Gender Difference and Age-Related Changes in Performance at the Long-Distance Duathlon

AU1 Christoph A. Rüst,[1] Beat Knechtle,[1,2] Patrizia Knechtle,[2] Susanne Pfeifer,[1] Thomas Rosemann,[1] Romuald Lepers,[3] and Oliver Senn[1]

[1]*Institute of General Practice and for Health Services Research, University of Zurich, Zurich, Switzerland;* [2]*Gesundheitszentrum St. Gallen, St. Gallen, Switzerland; and* [3]*INSERM U887, Faculty of Sport Sciences, University of Burgundy, Dijon, France* AU2

Abstract

Rüst, CA, Knechtle, B, Knechtle, P, Pfeifer, S, Rosemann, T, Lepers, R, and Senn, O. Gender difference and age-related changes in performance at the long-distance duathlon. *J Strength Cond Res* XX(X): 000–000, 2012—The differences in gender- and the age-related changes in triathlon (i.e., swimming, cycling, and running) performances have been previously investigated, but data are missing for duathlon (i.e., running, cycling, and running). We investigated the participation and performance trends and the gender difference and the age-related decline in performance, at the "Powerman Zofingen" long-distance duathlon (10-km run, 150-km cycle, and 30-km run) from 2002 to 2011. During this period, there were 2,236 finishers (272 women and 1,964 men, respectively). Linear regression analyses for the 3 split times, and the total event time, demonstrated that running and cycling times were fairly stable during the last decade for both male and female elite duathletes. The top 10 overall gender differences in times were 16 ± 2, 17 ± 3, 15 ± 3, and 16 ± 5%, for the 10-km run, 150-km cycle, 30-km run and the overall race time, respectively. There was a significant ($p < 0.001$) age effect for each discipline and for the total race time. The fastest overall race times were achieved between the 25- and 39-year-olds. Female gender and increasing age were associated with increased performance times when additionally controlled for environmental temperatures and race year. There was only a marginal time period effect ranging between 1.3% (first run) and 9.8% (bike split) with 3.3% for overall race time. In accordance with previous observations in triathlons, the age-related decline in the duathlon performance was more pronounced in running than in cycling. Athletes and coaches can use these findings to plan the career in long-distance duathletes with the age of peak performance between 25 and 39 years for both women and men.

Key Words running, cycling, gender difference, aging, ultraendurance AU3

Address correspondence to Dr. Beat Knechtle, beat.knechtle@hispeed.ch.

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Introduction

In recent years, an interest in investigating the participation and performance trends in endurance events such as long-distance running (7,8,13,19) and multisport events (e.g., triathlon) has increased considerably (11,18,22). The changes in triathlon performances over the years have been examined in traditional (i.e., swimming, cycling and running), long-distance and ultradistance triathlons (11,18), and off-road (i.e., swimming, mountain biking, and trail running) triathlons (22,23). These studies showed that after a period of improving performances in the years after the first race, a stabilization then generally occurred. However, the findings differed slightly between gender and distance.

The sports discipline duathlon (i.e., running, cycling, and running) is apart from triathlon another multisport discipline that is officially refereed by the International Triathlon Union (ITU) (www.triathlon.org/multisports/duathlon). To date, duathlons have received little attention from scientists (30,33), and no study has investigated their participation and performance trends. The "Ironman Hawaii" (http://ironman.com/worldchampionship) is the most prestigious Ironman triathlon in the world, and tens of thousands of triathletes try to qualify for it each year (18,20). Although the "Ironman" triathlon races series actually offers >25 races around the world to qualify for the "Ironman Hawaii" (http://ironman.com), the long-distance duathlon race series "Powerman" offers currently only 9 races around the world (www.powerman.org). Similar to the "Ironman Hawaii," the "Powerman Zofingen" duathlon (www.powerman.ch), held in Switzerland, is one of the most famous long-distance duathlons in the world. In the past years, the "Powerman Zofingen" was held as the

Table 1. Temperature and general weather conditions at the "Powerman Zofingen" from 2002 to 2011.

