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Author: Martin I. Jones, John K. Parker

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An Analysis of the Size and Direction of the Association between Mental Toughness and Olympic Distance Personal Best Triathlon Times

Martin I. Jones[a,*], John K. Parker[b]

[a] Sport and Health Science, College of Life and Environmental Sciences, University, of Exeter, Exeter Devon, EX1 2LU, United Kingdom

[b] School of Sport and Exercise Science, University of Gloucestershire, Gloucester, Gloucestershire, GL2 9HW, United Kingdom

* Corresponding Author
Email: m.i.jones@exeter.ac.uk

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Abstract

Background： Athletes, coaches, sport psychology practitioners, and researchers suggest that mental toughness represents an important construct that is associated with athletic performance. Unfortunately, the absence of real-world performance as a dependent variable has limited our ability to substantiate this claim. The concern of a lack of ecologically valid measures of sports performance might be addressed by examining the relationship between mental toughness and sports performance using a standardized measure of personal best (PB) triathlon time and a validated unidimensional measure of mental toughness.

Methods： Three hundred and sixteen triathletes completed the 8-item mental toughness index (MTI), reported their age, and provided a PB Olympic distance triathlon time and the total number of triathlons they had completed to date. Given that males are typically quicker than females, a standardized time was calculated by dividing the PB by the current Olympic record for gender; we also hypothesized that more experienced triathletes would report quicker PB times because of greater frequency and duration of training.

Once we had controlled for gender and experience, we predicted that mental toughness would be negatively associated with triathlon time and the size of the relationship would be of a moderate magnitude.

Results： Results revealed small to moderate sized negative relationships between both completed number of triathlons and mental toughness with standardized PB time.

Conclusion： The hierarchical regression analysis showed that mental toughness provided a unique contribution to the variability in standardized Olympic triathlon PB after controlling for the total number of triathlons completed.

***Keywords*：** Performance; Olympic distance triathlon; Endurance sport; Factorial validity; Mental toughness; Personal best times

1. Introduction

The ability to overcome obstacles, to push through pain, and to capitalize on beneficial training adaptations are necessary resources for endurance athletes (such as triathletes) to develop and maintain. If observations made by journalists and commentators are to be believed many of these abilities are commonplace in the world's best triathletes. It seems clear that whether in the water, on the bike, or in a pair of running shoes, triathletes (like most other athletes) need to be ready to perform in physically (e.g., pain and fatigue) and psychologically (e.g., stress) challenging conditions [1]. It is therefore not surprising that researchers often recruit triathletes when studying mental toughness (e.g., [2-4]); yet no one has examined the magnitude of the relationship between mental toughness and triathlon performance. The resources that facilitate performance in challenging conditions form the basis of what scholars and practitioners call mental toughness.

Since the turn of the millennium, mental toughness has gained in popularity among researchers, practitioners, coaches, and athletes as a broad construct that captures many of the psychological attributes help to account for athletes' success [4]. Gucciardi and colleagues [1] defined mental toughness as an aggregation of several personal resources that help people to deliver consistent objective and subjective performance in the presence of different situational demands. These resources facilitate striving (e.g., effort), surviving (e.g., coping), and thriving (e.g., performing). [5] Resources associated with mental toughness include (but are not limited to) emotional regulation, self-efficacy, optimism, attentional control, buoyancy, and success mindset [1].

Researchers have shown that mental toughness correlates with a variety of psychological constructs. Constructs include optimism, pessimism, coping [6], youth experiences [7], achievement goals and sport motivation [8], developmental assets [9], and stress appraisal [10]. To date, few researchers have been able to establish a relationship between mental toughness and meaningful indices of sports performance.

Despite Gucciardi and colleagues [1] contention that mental toughness leads to subjective and objective indicators of performance, researchers have typically compared mental toughness with psychological measures (e.g., optimism, coping, achievement goals) rather than real-world behavior [11]. This stratum of research has facilitated theory development and model testing (e.g., convergent and discriminant validity). Nevertheless, many of the measures used (both independent and dependent variables) were arbitrary metrics. Namely, metrics when observed scores provide only an indirect assessment of an individual's position on the latent construct [12]. Accordingly, Andersen [11] wrote that scholars and practitioners do not know what scores on mental toughness inventories mean regarding real-world competitive sports performance (e.g., personal best (PB) times).

