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Research article

Sociodemographic and clinical factors influencing serum potassium concentration: A retrospective cohort study

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ABSTRACT

Background: Self-care is crucial for maintaining the health and quality of life of individuals undergoing physical examinations, especially those with abnormal test results because they are at a higher risk of experiencing worse outcomes. However, there is currently a lack of comprehensive literature on the impact of sociodemographic and clinical factors on self-care practices related to serum potassium concentration among individuals undergoing physical examinations. Therefore, this study aimed to explore the sociodemographic and clinical factors influencing serum potassium concentration.

Methods: Data from 43,151 individuals who underwent physical examinations were retrospectively collected in January, April, July, and October of 2019–2021. The serum potassium concentrations of these individuals were compared based on sex, age, and residential area. Additionally, the whole cohort and a subset of 6698 individuals with available occupational information were included to analyze the sociodemographic factors associated with serum potassium concentration using logistic regression analysis. Furthermore, a propensity score matching approach was employed to match 642 individuals with abnormal serum potassium concentrations to 642 with normal serum potassium concentrations. Pearson's correlation analysis was subsequently used to investigate the clinical factors contributing to abnormalities in serum potassium concentration.

Results: High temperatures; older age; male sex; living in the southern part of the city; and chemical, communication system, and transportation occupations were associated with a higher likelihood of experiencing abnormal serum potassium concentrations. Individuals with abnormal serum potassium concentrations had a higher prevalence of underlying diseases. Compared with the hypokalemia group, the hyperkalemia group exhibited a higher incidence of diabetes and cardiovascular disease. In the hyperkalemia group, serum potassium concentration positively correlated with serum creatinine concentration and negatively correlated with the estimated glomerular filtration rate (eGFR). In contrast, in the hypokalemia group, serum potassium concentration negatively correlated with creatinine concentrations, blood glucose concentration, and systolic and diastolic blood pressure, and positively correlated with eGFR.

Conclusions: Sociodemographic and clinical factors can affect blood potassium concentration. During daily self-care, it is essential for individuals with abnormal potassium concentrations to avoid exposure to relevant sociodemographic risk factors and seek medical attention as soon as possible to screen for diseases, such as hypertension, cardiovascular disease, and diabetes.

1. Introduction

Potassium is an electrolyte necessary to maintain the normal physiological function of the human body, and its serum concentration is affected by the internal and external environment. Potassium homeostasis is maintained primarily through feedforward mechanisms, feedback mechanisms, and adaptive control. Feedforward regulation is driven by the sensing of dietary potassium intake by the gastrointestinal

Abbreviations: BMI, body mass index; COVID-19, coronavirus disease; eGFR, estimated glomerular filtration rate; ISE, indirect ion-selective electrode; PHAII, type II pseudo-hypoaldosteronism.

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tract leading to the excretion of potassium by the kidneys and its absorption by the muscles. Feedback is used to control these two processes based on the serum potassium concentration. Adaptive control is driven by circadian rhythm [1]. In addition, some studies have focused on the effect of the external environment on serum potassium concentrations and found that age, sex, exercise, diet, and occupation could play a role [2–4], for example, the male sex and administrative occupations were associated with a higher potassium intake [5]. Moreover, serum potassium concentrations show continuous and parallel decreases with age in both sexes, which may be related to physiological aging [6,7].

Serum potassium concentration is associated with the occurrence and development of various diseases. Studies have shown that a higher potassium intake is associated with lower stroke rates [8] and may reduce the risk of coronary heart disease and other cardiovascular diseases [9]. However, excessively high or low serum potassium concentrations can harm human health. Studies have shown a dose-dependent association between hyperkalemia and adverse neurological outcomes [10], and even patients with mild hyperkalemia should be referred for endocrinological or renal evaluation without delay [11]. Conversely, hypokalemia induces atrial and ventricular arrhythmias [12] and is associated with a high incidence of and mortality related to heart failure [13].

Individuals who regularly undergo routine physical examinations often pay more attention to their health status. For individuals with abnormal serum potassium concentrations, reasonable and correct self-care and timely clinical intervention are of great significance in improving their quality of life and clinical prognosis.

