ORIGINAL ARTICLE

Low-normal serum potassium is associated with an increased risk of cardiovascular and all-cause death in community-based elderly

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Background/Purpose: Several studies have already reported that serum potassium (SK) correlated inversely with adverse events among patients with preexisting cardiovascular disease and impaired renal function; less is known about the prognostic value of SK at the normal range in community-based elderly individuals. This study aimed to examine whether low normal SK value was associated with cardiovascular and all-cause mortalities in elderly people.
Methods: A prospective study was conducted using two independent elderly Taiwanese community cohorts that included 2065 individuals with relatively normal SK values (2.8—5.6 mmol/L). The participants were grouped as follows: low (2.8—3.4 mmol/L), low-normal SK (3.5—3.8 mmol/L), normal (3.9—4.4 mmol/L), and high-normal SK (4.5—5.6 mmol/L). Proportional hazards model was applied to compare the association between SK concentration groups and mortality.
Results: The relationship between baseline SK and all-cause and cardiovascular mortality was U-shaped, with the lowest mortality rates observed in patients with SK levels of 3.9—4.4 mmol/L. The low-normal SK group had significantly higher risks of all-cause (hazard ratio, 1.3; 95% confidence interval, 1.0—1.6) and cardiovascular mortality (hazard ratio, 1.6; 95% confidence interval, 1.1—2.3) than the normal SK group. The high-normal SK group had higher but nonsignificant risk compared to the normal group.

Conclusion: Our findings suggest that low-normal SK may be used as a marker of poor survival for elderly outpatient cares.

Introduction

Potassium homeostasis is critical to avoid adverse consequences in patients with cardiovascular disease (CVD). Normally, serum potassium (SK) level is tightly maintained between 3.5 mmol/L and 5.5 mmol/L,[1–3] and departure from normal may cause severe consequences including muscular weakness,[4] paresthesia, cardiac arrhythmias, and sudden death.[5] Although several studies have already reported that SK correlated inversely with adverse events among patients with preexisting CVD and impaired renal function,[6,7] less is known about the prognostic value of SK within the normal range and in general populations.

Walsh et al[8] have reported that there is no significant association between the SK level and adverse events among young participants. However, Wannamethee et al[9] showed that it is not the "low potassium," but the "raised potassium" that was associated with higher cardiovascular and all-cause mortality in middle-aged men, suggesting the questionable role of SK in determining future adverse events in the general population. By contrast, an earlier study has reported a negative association between potassium intake and risk of cerebrovascular events.[10,11] Our previous study showed that switching to potassium-enriched salt is beneficial for life span prolongation and CVD mortality and medical cost reduction in elderly men. The aforementioned suggests that the prognostic value of SK remains undetermined especially for the elderly.[12] However, there is a lack of adequately powered studies in the general elderly population, and this information is extremely important for geriatric care; to address this critical knowledge gap, we took advantage of two community-based elderly cohorts to examine whether the SK value within the normal range is associated with cardiovascular and all-cause mortalities in elderly people.

Participants, design, and methods

Study population

We performed the present study using two independent Taiwanese community-based elderly cohorts. One is the Elderly Nutrition and Health Survey in Taiwan (Elderly NAHSIT) performed during 1999—2000, which has complete information on 1400 participants.[13] The other is a cohort from a veteran retirement home (VRH) study, which has complete data on 665 veterans. The detailed description and design of the Elderly NAHSIT and the VRH study can be found elsewhere.[12,13] The VRH study was approved by reviewers of the National Science Council, and Elderly NAHSIT was approved by the Ethics Committees of the National Health Research Institutes and Academia Sinica in Taiwan.

Baseline measurements

Fasting venous blood samples were collected for a battery of biochemical analyses. Serum levels of potassium, sodium, glucose, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), total cholesterol, triglycerides, uric acid, and creatinine were measured using a COBAS INTEGRA 800 (Roche, Mannheim, Germany) for the VRH study and for the Elderly NAHSIT. The body weight and height of the elderly were measured, following the same protocol. The body mass index (BMI) was calculated by dividing body weight (kg) by height square (m^2). The estimated glomerular filtration rate (eGFR) was calculated using the abbreviated Modification of Diet in Renal Disease Study equation.[14] Structured questionnaires covering sociodemographics and medical histories were administered by trained interviewers. Medical histories included hypertension medication, diabetes mellitus medication, and self-reported doctor-diagnosed heart disease, kidney disease, and stroke. Three blood pressure measurements were obtained by trained technicians, and the last two measurements were averaged and used for statistical analysis. The measurement was taken with a calibrated mercury sphygmomanometer and cuffs of the appropriate size, with the participant seated for 5—10 minutes.

In order to examine the prognostic value of low-normal and high-normal SK, individuals with SK values between 2.8 mmol/L and 5.6 mmol/L were included in this study. As there are no standardized cut-points, in this study the participants were categorized into low (2.8—3.4 mmol/L), low-normal (3.5—3.8 mmol/L), normal (3.9—4.4 mmol/L), and high-normal (4.4—5.6 mmol/L), considering this should provide a sufficient number of people in the low-normal and high-normal groups and also taking into consideration the cut-points of several previous studies, in which low SK has been defined by ≤3.70 mmol/L,[15] ≤3.90 mmol/L,[9,16,17] or ≤4.00 mmol/L[8,18] and high SK by ≥4.00 mmol/L,[16,17] ≥4.50 mmol/L,[15] ≥5.20,[8,9] or ≥5.50 mmol/L.[18]

Follow-up and outcome measurements

Baseline information was linked to the National Death Registry database for an 8-year follow-up. The government's confidentiality regulations were followed in the linkage process. The personal identification numbers were encrypted, and thus no privacy data from the study individuals could be identified. All-cause and cardiovascular-related deaths were coded with the International Classification of Diseases, ninth revision (ICD-9). Cardiovascular-related deaths include those caused by diabetes (ICD-9:250), hypertension (ICD-9: 401—405), ischemic heart disease (ICD-9: 410—414), heart failure (ICD-9: 428), and stroke (ICD-9: 430—438).[12]