

The Effect of Age on the Seasonal Prevalence of Hyponatremia in Emergency Patients--A Survey of 66,827 Patients from the Emergency Department

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Abstract Background: Hyponatremia is one of the most commonly encountered electrolyte disorders in the emergency department (ED). Seasonal fluctuations of the prevalence of hyponatremia has been reported. We investigated the influence of age on the seasonal prevalence of hyponatremia in the emergency department in China. **Methods:** Total of 66827 patients presented to the ED between January 2015 and December 2017 were reviewed. The adult group aged between 18 and 59 years old consisted of 36190 patients and the elderly group aged between 60 and 79 years old consisted of 22064 patients and very elderly group aged over 80 years consisted of 8573 patients. Information collected included age, sex, serum sodium and serum creatinine. Hyponatremia was defined as a serum level <135 mEq/L and severe hyponatremia was defined as a serum sodium level <125 mEq/L. **Result:** Prevalence of hyponatremia was significantly higher in the very elderly group than in the other two groups (30.14%, 22.24%, 15.33%, respectively). Similarly, the prevalence of severely hyponatremia was significantly higher in the very elderly group than in the other two groups (3.37%, 1.97%, 0.85% respectively). Prevalence of hyponatremia and severe hyponatremia was significantly higher in the very elderly group than in the other two groups in all seasons. In the elderly group and the very elderly group, there was a significant correlation between the high temperature weather during summer and prevalence of hyponatremia ($r=0.6094$, $P=0.0354$; $r=0.6874$, $P=0.0135$, respectively). **Conclusion:** The age plays a major role on the seasonal prevalence of hyponatremia and severe hyponatremia. Strategies to prevent hyponatremia and severe hyponatremia should be taken especially in the very elderly patients during summer.

Keywords: hyponatremia, very elderly, emergency department, prevalence

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prevalence of hyponatremia in the emergency department in China.

1. Introduction

Hyponatremia is one of the most commonly encountered electrolyte disorders in the emergency departments [1,2]. Hyponatremia is known for its high morbidity and mortality and age is a strong independent risk factor of hyponatremia [3,4,5,6,7]. Only a few studies have investigated the influence of age on the seasonal prevalence of hyponatremia in patients admitted to emergency departments [7]. Considering the aging population in China, the increased susceptibility of the very elderly and elderly to develop hyponatremia is particularly important. The influence of age on the seasonal fluctuations on the prevalence of hyponatremia has not been reported in China. Thus, we investigated the influence of age on the seasonal

2. Materials and Methods

All adult patients (18 years old or older) who had their serum sodium levels and serum creatinine levels measured at the emergency department between January 2015 and December 2017 were included. Hyponatremia was defined as serum sodium levels of less <135 mEq/L. Severe hyponatremia was defined as serum sodium levels of less <125 mEq/L. Information collected included age, sex, serum sodium, and serum creatinine. We used the meteorological parameters provided by the China Meteorological Agency. The seasons are defined as follows: spring: March-May; summer: June-August; fall: September-November; winter: December-February.

3. Statistical Analyses

Data analysis was performed using SPSS Version 22.0(IBM Corp. Armonk, NY). Student t-test or analyses of variance we used to compare means for continuous variables. Chi-square tests were used to test statistical differences for categorical variables. A P -values of <0.05 was considered statistically significant.

4. Results

4.1. Patients Characteristics

From January 2015 to December 2017 a total of 66827 adult patients had their serum sodium measured at the emergency department. The key characteristics of the patients have been summarized (Table 1). The mean age of the patients was 56.2 ± 19.3 years and 51.88% of patients were male. The patients were divided into very elderly group aged 80 years and over, elderly group aged from 60 to 79 years and adult group aged from 18 to 59 years. The mean age of the very elderly group (N=8573) was 84.6 ± 3.9 years and 51.63% of patients were male. The mean age of the elderly group (N=22064) was 69.3 ± 5.5 years and 53.28% of patients were male. The mean age of the adult group (N=36190) was 41.5 ± 12.3 years and 51.08% of patients were male.

4.2. Prevalence of Hyponatremia and Severe Hyponatremia

Prevalence of hyponatremia was significantly higher in the very elderly group than in the other two groups (30.14% vs 22.24%, $P < 0.001$, 22.24% vs 15.33%,

$P < 0.001$, respectively). Similarly, the prevalence of severe hyponatremia was significantly higher in the very elderly group than in the other two groups (3.37% vs 1.97%, $P < 0.001$, 1.97% vs 0.85%, $P < 0.001$, respectively) (Figure 1).