Year	Temperature morning (° C)	Temperature noon (° C)	General weather conditions
2002	14	20	Dry, blue sky
2003	8	20	Variable, showers
2004	12	18	Rain
2005	13	17	Rain
2006	11	13	Rain
2007	14	30	Blue sky
2008	12	21	Blue sky
2009	8	23	Blue sky
2010	12	24	Blue sky
2011	11	17	Rain

"ITU Powerman Long-Distance Duathlon World Championships."

The age and gender interactions (20,31), and the age and locomotion mode interactions (1,23,24), in triathlon performances have previously been investigated in both the Olympic (short distance) and Ironman (long distance) distances. It appears that the age-related performance decline is greater in women compared with that in men and is specific to the locomotion mode. Indeed, it has been shown that the reduction in performance with advancing age was less pronounced in cycling compared with swimming and running (1,23,24). In addition, the age-related performance decline in cycling and running performances appears greater over the longer distances when compared with short distance triathlons, suggesting that the duration of exercise exerts an important influence on the magnitude of the age-related changes (24). A duathlon comprises only 2 disciplines, but like the triathlon, it also includes 3 legs, the first and third legs being running, with cycling in the middle. The first leg of a duathlon, consisting of a prolonged running exercise, may induce significant muscle fatigue (21), which could affect subsequent cycling and running performances to a greater extent when compared with a triathlon.

The gender differences in overall triathlon performances varied between approximately 15% and approximately 30 %, according to the distance and the type of triathlon (11,18,20,22). Regarding the split disciplines, the gender differences were between 15 and 23% for cycling and between 18 and 32% for running, respectively (11,18,20,22). Because skeletal muscle mass differs between male and female triathletes (10,12,14), muscle fatigue might also differ between the genders. Therefore, it might be interesting to examine whether there is a gender difference between

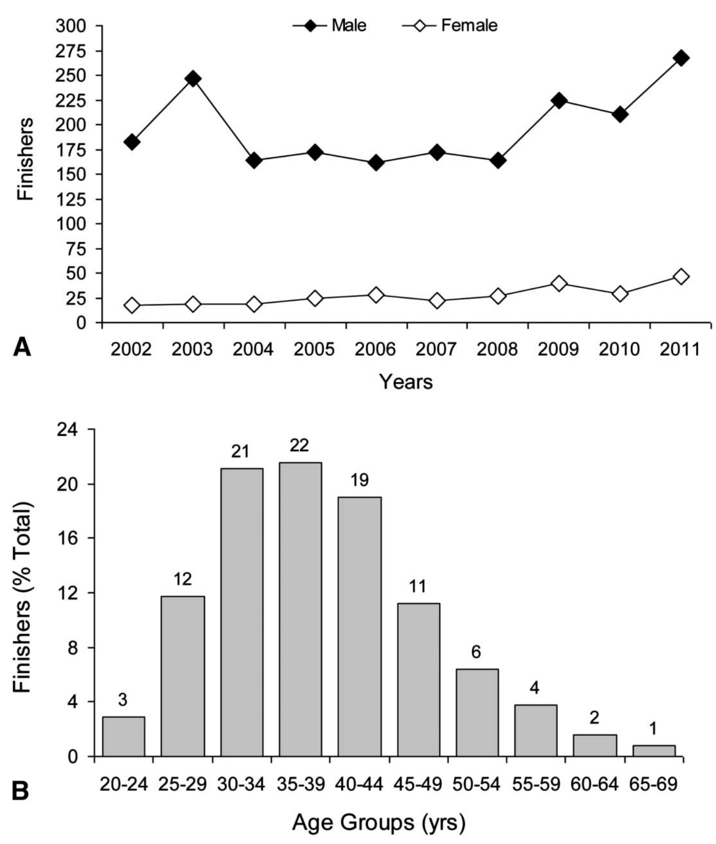

Figure 1. Number of female and male finishers at the "Powerman Zofingen" from 2002 to 2011 (A). Averaged age distribution of male finishers from 2002 to 2011 (B).