The few researchers who have studied mental toughness and sport behavior (e.g., [13]) have provided preliminary evidence that mental toughness could translate into action. For example, Gucciardi and colleagues [14] found that mental toughness was positively associated with behavioral persistence when participating in the multi-stage fitness test. Bell et al. [13] showed similar relationships between mental toughness (measured with a different measurement model to Gucciardi and colleagues) and measures of physical fitness and revealed that a mental toughness intervention could improve cricket batting performance in a pressurized condition. Crust and Clough [15] examined the relationship between mental toughness and an isometric shoulder contraction. The isometric contraction comprised holding a weight (1.5% of participant body weight) out in front of the chest with a straight arm. Clough and Crust indicated that a moderate correlation existed between mental toughness and isometric exercise providing initial evidence of a relationship between mental toughness and isometric strength. These authors are commended for collecting behavioral data; however, it is not clear how meaningful these data are in the context of sports performance. Specifically, it is our belief that it is unlikely that many athletes need to complete prolonged isometric contractions in their events. Despite being important aspects of training, we also contend that multistage fitness tests, vertical jumps, and cricket batting tests are not always ecologically valid measures of sports performance for most athletes where performance is multifaceted. Before researchers can establish causal relationships between mental toughness and sports performance, scholars and practitioners need to determine the size and direction of the relationship between mental toughness and an ecologically valid and meaningful measure of sports performance.

Mahoney et al. [5] provided one of the only examples of using race times as an objective measure of sports performance. Mahoney et al. revealed that mental toughness was inversely associated with race time; however, the researchers took the adolescents' end-of-season races and these results may not hold true for adult participants. Given the age of the participants (mean age 14.26 years), the variance in race time could have been heavily influenced by age from peak height velocity (i.e., more biologically mature will be quicker). Therefore, researchers need either to control for peak height velocity or establish the relationship between mental toughness and race time once physical development has plateaued (i.e., in adulthood). Researchers may also consider experience and gender because we argue that experienced (*vs*. inexperienced) and male (*vs*. female) athletes are likely to post faster times. In essence, researchers need to determine the size and direction of the relationship between mental toughness and race time after controlling for covariates of performance (i.e., maturation, experience, and gender).

It is clear that a gap exists. There is no evidence that observed scores on mental toughness inventories correspond to triathlon performance. It is plausible that real-world performance could represent an outcome variable that athletes, coaches, and sport psychologists are interested in and therefore the further study of the association between mental toughness and sport performance is warranted. We infer that considerable scope exists to explore the magnitude and direction of the relationship between mental toughness and performance in triathletes. To this end, we elected to examine the size and direction of the relationships between mental toughness and performance (i.e., PB Olympic distance triathlon time). Based on the evidence that more experienced participants will likely be quicker we hypothesized a large negative relationship between the number of completed triathlons and standardized PB times. After we control for experience we hypothesized a negative moderate sized relationship between mental toughness and standardized PB triathlon times.

2. Material and methods

2.1. Participants

Following ethical approval through the University of Gloucestershire's research ethics procedures and an a priori sample size calculation using G*Power Version 3.1 [16] we recruited a sample of triathletes from online triathlon forums. We calculated a total sample size requirement of 283 participants. We used a moderate predicted effect size ($f^2 = 0.10$), α error probability of 0.001, statistical power of 0.95, and 2 predictors (experience and mental toughness) to calculate the sample size. We posted a link to online triathlon forums that directed athletes to an information letter, a consent form, and the battery of questionnaires. We asked participants who were over the age of 18 years and had a PB time for the Olympic distance triathlon to consider participation. We asked participants to complete the study alone and not to call for help from others. We did not record participant's location when completing the questionnaires nor did we record the time or context (e.g., after a race or during training). We excluded participants who were under the age of 18 years or who did not report a PB triathlon time. We received data from 330 triathletes (39.23 ± 8.93 years, mean ± SD) over a 4-week period. Based on the reported PB times we can infer that our sample included a range of triathletes from very experienced expert triathletes to novice triathletes with relatively slow PB times.

2.2 Measures

We asked participants to report their gender, the total number of previously completed Olympic distance triathlons (i.e., experience), and PB Olympic distance triathlon time. Participants then completed the Mental Toughness Index (MTI). [1] The MTI is an 8-item unidimensional measure of mental toughness. The MTI instructs participants to indicate how they typically think, feel, and behave as an athlete. The MTI includes a 7-point Likert scale (1 = *false, 100% of the time* 7 = *true, 100% of the time*). Gucciardi et al. [1] revealed that the unidimensional model of mental toughness provided by the MTI fit the data well. The MTI also displayed strong factor loadings and produced an internally reliable score (ρ = 0.86 to 0.89).