4.3. Seasonal Prevalence of Hyponatremia and Severe Hyponatremia

The prevalence of hyponatremia was significantly higher in the very elderly group than in the other two groups in all seasons (Figure 2). Similarly, the prevalence of severe hyponatremia was significantly higher in the very elderly group than in the other two groups in all seasons (Figure 3). In the very elderly and elderly group, although the prevalence of severe hyponatremia didn't differ between the seasons, the prevalence of hyponatremia was significantly higher in Summer ($P < 0.001$, vs. spring and winter, respectively) (Table 2, Table 3). On the other hand, the prevalence of hyponatremia and severe hyponatremia in the adult group didn't differ between the seasons ($P > 0.05$) (Table 4).

4.4. Monthly Weather Temperature and Prevalence of Hyponatremia

The monthly weather temperature during the 3-year period is summarized (Table 5). In the elderly group and very elderly group, the monthly weather temperature showed a linear correlation with monthly prevalence of hyponatremia ($r=0.6094$, $P=0.0345$; $r=0.6874$, $P=0.0135$, respectively). In comparison, in the adult group, the monthly weather temperature didn't show any correlation with monthly prevalence of hyponatremia ($r=0.1728$, $P=0.5913$) (Figure 4).

Table 1. Patients characteristic

	All	Adult	Elderly	Very elderly
N	66827	36190	22064	8573
Male(N)	51.88%(34668)	51.08%(18486)	53.28%(11756)	51.63%(4426)
Age(year)	56.2 ± 19.3	41.5 ± 12.3	69.3 ± 5.5	84.6 ± 3.9
Serum creatinine(mg/mL)	1.08 ± 1.48	1.04 ± 1.65	1.09 ± 1.31	1.21 ± 1.15
eGFR(mL/min/1.7m ²)	80.3 ± 26.7	95.7 ± 24.4	76.1 ± 21.7	61.8 ± 28.9

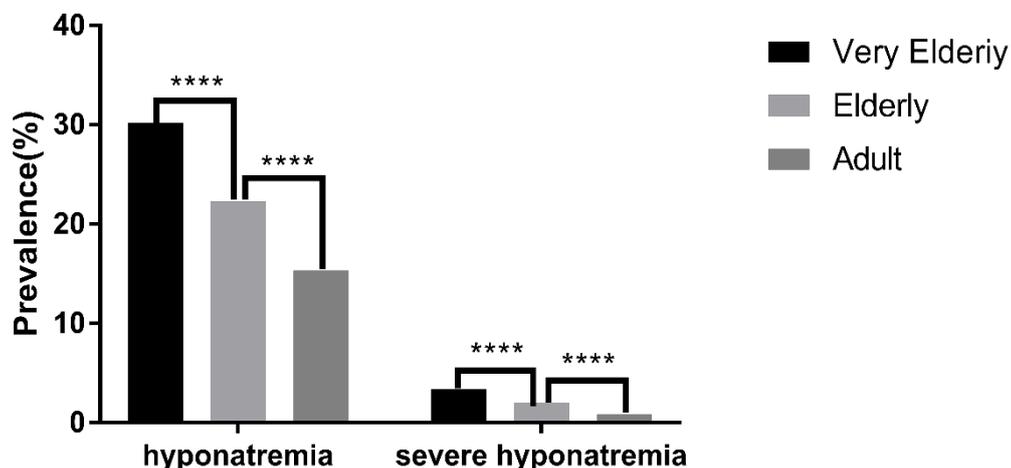


Figure 1. Prevalence of hyponatremia and severe hyponatremia(****: $p < 0.0001$)

