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Electrolyte Disorders in the Elderly: About 263 Cases in the Geriatrics Department of the Fann University Hospital Center in Dakar (Senegal)

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Abstract

Objectives: Aging is accompanied by a modification of the homeostasis of the body's electrolyte regulation, coupled with an increase in the frequency of comorbidities and polypharmacy, responsible for an increased risk of electrolyte disorders, often with serious consequences. The general objective was to determine the prevalence of electrolyte disorders and their sociodemographic characteristics, comorbidities, geriatric syndromes, and their evolutionary aspects in a geriatric short-stay unit. **Patients and Method:** This was a retrospective, descriptive study on 263 patient records presenting at least one electrolyte disorder in the geriatrics department of FANN Hospital, between September 1, 2021, and August 31, 2023. **Results:** The overall prevalence of the disorder was 94.96%. The average age of the patients was 79 ± 8 years with a slight female predominance (52%). High blood pressure (63.50%) and mellitius diabetes (26.62%) were the main comorbidities. The most common electrolyte disorders were hypokalemia (33.46%) and hyponatremia (26.24%). Geriatric syndromes were dominated by frailty syndrome (98.39%) and acute loss of functional autonomy (97.72%). The mortality rate was 20.91%, higher in patients with hypernatremia (27.59%). **Conclusion:** Electrolyte disorders in the elderly are common, particularly sodium imbalance, and are responsible for increased mortality. Proper management of comorbidities in the elderly would improve patient prognosis.

Keywords

Electrolyte Disorders, Elderly Person, Geriatrics, Senegal

1. Introduction

Rapid population aging is one of the greatest challenges of the 21st century, particularly in developing countries [1]. Senegal's population, although still young, will also undergo this transition: the proportion of the population in the geriatric age group increased from 3.5% in 2013 to 3.8% in 2023 [2]. This demographic transition is accompanied by an epidemiological transition characterized by the persistence of infectious diseases, but above all by the emergence of chronic diseases—hypertension, heart disease, diabetes, kidney disease, and others, and geriatric syndromes, including falls, cognitive impairment, and malnutrition. These conditions predispose older adults to acute illnesses, including electrolyte disorders.

The prevalence of electrolyte disorders increases exponentially with age, ranging from 2.3% to 44% for hyponatremia, 1.1% to 4.4% for hypernatremia, 10.2% to 39% for hypokalemia, and 0.8% to 13% for hyperkalemia [3]. This is explained by the physiological effects of aging on the principal mechanisms responsible for electrolyte homeostasis, including renal, gastrointestinal, and cutaneous mechanisms [3]. In addition, the high prevalence of multimorbidity and polypharmacy further compromises the body's ability to adapt to stressful situations.

The often atypical clinical presentation, together with the coexistence of common comorbidities and frailty, frequently worsens prognosis and leads to substantial consequences. Mortality associated with electrolyte disorders is estimated at 7.2% of hospital admissions among older adults [4]. In Senegal, despite population aging and the serious consequences of electrolyte disorders, few studies have specifically examined this issue in the geriatric population. This study was therefore conducted with the primary objectives of assessing the prevalence of electrolyte disorders and describing the sociodemographic characteristics, diagnostic features, and outcomes of older adults hospitalized in the short-stay geriatric unit of the Geriatrics Department at Fann Hospital.

2. Patients and Methods

- **Study setting**

This study was conducted in the short-stay unit of the Geriatrics Department at Fann National University Hospital Center (CHNU), which occupies the highest level of the national healthcare referral system. The Geriatrics Department was established in 2015. Its services include acute geriatric care in a 16-bed unit distributed across two buildings, a geriatric consultation and assessment unit, and a mobile team operating both within and outside the hospital. Expansion work is underway and is expected, within a few months, to create the largest geriatrics department in the subregion, with a capacity of 60 beds and additional services, including long-term geriatric care and post-acute and rehabilitation care.

- **Study design and period**

This was a retrospective descriptive study covering a two-year period, from September 1, 2021, to August 31, 2023.