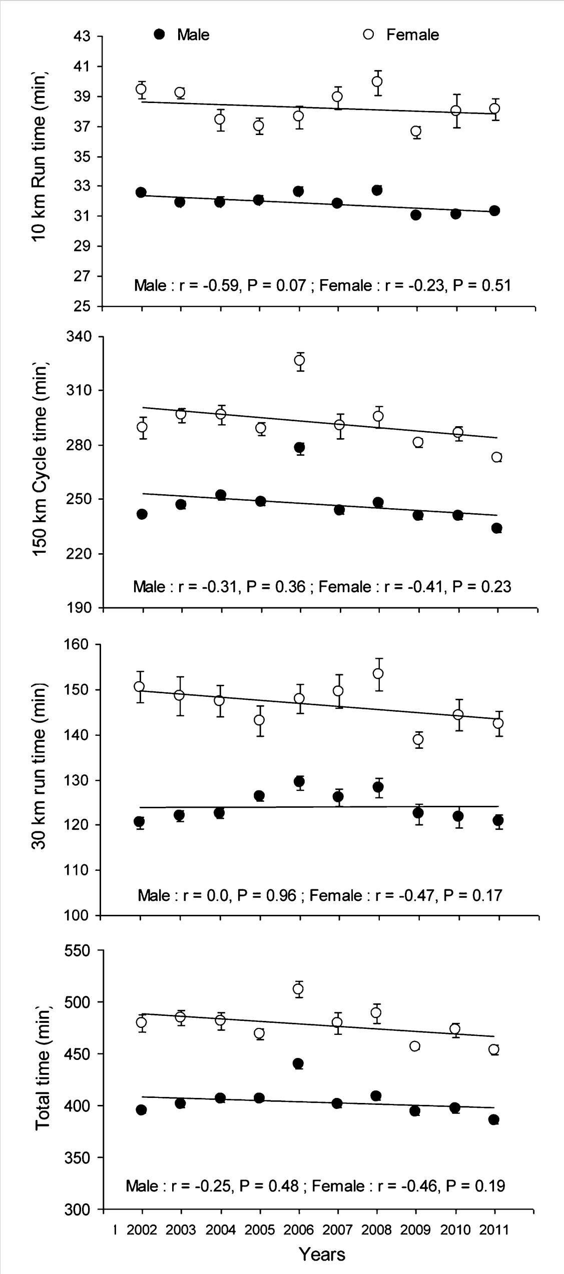

Figure 2. Mean running (10 km), cycling (150 km), running (30 km), and overall race times in the "Powerman Zofingen" of the top 10 men (black circles) and women (white circles) from 2002 to 2011. Values are mean ± *SE*. The solid lines represent the linear regressions between 2002 and 2011.

running and cycling in a duathlon and also between the first and second run split.

The aims of this study were (a) to analyze the participation and performance trends of both men and women at the "Powerman Zofingen" duathlon from 2002 to 2011, (b) to examine gender differences in running, cycling, and total times in elite duathletes, and (c) to analyze the age-related decline in running, cycling, and total duathlon performances.

Methods

Experimental Approach to the Problem

The "Powerman Zofingen" is one of the oldest and best known long-distance duathlons in the world (www.powerman.ch) and is now held as the official "ITU Powerman Long-Distance Duathlon World Championships" (www.powerman.org). The race has existed since 1989, and the race course has been changed several times. However, since 2002, it has remained unchanged, and consists of a 10-km run, a 150-km cycle, and a 30-km run. In contrast to the "Ironman Hawaii," where the field of starters is limited and the athletes have to qualify for the race, there is no limitation to the number of athletes that can take part in the "Powerman Zofingen."

Subjects

The subjects were all finishers (272 women and 1,964 men) of the 'ITU Powerman Long-Distance Duathlon World Championships' from 2002 to 2011. The data set from this study was obtained from the race website and the Race Director. The study was approved by the Institutional Review Board of St. Gallen, Switzerland, with a waiver for the requirement of an informed consent, given that the study involved the analysis of publicly available data. The age at the time of competition, and the running, cycling and total time performances of both female and male finishers at the 'Powerman Zofingen' were analyzed from 2002 to 2011. First, the age at the time of competition and the 10-km run, 150-km cycle, 30-km run and total time performances of the top ten elite male and female finishers overall were analyzed from 2002 to 2011. Second, because women's data were limited, we focused on the run, cycle, and total time performances of the top 5 men in 10 age groups over the same period. Each age group covers a period of 5 years as follows: 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, and 65–69 years, respectively.

