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RESEARCH LETTER

Elevation of Cardiac Troponins After Endurance Running Competitions

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Marathon races have become one of the most popular endurance events. Amateur runners perceive the distance as a physical challenge, and they seek to obtain the multiple beneficial health effects derived from regular endurance exercise. However, a controversial debate has emerged about whether the marathon distance is healthy or potentially harmful to the amateur athlete's cardiovascular system.[1] Although the overall incidence of cardiac arrests in marathoners is only ≈1 in 100 000 finishers,[2] a high proportion of all exercise-induced cardiac events occurs during marathon competitions, particularly in male runners >35 years of age. Competing in a marathon produces an increase in cardiac biomarkers and acute functional cardiac alterations that reflect the strenuous load imposed on the myocardium during the race. The acute increase in the concentration of the cardiac biomarkers after exercise is considered a benign event because the values in these markers are normally re-established within days after the race.[3] However, the clinical relevance of the elevated cardiovascular strain imposed by the marathon is unclear and remains a matter of controversy.[4]

In the present investigation, we selected 63 healthy runners (in triplets) from a group of 322 nonprofessional finishers because of their similarities in age (mean±SD age, 37±7 years), anthropometry (66.9±12.8 kg), and running experience (3.3±0.2 years). The triplets also had similar 10-year absolute cardiovascular risks (2.8±2.1%) calculated by the non–laboratory-based Framingham function.[5] In each group, there were 13 women and 8 men. From each triplet, 1 runner competed in a 10-km race, another in a half-marathon race, and the third in a full marathon race. As would be expected, as a result of the different training patterns for each distance, training volume in the month before the race increased with the competition distance (23.9±9.0, 34.8±8.0, and 40.6±16.4 km/wk for 10-km runners, half-marathoners, and marathoners, respectively; $P<0.01$). Before and 10 minutes after the race, body mass was measured to assess dehydration. Blood samples were obtained to measure cardiac biomarkers, including high-sensitivity cardiac troponins I and T, NT-proBNP (N-terminal pro-B-type natriuretic peptide), and the cardiac (creatine kinase-MB) and skeletal muscle (creatine kinase-MM) isoenzymes of creatine kinase and myoglobin at the end of the races. The between-group differences in these variables were analyzed by a 2-way ANOVA. The study was approved by the Ethics Committee for Research of the Camilo Jose Cela University. All the research protocols described here were carried out in accordance with the Declaration of Helsinki, and all subjects gave informed consent to participate in the study.

As expected, the time used to complete the races (58±9, 116±16, and 252±35 minutes for the 10-km race, half-marathon, and marathon, respectively; $P<0.01$)