- **Study population**

The study examined the medical records of adults aged 65 years or older who were hospitalized during the above-mentioned period had at least one abnormal value in the routine full blood ionogram (sodium, potassium, phosphorus, calcium, and magnesium) during their stay. The exclusion criteria were: absence of a full blood ionogram during hospitalization, readmission of patients already included during a previous hospitalization, and incomplete or unusable medical records. The prevalence was assessed using patient records with a complete blood electrolyte panel during hospitalization with usable medical records.

- **Study variables**

A data collection form was developed, and the following variables of interest were extracted from patients' medical records: sociodemographic characteristics: age, sex, place of residence, route of admission, educational level, marital status, occupation, and socioeconomic status; medical history and comorbidities: personal medical history, comorbidities, and surgical history; diagnostic features: reasons for hospitalization, clinical manifestations, geriatric syndromes, serum electrolyte results, and other laboratory parameters, including hemoglobin level and renal function; outcomes: length of stay and hospital outcomes. The principal validated scales, the domains assessed, and their interpretation thresholds were as follows: the Katz Activities of Daily Living (ADL) scale was used to assess independence in daily and instrumental activities, with loss of functional independence defined as an ADL score < 3; For the nutritional assessment, the full Mini Nutritional Assessment (MNA) is used and the interpretation thresholds were as follows: normal between score 23.5 and 30, risk of malnutrition between 17 and 23.5, malnutrition if < 17; the Fried scale was used to assess frailty; and the Confusion Assessment Method was used to screen for acute delirium, with delirium defined by the presence of criteria 1 + 2 + 3 or 4.

- **Operational definitions of variables**

Electrolyte disorders were defined using the following thresholds: sodium imbalance (hyponatremia was defined as serum sodium < 135 mmol/L with plasma osmolarity < 280 mOsm/L; hypernatremia was defined as serum sodium > 145 mmol/L); potassium imbalance(hypokalemia was defined as serum potassium <3.5 mmol/L; hyperkalemia was defined as serum potassium > 5 mmol/L); calcium imbalance (hypocalcemia was defined as corrected serum calcium < 2.2 mmo/L; hypercalcemia was defined as total serum calcium > 2.60 mmol/L); phosphorus imbalance (low level of phosphorusa was defined as serum phosphorus < 25 mg/L; high level of phosphorus was defined as serum phosphorus > 45 mg/L); magnesium imbalance (Low magnesium level was defined as serum magnesium < 18 mg/L; High magnesium level was defined as serum magnesium > 26 mg/L).

Corrected blood calcium = Measured calcium + 0.8 × (40 − Measured serum albumin).

Multimorbidity was defined as the coexistence of at least three comorbidities. Polypharmacy was defined as the daily use of at least five oral medications.

- **Statistical analysis**

The collected data were entered and analyzed using Epi Info version 7.2.5.0 for Windows. Qualitative variables were expressed as counts and percentages. Quantitative variables were expressed as means with standard deviations, as well as medians and minimum and maximum values. Tables, pie charts, and bar charts (histograms) were produced to illustrate selected variables.

- **Ethical considerations**

This retrospective study used anonymized patient data extracted from medical records. Because the study involved the analysis of existing data, without any direct patient contact or intervention, individual consent was not required. However, approval to conduct the study was obtained from the head of the department.

3. Results

Out of 518 patients hospitalized during this period, 255 patient records were not included. Of the 277 patients included, 263 had at least one ionic disorder, corresponding to a hospital prevalence of 94.96%.

The mean age of the patients was 79 ± 8 years, with ages ranging from 65 to 101 years. There was a female predominance (52%), with a male-to-female ratio of 0.90. More than one-third of patients (34.22%) were admitted directly from the geriatric outpatient clinic, followed by transfers from the hospital's medical and surgical departments (20.15%). Approximately one-quarter of patients (24.34%) had multimorbidity, and one-third (33.08%) were receiving polypharmacy. High blood pressure was the most common comorbidity, affecting 63.5% of patients, followed by mellitius diabetes and ischemic stroke, affecting 26.62% and 21.29%, respectively. The distribution of patients' general characteristics is presented in Table 1.

