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ORIGINAL ARTICLE

STUDY OF THE PREVALENCE OF SODIUM AND POTASSIUM DISTURBANCES IN THE ELDERLY

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ABSTRACT

Background: Electrolyte disturbances establish a broad problem among old individuals. A medication adverse effect that in youngsters would deliver just a trifling change in the plasma sodium and potassium may cause a major serious effect in the older, mostly because of aging. This study was directed to assess the commonness of sodium and potassium disturbances in the old. **Methods:** A Cross-sectional study was completed among old patients who were regular visitors to Internal Medicine Department outpatient clinics of the Zagazig University from February 2018 to February 2019. This examination included 100 older patients. **Results:** Our examination revealed the predominance of hypokalemia was 17% and hyperkalemia was 25%. While hyponatremia was 32% and hypernatremia was 4%. Diuretics were the most affecting medication on potassium and sodium levels. No significant difference was found in age among potassium and sodium gatherings. **Conclusion:** In this study, we found that disturbances in the sodium and potassium are commonly found in the old and a few sorts of medications are assosciated with these disturbances however diuretics were the most commonly to be found. Different components, including polypharmacy , disabled organ work and numerous ailments, put them at a more serious danger of medication induced changes in electrolyte homeostasis. Specialists should know about this hazard and screen both medication records and sodium and potassium levels ,so as to counteract and deal with these disturbances that may some way or another further affect the health of these old and frail patients.

Keywords: the prevalence; sodium; potassium; the elderly; diuretics; polypharmacy; aging; chronic kidney disease.

INTRODUCTION

Generally, in geriatric age group, individuals are progressively prone to lack of hydration and electrolyte irregularities. The causes are multifactorial which incorporate physical inability confining access to sufficient liquid intake , iatrogenic causes like utilization of diuretics and different medications, living alone, Lower financial foundations, previous comorbidities, various medications usage , physical and mental decrease make old people progressively defenseless to lack of hydration and electrolyte aggravations which are related with high dismalness and mortality **[1].**

Moreover, auxiliary and utilitarian changes in the kidneys contribute altogether to electrolyte disturbances in the old. Glomerular changes, adjusted tubular capacities, varieties in renal plasma stream and glomerular filtration rate, brought limit of kidney to conserve sodium , decrease water intake because of hindered thirst mechanisms ; decrease in hormonal activities (antidiuretic hormone, renin-angiotensin system, atrial natriuretic peptide) lead to electrolyte unsettling influences. Studies has

recommended that age is a free hazard factor for electrolytes aggravations **[2].**

There is no uncertainty that aging is related with dynamic decrease in renal capacity alongside simultaneous morphological changes that at last lead to glomerulosclerosis **[3].**

A medication actuated antagonistic impact that in youngsters would deliver just a unimportant change in the plasma sodium and potassium levels may cause major durable unsettling influences in the older, basically neurohumoral on account of aging and changes in renal capacity. Indeed, even a similarly minor unsettling influence of the electrolyte equalization may have genuine results, for example, gloom, laziness, sluggishness, perplexity or falls **[4].**

Hyponatraemia is a standout amongst the most successive electrolyte variations from the norm, happening in a few disorders including congestive heart failure and certain central nervous system (CNS) disorders , for example, stroke or head injury. Neurological unsettling influences are the important clinical sign of hyponatraemia. Hypernatraemia is less regular than hyponatraemia in more established individuals, and it is frequently connected with a genuine hidden sickness **[5].**

Hypokalaemia is regularly brought about by medications and is much of the time experienced in the older . Hypokalaemia may cause weakness of the muscles , and lead to cardiovascular arrhythmias including heart block , atrial flutter, and ventricular fibrillation. In addition, hypokalaemia brings down the limit for digoxin-initiated cardiotoxicity. Hyperkalemia in the overall public is less frequent , yet demonstrates a more noteworthy pervasiveness in the old. Hyperkalemia causes hyperpolarization of cell membranes prompting a diminished heart excitability, bradycardia, hypotension, and in the long run asystole **[6].**

METHODS

A Cross-sectional study was completed among old patients who were regular visitors to Internal Medicine Department outpatient clinics of the Zagazig University from February 2018 to February 2019. This examination included 100 older patients.