2.3 Data analysis plan

We calculated standardized PB triathlon times by dividing each participant's gender specific Olympic distance triathlon PB by the current Olympic record (i.e., males = 1:46:25, females = 1:58:27). Standardized scores ranged from 1.07 to 2.14. The resulting variable provided a percentage difference between each participant and the Olympic record. For example, a score of 1.07 represented a time 7% slower than the Olympic record; a score of 2.14 represented a time 114% slower than the Olympic record. Larger scores, therefore, demonstrated slower triathlon times. The strength of standardizing scores by the current Olympic record was that we could control for gender differences (i.e., females typically report slower times than males). We conducted a Confirmatory Factor Analysis (CFA) and calculated Cronbach's α to assess model fit and internal reliability of the MTI. We then screened data for assumptions of ordinary least squares regression and calculated means, *SD*, and Pearson's *r* (with 95%CI). Finally, we conducted Pearson's correlations with both *p* values and Bayes factors, and a hierarchical multiple regression analysis to evaluate the size of the relationship between the dependent variables and standardized PB Olympic distance triathlon time. Based on the number of statistical tests α was set at 0.001 to reduce type 1 error rate. We recognize an issue of temporal sequence (i.e., PB achieved before completing measures of mental toughness); however, readers should appreciate that the purpose of this study was to examine the magnitude and direction of the relationship between mental toughness and PB triathlon time, not to establish a causal connection.

3. Results

The online data collection meant that there was no missing data; however, there was evidence of the inaccuracy of data input. Evidence included 14 participants who had either did not report a PB, had an 10 extreme PB times that either significantly surpassed current world records or were so slow it was unlikely to represent real-time (i.e., days rather than hours). These extreme cases were deleted leaving 316 cases (female = 56) for subsequent analysis. Data screening of the remaining cases revealed violations of univariate normality on the total number of triathlons completed (i.e., z_{skewness} / z_{kurtosis} > ± 3.29). There were no violations of univariate normality on PB triathlon time or mental toughness scores. Full inclusion and exclusion of outliers were considered and we were guided by statistical advice by Tabachnick and Fidell.[17] Five outliers on the total number of triathlons suggested that the distribution had more extreme cases than a normal distribution. In the current sample, the outliers had completed between 40 and 50 Olympic level triathlons. These outliers were likely from the population of interest. Consequently, the outliers were retained and re-coded to the next extreme value that was not a univariate outlier (i.e., 24 completed triathlons).[17] Tabachnick and Fidell[17] stated that it is acceptable to change the score on the variables(s) for outliers, so they are still deviant (i.e., at the extreme of a normal distribution) but not as deviant as they were before the re-scoring. We checked for multivariate outliers through Mahalanobis distance (i.e., using a $p < 0.001$ criterion for Mahalanobis D^2) revealing 1 multivariate outlier. This multivariate outlier was a female who had completed a considerable number of triathlons, had recorded very high mental toughness scores, and a relatively quick PB time. This participant was a multivariate outlier because others with a similar profile were male. We retained the outlier but re-coded her total number of triathlons to 20 in line with the next highest female.[17] The re-coding of these outliers changed the mean total completed triathlon score from 5.56 $\pm$ 6.74 to 5.29 $\pm$ 5.04 and reduced the influence of the univariate and multivariate outliers. We evaluated variables for linearity (scatterplots), independence of errors (Durbin-Watson), homoscedasticity of residuals (residuals scatterplot), and multicollinearity (tolerances approaching 0 and condition index > 30 coupled with variance proportions > 0.50 for at least 2 variables).[17] We found all of these assumptions of ordinary least squares regression to be satisfactory.

We evaluated the model goodness of fit by using a combination of absolute fit (χ^2 test), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and comparative/incremental fit (Comparative Fit Index (CFI)). Hu and Bentler [18] stated that evidence of a good fitting model is obtained when RMSEA is close to or < 0.06, SRMR is close to or < 0.08, and CFI is close to or > 0.95. Results from the CFA revealed that the model fit indices reached the criterion values to conclude that a good fitting model had been achieved (χ^2 20, N = 316 = 40.605, p = 0.004; RMSEA = 0.057, SRMR = 0.041, CFI = 0.961). We also found the internal reliability for the MTI to be at an acceptable level (α = 0.786, 95%CI: 0.748 to 0.820)[19].