Research has shown that sociodemographic and clinical factors can be used to identify patients at risk of adverse events. Clinicians should systematically evaluate these risk factors to develop personalized care plans [14]. A study among patients with oral cancer showed a significant correlation between sociodemographic characteristics—such as marital status and religious beliefs—and survival rate, revealing a possible connection between the social environment and the rate of cancer progression. Therefore, in addition to routine clinical management, healthcare providers should consider the sociodemographic characteristics of patients and provide personalized care, such as psychological counseling, to help improve survival rates [15].

It is clear that exploring the sociodemographic and clinical factors affecting serum potassium concentration is of clinical value. However, there is a lack of comprehensive literature on the impact of these factors on self-care practices related to serum potassium concentration among individuals undergoing physical examinations. Therefore, in this study, we comprehensively explore the sociodemographic and clinical factors affecting serum potassium concentration in individuals who have undergone physical examinations to provide a reference for clinicians and public health workers to correctly interpret test results and propose prevention and treatment strategies.

2. Materials and methods

2.1. Participants

For the representative winter, spring, summer, and autumn months are January, April, July, and October, respectively, the data of 43,151 individuals aged between 11 and 100 years who underwent physical examinations in January, April, July, and October of 2019–2021 at the Physical Examination Center of Taizhou Hospital of Zhejiang Province, China, were retrospectively collected. Of them, 6698 had occupational information records.

2.2. Grouping

The participants were divided into normal and abnormal serum potassium groups. A normal serum potassium concentration was defined as 3.5–5.3 mmol/L (normal serum potassium group). A serum potassium concentration $<$ 3.5 mmol/L and $>$5.3 mmol/L were defined as hypokalemia and hyperkalemia, respectively (abnormal serum potassium group). There were 42,237 individuals in the normal serum potassium group and 914 in the abnormal serum potassium group. In the abnormal serum potassium group, 642 individuals had underlying disease information records (Fig. 1A).

2.3. Data collection

The temperature and humidity at 8 time points per day in January, April, July, and October from 2019–2021 were obtained from a meteorological website (https://rp5.ru), and the sociodemographic information of the participants, including sex, age, residential area, and occupation, was collected from physical examination management systems. The underlying diseases of the participants were also recorded.

2.4. Serum potassium detection

Serum potassium was detected using the indirect ion-selective electrode (ISE) method. The sample and buffer solution were mixed in the dilution tank of the ISE unit, the mixture was extracted, and the potential generated by the potassium electrode was measured. The potential of specific ions was calculated using the Nernst equation. Compared to the internal reference electrode, this potential was converted into voltage and subsequently into the ion concentration of the sample. The reagents for the AU5800 automated biochemical analyzer, including the reference electrolyte, diluent, and internal standard solution, were provided by Beckmann Coulter Co., Ltd. (Suzhou, China).

2.5. Outcome measures

Seasonal variation in serum potassium concentration was analyzed in all 43,151 participants, as were the effects of sex, age, region, temperature, and humidity on serum potassium concentrations. Participants with more than five serum potassium records during the study period were selected to explore the seasonal variation. The effect of occupation on serum potassium concentration was assessed in the 6698 participants with occupational information. Sociodemographic factors associated with serum potassium abnormalities were investigated in 42,237 participants with normal serum potassium concentrations and 914 with abnormal serum potassium concentrations. Subsequently, 642 participants with information on previously confirmed underlying diseases in the electronic medical record system were screened in the abnormal serum potassium group, and 642 with normal serum potassium concentrations were matched using propensity score matching to explore the clinical factors associated with serum potassium abnormalities. A total of 642 individuals with abnormal serum potassium concentrations were divided into hypokalemia and hyperkalemia groups, and the differences in the underlying diseases between the two groups were compared. Finally, the correlations between serum potassium concentration and other clinical and laboratory indicators were explored.

2.6. Statistical analysis

R (Version 4.0.2, R Foundation for Statistical Computing, Vienna, Austria.) was used for statistical analysis and mapping. T-tests and χ^2 tests were used for intergroup comparisons of continuous and categorical variables, respectively. Logistic regression analysis was performed to screen for risk factors. Statistical significance was set at $P < 0.05$.

