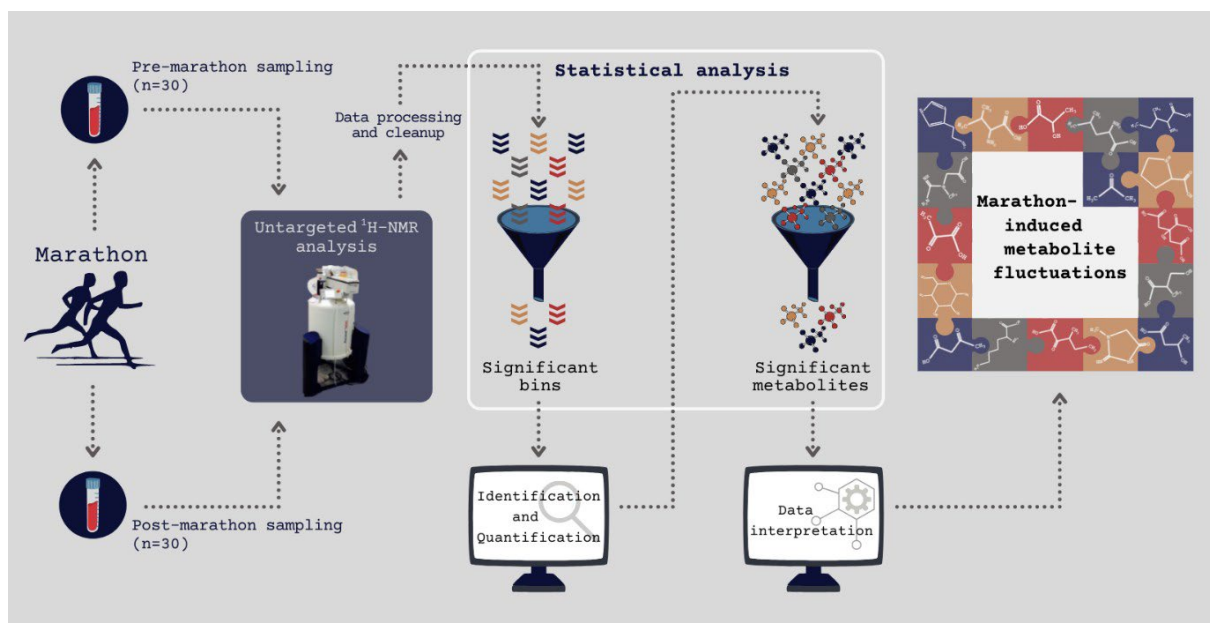


## Characterizing marathon-induced metabolic changes using $^1\text{H-NMR}$ metabolomics

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Summary of untargeted  $^1\text{H-NMR}$  metabolomics workflow.

**Introduction:** Although physical activity is considered a health-promoting, popular global pastime, regular engagement in extremely strenuous exercises, such as very long-distance endurance running races, has been associated with a variety of potentially detrimental physiological and immunological health effects (1-3). The resulting altered physiological state has previously been associated with fluctuations in various key metabolite concentrations (4), however, limited literature exists pertaining to the global/holistic metabolic changes that are induced by such.

**Methodology:** This investigation subsequently elucidated the metabolic changes induced by a marathon using an untargeted proton nuclear magnetic resonance ( $^1\text{H-NMR}$ ) spectrometry metabolomics approach (5).

**Results:** A principal component analysis (PCA) plot shows a natural differentiation between pre- and post-marathon metabolic profiles of the 30-athlete cohort, where 17 metabolite fluctuations were deemed to be statistically significant.

**Discussion and Conclusion:** Reduced concentrations of various amino acids (AA), accompanied by elevated concentrations of ketone bodies, glycolysis, tricarboxylic acid (TCA) cycle, and AA catabolism intermediates, were identified as significantly altered due to marathon intervention. Moreover, elevated concentrations of creatinine and creatine in the post-marathon group supports previous findings of marathon-induced muscle damage. Collectively, the results of this investigation characterize the strenuous metabolic load induced by a marathon and the consequential regulation of the main energy-producing pathways to accommodate for this, in addition to giving a better understanding of the physiological changes seen after the completion of a marathon.

**Keywords:** endurance races; marathon; metabolites; untargeted metabolomics;  $^1\text{H-NMR}$  spectrometry; serum metabolome

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