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Review

Prevalence of hyponatremia on geriatric wards compared to other settings over four decades: A systematic review

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ABSTRACT

Aim of the study was to analyze temporal trends in prevalence of hyponatremia over four decades in different settings. A systematic review of the literature from 1966 to 2009 yielded prevalences of hyponatremia, with standard errors (SE) and pooled estimated means (PEM), calculated by year and setting (geriatric, ICU, other hospital wards, psychiatric hospitals, nursing homes, outpatients). 53 studies were included. Prevalence of hyponatremia was stable from 1976 to 2006, and higher on geriatric wards accept for ICU: e.g. PEM prevalence of mild hyponatremia (serum sodium <135 mM) was 22.2% (95%CI 20.2–24.3) on geriatric wards, 6.0% (95%CI 5.9–6.1) on other hospital wards and 17.2% (SE 7.0) in one ICU-study; for severe hyponatremia (serum sodium < 125 mM) these figures were 4.5% (95%CI 3.0–6.1), 0.8% (95%CI 0.7–0.8) and 10.3% (SE 5.6). In nursing homes PEM prevalence of mild hyponatremia was 18.8% (95%CI 15.6–22.2). The higher prevalence on geriatric wards could partly be explained by age-related changes in the regulation of serum sodium. Other underlying factors can be the presence of multiple diagnoses and the use of polypharmacy.

1. Introduction

Hyponatremia is an electrolyte disorder usually defined as a serum sodium level ([Na^+]) of less than 135 mM (Alvarez and Coto, 2011). Clinical manifestations are largely related to dysfunction of the central nervous system as a result of a water shift from extra- to intracellular, leading to e.g. nausea, cognitive disorders and falls (Ellison and Berl, 2007). In hospitalized patients (Zilberberg et al., 2008; Wald et al., 2010) and in acutely admitted older patients (Hoorn et al., 2011), the mortality rate is higher in patients with hyponatremia than in patients with normonatremia.

The prevalence of hyponatremia is thought to have increased in the last decade (Anpalahan, 2001; Hoyle et al., 2006; Chua et al., 2007). Aim of this study was to determine, on the basis of published data, whether prevalence of hyponatremia in different settings showed temporal trends over the last 40 years.

2. Materials and methods

2.1. Search strategy and selection criteria

The MEDLINE and EMBASE databases were searched for relevant studies, using the following keywords: 'hyponatremia', 'water-electrolyte imbalance', 'SIADH', 'inappropriate ADH syndrome', 'sodium blood level', 'sodium depletion' or 'sodium ions', all with their related terms. The search was limited to 'humans'; "yr = '1966-current' "; 'all adult (19 plus years)' and 'English or Dutch or German or French' language with 'remove duplicates' at the end of the search history. Studies were eligible for inclusion if they met the following criteria: (1) cross-sectional or longitudinal studies in which data on the prevalence of hyponatremia were mentioned or could be calculated; (2) there was no pre-selection (e.g. population with certain drug use or diseases; or hyponatremia in marathon runners) other than setting or age; (3) hyponatremia was defined with a cut-off level for [Na^+] under the normal range (<135 mM); the study reported the population size; and the study reported the setting investigated.

In first analysis (September 6, 2009), it was found that data from developing countries diverged from those of developed countries