Procedures

Data (i.e., age, running, cycling, and total performance times) were averaged over the first 10 male and female finishers in each year from 2002 to 2011, and the running, cycling, and total performance times were converted to minutes. The spread of the top 10 elite times, that is, the time difference between the winner and the tenth, was also analyzed and expressed as a percentage of the winner's time, for both sexes, over the same period. The magnitude of the gender difference was examined by calculating the percent difference in the running, cycling, and total times of the top 10 male vs. female participants. The 1-way analysis of variance (ANOVA) showed that there was no statistical difference in the total performance times of the top 5 men in each age group in our studied years, so we pooled 9 years of data. Therefore, we considered only the performances of

Table 2. Age, total event, 10-km running, 150-km cycling, and 30-km running performance times for the top 10 men and top 10 women at the "Powerman Zofingen".*

	Age (y)	Total event (min)	10-km Run (min)	150-km Cycle (min)	30-km Run (min)
Men	32.2 ± 2.0	403.3 ± 14.6	31.9 ± 0.6	247.1 ± 12.0	124.0 ± 3.2
Women	32.3 ± 2.7	477.5 ± 16.5	38.2 ± 1.1	292.3 ± 13.9	146.6 ± 4.4
Gender difference (%)		18.4 ± 2.1	19.9 ± 2.9	18.3 ± 1.4	18.3 ± 3.7

*Gender difference is expressed as a percentage of the male values and calculated for the top 10. Data were averaged from 2002 to 2011. (Values are mean ± *SD*.)

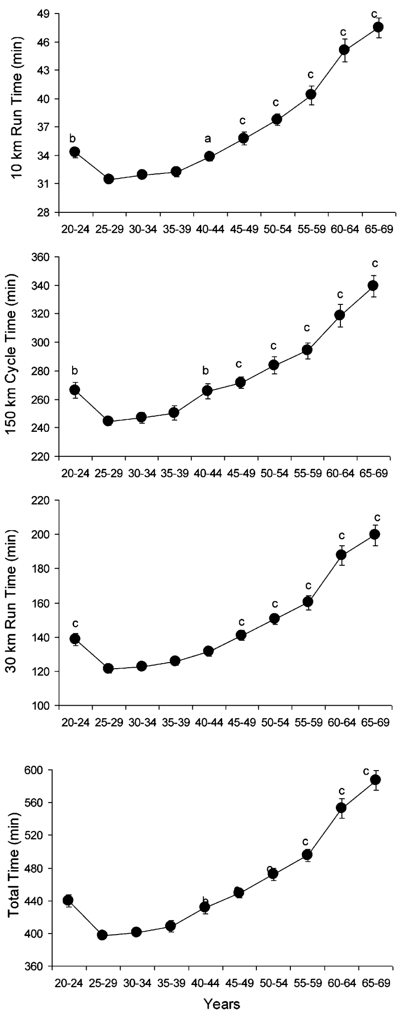

Figure 3. Age-related changes in running (10 and 30 km), cycling (150 km), and total male performances at the "Powerman Zofingen" (mean ± *SE*). The 2002 to 2011 pool data ($n = 20$ for each age group). A) $p < 0.01$, significantly different from age group 25–29 years only. B) $p < 0.01$, significantly different from age groups 25–29 and 30–34 years. C) $p < 0.01$, significantly different from age groups 25–29, 30–34, and 35–39 years.

the best 20 male duathletes in each age group over this period to analyze the age-related changes. The 10-km run, the 150-km cycle, the 30-km run, and the overall times of the 20 best male duathletes in each age group were then normalized to the mean time of the best performing age group. Thus, the age-related declines in performance were expressed using a ratio calculated between the individual and the mean time performances of the best performing age group in each discipline, plus the overall race time (24). The local temperature at the start and at noon and general weather conditions were provided by www.meteoschweiz.ch (Table 1). T1