Inclusion criteria: Age > 60 years . Both sex males and females . Drug intake at any time during the 2 weeks preceding the meeting .

Exclusion criteria: None of the investigation members has any known intense state or ailment known to cause electrolyte unsettling influences amid the week going before the examination. Patients with advanced kidney disease or decompensated liver disease decompensated heart disease and patients known to have malignancy .

Ethical Clearance: Written Informed consent was taken from the patient to participate in the study. Approval for performing the study was obtained from Internal Medicine Department, Zagazig University Hospitals after taking Institutional Review Board (IRB) approval.

Methods:

1)Medical History: Detailed past and present medical history taking include name, age, sex, special habits, medical history, comorbidities such as hypertension, diabetes mellitus and IHD and history of medication use.

2) Full general and local examination : Pulse examination ,Blood pressure measurement; It was measured by a mercury sphygmomanometer with the subject recumbent in bed , Weight , height ,Respiratory rate and temperature and Thorough examination of head , neck ,upper limbs , chest , heart, abdomen , lower limbs.

3) Laboratory investigations that included : Laboratory investigations performed according to Protocols of Zagazig University Laboratories and included :**Complete blood count (CBC):** measured by automated blood counter, **Kidney function tests:** serum creatinine, serum urea by colorimetric assay , **Liver function tests:** serum bilirubin (total, indirect and direct), total protein, serum albumin, serum alanine transaminase and aspartate transferase. , **Electrolytes:** Sodium and potassium , **Random blood sugar.**

4) Hyponatremia was defined as a serum sodium concentration <136 mmol/L, hypernatremia as serum sodium >146 mmol/L , Hypokalemia as serum potassium

<3.5 mmol/L, and hyperkalemia as serum potassium >5.0 mmol/L.

Statistical Analysis

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA) & MedCalc 13 for windows (MedCalc Software bvba, Ostend, Belgium).Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) and Fisher exact was used to calculate difference between qualitative variables as indicated. Quantitative data were expressed as mean ± SD (Standard deviation) and median and range. One way ANOVA test was used to compare between more than two dependent groups of normally distributed variables.

Pearson's and Spearman's correlation coefficient were used for correlating normal and non-parametric variables respectively.The (+) sign was considered as indication for direct correlation i.e. increase frequency of independent lead to increase frequency of dependent & (-) sign as indication for inverse correlation i.e. increase frequency of independent lead to decrease frequency of dependent, also we consider values near to 1 as strong correlation & values near 0 as weak correlation.

All statistical comparisons were two tailed with significance Level of P-value ≤ 0.05 indicates significant, p <0.001 indicates highly significant difference while, P> 0.05 indicates Non-significant difference.

RESULTS

There was a highly significant difference between the three studied groups: Normokalemia (groupI) , Hypokalemia (groupII) and Hyperkalemia (groupIII) as regards serum potassium and sodium levels with P-value less than 0.001 (table 2).

There was a significant difference between the three studied groups: Normokalemia (groupI), Hypokalemia (groupII) and Hyperkalemia (group III) as regards creatinine level with P-value less than ≤0.05 (table 2).

There was a highly significant difference between the three studied groups: Normonatremia (group I), Hyponatremia (group II) and Hypernatremia (group III) as regards serum potassium and sodium levels with P-value less than 0.001 (table 3).

There was a strong significant positive correlation between sodium with potassium and total bilirubin and a negative correlation between sodium with (weight, height, albumin ,total protein, ALT ,alkaline phosphatase and random blood sugar) (table 4).

There was a strong significant positive correlation between K with creatinine and BUN and a negative correlation between potassium with (height, Hemoglobin , TLC ,albumin ,total bilirubin, ALT , AST) (table 4).

Table (1): Demographic data of the two studied groups

***Age (years** ± SD)*		68.69± 4.48
range		63 – 87
Sex	*Male*	41 (41%)
	Female	59 (59%)
Height (cm)		
Mean ± SD		167.84 ± 7.93
Range		152 – 184
Weight (kg)		
Mean ± SD		83.02 ± 5.92
Range		65 – 96

Table (2): Comparison between different parameters according to potassium disturbances.

