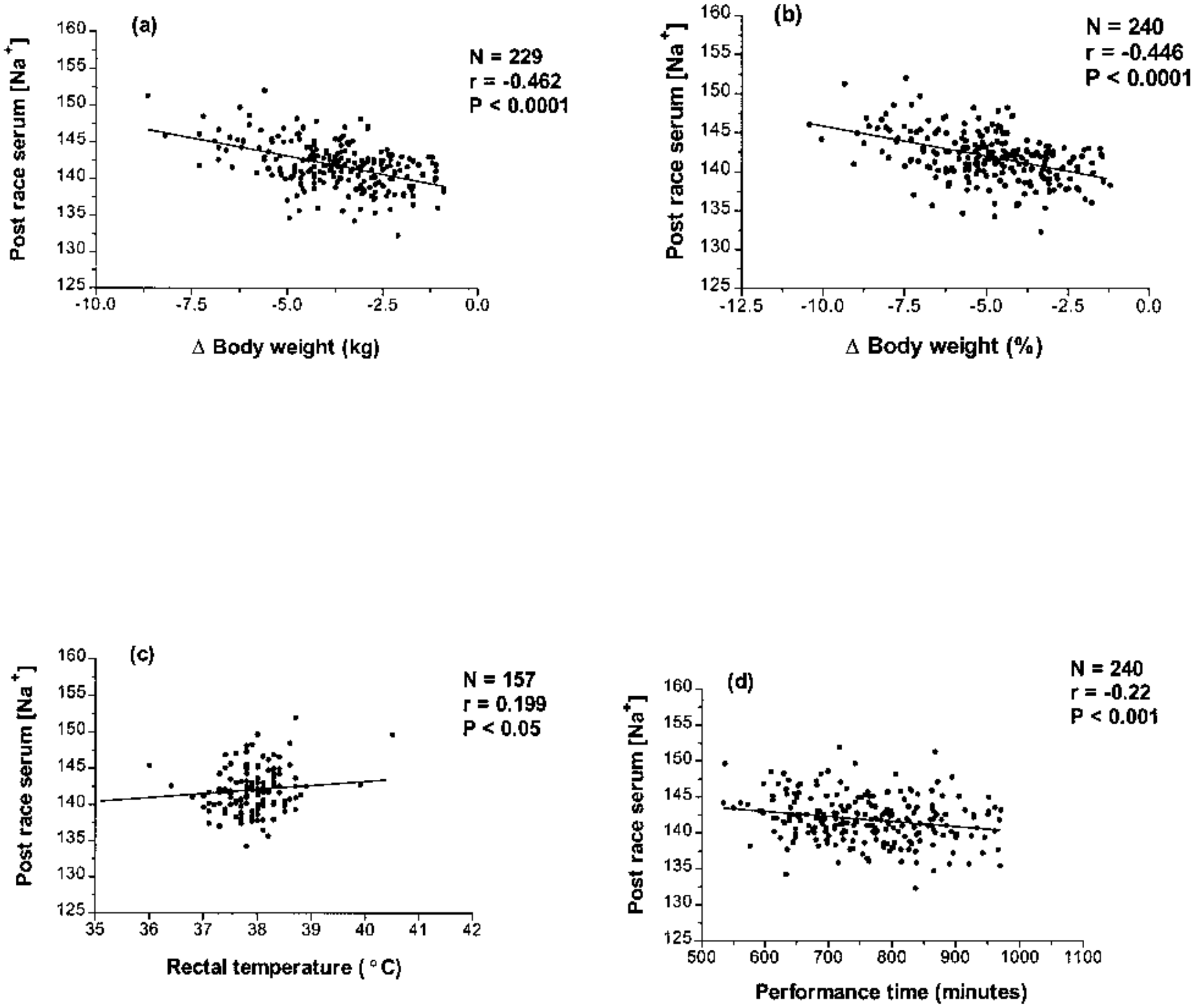

FIG. 3. Relationships between postrace serum sodium concentration (mmol.L^{-1}) and (**A**) change in body weight (kg), (**B**) percentage dehydration, (**C**) rectal temperature, and (**D**) performance time in triathletes.