Table 1. General characteristics of patients with electrolyte disorders hospitalized in the geriatrics department of Fann Hospital in Dakar from September 1, 2021, to August 31, 2023; N = 263.

Variables	Categories	Counts	Frequencies (%)
Age group	65 - 74	85	32.31
	75 - 84	94	35.74
	85 - 94	74	28.14
	≥95	10	3.80
Hospital origin	GCU	90	34.22
	Other hospital services	53	20.15
	ERS of the hospital	48	18.25
	EMAS	07	2.67
	Not specified	65	24.71
Comorbidity	HBP	167	63.5
	Diabetes mellitus	70	26.62

Continued

	Ischemic stroke	56	21.29
	Cardiomyopathy	35	13.31
	Dementia	28	10.65
	Osteoarthritic disease	21	7.98
	Glaucoma	17	6.46
	Active cancer	17	6,46
	Asthma	13	4.94
	BPH	13	4.94
	CKD	8	3.04
	Parkinson Disease	12	4.56
	Cataract	9	3.42
	artery disease of the lower limbs	9	3.42

Abbreviations: GCU: Geriatric Consultation Unit; HBP: High Blood Pressure; EMAS: Emergency Medical Assistance Service; ERS: Emergency Reception Service; CKD: Chronic Kidney Disease; BPH: Benign Prostatic Hyperplasia.

Potassium imbalance were the most common electrolyte disorders, accounting for 50.01% of cases: hypokalemia accounted for 33.46% and hyperkalemia for 16.35%. These were followed by sodium imbalance, accounting for 48.29%: hyponatremia accounted for 26.24% and hypernatremia for 22.05%. Calcium imbalance is accounted for 18.25%, comprising hypercalcemia in 6.08% and hypocalcemia in 12.17%. Phosphorus imbalance was less common, accounting for 5.32%, including high phosphate level in 3.04% and low phosphate level in 2.28%. The distribution of electrolyte disorders is presented in Figure 1.

The most common geriatric syndrome was frailty (98.39%), followed by acute

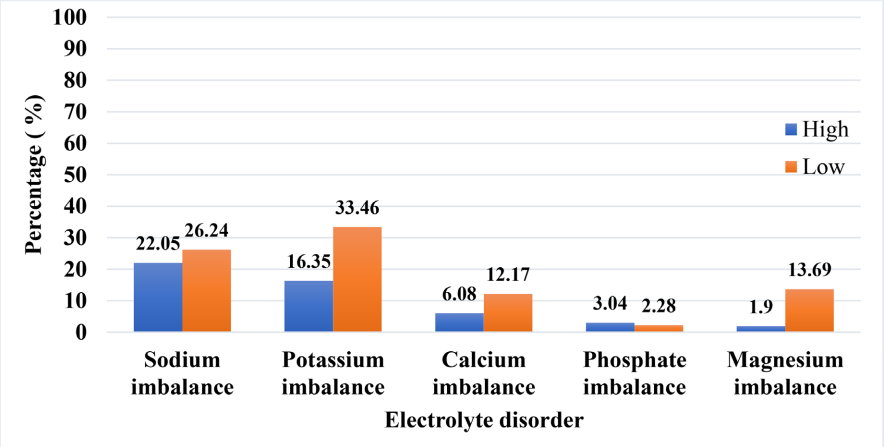
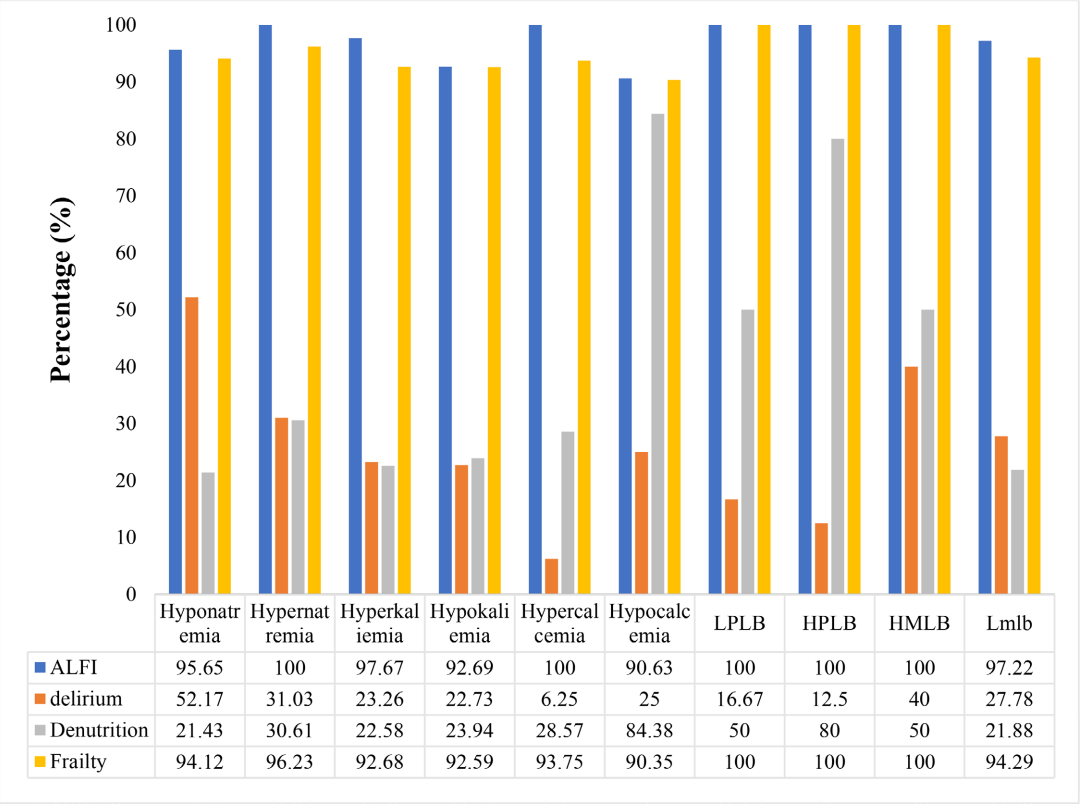