Age *(years ± SD)*		68.12 ± 3.99	69.47 ± 3.54	69.48 ± 5.91	1.117	.331
Sex	**Mal**	20 (34.5%)	9 (52.9%)	12 (48%)	2.527	.283
	Fema	38 (65.5%)	8 (47.1%)	13 (52%)		
Hb (g/dl ± *SD)*		10.75 ± 1.19	10.72 ± 1.33	10.27 ± 1.16	1.412	.249
TLC(10^3 /µL ± *SD)*		10.56 ± 2.01	10.99 ± 2.63	10.86 ± 1.95	.369	.692
PLT(10^3 /µL ± *SD)*		222.9±	205.2±62.35	230.68 ± 81.24	.602	.550
K(mmol/L ± *SD)*		4.27 ± .403	3.11 ± .124	5.48 ± .188	**26.214**	**.000**
Na*(mmol/L ± SD)*		140.21±75.2	130.4±2.15	138.8±3.34	**73.570**	**.000**
AST *(I.U/L ± SD)*		23.03 ± 5.77	22.69 ± 6.49	22.54 ± 5.76	.060	.942
ALT *(I.U/L ± SD)*		25.34 ±	26.67 ± 12.92	23.34 ± 11.28	.435	.648
Albumin(g/dl ± *SD)*		3.25 ± .644	3.5 ± .605	3.08 ± .442	2.531	.085
S. creatinine (mg/dl± *SD)*		1.04 ± .463	.822 ± .191	1.31 ± .768	**4.527**	**.013**
RBS (mg/dl ± *SD)*		151.8 ±	165.2 ± 45.8	162.8 ± 40.67	1.012	.367

Table (3): Comparison between different parameters according to sodium disturbances

Age(years ± SD)		68.72 ±	68.28 ± 3.94	71.5 ± 5.51	.920	.402
Sex	*Male*	23	16 (50%)	2 (50%)	1.884	.390
	Female	41	16 (50%)	2 (50%)		
Hb (g/dl ± SD)		10.54 ±	10.69 ± 1.34	11.38 ±	.960	.386
***TLC* (10^3 /µL ±**		10.68 ±	10.78 ± 2.23	10.68 ±	.023	.977
***PLT*(10^3 /µL ±**		225.1 ±	217.8 ± 70.1	201.5 ±	.252	.777
K(mmol/L ± SD)		4.64 ±	3.903 ± .986	3.8 ± 0.2	**11.31**	**.000**
Na(mmol/L ± SD)		140.29 ±	131.8 ± 2.29	155.75 ±	**67.76**	**.000**
AST(I.U/L ± SD)		22.56 ±	23.22 ± 6.01	24.15 ±	.239	.788
ALT(I.U/L ± SD)		24.22 ±	26.79 ± 12.06	24.75 ±	.504	.605
Albumin (g/dl ±		3.18 ±	3.35 ± .551	3.43 ± .665	1.015	.366
S. creatinine (mg/dl ± SD)		1.14 ± .6001	.919 ± .416	1.11 ± .279	1.794	.175
RBS (mg/dl ± SD)		157.9 ±	158.22 ± 45.06	128.5 ±	.946	.392

Table (4): Correlation between sodium & potassium with different parameter:

k (mmol/L)± SD	*Pearson Correlation*	**.278****	
	Sig. (2-tailed)	**.005**	----
Age(years ± SD)	*Pearson Correlation*	.011	.025
	Sig. (2-tailed)	.915	.804
Weight(kg± SD)	*Pearson Correlation*	-.037	.065
	Sig. (2-tailed)	.715	.518
Height(cm± SD)	*Pearson Correlation*	**-.230***	-.061
	Sig. (2-tailed)	**.022**	.549
TLC(10^3 /µL± SD)	*Pearson Correlation*	.013	-.010
	Sig. (2-tailed)	.901	.924
HB(g/dl± SD)	*Pearson Correlation*	.027	-.160
	Sig. (2-tailed)	.787	.112
PLT(10^3 /µL± SD)	*Pearson Correlation*	.006	
	Sig. (2-tailed)	.950	.076
Creatinine(mg/dl± SD)	*Pearson Correlation*	.240*	**.334****
	Sig. (2-tailed)	.016	**.001**
BUN(mg/dl± SD)	*Pearson Correlation*	.071	**.211***
	Sig. (2-tailed)	.481	**.035**
Albumin(g/dl± SD)	*Pearson Correlation*	-.078	-.187
	Sig. (2-tailed)	.441	.063
Total protein(g/dl± SD)	*Pearson Correlation*	-.129	.020
	Sig. (2-tailed)	.202	.842
Total Bilirubin(mg/dl± SD)	*Pearson Correlation*	**.202***	-.022
	Sig. (2-tailed)	**.044**	.825
Direct Bilirubin (mg/dl± SD)	*Pearson Correlation*	.051	.048
	Sig. (2-tailed)	.617	.636
Alk. Phos. (I.U/L ± SD)	*Pearson Correlation*	-.109	.013
	Sig. (2-tailed)	.281	.896
ALT (I.U/L ± SD)	*Pearson Correlation*	-.072	-.139
	Sig. (2-tailed)	.477	.167
AST(I.U/L ± SD)	*Pearson Correlation*	.001	-.066
	Sig. (2-tailed)	.995	.515
RBS(mg/dl± SD)	*Pearson Correlation*	-.139	.035
	Sig. (2-tailed)	.168	.727