The total number of triathlons completed and mental toughness were significantly correlated with standardized triathlon time at the $p \leq 0.001$ level ($r = -0.439$, Bias corrected and accelertated (BCa) 95%CI: –1.000 to –0.361, p (1-tailed) ≤ 0.001, BF_{-0} = 5.217e +15; r = −0.203, 95%CI: –1.000 to –0.113, p (1-tailed) ≤ 0.001, BF_{-0} = 103.202 respectively). Mental toughness was not significantly correlated with the total number of completed triathlons (r = 0.034, 95%CI: –1.000 to –0.126, p (1-tailed) = 0.724, BF_{0+} = 8.219). BF_{-0} quantifies evidence for the one-sided alternative hypothesis that the population correlation is lower than 0. BF_{0+} quantifies evidence for the null hypothesis relative to the one-sided alternative hypothesis that the population correlation is higher than 0. Therefore, the relationship between completed triathlons and standardized PB is 5.217e +15 times more likely under the one-sided alternative hypothesis that the population correlation is lower than 0 than under the null hypothesis that the population is not lower than 0. The Bayes factor also revealed that the relationship between mental toughness and standardized triathlon PB time is 103.202 times more likely under the one-sided alternative hypothesis that the population correlation is lower than 0 than under the null hypothesis that the population is not lower than 0. Finally, the Bayes factor for the relationship between mental toughness and the total number of triathlons completed reveals that the relationship is 8.219 times more likely under the null hypothesis relative to the alternative hypothesis that the population correlation is higher than 0.

Table 1 displays the results of the regression analysis after each step. In model 1, only the total number of triathlons was entered into the equation. We entered the total number of completed triathlons in the first step because of the likelihood that more experienced participants also trained more than less experienced participants. Essentially, the number of completed triathlons served as a proxy measure of experience. Model 2 comprises the total number of triathlons completed and mental toughness to examine the unique contribution of mental toughness. R was significantly different from 0 at the end of each step. After step 2, with all the IVs in the equation R^2 = 0.229, 95%CI: 0.148 to 0.310, adjusted R^2 = 0.224, F(2, 313) = 46.528, $p \leq 0.001$, f^2 = 0.047.

After step 1, with the total number of triathlons completed in the regression equation, R^2 = 0.193, 95%CI: 0.116 to 0.270, adjusted R^2 = 0.191, F_{inc} (1, 314) = 75.292, $p \leq 0.001$, f^2 = 0.239, r_s (structure coefficient) = –1.000. After step 2 with mental toughness added to the regression equation, R^2 = 0.229, 95%CI: 0.148 to 0.310, adjusted R^2 = 0.224, F_{inc} (1, 313) = 14.522, $p \leq$ 0.001, f^2 = 0.297, r_s = –0.426. This pattern of results suggests that the total number of completed triathlons accounts for approximately 19% of the variability in standardized triathlon PB time. The level of mental toughness reported by participants contributed an additional 3.6% to the variability in standardized triathlon PB time. Standardized beta weights (β) and squared structure coefficients (r_s^2) suggest that the number of completed triathlons was the best predictor of standardized triathlon PB time; however, the combination of β and r_s^2 of mental toughness (0.181) indicated that this variable also had sizeable predictive ability. Specifically, the squared structure coefficient revealed that mental toughness accounted for approximately 18% of the effect (i.e., 18% of the R^2 value: 0.229). It is noteworthy that the sum of the r_s^2 (i.e., 1.181) is marginally greater than 1[20], which suggests a small degree of multicollinearity despite tolerances approaching 0 and condition indices > 30 coupled with variance proportions >0.50 for at least 2 variables. Results revealed that we had overestimated the predicted effect size of f^2 = 0.10. *Post hoc* power calculations with a revised f^2 of 0.047, an α level of 0.001, and a total sample size of 316 revealed a statistical power of 0.591.

4. Discussion

The purpose of this study was to examine the direction and magnitude of the relationship between mental toughness and Olympic distance triathlon PB time. We hypothesized mental toughness would be negatively related to PB times after statistical adjustment for gender (i.e., standardizing times) and experience. Results revealed small to moderate sized negative relationships between both completed number of triathlons and mental toughness with standardized PB time. The hierarchical regression analysis showed that mental toughness provided a unique contribution to the variability in standardized Olympic triathlon PB after controlling for the total number of triathlons completed.