Figure 1. Distribution of the prevalence of electrolyte disorders in elderly patients hospitalized in the geriatrics department of Fann Hospital in Dakar from September 1, 2021, to August 31, 2023; N = 263.

loss of functional independence (97.72%), acute delirium (57.03%), and malnutrition (56.28%).

Acute delirium was more frequently observed among patients with sodium disorders, occurring in 52.17% of those with hyponatremia and 31.03% of those with hypernatremia. Malnutrition was more common among patients with hypocalcemia, affecting 84.38%. Acute loss of functional independence and frailty were present in almost all patients, regardless of the type of electrolyte disorder (Figure 2).



	Hyponatremia	Hypernatremia	Hyperkaliemia	Hypokaliemia	Hypercalcemia	Hypocalcemia	LPLB	HPLB	HMLB	Lmlb
ALFI	95.65	100	97.67	92.69	100	90.63	100	100	100	97.22
delirium	52.17	31.03	23.26	22.73	6.25	25	16.67	12.5	40	27.78
Denutrition	21.43	30.61	22.58	23.94	28.57	84.38	50	80	50	21.88
Frailty	94.12	96.23	92.68	92.59	93.75	90.35	100	100	100	94.29

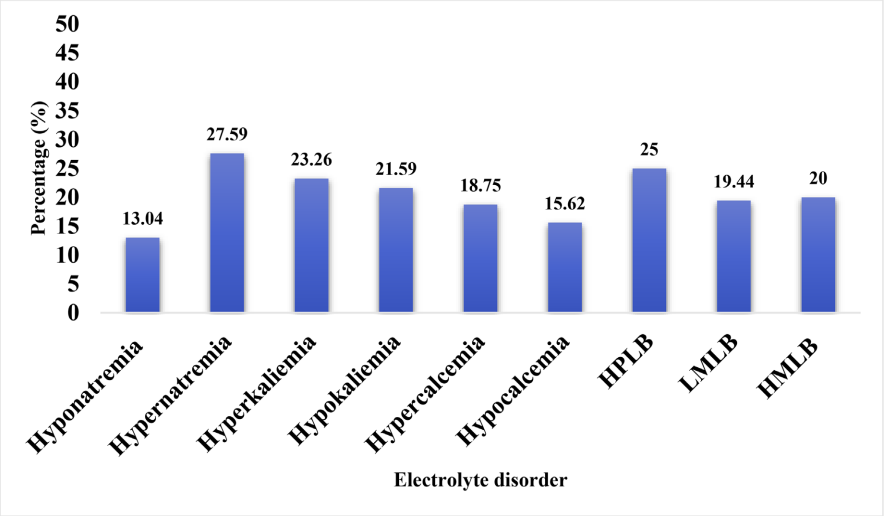
Abbreviations: ALFI: Acute Loss of Functional Independence; LPLB: Low of Phosphate Level in the Blood; HPLB: High Level of phosphate in the Blood; HMLB: High Magnesium Level in the Blood; LMLB: Low Magnesium Level in the Blood.