3. Results

3.1. Basic participant information

Among the 43,151 individuals included in the study, 26,230 (60.8%) lived in northern Taizhou, 23,804 (55.2%) were men, and 28,195

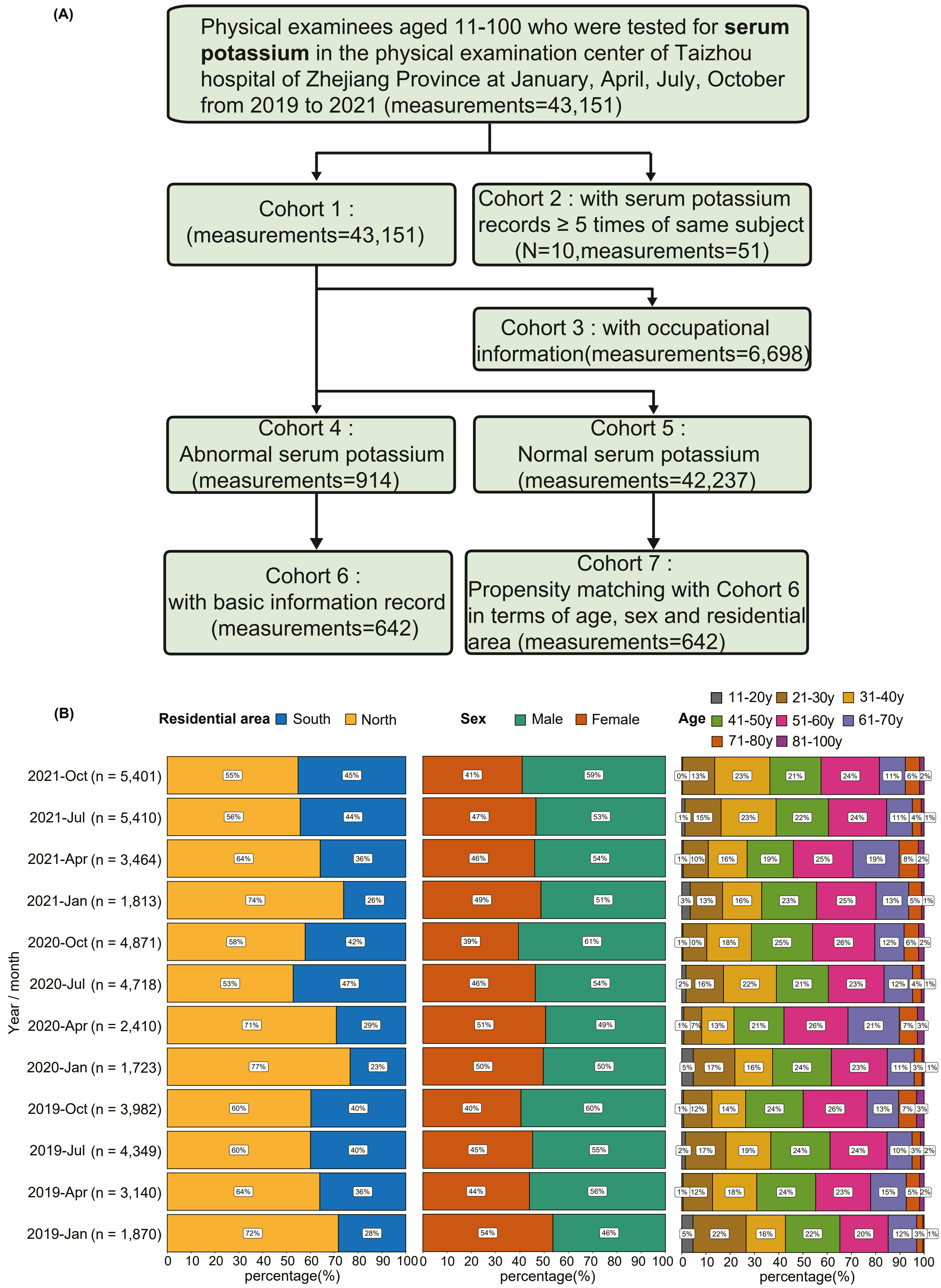

Fig. 1. Workflow and basic participant information. (A) Flowchart of the cohorts. (B) Residential area, sex, and age distribution of the participants by month. Each row represents the participant details over 1 month, with the x-axis as a stacking percentage and the y-axis as a month.

(65.3%) were aged between 31 and 60 years (Fig. 1B).

