Global warming, renal function and heart failure: a 20-year follow-up study

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Funding Acknowledgement: Type of funding sources: None.

Background: There is a growing concern about the possible effects of global warming on human health. In HF outpatients, renal function significantly worsens during summer. More specific analyses on the impact of increasing temperatures on body homeostasis are lacking.

Purpose: We investigated the relationship between the trend of temperatures from 2002 to 2021 and renal function in heart failure (HF) outpatients.

Methods: All creatinine and estimated glomerular filtration rate (eGFR) values of HF outpatients followed at one tertiary hospital in a Mediterranean area of Spain were retrieved from electronic health records. eGFR was calculated through the CKD-EPI formula. Temperature data from the local municipality were derived from the MeteoCat service; as temperatures from the years 2004–2005 were not available, these years were not analysed. Summer was defined as the timespan from June to September included. We calculated average values of creatinine and eGFR during summer and the rest of the same year, considering each patient and each year. Similarly, we averaged temperature values during summer and the rest of the same year.

Results: We derived 6,307 couples of average creatinine/eGFR values in summer and in the rest of the year from 2,194 patients. Across all the years (2002–2003 and 2006–2021), creatinine was slightly higher in summer than in the rest of the year (1.26 vs. 1.21 mg/dL, p < 0.001), and eGFR was lower (65 vs. 67 mL/min/1.73 m², p < 0.001). Temperatures in summer and the rest of the year increased gradually, albeit not linearly, from 2002 to 2021 (Figure 1). The absolute (Δ) and percent changes (Δ%) in median temperatures between summer and the rest of the year increased across years (r=0.149, p=0.001 and r=0.144, p=0.002, respectively), as well as Δ and Δ% of the monthly median of maximal temperatures (r=0.119, p<0.001 and r=0.052, p<0.001, respectively) (Figure 1). The Δ and Δ% temperatures between summer and the rest of the year displayed several significant correlations with Δ and Δ% creatinine and eGFR after adjusting for several variables including age, sex, HF therapies, and creatinine outside of summer (Figure 2).

Conclusions: Over a 20-year timespan there has been an increase in 1) temperatures in summer and in the rest of the year, and 2) the temperature excursion between summer and the rest of the year. Changes in temperatures between summer and the rest of the year correlated with the magnitude of the decrease in renal function during summer, likely because of worse dehydration with higher temperatures. Therefore, the progressive rise in temperature may have detrimental effects on renal function during summer in HF outpatients.