

## **In IRONMAN® Age Group Triathletes the Influence of Origin and Race Location on Performance**

An international team of researchers examined how the origin and race location affect the performance of age-group [triathletes](#) in Ironman competitions.

The researchers identified the fastest racecourses globally and analyzed how factors such as climate, course characteristics, and demographic variables contribute to finishing times. The findings were aimed at guiding coaches and athletes in optimizing [race selection](#).



### **Study**

In the present study, the researchers utilized a large dataset of close to 700,000 records from age-group [Ironman](#) triathletes who competed in 444 races held across 66 locations worldwide between 2002 and 2022.

Publicly available race data was collected, which included participant demographics, event details, and environmental factors such as air and [water temperatures](#). After extensive data cleaning, the researchers excluded invalid entries, such as incomplete records and those with implausible times. The dataset was categorized into 5-year age groups and sorted by variables including gender, country of origin, and race location.

To analyze the athletes' performance, the researchers employed descriptive statistics and a machine-learning model known as XGBoost Regression. The model was trained on 75% of the data and validated with the remaining 25%. Finish time was used as the outcome variable, while predictors included gender, age group, country, race location, and [environmental conditions](#).

Furthermore, the predictive variables were numerically encoded to ensure compatibility with the model, such as categorizing gender and assigning rankings to countries and [locations](#). The model aimed to identify the factors most strongly associated with race times.

Several interpretative tools, including [SHapley Additive exPlanations](#) (SHAP values) and partial dependence plots, were used to understand the relative importance of each variable. SHAP values highlighted the impact of predictors on race time outcomes, revealing patterns such as the influence of younger age groups and specific environmental conditions on faster times, while partial dependence plots offered visual insights into the relationship between predictors and predicted outcomes. However, the relatively low  $R^2$  score (0.27) indicated that the model explained only a modest portion of the variability in race times.

## **Results**

The study found that performance in Ironman triathlons varied significantly based on race location, environmental conditions, and participant [demographics](#). Ironman Hawaii was identified as the fastest racecourse overall.

Additionally, younger male athletes, particularly those under 35, recorded the fastest times. Furthermore, athletes from countries such as Austria, [Germany](#), Belgium, and Finland consistently performed better than those from other nationalities.

The main findings showed that the optimal environmental conditions for the fastest race times included an air temperature of approximately 27 °C and a water temperature close to 24 °C. These conditions were most likely to minimize physiological strain and contribute to improved endurance performance. Despite these favorable conditions, the study noted that race performance could also be influenced by factors such as elevation gain, [pacing strategies](#), and previous experience, which were not included in the analysis.

Moreover, the participation analysis revealed that most finishers came from the United States, although [athletes](#) from other countries frequently outperformed them. The 30–35-year-old age group showed the highest performance levels, while athletes aged 40 to 45 constituted the largest demographic.

The results from the SHAP analysis confirmed that country of origin, race [location](#), and temperature conditions were the most influential factors. Other demographic variables, such as age and gender, also played significant roles in determining outcomes. The findings emphasized that selecting racecourses with favorable climatic and geographic conditions is crucial for achieving faster times.

The researchers indicated that Ironman Austria, Copenhagen, Barcelona, and Brazil Florianopolis racecourses were the most favorable for achieving the fastest race times. This insight could be particularly beneficial for amateur triathletes seeking to qualify for prestigious events such as the Ironman [World Championship](#) in Hawaii.

## **Conclusion**

Overall, the study confirmed the importance of environmental, geographic, and demographic factors in Ironman triathlon performance. While the findings provide [practical guidance](#) for race selection, the researchers emphasized the need for future studies to consider additional variables, such as detailed weather data, nutrition, and pacing strategies, to better understand performance outcomes.

The researchers noted that athletes aiming for the Ironman World Championship in Hawaii should prioritize races with favorable temperatures and [minimal elevation](#) gain. These findings offered practical guidance for triathletes and coaches in planning strategies to achieve personal bests and qualification goals.

## **Source:**

<https://www.news-medical.net/news/20241210/Ironman-performance-How-age-climate-and-geography-make-or-break-success.aspx>