3.2. Seasonal variations in serum potassium concentration

Serum potassium concentrations were the highest in January and lowest in July. However, the changing trend in 2019 differed from those in 2020 and 2021. The degree of difference in serum potassium concentration between January and April in 2020 and 2021 was smaller than that in 2019. A similar annual temperature trend was observed from 2019 to 2021, with the highest temperature occurring in July and the lowest in January. The highest humidity occurred in July of each year, while the lowest occurred in October of 2019 and 2020 and January of 2021 (Fig. 2).

Additionally, dynamic changes in serum potassium concentration in 10 patients who were tested more than five times were analyzed, and no seasonal variation was observed (Supplementary Figure 1).

3.3. Sociodemographic factors associated with serum potassium concentration

Higher serum potassium concentrations were observed in participants living in northern Taizhou compared to those living in the south, and concentrations were higher in men than in women. In addition, among the participants aged < 50 years, serum potassium concentrations were higher in those aged < 20 years, with those aged 21–50 years having similar concentrations. Serum potassium concentrations increased with age in participants aged > 50 years (Fig. 3A–C, Supplementary Figure 2).

The changing trend in serum potassium concentration varied among the occupational groups. Concentrations were lower in chemical workers and telecommunications staff. In contrast, seasonal trends in the serum potassium concentrations of medical and transportation staff were similar, being the lowest in July and similar in the other months. Teachers showed a notable change in trend, displaying lower serum potassium levels in January when compared to individuals in other occupations, and October being the month in which they had the highest serum potassium concentration. Although July was the month in which they had the lowest concentration, the difference between the concentrations in July and those in the other months was small (Fig. 3D).

3.4. Sociodemographic factors associated with abnormal serum potassium concentration

Among the participants in the normal ($n = 42{,}237$) and abnormal ($n = 914$) serum potassium groups, it was found that high ambient temperatures, older age, male sex, and living in the southern part of the city were associated with an increased risk of abnormal serum potassium concentrations. Humidity was not associated with abnormal serum potassium concentrations. Chemical, telecommunications, and transport workers had a high risk of abnormal serum potassium concentrations (Fig. 4).

3.5. Comparison of sociodemographic and clinical factors between groups

Of the 914 participants in the abnormal serum potassium group, 642 had detailed records of previously confirmed underlying diseases. Propensity score matching was performed on 642 participants with normal serum potassium concentrations. Participants with abnormal serum potassium concentrations had a higher proportion of underlying diseases, except for respiratory diseases. Compared with the hypokalemia group, the hyperkalemia group had a higher incidence of diabetes and cardiovascular disease ($P < 0.001$ and $P = 0.009$, respectively) (Table 1).

3.6. Correlation between serum potassium concentration and other clinical and laboratory indicators in the hyperkalemia and hypokalemia groups

In the hyperkalemia group, serum potassium concentration positively correlated with serum creatinine concentration ($r = 0.370$, $P = 0.008$) and negatively correlated with estimated glomerular filtration rate (eGFR) ($r = -0.300$, $P = 0.041$); however, no significant correlation was observed between serum potassium concentration and blood glucose, total serum protein, and albumin concentrations; body mass index (BMI); or blood pressure.

In the hypokalemia group, serum potassium concentration negatively correlated with serum creatinine concentration ($r = -0.130$, $P = 0.001$), blood glucose concentration ($r = -0.140$, $P < 0.001$), and systolic and diastolic blood pressure ($r = -0.140$, $P < 0.001$; $r = -0.130$, $P = 0.002$) and positively correlated with eGFR ($r = 0.140$, $P = 0.002$) but not with total serum protein and serum albumin concentration or BMI (Fig. 5).

3.7. Abnormal serum potassium concentrations in individuals without previously confirmed underlying diseases

Seventeen of 642 participants with abnormal serum potassium concentrations had not been previously confirmed to have underlying diseases. Among them, A011 was a hyperkalemia case with a serum potassium concentration of 5.72 mmol/L and an elevated blood glucose concentration; the remaining patients had hypokalemia, and their serum potassium concentrations were > 3.29 mmol/L with liver dysfunction, elevated homocysteine concentrations, low body weight, diarrhea, and abnormal electrocardiographic or cardiac ultrasound results. A001–A010 showed no other abnormal results (Fig. 6).