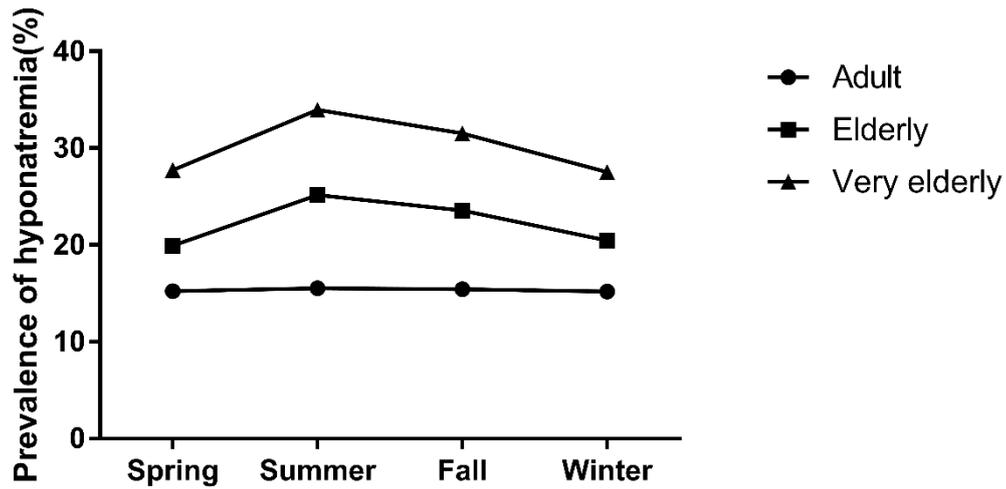


Figure 2. Seasonal prevalence of hyponatremia in adult group, elderly group and very elderly group

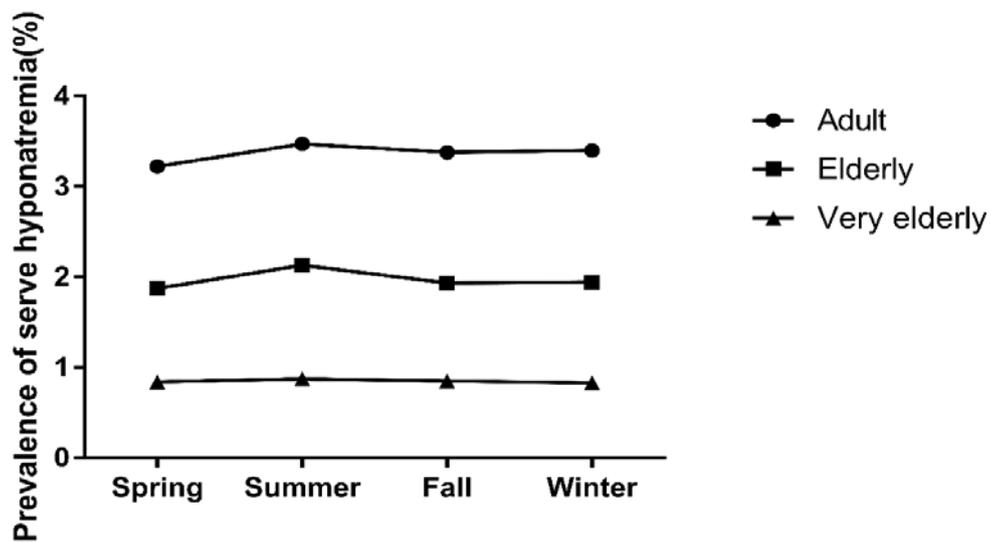


Figure 3. Seasonal prevalence of severe hyponatremia in adult group, elderly group and very elderly group

Table 2. Seasonal prevalence of hyponatremia and severe hyponatremia: Very elderly group

	Spring	Summer	Fall	Winter
Hyponatremia (%)	27.72%	33.94%*	31.50%	27.53%
Severe hyponatremia (%)	3.22%	3.47%	3.38%	3.40%

*p<0.001 vs Spring and Winter.

Table 3. Seasonal prevalence of hyponatremia and severe hyponatremia: Elderly group

	Spring	Summer	Fall	Winter
Hyponatremia (%)	19.93%	25.16%*	23.55%	20.46%
Severe hyponatremia (%)	1.87%	2.13%	1.93%	1.94%

*p<0.001 vs Spring and Winter.

Table 4. Seasonal prevalence of hyponatremia and severe hyponatremia: Adult group

	Spring	Summer	Fall	Winter
Hyponatremia (%)	15.21%	15.50%	15.41%	15.19%
Severe hyponatremia (%)	0.84%	0.87%	0.85%	0.83%

Table 5. Mean monthly weather temperature during 3-year period(°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly weather temperature	4.6	6.6	10.7	17.0	21.4	24.3	28.3	28.7	23.6	18.0	11.8	6.6