Despite not being an explicit aim of this study, we heeded the advice of Gucciardi et al. [21] that researchers should report empirical data about the factorial validity of the measurement model used in research. To this end, we conducted a CFA of the MTI utilized in the present study. The current results suggest that the 8-item unidimensional measure of mental toughness developed by Gucciardi and colleagues [1] did fit our data and produced an internally reliable score. The current results, add support for the use of Gucciardi et al.'s MTI when examining mental toughness based on the definition that mental toughness is an aggregation of several personal resources that help people to deliver consistent objective and subjective performance in the presence of different situational demands [1].

To the best of our knowledge, this is the first study that has examined mental toughness and PB Olympic distance triathlon time. More importantly, this is the first study that has shown that mental toughness has a small to a moderate sized negative relationship with triathlon performance in an adult population and that this relationship is approximately 100 times more likely under the one-sided alternative hypothesis that the population correlation is lower than 0 than under the null hypothesis. Although it is not possible to claim a causal relationship, the current findings provide the impetus for researchers to examine causality.

The finding that participants with more triathlon experience reported quicker standardized times was not surprising. We deduce that those participants who have completed more triathlons likely to train more and are fitter or have the greater technical skill, which facilitates performance. We thought that mental toughness would also be positively related to the number of completed triathlons although the size of the relationship was thought to be small (given the many other factors that could influence participation). The data did not support our hypothesis. We found an arguably meaningless relationship between mental toughness and the number of completed triathlons and Bayes factors revealed the data were approximately 8 times more likely under the null hypothesis than the alternative one-sided hypothesis. Therefore, in the current sample mental toughness is not meaningfully related to experience.

Mental toughness could be associated with PB triathlon time through several mechanisms. Researchers have recently shown that cognitive processes underpin mental toughness (e.g., [22]). Dewhurst and colleagues [22] found preliminary evidence that people with greater mental toughness than their lower mental toughness counterparts had the ability to prevent unwanted information from interfering with current goals. An inability to concentrate on current objectives or to ruminate on past events could negatively affect performance by interfering with task-relevant behaviors. For example, slowing down pedal cadence, dismounting the bike in the wrong areas of transition, or by myopically focusing on pain sensations associated with prolonged exertion. Delaney, et al. [23] were not able to replicate Dewhurst and co-worker's findings but did find that the effects of mental toughness were mainly due to conscientiousness. It may be that mental toughness is associated with triathlon performance because individuals with high mental toughness might also exhibit higher conscientiousness. In triathlon, conscientiousness may manifest in being vigilant of attacks from competitors, thorough preparation, careful planning, and efficient execution of race plans. Researchers may wish to test conscientiousness as a mediator between mental toughness and performance-related behaviors (e.g., [24]).

The emotional regulation of the athlete may also provide an explanation of why mental toughness uniquely contributed to the variance in standardized PB Olympic triathlon time. Baron, et al. [25] suggested that less favorable emotional responses can lead to maladaptive behaviors in runners. Negative emotional reactivity to events before or during an event might influence task-relevant behavior. For example, negative appraisal of exertion during the swim might result in a change of stroke or alternation of rhythm, timing, and stroke rate to reduce perceived exertion (but also speed). Future researchers may wish to examine whether a nondiscriminatory or nonjudgmental (i.e., mindful) form of attention could mediate the relationship between mental toughness and performance in triathlon. This research question is particularly salient given Andersen's [11] suggestion that mindfulness and mental toughness are likely to be linked.

It is important to acknowledge possible future research directions that arise from the limitations of the current study. Firstly, the nonexperimental nature of the present study does not permit inferences about causality. Researchers could conduct longitudinal and experimental manipulations of the mental toughness resources (e.g., self-efficacy, behavioral inhibition) to establish the causal nature of mental toughness and triathlon performance. Several researchers have alluded to the consistency of performance when defining mental toughness. In the current study, we took a single measure of performance that does not provide the reader with information about consistency. It is possible the PB performance was facilitated by favorable environmental conditions (e.g., tailwind on the bike), and the athletes may have struggled to replicate these times. Future researchers could consider an index of performance by looking at several times across a season rather than just 1 PB measurement. We did not collect any data about the nature of the competition that could have influenced the likelihood of reporting a quick time. For example, bunch start *vs*. staggered starts will affect times as will open water swims *vs*. pool swims. It might be that athletes gained the fastest times when not racing or when not racing using open water and bunch starts.

