Exercise is normally recommended for its beneficial effects on health; however, exercising at very high heart rate (HR) may increase the risk of cardiac events. Theoretical maximal HR (TMHR) is subject dependent and may be easily computed through several formulas; according to the guidelines, recommended target HR range during a stress test for clinical evaluation is 50 to 85% of TMHR. Considering the new widely diffused use of wearable sensors, an into-the-field assessment of the highest HR (HHR) reached during exercise is now possible. Thus, the present study aims to assess HHR during uncontrolled exercise and to relate it to TMHR.

To this aim, 178 HR series were acquired through the BioHarness 3.0 by Zephyr from 122 athletes, while practicing 15 different sports (Aerial Skills, American Football, Basketball, CrossFit, Cycling, Fitness, Jogging, Middle Distance Running, Running, Skating, Soccer, Zumba, Tennis, Trekking). TMHR was assessed by applying the following formulae:

\[
\begin{align*}
\text{Gulati} & \rightarrow TMHR_G = 206 - 0.88 \times \text{age} \\
\text{INBAR} & \rightarrow TMHR_I = 205.8 - 0.685 \times \text{age} \\
\text{Karvonen} & \rightarrow TMHR_K = 220 - \text{age} \\
\text{Londeree} & \rightarrow TMHR_L = 206.3 - 0.711 \times \text{age} \\
\text{Miller} & \rightarrow TMHR_M = 217 - 0.85 \times \text{age} \\
\text{Nes} & \rightarrow TMHR_N = 211 - 0.64 \times \text{age} \\
\text{Tanaka} & \rightarrow TMHR_T = 208 - 0.7 \times \text{age}
\end{align*}
\]

Percentages of athletes whose HHR overcame 85% of TMHR and TMHR were computed. Moreover, HHR and TMHR distributions were compared by paired T-Student test (statistical significance at 0.05).

HHR of 90% or more of athletes overcame 85% of TMHR (specifically, HHR of 94%, 93%, 91%, 90%, 90%, 90%, and 92% of athletes overcame 85% of TMHR_G, TMHR_I, TMHR_K, TMHR_L, TMHR_M, TMHR_N and TMHR_T, respectively). HHR of 39% or more of athletes overcame TMHR (HHR of 66%, 53%, 39%, 55%, 39%, 39%, and 48% of athletes overcame TMHR_G, TMHR_I, TMHR_K, TMHR_L, TMHR_M, TMHR_N and TMHR_T, respectively). HHR (191±26 bpm) was significantly higher than TMHR_G (180±10 bpm; P<0.01), TMHR_I (186±8 bpm; P<0.05) and TMHR_L (186±8 bpm; P<0.01) but not significantly different from TMHR_K (191±12 bpm), TMHR_M (192±10 bpm), TMHR_N (192±7 bpm), and TMHR_T (188±8 bpm).

Thus, HHR normally approaches, and sometimes overcomes, TMHR when exercising.