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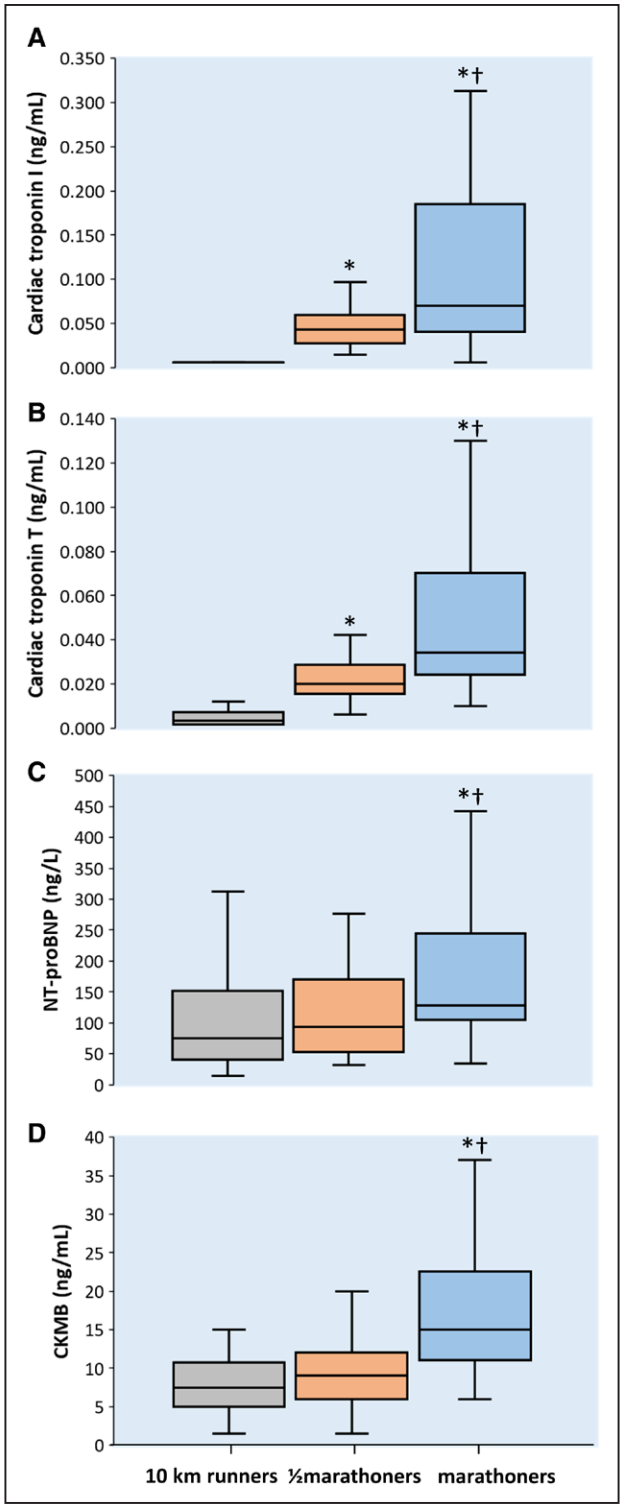

Figure. Box-and-whisker plots for the serum concentration of cardiac biomarkers after completion of 10 km, half-marathon and marathon races in amateur endurance runners.

A, high-sensitivity cardiac troponin I, (**B**) high-sensitivity cardiac troponin T, (**C**) NT-proBNP (N-terminal pro-B-type natriuretic peptide), and (**D**) creatine kinase-MB (CKMB). End of the whiskers represents lowest and highest 1.5 interquartile ranges. *Different from 10-km runners at $P<0.01$. †Different from half-marathoners at $P<0.01$.

and body mass loss (−1.0±0.4%, −1.7±0.7%, and −2.5±0.7%, respectively; $P<0.01$) increased with distance. However, the self-reported perceived exertion ratings measured with the Borg scale (15±2, 15±2, and 16±2 arbitrary units, respectively; $P=0.17$) were similar in all races. After the competitions, the serum concentrations of cardiac troponins I and T were significantly higher across running distances (Figure), whereas the NT-proBNP and creatine kinase-MB concentrations were higher only in marathon runners. A similar pattern of higher serum concentration with running distance was found for serum myoglobin (median, 82 [interquartile range, 68–107], 199 [154–436], and 636 [436–958] ng/mL, respectively; $P<0.01$) and creatine kinase-MM concentrations (145 [81–224], 157 [119–213], and 273 [216–654] ng/mL, respectively; $P<0.01$).

These data suggest that the strain imposed on the myocardium by competing in a full marathon is much greater compared with competing in shorter distances such as the half-marathon or 10-km races. Although the release of cardiac troponins after the exercise may not be indicative of any cardiovascular dysfunction, the higher concentration of cardiac troponins after the marathon reflects a superior cardiac stress at this running distance. The greater cardiac stress after the marathon was present despite a higher training volume. To assess the clinical significance of these findings, future studies should examine both the mechanism of cardiac troponin release with long-distance running and its potential impact on long-term clinical outcomes. Regardless, the findings from the present study demonstrate how running distance affects the cardiac stress induced by an endurance running competition in athletes with low experience and low training background.

ARTICLE INFORMATION

Data Sharing: The authors of this investigation declare that all the data, analytical methods, and study materials will be available to other researchers for purposes of reproducing the results or replicating the procedure. All this information will be available on request by contacting the corresponding author.

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Disclosures

None.

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