The recruitment of participants via online triathlon forums is potentially problematic because it might limit the generalizability of the findings. Specifically, our sampling frame (i.e., those people who frequent online forums) may not be representative of triathletes as a population. Therefore, future researchers may consider recruiting participants through triathlon clubs and at triathlon events to gather a representative sample. The cross-sectional design that exclusively relies on self-report measures is a limitation of the current study (and the majority of existing of mental toughness research). Self-report leaves open the possibility that participants' self-perceptions of mental toughness were in part driven by their triathlon performance. For example, if an athlete records an excellent PB time, he or she may use that as evidence for high mental toughness when, in fact, this may or may not be an accurate inference. There is also a possibility that self-report biases are inflating the association between the 2 constructs. Specifically, people who self-enhance their mental toughness are also likely to self-enhance their triathlon times. A future research study could involve the collection non-self-report measures of triathlon times and, ideally, non-self-report measures of mental toughness, (e.g., ratings by peers or trainers). Hardy and colleagues [26] have developed a test of mental toughness based on a score from significant others. Researchers may choose to adopt this new measure in future studies. Before rejecting self-report measures of mental toughness, it might be worth considering that mental toughness as Gucciardi et al. [1] currently define it may represent principal evaluations that people make of themselves. Mental toughness may be a broad latent concept indicated by an appraisal of self-worth with the addition of the beliefs about competence (e.g., coping), controlling one's life, and resilience to stress (amongst other concepts). Another person (e.g., coach) rated mental toughness cannot address self-worth (or similar constructs) but can explore behavior. As such, researchers need to consider whether the absence of a behavioral measure of mental toughness renders an investigation second rate. It is our contention that self-report and other person estimated measurement of mental toughness serves different purposes and researchers should use them appropriately.

Finally, each triathlon course is different. Therefore, the Olympic record is nonofficial. We used the Olympic record to standardize the outcome variable; however, it is unlikely that any of the athletes recorded their PB on an Olympic course. Moreover, some athletes would have raced on "quick" courses and others on "slow" (e.g., hilly) courses. Despite these notable limitations, a significant strength of the paper is the use of a real world performance variable. We, therefore, encourage researchers to find ways of overcoming the limitations above rather than abandoning real world measures for simpler metrics of behavior.

5. Conclusion

In conclusion, our results support the use of the MTI when measuring mental toughness and demonstrate mental toughness has a negative small to a moderate sized relationship with PB triathlon performance. Once we standardized the PB times to account for gender differences, and statistically controlling for the number of triathlons completed, mental toughness contributed 3.6% to the variability in performance. Attention should now be focused towards potential mediators and moderators of the relationship between mental toughness and performance to examine why the relationship exists (e.g., which resources within mental toughness), and in which conditions.

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Authors' contributions

MIJ conceived of and designed the study, collected data, analyzed data, and contributed to the draft of the manuscript. JKP conceived of and designed the study and contributed to the draft of the manuscript.

Competing interests

The authors declare that they have no competing interests.

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Table 1: Hierarchical multiple regression analysis predicting standardized PB Olympic triathlon time from gender, number of completed Olympic distance triathlons and mental toughness (n = 316)

Variables	b	95%CI for b	$SE\ b$	β	p	sr^2 (incremental)	r_s	r_s^2
Model 1								
Constant	1.529	1.500 to 1.558	0.015	—	≤0.001	—	—	—
No. of completed triathlons	− 0.017	− 0.021 to −0.014	0.002	− 0.440	≤0.001	0.194	−1.000	1.000
Model 2								
Constant	1.880	1.696 to 2.063	0.093	—	≤0.001	—		
No. of completed triathlons	−0.017	− 0.021 to −0.013	0.002	−0.443	≤0.001	0.192	−1.000	1.000
Mental toughness	−0.008	−0.012 to −0.004	0.002	−0.189	≤0.001	0.036	−0.426	0.181

Abbreviations: β= standardized beta weights; b = unstandardized regression coefficient; CI = confidence interval; PB = personal best; r_s = structure coefficients for each predictor variable included in the regression models estimated with the following formula r/R (where r is the bivariate correlation, and R is the multiple regression coefficients per model); r_s^2 = the squared structure coefficient where values represented the proportion of variance in the effect rather than the dependent variable Standardized beta weights; $SE\ b$ = standard error for the unstandardized regression coefficient; sr^2 (incremental) = estimate of unique variance per predictor variable in the regression models where values represent the square of the part correlation coefficients for each predictor.