The same procedures were adopted in this race, with the result that the distribution of weight losses was essentially similar to those reported by Speedy et al.,[2] as was the distribution of postrace serum sodium concentrations (Fig. 2B), although fewer cases of hyponatremia occurred in the South African race.

We also show that the postrace serum sodium concentrations were inversely related to both the absolute weight loss (kg) (Fig. 3A) and the percentage weight loss developed during the race (Fig. 3B), as now reported in three separate studies.[8–10] This evidence forms part of the argument that exercise-associated hyponatremia, especially the symptomatic form, results from fluid overload.[1,11]

If this is indeed the case, then the very low incidence of hyponatremia in this race probably resulted from the conservative drinking advice given to the triathletes (limit fluid intake to 500–800 ml.hr^{-1} during the cycle leg and 300–500 ml.hr^{-1} during the run, lighter women and slower men to drink lower volumes) and the conser-

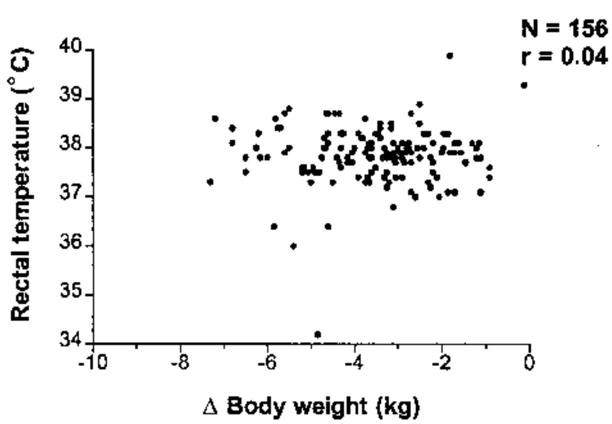

FIG. 4. Relationship between rectal temperature and change in body weight (kg) in triathletes.