4. Discussion

In recent years, an increasing number of researchers have promoted personalized healthcare using artificial intelligence and multimodal multi-omics tools [16]. A recent study used toxicology to predict individual susceptibility to environmental pollutants and therapeutic drug toxicity. By identifying genetic variations that affect the metabolism or detoxification of these compounds, risk assessment can be improved and more effective interventions can be developed to protect vulnerable populations [17]. This study analyzed the factors affecting serum potassium concentration by comprehensively collecting multimodal data from physical examination management systems, hospital information systems, and laboratory information systems with the aim of assisting physicians to develop more effective intervention measures and daily life recommendations for individuals with abnormal serum potassium concentrations.

This study found that the serum potassium concentrations of individuals who underwent physical examination showed seasonal variation, and that sociodemographic and clinical factors could affect serum potassium concentrations. A high air temperature, older age, male sex, and living in the southern part of the city were associated with a higher risk of serum potassium abnormalities. Chemical, telecommunications, and transport workers showed an increased risk of abnormal serum potassium concentration. The abnormal serum potassium group had a higher proportion of individuals with hypertension and cardiovascular diseases. The hyperkalemia group had a higher incidence of diabetes and cardiovascular disease than the hypokalemia group did. An abnormal serum potassium concentration can be caused by underlying diseases and pathological conditions as well as transient abnormalities that require comprehensive assessment.

We found that serum potassium concentrations were highest in January (Winter) and lowest in July (Summer). However, the changing temperature trend was the opposite, which was related to an increase in potassium loss caused by high temperatures, suggesting that