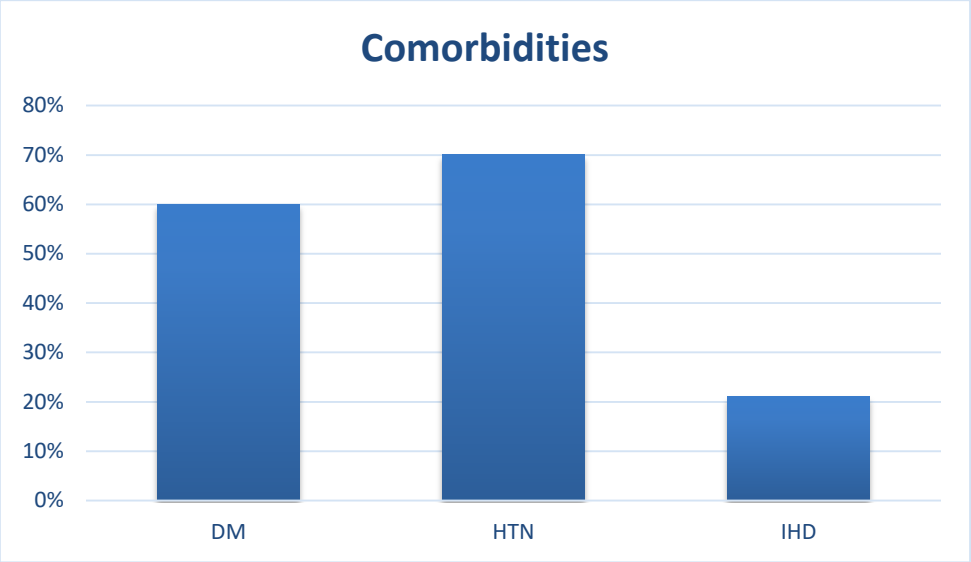

Figure (1): showing comorbidities of the studied population.

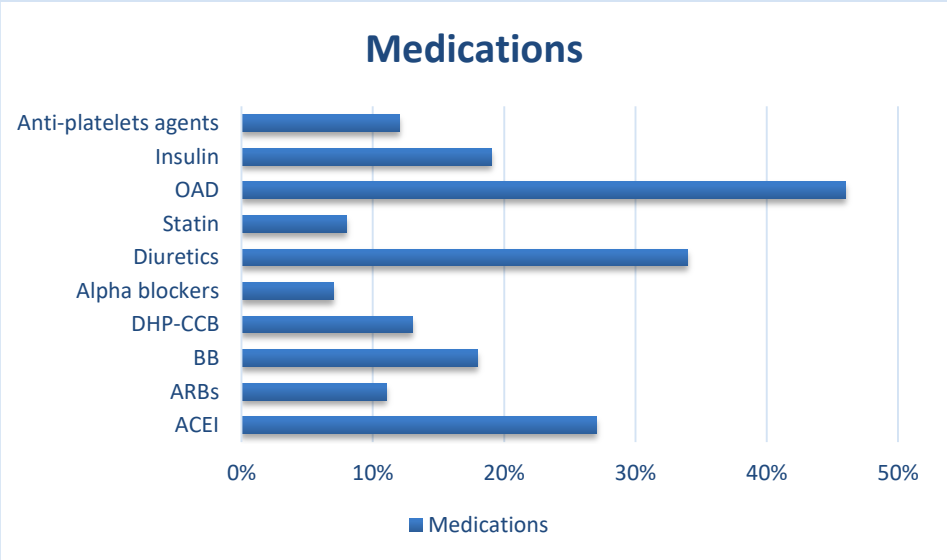

Figure (2): showing medications distribution of the studied population.