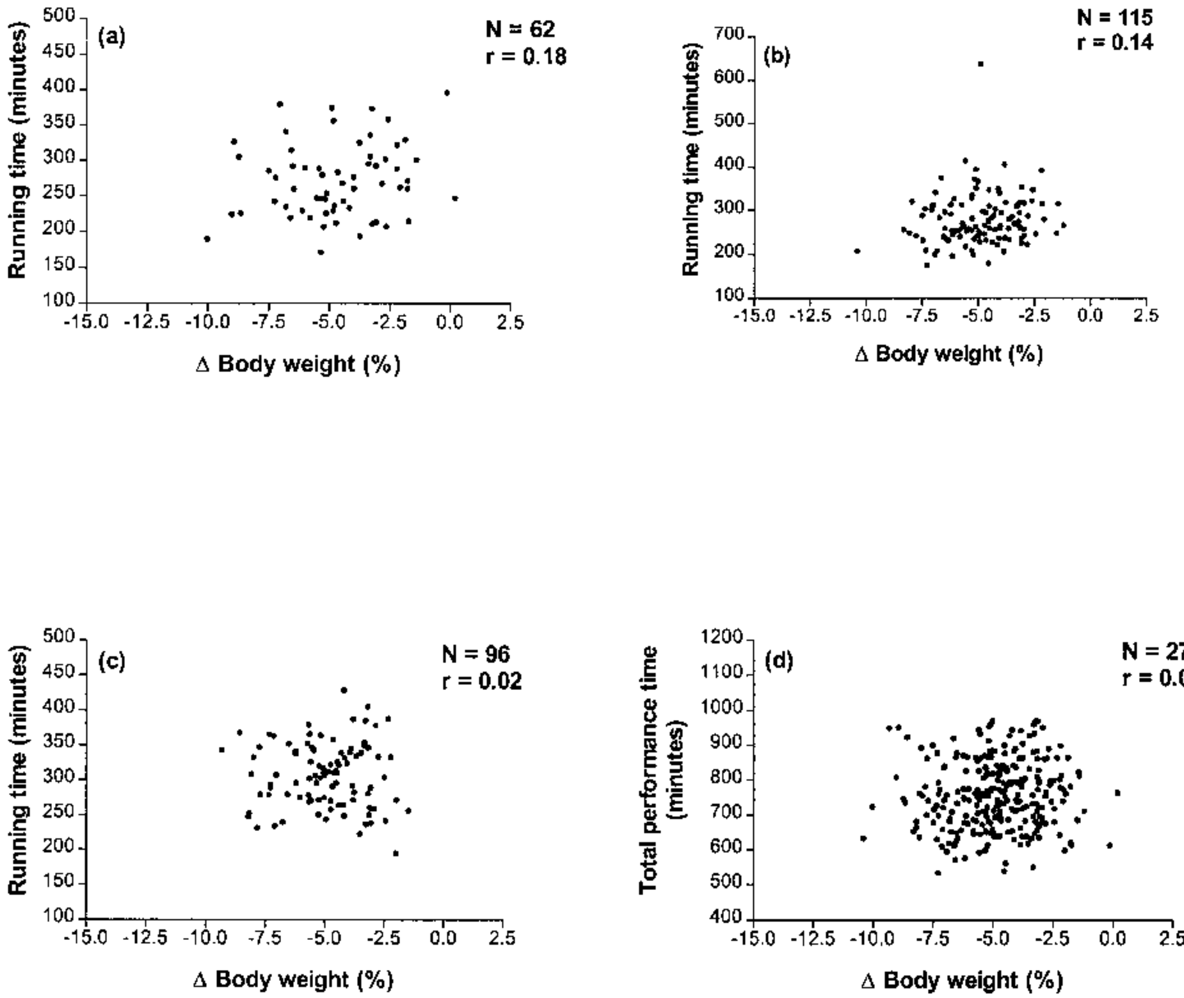

FIG. 5. Relationship between marathon performance time and percentage change in body weight in Ironman triathletes grouped as body weight (**A**) < 70 kg, (**B**) 70–80 kg, and (**C**) > 80 kg; and (**D**) relationship between total performance time and percentage change in body weight for all triathletes.

vative placement of drinking stations during the cycle and running legs (cycle drink stations placed every 20 km and run drink stations every 2.5 km). Although this more conservative approach could perhaps explain why the mean weight loss was 3.7 ± 1.6 kg (range, 12.8–0.1 kg), it was not associated with a high rate of referral to the medical tent at the end of the race. Rather, the proportion of starters requiring medical attention (5%) is one of the lowest yet reported in any Ironman Triathlon and compares to rates of 20 to 30%[7,12] in the Hawaiian and 17%[2] in the 1997 New Zealand Ironman Triathlon. Since the overall distribution of body weight losses is not likely different between triathletes in the New Zealand and South African triathlons,[2] this finding suggests that the lower proportion of medical casualties in the South African triathlon cannot be explained by differences in the hydration states of the triathletes in the two different races.

We also found that the prerace weight was not achieved even 12 hours after the end of the race at the prize ceremony. Rather, average body weight was still 3.7 ± 1.5 kg less than the immediate prerace weight (Table 1), possibly because that 2 kg represents fuel and water stores that do not contribute to dehydration.[5] This finding suggests that the weight lost during the Ironman does not come solely from fluid losses, as is usually thought.[12] Rather, as Brouns,[13] Pastene et al.,[14] and Speedy et al.[5] have calculated, other factors, including oxidation of body fat and glycogen stores and release of water stored with muscle and liver glycogen, may contribute substantially to changes in body weight during prolonged exercise. This weight loss could account for up to 2 kg.[13,14] If this calculation were correct, the mean weight loss due to dehydration alone during this race would be closer to 1.7 to 2.7 kg, or 2.2 to 3.6% of starting body weight.

Indeed, in this context, it is of interest that Figure 3 predicts that, to maintain the normal prerace serum sodium concentration of 141 mmol.L, triathletes would need to lose approximately 2.4 kg (Fig. 3A) or 3.8% of body weight (Fig. 3B) during this race. This prediction was also reported by Speedy et al.[9] and further suggests