Statistical Analyses

Data are reported as mean ± *SD* in the text and displayed as mean ± *SE* in the figures. Linear regressions were used for estimating the changes of selected variables each year. Pearson's correlation coefficients were used to assess the association between differing variables (Statsoft, Version 6.1, Statistica, Tulsa, OK, USA). To determine whether the overall race time of the top 10 male and female finishers differed over the years, a 2-way ANOVA was performed. One-way ANOVA was used to compare the running, cycling, and overall race times between the different age groups. A 2-way ANOVA was used to compare the performance ratios between the 10-km run, the 150-km cycle, and the 30-km run over this period. Tukey's post hoc analyses were used to test differences within the ANOVA when appropriate. Statistical significance was accepted at $p \leq 0.05$. The associations between performance (total, and 3 split times, i.e., first run, cycling, second run) and athletes characteristics (i.e., age, gender) taking into account environmental factors (i.e., morning and noon temperatures) were further investigated. To account for potential clustering between time periods, we performed multilevel (hierarchical) regression analysis including race year as cluster variable. We calculated intraclass correlation coefficients (ICCs) to estimate the variance that can be explained on the cluster level (i.e., race year). The ICCs were calculated as follows: (variance of the performance time/total variance) ×100. Statistical significance was accepted at a 2-sided $p \leq 0.05$.

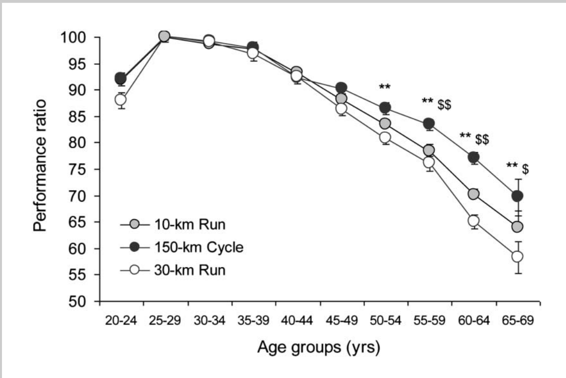

Figure 4. Age-related declines in running, cycling, and total performances at the "Powerman Zofingen" (mean ± *SE*). The 2002–2011 pool data ($n = 20$ for each age group). * $p < 0.05$; ** $p < 0.01$: Significantly different from 30-km running for the same age group. $ $p < 0.05$; $$ $p < 0.01$: Significantly different from 10-km running for the same age group.

Results

From 2002 to 2011, there were 2,236 finishers (272 women and 1,964 men, respectively) at the "Powerman Zofingen." The number of finishers each year over the history of the event is shown in Figure 1A, ranging from 162 to 267 men and from 17 to 47 women, respectively. Women accounted, on average, for 12 ± 3% of the field. The age distribution of the male finishers during this period is shown in Figure 1B. The 5-year age brackets with the largest participation have been 30–34 and 35–39 years. Nonfinishers represented 14 ± 3% of the starters field for the men and 12 ± 5% for the women, respectively. The rate of nonfinishers did not significantly change across the years.

The ANOVA shows that the total time performance of the top 10 men and women did not differ over the years, and Figure 2 shows the historical performance trends of this group. Regression lines for the 3 split times and the total event time demonstrated that both the running and cycling times were fairly stable from 2002, for both genders. The mean age, and the 10-km running, 150-km cycling, 30-km running, and total performance times for the top 10 of both sexes, over the last decade, are given in Table 2. From 2002 to 2011, the average differences in time between the winners and the tenth-placed finishers remained stable and was equal to 7.5 ± 1.6% for men and 15.4 ± 5.2% for women, respectively. The average differences between the top 10 men's and women's running, cycling, and overall race times were consistent at approximately 18–19% (Table 2).

The mean age-related changes in running, cycling, and overall race times from 2002 to 2011 are shown in Figure 3. The times of the 3 splits, and the overall race time, increased in a curvilinear manner with advancing age. There was a significant ($p < 0.0001$) age effect for each discipline and for the total time. The best 10-km run, 150-km cycle, and total time was found in the age groups 25–29, 30–34, and 35–39 years, and no differences in times were observed between these 3 age groups. For the 30-km run, the times of the 40- to 44-year group were similar to that of the 3 younger age groups.

Table 3. Results of the multilevel (hierarchical) regression analysis showing the effects of athletes characteristics and temperature on overall race time and the split times including race year as cluster variable.

