

## Brief Review

# High temperatures and nephrology: The climate change problem<sup>☆</sup>

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### ABSTRACT

It is well known that climate change greatly affects human health, even though there are few studies on renal outcomes. Heat waves have been found to increase cardiovascular and respiratory morbidity and mortality, as well as the risk of acute renal failure and hospitalisation due to renal diseases, with related mortality. Recurrent dehydration in people regularly exposed to high temperatures seems to be resulting in an unrecognised cause of proteinuric chronic kidney disease, the underlying pathophysiological mechanism of which is becoming better understood. However, beyond heat waves and extreme temperatures, there is a seasonal variation in glomerular filtration rate that may contribute to the onset of renal failure and electrolyte disorders during extremely hot periods. Although there are few references in the literature, serum sodium disorders seem to increase. The most vulnerable population to heat-related disease are the elderly, children, chronic patients, bedridden people, disabled people, people living alone or with little social contact, and socioeconomically disadvantaged people.

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## Altas temperaturas y nefrología: a propósito del cambio climático

### RESUMEN

#### Palabras clave:

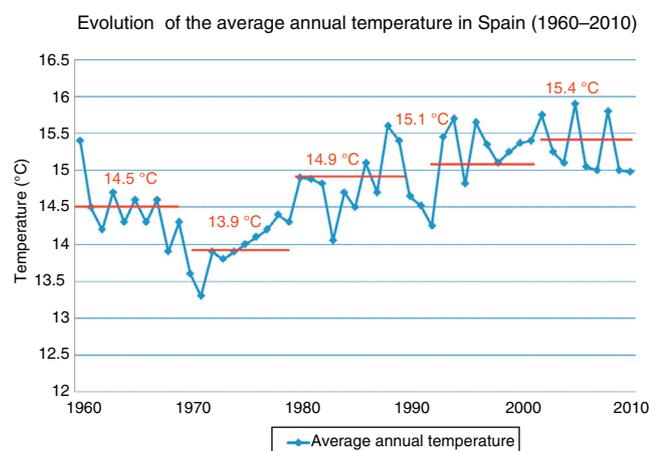
Cambio climático  
Nefrología  
Fracaso renal agudo  
Alteraciones electrolíticas  
Enfermedad renal crónica de

Sabemos que el cambio climático afecta de forma considerable a la salud, si bien son muy pocos los estudios que recogen sus consecuencias a nivel renal. Se ha visto como las olas de calor aumentan la morbimortalidad cardiovascular y respiratoria, pero también el riesgo de fracaso renal agudo, así como el índice de ingresos de causa nefrológica, con la mortalidad que ello implica. Las situaciones de deshidratación repetidas en población expuesta de forma habitual a altas temperaturas parecen estar generando una nueva entidad dentro de la enfermedad renal crónica proteinúrica, cuyo mecanismo fisiopatológico se va dilucidando. Pero más allá de olas de calor y temperaturas extremas, se ha comprobado que existe una variación estacional del filtrado glomerular que pudiera facilitar el desarrollo de fracaso renal y alteraciones electrolíticas en periodos extremadamente cálidos. Entre las alteraciones del medio interno, parecen aumentar fundamentalmente las disnatremias, aunque es poca la evidencia bibliográfica al respecto. Los grupos de riesgo para presentar enfermedades asociadas al calor son ancianos, niños, enfermos crónicos, personas encamadas, discapacitados, sujetos que viven solos o con escaso contacto social y las poblaciones más desfavorecidas a nivel socioeconómico.

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## Introduction

The global variation in the Earth's climate is called climate change, which occurs at various timescales and in any meteorological parameter (temperature, rainfall, cloudiness, etc.), and it is a consequence of our mode of energy production and consumption. Carbon dioxide is the main factor in this phenomenon; its atmospheric concentration has almost doubled from the pre-industrial era to the present. The Earth's temperature has increased by about 0.7 °C in the twentieth century, and the rate of increase has been greater during the past 50 years (Fig. 1).<sup>1</sup> In fact, 11 of the past 12 years have



**Fig. 1 – Course of the average annual temperature in Spain. The average annual temperature in Spain is increasing progressively: the average for the period 2001–2010 (15.4 °C) is the highest of the past 50 years.**

**Source:** Spanish National Weather Service and National Institute of Statistics.

been the hottest recorded since 1850. Due to its geographical location, Spain is very vulnerable to climate change; in fact, it is expected that in the last third of the century, summer temperatures will be 5–7 °C higher. The potential impact of climate change is therefore enormous, with a lack of drinkable water, difficulties in producing food and rising mortality rates due to floods, droughts and heat waves, etc. In short, this is not only an environmental phenomenon, but also involves profound economic and social health consequences.<sup>2</sup>

Numerous studies have shown that abrupt changes in temperature, including both cold snaps or heat waves, have a direct effect on the number of hospital admissions, morbidity and mortality.<sup>3–10</sup> In the United States, 650 people die each year due to heat waves; this is the most lethal weather event and one which has been occurring more and more frequently. These periods of extreme warm temperatures can cause life-threatening situations, such as hyperthermia and heat stroke.

It is easy to imagine how sweating combined with an inadequate water intake or an excess intake of water can cause electrolyte imbalances during periods of high temperatures and variable humidity may cause electrolyte imbalances that are independent predictors of mortality.<sup>11–13</sup> Further, compensatory physiological mechanisms, such as circulatory adaptation and thermoregulation, may compromise kidney function. Several studies have demonstrated the relationship between high ambient temperature and an increase in the number of hospital admissions due to kidney failure.<sup>5,14–17</sup> During the heat wave that struck Europe in August 2003, more than 70,000 people died across the continent (6500 in Spain); France was the country most affected, with 14,729 deaths,<sup>18</sup> most of whom were elderly people dehydrated with kidney failure.<sup>19–21</sup>

The groups that are at a risk of heat-related illness include children, the elderly, the chronically ill (heart, respiratory and

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