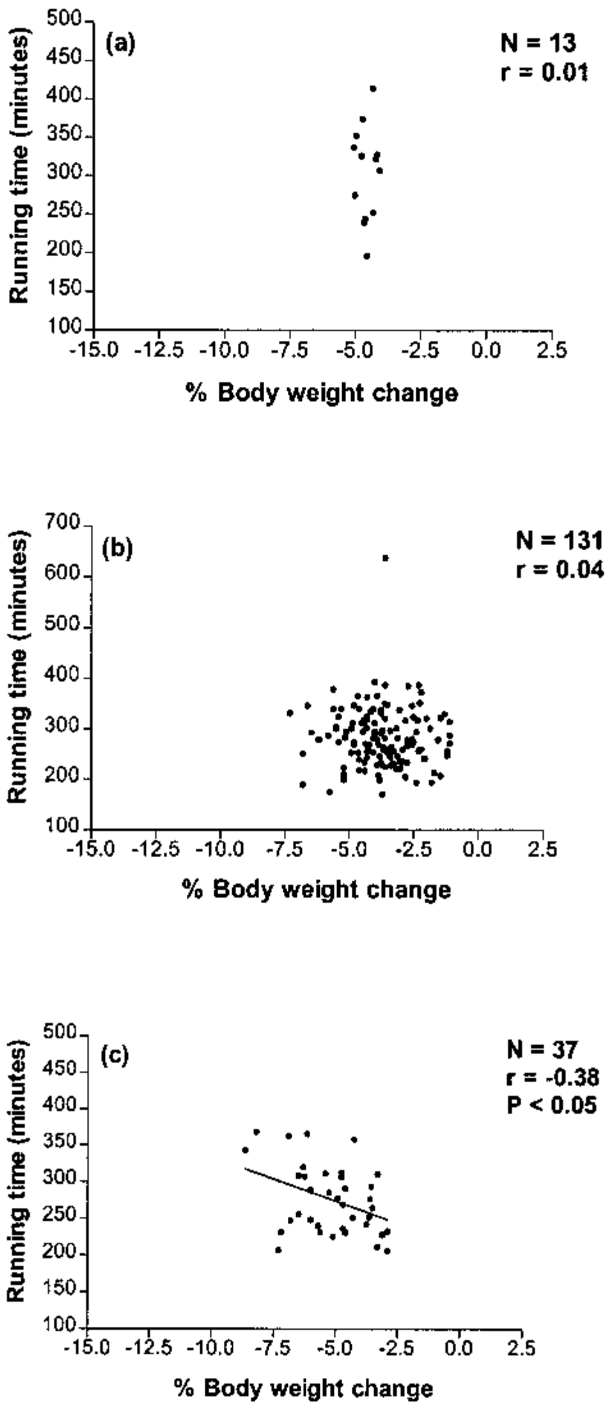

FIG. 6. Relationship between marathon performance time and percentage change in body weight in Ironman triathletes grouped as postrace serum sodium concentrations of (**A**) < 140 $mmol.L^{-1}$, (**B**) 140–145 $mmol.L^{-1}$, and (**C**) > 145 $mmol.L^{-1}$.

that a quite substantial proportion (approximately 2 kg) of the body weight lost during exercise must come from sources other than the body water reserves. If this is indeed correct, then triathletes who do not lose approximately 2 kg during the Ironman Triathlon may be euhydrated or overhydrated.

Since the publication of the classic paper by Wyndham and Strydom[15] more than 30 years ago, it has been popularly accepted that dehydration is the most important factor determining the postexercise rectal temperature and, hence, a major factor limiting endurance performance.[15] These conclusions have been challenged.[16] Indeed, even in the study of Wyndham and Strydom,[15] the fastest runners were also the most dehydrated, a finding incompatible with the theory that mild dehydration is a significant determinant of athletic performance. Two findings in this study add further material to this debate.

First, postrace rectal temperature ranged from 34.2 to 40.5°C, and there were no cases of heat stroke. We do not recognize the diagnostic category of heat exhaustion, since patients with this condition have postural hypotension without evidence of marked hyperthermia.[17,18] Furthermore, they recover fully without requiring active cooling. The mean rectal temperature of the top 20 triathletes in our sample who completed the race was only 38.5 ± 1.0°C, while the average rectal temperatures of the last 20 athletes to finish the race was 37.7 ± 0.4°C. Although we acknowledge the differences in the time of day that these groups of athletes finished the race, these data are still compatible with the hypothesis that the metabolic rate influences the postrace rectal temperature.[19] Furthermore, the generally low postrace rectal temperatures can be explained by the slow running speeds corresponding to moderate (< 66% of VO_2 max) exercise intensities sustained during the Ironman Triathlon[8] and the relatively mild conditions in our race.