Overall race time ($n = 2,236$)	β	*p*	95% Confidence interval	
Women	−39.3	0.000	−45.8	−32.9
Age (y)	2.5	0.000	2.3	2.8
Temperature morning (° C)	0.4	0.798	−2.7	3.5
Temperature noon (° C)	−1.2	0.102	−2.6	0.2
Split time first run ($n = 2,236$)				
women	−3.9	0.000	−4.4	−3.3
Age (y)	0.2	0.000	0.2	0.3
Temperature morning (° C)	−0.02	0.833	−0.3	0.2
Temperature noon (° C)	−0.006	0.924	−1.2	0.1
Split time cycling ($n = 2,236$)				
Women	−28.1	0.000	−31.4	−24.8
Age (y)	1.3	0.000	1.1	1.4
Temperature morning (° C)	−0.2	0.894	−2.9	2.5
Temperature noon (° C)	−1.5	0.017	−2.8	−0.3
Split time second run ($n = 2,236$)				
Women	−7.3	0.000	−10.4	−4.2
Age (y)	1.0	0.000	0.9	1.1
Temperature morning (° C)	0.6	0.275	−0.5	1.6
Temperature noon (° C)	0.2	0.347	−0.2	0.7

F4 The performance ratios for each mode of locomotion decreased in a curvilinear manner with advancing age (Figure 4). There was a significant interaction between age and the disciplines in the performance ratio ($F = 6.9$, $p < 0.001$), and these ratios also differed between the locomotion modes ($F = 68.9$, $p < 0.0001$). Independent of the age, the ratios were significantly different ($p < 0.001$) between each of the 3 disciplines (10-km run, 150-km cycle, and 30-km run). In addition, independent of the discipline, the performance ratio differed between the age groups ($F = 161.8$, $p < 0.001$) and was significantly lower ($p < 0.01$) for the age groups ≤40–44 years when compared with the age groups 25–29 and 30–34 years.

T3 Results of the multilevel regression analysis not restricted to the top 10 athletes are shown in Table 3. Female gender and increasing age remained significantly associated with increased performance times when additionally controlled for environmental factors (i.e., morning and noon temperature) and taking into account a potential clustering because of the time period (i.e., race year). An increased noon temperature was associated with an increased split time for cycling. The corresponding ICCs for race year as cluster variable on performance were as follows: 3% for total race performance and for the split time first run, 10% for the split time cycling, and 1% for the split time second run. Therefore, 3% of the total performance variance can be explained on the race-year level, or in other words the correlation between 2 athletes in the same year is only 0.03.

Discussion

The aim of this study was to analyze the participation and performance trends and the gender differences and the age-related decline in running, cycling, and total long-distance duathlon performances during the last decade. The effects of environmental conditions such as temperature on performance were also investigated.

Regarding the participation in the "Powerman Zofingen," after a peak in 2003, the number of male finishers remained stable for 5 years and then slightly increased these last 3 years. The number of female finishers remained quite stable from 2002 to 2008, with a small increase in 2009 and 2011. These data relating to a long-distance duathlon differ from those of other endurance events such as ultraendurance running. For example, Hoffman et al. (8) analyzed the participation trends in 161-km ultramarathons, in North America, from 1977 to 2008 with a total of 32,352 finishers. The annual number of races, and the number of finishers, increased exponentially over this time frame. Knechtle et al. (11) analyzed the participation and performance trends in ultratriathlons from 1985 to 2009. The number of starters in a Double Iron ultratriathlon (i.e., 7.8-km swim, 360-km cycle, and 84.4-km run), a Triple Iron ultratriathlon (i.e., 11.4-km swim, 540-km cycle, and 126.6-km run), and a Deca Iron ultratriathlon (i.e., 38-km swim, 1,800-km cycle, and 420-km run) increased progressively from 1985 to 2009. In both the 161-km ultramarathons (7–9) and the ultratriathlons (11), there were no limits to the number of participants. Similarly, at the "Powerman Zofingen," there was no participation limit, in contrast to the "Ironman Hawaii" (18) where triathletes need to qualify. So, the unchanged participation level in the "Powerman Zofingen" was presumably not because of a limit set by the organizer but rather because of other factors.