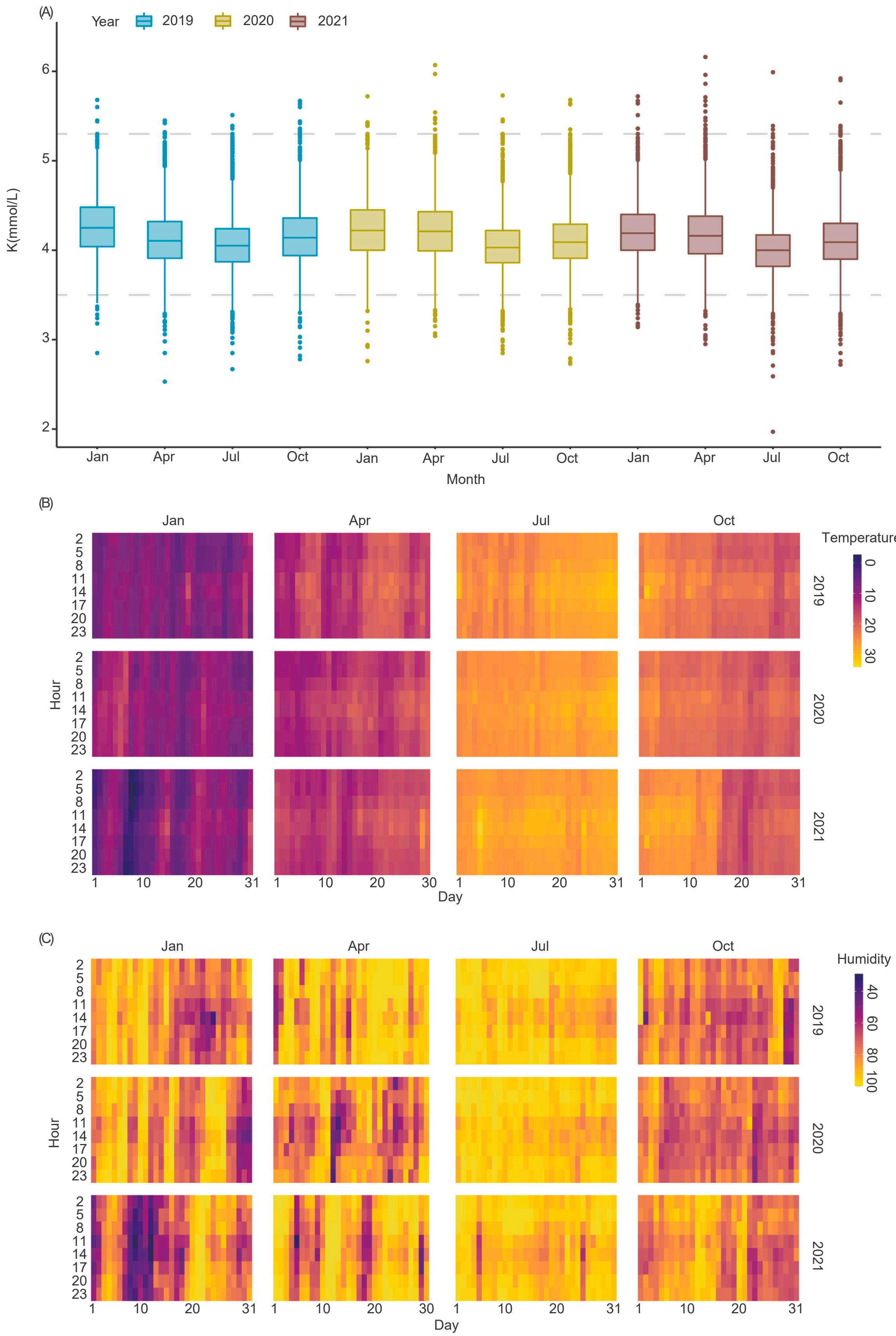

Fig. 2. Dynamic changes in serum potassium concentration and environmental temperature and humidity. (A) Dynamic changes in serum potassium concentration. (B) Dynamic changes in environmental temperature. (C) Dynamic changes in environmental humidity. The temperature and humidity at eight time points per day were recorded. Yellow indicates high temperature and humidity, while purple indicates low temperature and humidity. The horizontal axis represents the date, and the vertical axis represents the eight time points.

