

Into-the-Field Assessment of Maximal Heart Rate during Exercise

Agnese Sbrollini, Micaela Morettini, Laura Burattini

Università Politecnica delle Marche
Ancona, Italy

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:

$$Gulati \rightarrow TMHR_G = 206 - 0.88 \cdot age$$

$$INBAR \rightarrow TMHR_I = 205.8 - 0.685 \cdot age$$

$$Karvonen \rightarrow TMHR_K = 220 - age$$

$$Londeree \rightarrow TMHR_L = 206.3 - 0.711 \cdot age$$

$$Miller \rightarrow TMHR_M = 217 - 0.85 \cdot age$$

$$Nes \rightarrow TMHR_N = 211 - 0.64 \cdot age$$

$$Tanaka \rightarrow TMHR_T = 208 - 0.7 \cdot age$$

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.