We assume that duathlon is less attractive than triathlon because, first, in contrast to triathlon, it is not an Olympic discipline, and second, there is less media coverage given to duathlon races. For example, the swim start of triathlon is more spectacular and attractive to spectators compared with the first run leg of duathlon. To date, no study has investigated the participation trends in Ironman triathlons. However, considering the fact that >25 Ironman races are offered around the world, to qualify for the "Ironman Hawaii" (http://ironman.com/events), one must assume that a kind of 'market force' affects the demand. For example in 2011, 11 Ironman races are offered in North America, 8 in Europe, 3 in Australia and New Zealand, 2 in Asia, 1 in South America, and 1 in Africa. In the long-distance duathlon race series, the "Powerman" offers only 9 races each year (www.powerman.org). In 2011, those offered 6 races in Europe, 2 races in the U.S.A., and 1 race in Asia. Presumably, the large number of Ironman races on offer makes it more attractive to multisport athletes compared with Powerman duathlons.

Regarding the performances of the male and female elite duathletes, there were no changes in the cycling, running and total times since 2002. In contrast, it has been shown that at the "Ironman Hawaii," the performance times of the male and female elite triathletes decreased during the 1980s and then tended to stabilize over the last 2 decades (18). Elite duathletes racing in the "Powerman Zofingen" are experienced multisport athletes, and this could explain the relative stability of performance over this period. In addition, some experienced triathletes may have moved from triathlon to duathlon because of their relative weakness in swimming compared with running and cycling. The observed gender differences in performances should not arise from motivation regarding prize money as the total prize money of US$50,000 is distributed equally between the top male and female athletes. The gender difference in running, cycling, and total event time was consistent approximately 18–19% in long-distance elite duathletes. These findings are in accordance with previous values observed in off-road (23) and Ironman triathlons (18).

The gender difference for the overall performance might be explained by anthropometric and physiological differences for these multisports athletes as has been reported for Ironman triathletes competing in swimming, cycling and running. For example, Knechtle et al. (16) showed that female triathletes with 28.0-kg skeletal muscle mass have a 32% lower muscle mass compared with male triathletes with 41.0 kg. The lower skeletal muscle mass in female triathletes might be responsible for the 14% lower maximum oxygen uptake ($\dot{V}O_2$max) in female triathletes (52.8 ml·min^{-1}·kg^{-1}) compared with male triathletes (61.3 ml·min^{-1}·kg^{-1}) (12). Because $\dot{V}O_2$max is related to triathlon performance (26), the lower $\dot{V}O_2$max in women might explain the gender difference for overall race time. Also, percent body fat is related to performance in long-distance triathlon in male Ironman triathletes (15,16). Male Ironman triathletes with 13.7% body fat have a 42% lower body fat compared with female Ironman triathletes with 23.6% (16). The eccentric component of the first run leg may affect differently skeletal muscle damage in men and women and therefore impair, to a greater or lesser extent, the cycle and second run performance. For example, the impairment of performance might be greater in women compared with that in men because of their lower skeletal muscle mass (10,12,14). However, this assumption has not been verified because the gender difference was very similar between the first and the second run (~19%) suggesting that the fatigue induced during the first run was similar for both genders.

Considering the age-related changes in duathlon performances, the present results showed that the best age to perform a long-distance duathlon was between 25 and 39 years. In the 30-km run, athletes up to the age of 44 years were still competitive. The age-related changes differed among the 3 disciplines, but the decline was less in cycling compared with AU4 that in either the 10- or 30-km run. The lower age-related decline in cycling compared with running performance observed for duathlon confirms recent findings on triathlon (1,23,24). Several hypotheses have been proposed to explain this finding, such as different mechanical powers required by the 2 disciplines, changes in muscle characteristics with age, lesser reduction in lactate threshold and economy in cycling compared with running, or the maintenance of a greater "training stimulus" in cycling, with advancing age (24).

Lepers et al. (24) showed that after 55 years of age, there was a lesser age-related decline in cycling performance compared with running in Olympic distance triathletes, and after 50 years in Ironman triathletes. Similarly, Bernard et al. (1) investigated the age-related changes in performance in Olympic distance triathletes and found that the decline in performance was more pronounced in running compared with cycling after 55 years of age. In cycling, the age-related decline in performance was not significant until the age of 55 years and was <3% per year until the age of 60 years. The present results suggest that the age-related decline in performance appears earlier in duathletes (~40 years) compared with triathletes (~45–50 years). A combination of a reduced skeletal muscle mass with increasing age, and an increased skeletal muscle damage after the eccentric component of the first run leg, might explain this finding. However, a comparison of duathlon and triathlon performances in the same subjects would be necessary to validate this hypothesis.