DISCUSSION

The elderly population is susceptible to electrolyte disorders like sodium and potassium imbalance due to the physiological changes. All these may increase health problems and have serious economic impacts in especially developing countries **[7].**

A large number of pharmacological agents, including diuretics, antihyperglycaemic drugs and several types of cardiovascular drugs can cause electrolyte disorders. However, few studies have examined the prevalence of electrolyte disturbances in relation to drug use in the elderly; Therefore, early detection of sodium and potassium disturbances in the elderly is valuable for reduction of morbidity and mortality in those group of subjects **[8] .**

Our aim was to investigate the prevalence of electrolyte disturbances in elderly and to find out to what extent drugs with potential effects on electrolyte levels cause hyponatremia or hypernatremia, and hypokalemia or

hyperkalemia. In our study, prevalence of hyponatremia was 32% and hypernatremia was 4%. While hypokalemia was 17% and hyperkalemia was 25%.

In our study, the prevalence of **hyponatremia** was 32% and it was the most commonly encountered electrolyte disturbance.In agreement with our study , **Imai et al [9]** reported that the prevalence of hyponatremia among 4721 elderly patients over 65 years pld was 17% and that it was the most commonly encountered electrolyte disturbance. Also, **Kayar et al [10]** reported that among 978 elderly patients aged 65 years and above ,hyponatremia was found in 18% of the studied population.Also, **Mannesse et al [11]** stated that prevalence of mild hyponatremia (130_135 mmol/l) in geriatric wards was 22,2% and was 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.Also, **Grattagliano et al [12]** found the prevalence of hyponatremia among the elderly in 8% of the studied population .38% of them were receiving diuretics. **Olsson et al [13]** reported that the prevalence of hyponatremia among the elderly in 3% of the studied population where the leading etiologies were thiazide diuretics(17%) ,SIADH(17%) ,other diuretics(14%). **Liamis et al. [14]** stated that the prevalence of hyponatremia among the elderly in 7.7% of the studied population**. Ganguli et al [15]** reported that the prevalence of initial hyponatremia among the elderly was 8.71% of the studied population and persistent hyponatremia more than 6 months was found in 4.1%. **Funk et al [16]** reported that the frequencies of borderline hyponatremia(130-135 mmol/l) was found in 13.8% and mild hyponatremia (125-130 mmol/l) was found in 2.7% and severe hyponatremia (≤ 125 mmol/l) was found in 1.2%. **Passare et al. [8]** found that the prevalence of hyponatremia among hospital elderly inpatients have been reported to be 9.4%

In our study, the prevalence of **hypernatremia** was 4%In agreement with our study **,Lopes et al [17]** reported that about 3% of patients in a general internal medicine ward had hypernatremia at admission or develop it during hospitalization. **Liamis et al [14]** stated that the prevalence of hypernatremia among the elderly in 3.4% of the studied population. **Funk et al [16]** reported that the frequencies of borderline hypernatremia(145-150 mmol/l) was found in 5.1% and mild hypernatremia (150-155 mmol/l) was found in 1.2% and severe hypernatremia (≥155 mmol/l) was found in 0.6%.Also**, Darmon et al [18]** reported that the prevalence of mild hypernatremia was 11.1% and moderate to severe hypernatremia was 4.2% among an elderly population aged more than 65 years old .**Passare et al. [8]** found that the prevalence of hypernatremia among hospital elderly inpatients have been reported to be 2.3%

In our study, the prevalence of **hyperkalemia** was 25%In agreement with our study**, Nilsson et al [19]** reported that the prevalence of hyperkalemia among an elderly population aged more than 65 years old was 7% .Also, **Kovesdy [20]**, reported that hyperkalemia was present in 2.6% of emergency room visits and in 3.5% of hospital admissions.Also , **Sarafidis et al** [21] reported that among an elderly population aged more than 65 years old the prevalence of mild hyperkalemia (≥ 5 meq/l) was 54% and the prevalence of moderate to severe hyperkalemia (≥ 5.5 meq/l) was 40% **Passare et al [8]** found that the prevalence of hyperkalemia among hospital elderly inpatients have been reported to be 2.8 %. **Turgutalp et al [22]** reported that prevalence of hyperkalemia in elderly was 3%. This difference may be due to that frequency of potassium disturbance in elderly may be associated with underlying renal dysfunction, a number of comorbidities, and use of medications causing potassium disturbance.