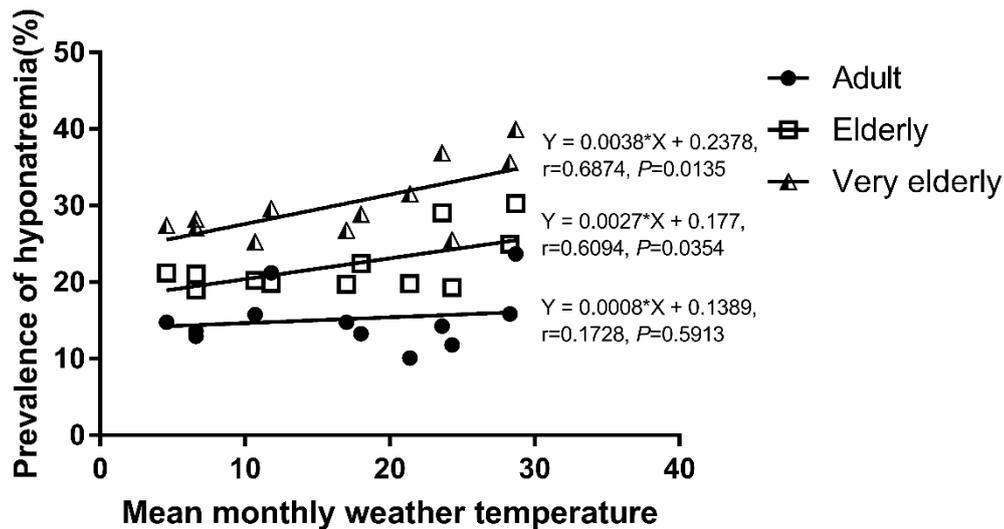


Figure 4. Monthly weather temperature and prevalence of hyponatremia

5. Discussion

The prevalence of hyponatremia including severe hyponatremia was significantly higher in very elderly group of people compared to the other two groups during the 3-years period. Also, the seasonal prevalence of hyponatremia including severe hyponatremia was significantly higher in very elderly group compared to the other two groups during the 3-years period.

The prevalence of hyponatremia has been observed in emergency departments varies between studies. The 15.33% prevalence of hyponatremia in the adult group observed in our study was higher than the previous report [7,8]. Similarly, the 0.85% prevalence of severe hyponatremia in the adult group observed in our study was higher than the previous report [9]. On the other hand, the 22.24% prevalence of hyponatremia in the elderly group was higher than the previous report [7], the 30.14% prevalence of hyponatremia in the very elderly group was close to the previous report [10].

The prevalence of hyponatremia is highly correlated with age, which is higher in elderly patients [3,7]. Various risk factors including a decline in renal function, excessive water intake, reduce salt intake, and medications could all contribute to develop hyponatremia in the elderly patients [7,11,12]. Although we could not assess in this study, diuretics, especially thiazides, is a known risk factors for developing hyponatremia [13,14]. It is important that physician taking care of elderly patients, especially very elderly patients, is fully aware of the fact that elderly patients are susceptible to develop hyponatremia because the increased morbidity and mortality associated with hyponatremia can't be ignored [11,15,16].

The prevalence of hyponatremia is also strongly affected by the high weather temperature and is higher during the summer [7,9]. An increased prevalence of hyponatremia during heat periods has been reported too [11]. In our study, the prevalence of hyponatremia in the very elderly group was highest during the summer. Water intake and loss are approximately 40% higher in the summer than in the winter [17]. Also, it is reported that salt appetite is not increased in summer heat [18]. These findings could have caused the high prevalence of

hyponatremia during the summer in the very elderly and elderly patients. The strong correlation between the prevalence of hyponatremia in the very elderly group and elderly group and the monthly weather temperature was confirmed in our study. The correlation was not observed in the adult group.

The present study has some limitations. First, this is a single central study and there is a possibility of selection bias on the enrolled patients. Second, the serum sodium was not corrected for plasma glucose levels, when elevated. Thus, patients with pseudohyponatremia are not completely ruled out. Third, several potential confounders such as reason for visit, medications which could induce hyponatremia, history of hyponatremia, and past medical history were not collected.

6. Conclusion

In conclusion, we observed a major influence of age on the seasonal prevalence of hyponatremia. Elderly patients, especially very elderly patients, had significantly higher seasonal prevalence of hyponatremia and severe hyponatremia compared to adult patients. Strategies to prevent hyponatremia and severe hyponatremia should be taken especially in the very elderly patients.

Abbreviations

ED= emergency department

Conflict of Interest

The authors have declared that no conflict of interest exists.

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