In these duathletes, the age of peak performance was between 25 and 39 years for both women and men. In 1988, Schulz and Curnow (29) reported data from analyses of Olympic track and field and swimming data showing that for both women and men, the age of peak performance increased with the length of the foot race, where women generally achieved peak performance at younger ages. The pattern of increased age with increasing distance is reversed for female swimmers, where younger ages are associated with increasing distance. In a recent study on ultramarathoners, Knechtle et al. (13) demonstrated that the best 100-km running times was observed for the age between 30 and 49 years for men, and between 30 and 54 years for women, respectively. We assume that the age of peak performance in ultradistances increases with increasing length. Most probably, women are able to achieve peak performance in ultraendurance races at a higher age compared with men. Future studies are needed to verify this assumption.

An important finding was that both female gender and increasing age were associated with increasing race performance times when controlled for temperature and race year. Recent studies showed that weather showed an effect of performance in marathoners (3,4,25,32,34) and ultramarathoners (27,35). The effect of weather was ambiguous in marathoners regarding the runners' ability. Vihma (34) reported that marathon race results of slower runners were more affected by unfavorable weather conditions. Ely et al. (4), however, demonstrated that increasing air temperatures slowed running pace more in faster marathoners than in slower marathoners. For ultramarathoners, Parise and Hoffman (27) showed that extreme heat impaired all runners' ability to perform in a 161-km ultramarathon where raster runners were at a greater disadvantage compared with slower runners. Wegelin and Hoffman (35) reported that advancing age and warmer weather impaired performance in 161-km ultramarathoners. Regarding these findings for ultramarathoners, we expected to find similarities for these long-distance triathletes. However, we found only an independent temperature effect on athlete's cycling performance but not on overall performance. Presumably, the temperatures at Zofingen were rather moderate compared with the temperatures at the "Western States Endurance Run" where the temperature was generally higher than 30° C (27).

Female gender was associated with slower race times in the duathletes when controlled for environmental temperatures. Recent studies showed equivocal findings regarding the association of gender and performance regarding environmental temperatures for marathoners. Ely et al. (3) found no gender difference for marathon race times with increasing temperatures. Vihma (34), however, showed that effects of warm weather were less evident for women than for men and assumed that female runners' larger ratio of surface area to body mass and slower running speed were responsible for their findings. The effect of environmental temperature seems to be different for women in ultraendurance performances. For ultramarathoners, Wegelin and Hoffman (35) reported that warmer weather had similar effects of finish rates for men and women. However, finish times were slower with advancing age, slower for women than men and less affected by warm weather for women than for men. The longer duration in an ultraendurance performance seems to have different effects on race outcome regarding a marathon.

Also, we found only a marginal time period effect with ICCs ranging between 1 and 10%. For overall race time, 3% of the total performance variance can be explained on the race-year level. Or expressed in other words, the correlation between 2 athletes in the same year was only 0.03. These athletes showed no improvement in performance across the past years in the "ITU Powerman Long-Distance Duathlon World Championships" as it has been reported for other ultra-endurance races such as the Hawaii Iroman triathlon (18) or the "Western States Endurance Run" (7–9). Generally, we would expect an improvement in performance because of improvements in technical equipment (6), training (5), or sports nutrition (2,28). Most probably, the top 10 athletes competing at a World Championship were at the top of their performance, and they seemed to have reached their limits in performance.

This study is limited in that we have no variables of training (5,17) and anthropometry (15–17) included in this data analysis. Duathletes are multisport athletes such as triathletes, and we assume that they are similar to triathletes regarding their anthropometry and prerace preparation.

Practical Applications

The performances in the "ITU Powerman Long-Distance Duathlon World Championships" remained stable in elite duathletes from 2002 to 2011. The gender differences in running, cycling, and total event time were consistent approximately 18–19% in the elite duathletes and did not differ between the first and the second run legs. As previous observations on triathlons showed, the age-related decline in performance was more pronounced in running than in cycling. Female gender and increasing age were associated with increasing race performance times when controlled for temperature and race year. Future studies should compare duathlon and triathlon performances, involving the same subjects, to investigate the possible differences in age-related changes in performance between these 2 long-duration multisport events. Athletes and coaches can use these present findings to plan the career in long-distance duathletes with the age of peak performance between 25 and 39 years.

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