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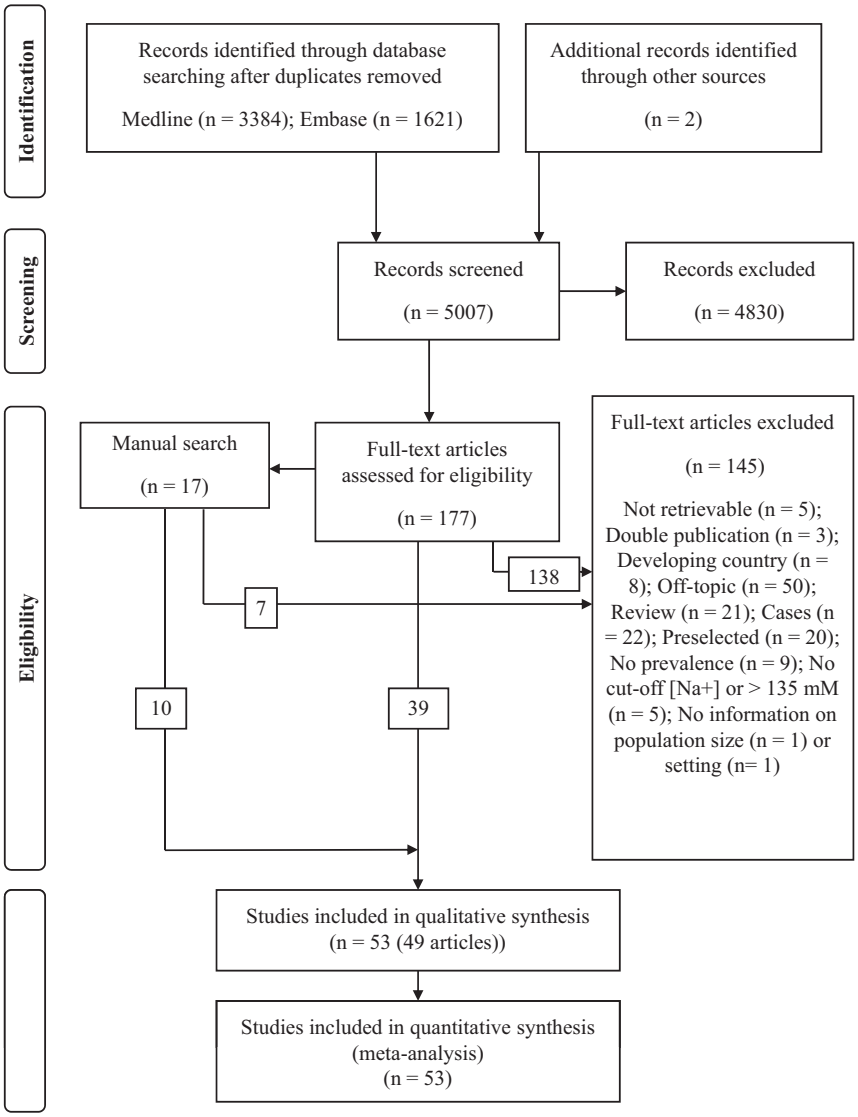

Fig. 1. Numbers of included and excluded studies.

with more heterogeneity in health systems. For this reason, studies from developing countries as defined by the World Bank[1] were excluded from the analysis.

The final search was performed on March 2, 2010. Two reviewers (CKM, AMV) independently screened the titles and abstracts for relevance with final agreement on the shortlist for inclusion. Potentially relevant publications that were not retrievable in full-text were excluded. Retrieved full-text publications were evaluated by two reviewers (CKM, AMV), and the reference lists were searched for additional references.

2.2. Data extraction, definition of hyponatremia

The following data were extracted: the setting (hospital, inpatient or outpatient, with separate data on intensive care unit (ICU) and geriatric ward; psychiatric hospital; nursing home; primary care population or general population), year of study (when missing, one year was subtracted from the year of publication), country of the study, length of study, size, age, and gender of total population, and prevalence of hyponatremia. Most often reported definitions of hyponatremia (mild, i.e. $[Na^+]$ <135, <130 and severe hyponatremia, i.e. $[Na^+]$ <125 and <120 mM) were used and a differentiation was made between community-acquired and/or hospital-acquired hyponatremia (Wald et al., 2010).

2.3. Data analysis

Prevalence of hyponatremia (%) was calculated by dividing the number of patients with hyponatremia by the number of patients admitted to the setting in the individual ($_i$) study (total population, N_i). For prevalence, age, and gender of the total population, weighted means (M_i) were calculated using the inverse variance method (Deeks et al., 2005) in which studies were weighted by their standard error (SE_i), which is related to population size.

First, SE_i for the data of each study was calculated. For age of the total population, this was calculated from age range, after transformation to standard deviation (SD_i), with SE_i being calculated using $SD_i/\sqrt{N_i}$. SE_i was calculated with $\sqrt{(P_i(1-P_i))}/N_i$ for prevalence as well as for percentage of women, where P_i stands for the proportion of patients with hyponatremia and the proportion of women in the total population, respectively. With the calculated SE_i, the weight of the average from each study was calculated with $W_i = 1/(SE_i)^2$. Pooled estimated mean (PEM) was calculated with $\sum M_i W_i / \sum W_i$,

[1] http://www.icce2010.org/docs/developingCountries.pdf.