Figure 2. Distribution of geriatric syndromes according to electrolyte disorders in elderly patients admitted with an electrolyte disorder to the geriatrics department of Fann Hospital in Dakar between September 1, 2021, and August 31, 2023; N = 263.

The mean length of stay was 10 ± 8 days. The hospital course was favorable, with discharge home in 73.64% of cases. The overall case fatality rate was 20.91%. Hypernatremia was the electrolyte disorder associated with the highest mortality rate (27.59%), followed by hyperphosphatemia (25%) (Figure 3).

4. Discussion

Our study highlighted the high frequency of electrolyte disorders, with hypokalemia predominating (33.46%), followed by hyponatremia (26.24%) and hypernatremia (22.05%). These electrolyte disorders generally occurred in the context



Abbreviations: HPBL: High Level of phosphate in the Blood; LMLB: Low Magnesium Level in the Blood; HMLB: High Magnesium Level in the Blood.

Figure 3. Breakdown of the death rate by electrolyte disorder in elderly people admitted with an electrolyte disorder to the geriatric department of Fann Hospital in Dakar between September 1, 2021 and August 31, 2023.

of multimorbidity (24.34%), with hypertension being the most common comorbidity (63.50%), and geriatric syndromes, with frailty and loss of functional independence present in almost all patients. Mortality was high, particularly among patients with hypernatremia.

The mean age of our patients was 79 ± 8 years, with a slight female predominance (52%). The mean age in our series was close to that reported in an American study conducted in a geriatric hospital, which was 81.9 ± 8.5 years [5]. A large systematic review reported a mean age of 78.5 ± 2.8 years [6]. This high mean age is primarily explained by the geriatric focus of the study setting, as well as by global population aging. The female predominance observed in our series is consistent with the study by Ba *et al.* [7] conducted in a short-stay geriatric unit. Senegal's latest general population census reports a feminization of aging, with women accounting for 51.67% of people aged 60 years or older [2].

Hypertension was the most common comorbidity, affecting 63.5% of patients, followed by type 2 diabetes, affecting 26.62%. This finding is consistent with a study conducted in our setting, which reported hypertension in 53.3% and diabetes in 25.6% of older patients [8]. Multimorbidity was found in 24.34%, and polypharmacy in slightly more than one-third of patients (33.08%). Previous studies in Senegal reported polypharmacy rates ranging from 20% to 39.39% [8].

The principal electrolyte disorders in our series were hypokalemia (33.46%) and hyponatremia (26.24%), consistent with several reports in the literature. In Mali, hyponatremia was found in 33% of patients in a geriatric population [9]. Hypokalemia was found in 11% of patients aged 60 - 71 years in an emergency department [10]. The prevalence of hyponatremia ranges from 15% to 30% among hospital-

ized patients, particularly in the geriatric population [11]. A large study found that the frequency of hyponatremia increased from 2.8% among adults aged 31 - 40 years to 16% among patients older than 80 years [10]. In China, hyponatremia was found in 24.7% of hospitalized older patients [12].