Second, there was no relationship between the percentage change in body weight during the race and the postrace rectal temperature (Figure 4a). The conclusion that the level of dehydration causes a significant elevation in the rectal temperature during exercise is based on findings in at least five carefully conducted laboratory studies.[20–24] Surprisingly, to our knowledge, this finding has never been replicated in field studies.[19] Further work is necessary to explain this apparent anomaly, which is not without significant practical relevance, since the fluid replacement guidelines of the American College of Sports Medicine are based, at least in part, on belief that dehydration must be prevented during prolonged exercise because it causes an elevation in the rectal temperature, thereby increasing the risk of heat injury and performance impairment.[25]

In this context, we were also surprised to find that higher levels of dehydration were not associated with slower finishing times in the 42.2-km marathon (Fig. 5). In fact, a few athletes who showed the greatest changes in body weight were among the fastest finishers, as also reported in other studies.[15,19]. In this context, our recent studies found that higher than ad libitum rates of fluid ingestion neither enhanced nor impaired running performance,[26] but that rates of ingestion that equaled sweat rates impaired cycling performance.[27] Similar findings have also been reported by McConell et al.[28] These data suggest that the optimum rates of fluid ingestion during exercise may not necessarily be those that equal the sweat rates and prevent any weight loss during exercise.

We also found that starting body weight predicted performance in the cycle (Fig. 1B) and in the run (Fig. 1C) as well as overall triathlon performance time (Fig. 1A) so that lighter athletes were at an advantage. Dietrick[29] also found that heavier athletes are at competitive disadvantage during endurance events, specifically running and cycling. This disadvantage becomes more apparent when a large portion of the race consists of uphill racing, since hill climbing ability is strongly influenced by body weight.[29] In this event, the cycling leg of the race was on a steeply undulating course, whereas the running leg was essentially flat. Hence, the disadvantage posed by the extra weight of the heavier runners occurred also when they ran on a flat course. Presumably, the effect would be even greater on a hilly course. Since body weight is related to performance, mild dehydration could influence performance simply by reducing the weight carried by each athlete, especially during the run. Although this study provides no evidence to support that hypothesis (Figs. 5A, B, and C), it is a possibility that is not usually considered.

Somewhat surprisingly, because higher postrace serum sodium concentrations occur in the more dehydrated athletes (Figs. 3A and B), we found a significant negative correlation between postrace [Na^+] and performance time (Fig. 3D). This finding was similar to that of Speedy et al.[10] and can be interpreted three ways: 1) the faster athletes suffer the most dehydration due to having both higher metabolic rates and higher sweats rates,[19] thereby presenting with higher postrace [Na^+]; 2) a mild weight loss actively aids performance during such a prolonged event, compatible with the finding that the prerace body weight predicts triathlon performance (Fig. 1A); or 3) a falling serum sodium concentration may impair performance, compatible with the finding of Vrijens and Rehrer[4] and our clinical impression that triathletes who developed hyponatremia during the Ironman Triathlon inevitably complained that they performed less well than they expected, especially in the marathon leg.

To evaluate this relationship further, we analyzed the relationship between marathon finishing time and percentage change in body weight in three groups according to their postrace serum sodium concentrations (<140 $mmol.L^{-1}$, 140–145 $mmol.L^{-1}$, > 145 $mmol.L^{-1}$). Figures 6A, B, and C show this relationship. Surprisingly, there was a significant inverse correlation between marathon performance time and percentage body weight change only in those athletes whose postrace serum sodium concentrations were greater than 145 $mmol.L^{-1}$. The meaning, if any, of these findings is currently unclear.

SUMMARY AND CONCLUSIONS

This study found a very low incidence of (asymptomatic) hyponatremia and medical casualties in the inaugural South African Ironman triathlon despite or perhaps because of the conservative drinking policy advocated for the race. Although the correlations observed in this study were relatively weak, there was a definite trend to suggest that body weight changes of up to 10% during the race were unrelated to postrace rectal temperatures or, apparently, to performance in the marathon leg of the race. We conclude that a conservative drinking policy can be advocated for those Ironman Triathlons that are held in the moderate environmental conditions similar to those present in this race, without risking the health of the triathletes.

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