In our study, the prevalence of **hypokalemia** was 17%.In agreement with our study, **Nilsson et al [19]** reported that the prevalence of hypokalemia among an elderly population aged more than 65 years old was 13.6%. **Liamis et al [14]** stated that the prevalence of hypokalemia among the elderly was 2.7% of the studied population. **Passare**

et al [8] found that the prevalence of hypokalemia among hospital elderly inpatients have been reported to be 2.5%

In our study, we found no significant difference in sodium and potassium levels in different age groups. Similar to our study, **Moliterno et al. [23]** reported a non- statistically significant difference in age between Na/K .In the contrary, **Jiang et al [24]** reported that hyponatremic patients and hypokalemic patients were significantly older than normonatremic and normokalemic patients. This may be related to the compensation of age-related change of potassium and sodium secretion by the remaining nephrons.

When comparing patients according to potassium status, serum creatinine was found to be significantly higher in hyperkalemic patients compared to hypokalemic and normokalemia patients. On the other hand, sodium was significantly decreased in hypokalemic patients. These findings was in line with **Legrand et al [25]**.

Similar to our findings as regard diuretic usage , **Jiang et al [24] and Legrand et al [25]** reported that among all drug classes, thiazide diuretics users had higher proportions of hyponatremia patients, while loop diuretics users had higher proportions of hypokalemia than normokalemic patients.

similar to our study regarding hyperkalemia resulting from ARBs and ACEIs , **Elgendy et al [26]** carried out a meta- analysis consisting of 113,386 patients older than 65 years and concluded that ARBs are the risk factor for the development of hyperkalemia. Beta blockers decrease catecholamine-induced renin release, which decreases angiotensin II and aldosterone secretion and cause hyperkalemia. They also decrease potassium shift into the cell and contribute to hyperkalemia.

We observed that young-old patients had higher number of comorbidities and also drug use that cause electrolytes disturbance.Unlike our study, **Turgutalp et al [22]**, number of comorbidities was higher in oldest old patients compared to middle and young-old patients and was found to be higher in middle-old patients than the young-old patients. Besides, use of the drugs causing electrolytes disturbance was found to be higher in oldest and middle- old patients who had more comorbid diseases compared to young- old patients.**Buurman et al [27] and Mukete et al [28]** reported that the number of comorbid diseases increases in patients older than 65 years and this might cause polypharmacy, which may cause electrolytes disturbance.

In our study, age was found to be not correlating with Na or K. However, **Turgutalp et al [22]** reported that although positive relation was obtained between the age and hyperkalemia, This may be related to the common use of the drugs like ACEI, ARB, spironolactone, and increased number of comorbidities, which may cause hyperkalemia in the elderly.We also found a significant positive correlation between Na with K and total bilirubin and a negative correlation with height. Meanwhile, a significant positive correlation was found between K with creatinine.

Takaichi et al [29] tried to determine the risk factors of hyperkalemia in 9117 patients whose mean age was above 60 years old and with a serum creatinine level of more than 5 mg/dL and showed that serum creatinine level, diabetes mellitus, use of ACEI, ARB, and beta blocker, male gender, and age were all independent risk factors for hyperkalemia.

CONCLUSION

In this study, we found that disturbances in the sodium and potassium balance are fairly commonly seen in the elderly and several types of drugs are assosciated with these disturbances but diuretics were the most commonly to be found. other factors, including polypharmacy , impaired organ function and multiple illnesses, put them at a greater risk of drug-

induced changes in electrolyte homeostasis. Doctors need to be aware of this risk and monitor both drug lists and sodium and potassium levels ,in order to prevent and manage these disturbances that might otherwise further compromise the health of these old and often frail patients.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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