This high prevalence may be explained by the frequency of cardiovascular comorbidities, including hypertension and heart disease, which often lead to renal complications and the use of medications—such as angiotensin-converting enzyme inhibitors and diuretics—that can cause respectively a potassium retention and a sodium depletion at the kidney level [12]. In addition, aging reduces the kidneys' functional adaptive capacity, predisposing older adults to hyponatremia and hypokalemia in the event of substantial depletion or inadequate intake [13]. Differences from our study could be explained by the higher frequency of kidney disease in nephrology departments.

The frequency of hypernatremia in our study (22.05%) was somewhat higher than that reported in India, where hypernatremia occurred in 16% of patients in a short-stay geriatric unit [14]. The frequency of hypernatremia is partly explained by impaired water and sodium homeostasis, with reduced water reserves, diminished thirst sensation, and reduced responsiveness of antidiuretic hormone (ADH) receptors in the renal collecting ducts [15]. In addition, the frequency of functional dependence and cognitive impairment in our series predisposes older adults to inadequate fluid intake, increasing the risk of intracellular dehydration.

Acute delirium was more frequently observed among patients with sodium disorders, occurring in 52.17% of those with hyponatremia and 31.03% of those with hypernatremia. Malnutrition was more common among patients with hypocalcemia, affecting 84.38%. An interrelationship between hyponatremia and certain geriatric syndromes, including falls, osteoporosis, and functional dependence, has been demonstrated in the literature [15]. A large study highlighted the predominance of signs of acute delirium, such as drowsiness and disorientation in time and space, in patients with hypernatremia [16].

Reduced functional reserve resulting from age-related structural changes in the brain, combined with frequent comorbidities—such as chronic cognitive impairment, stroke, and depression—predisposes older adults to cerebral decompensation when sodium metabolism is disturbed. The relationship between malnutrition and hypocalcemia may be explained, on the one hand, by the frequency of inadequate calcium intake in the geriatric population and, on the other, by the high prevalence of vitamin D deficiency, given the essential role of vitamin D in calcium and phosphorus metabolism. Hypokalemia can cause muscle weakness, cramps, and fatigue, reducing muscle strength and contributing to functional decline. Electrolyte disorders and geriatric syndromes thus create a vicious cycle that may worsen these patients' prognosis.

The mortality rate observed in our study was 20.91%, with a particularly high rate among patients with hypernatremia (27.59%). In a study conducted in a geriatric population, 33% of deaths were associated with hypernatremia [17]. In a

French study [18], advanced age was a risk factor for both more severe hypernatremia and death. The principal risk factors for death were tachycardia (OR = 1.02; 95% CI: 1.00 - 1.04) and the presence, at admission, of neurological signs related to hypernatremia (OR = 4.63; 95% CI: 1.17 - 18.2). The lower mortality rate associated with hyponatremia in our series may be explained by improvements in diagnosis, including routine screening in acute geriatric care, and the development of diagnostic and treatment protocols within the department. However, the lack of adjustment for disease severity prevents attributing the increase in mortality exclusively to electrolyte disorders.

Study limitations

The principal limitation of our study was data collection bias related to its retrospective design, with missing data potentially affecting the quality of the results.

5. Conclusion

Electrolyte disorders are common in acute geriatric practice, with hypokalemia and hyponatremia predominating. They generally occur in the context of multimorbidity and geriatric syndromes, which can complicate diagnosis and management. They are associated with substantial mortality, particularly in cases of hypernatremia. A complete serum electrolyte panel should be routinely performed in acute geriatric practice to enable early detection and management of electrolyte disorders. Prevention remains essential through optimization of the prescribing of medications that can cause electrolyte disorders and effective management of chronic comorbidities and geriatric syndromes.

What Is Already Known about This topic

- Electrolyte disorders are particularly common in older adults.
- Iatrogenic causes are common, particularly those involving cardiovascular medications.
- Electrolyte disorders are associated with substantial morbidity and mortality.

What This Study Adds

- Hypokalemia is more common in geriatric care, but hypernatremia is associated with the highest mortality among older adults.
- Certain geriatric syndromes, such as frailty and acute loss of functional independence, are particularly common among older adults with electrolyte disorders.
- Acute delirium is a very common manifestation of sodium disorders, while malnutrition remains the principal geriatric syndrome associated with hypocalcemia.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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