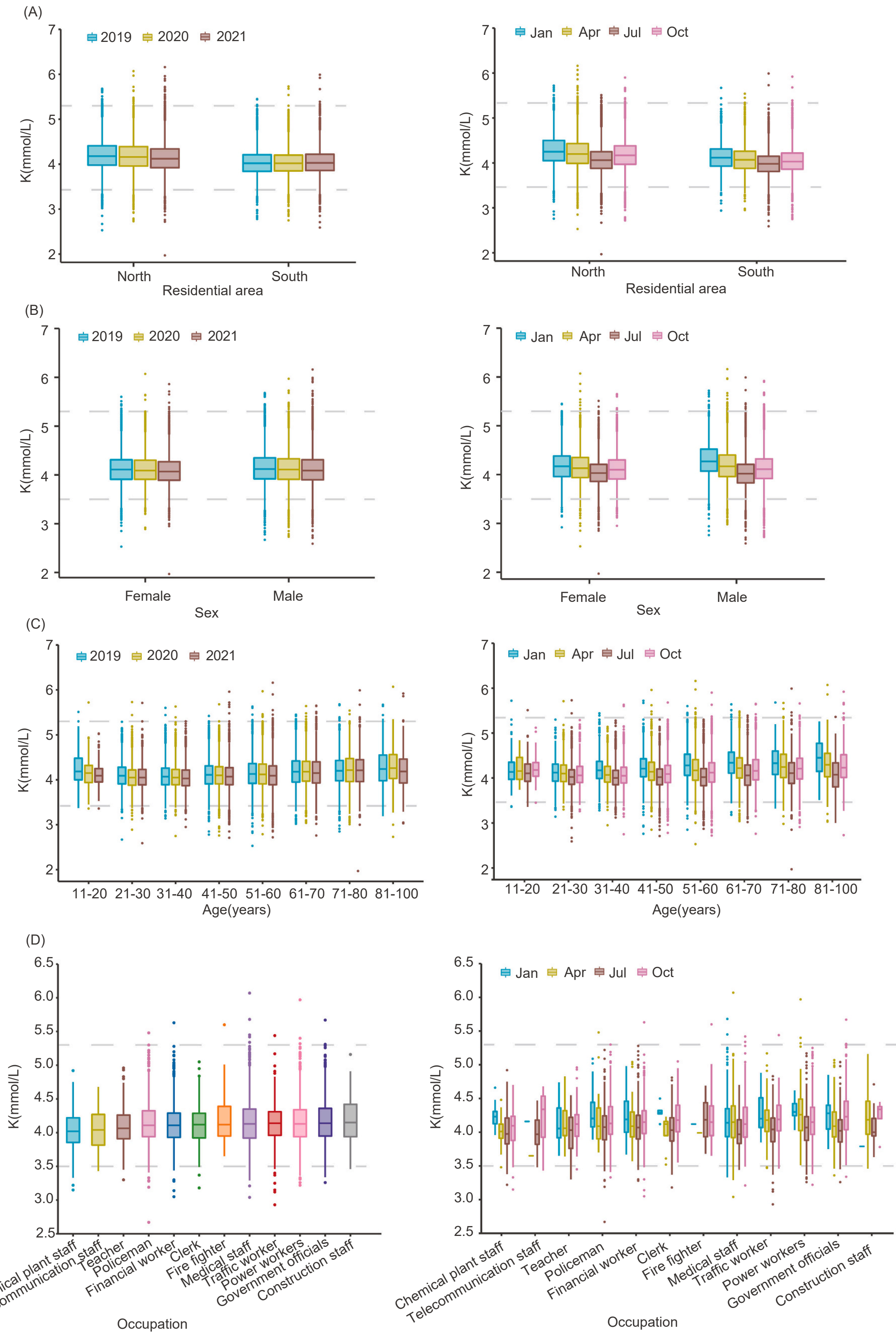

Fig. 3. Sociodemographic and clinical factors associated with serum potassium concentration. (A) Serum potassium concentration per year and month in different residential areas. (B) Serum potassium concentration per year and month according to sex. (C) Serum potassium concentration per year and month according to age. (D) Serum potassium concentration according to occupation.

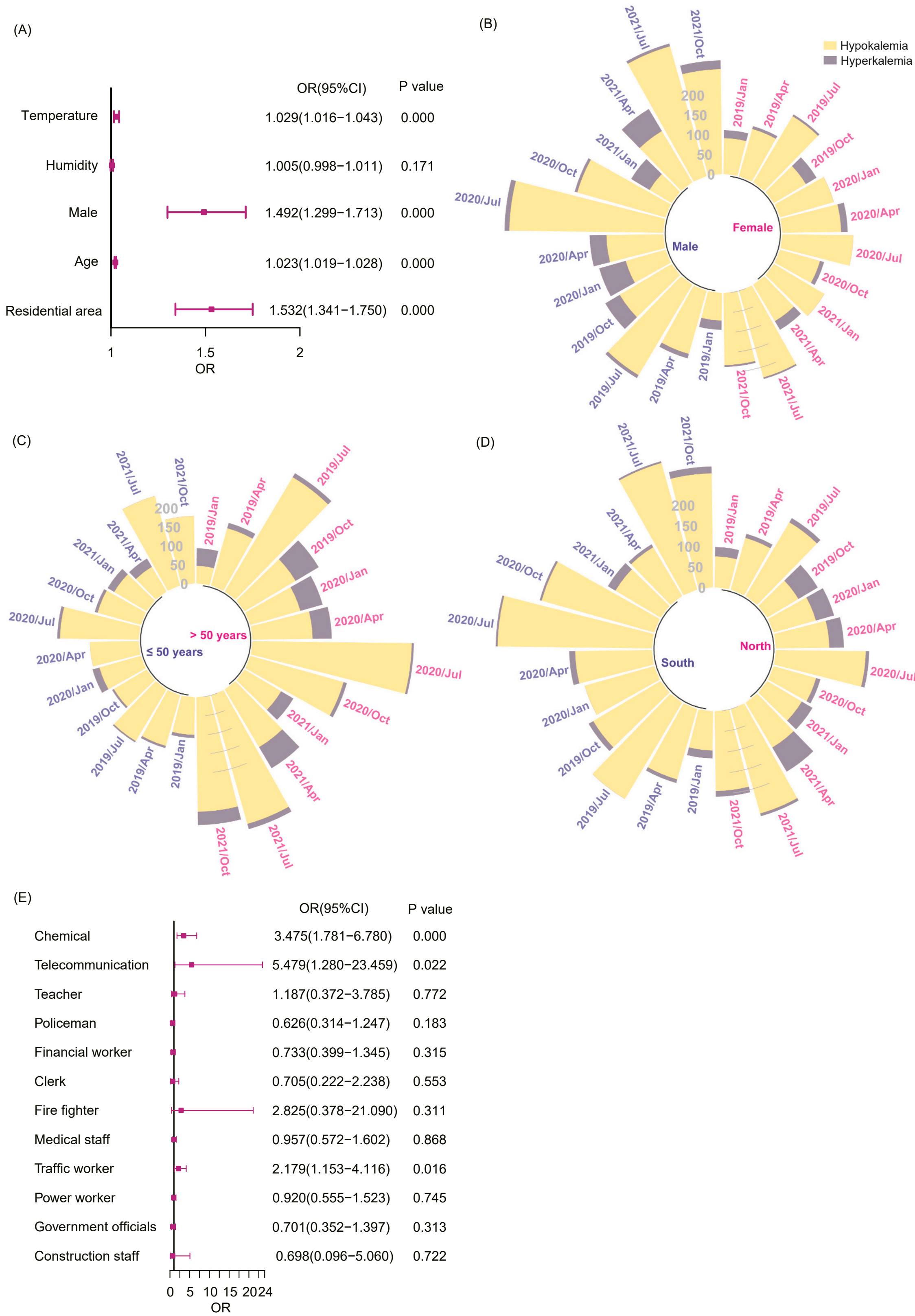

Fig. 4. Forest plots and circular stacking diagrams of normal and abnormal serum potassium concentration. (A) Forest plot illustrating temperature, humidity, sex, age, and residential area of individuals with abnormal serum potassium concentrations. Odds ratios and P values were obtained using multivariate logistic regression. (B) Circular stacking diagrams showing hyperkalemia and hypokalemia ratios in males and females. (C) Circular stacking diagrams showing hyperkalemia and hypokalemia ratios in the participants > 50 years and ≤ 50 years. (D) Circular stacking diagrams showing hyperkalemia and hypokalemia ratios in the participants living in southern and northern Taizhou. (E) Forest plot illustrating the occupations related to abnormal serum potassium concentrations. Odds ratios and P values were obtained using univariate logistic regression. The ratios in B–D refer to the permillage of individuals with hyperkalemia and hypokalemia of the total number of participants.

Table 1
Comparison of sociodemographic and clinical factors between participants with normal and abnormal serum potassium concentrations and those with hypokalemia and hyperkalemia.

	Normal serum potassium	Abnormal serum potassium	P value	Hypokalemia	Hyperkalemia	P value
n	642	642		591	51	
Gender (%)			1.000			0.239
Male	425 (66.2)	424 (66.0)		386 (65.3)	38 (74.5)	
Female	217 (33.8)	218 (34.0)		205 (34.7)	13 (25.5)	
Age (years)	52.7 ± 15.1	52.8 ± 15.1	0.823	**52.2 ± 14.7**	**59.8 ± 17.8**	**0.001**
Residential area (%)			1.000			**< 0.001**
South area	320 (49.8)	319 (49.7)		**310 (52.5)**	**9 (17.6)**	
North area	322 (50.2)	323 (50.3)		**281 (47.5)**	**42 (82.4)**	
Height (cm)	164.6 ± 8.4	164.3 ± 8.5	0.467	164.3 ± 8.5	164.5 ± 8.9	0.848
Weight (kg)	66.6 ± 12.1	66.0 ± 12.4	0.428	66.1 ± 12.6	65.0 ± 9.6	0.568
BMI (kg/m^2)	24.4 ± 3.2	24.4 ± 3.5	0.904	24.4 ± 3.5	24.0 ± 3.1	0.469
Heart rate (times/min)	80.0 ± 12.5	81.0 ± 12.1	0.298	81.2 ± 12.2	78.8 ± 11.1	0.210
Systolic pressure (mmHg)	**129.5 ± 19.3**	**136.1 ± 21.0**	**< 0.001**	135.9 ± 20.8	137.8 ± 24.0	0.556
Diastolic pressure (mmHg)	**76.8 ± 11.9**	**80.8 ± 13.1**	**< 0.001**	80.8 ± 13.1	79.6 ± 12.8	0.530
Previously confirmed underlying diseases (%)						
Diabetes mellitus	**51 (7.9)**	**82 (12.8)**	**0.006**	**62 (10.5)**	**20 (39.2)**	**< 0.001**
Hypertension	**108 (16.8)**	**300 (46.7)**	**< 0.001**	280 (47.4)	20 (39.2)	0.330
Hyperlipidemia	**223 (34.7)**	**264 (41.1)**	**0.021**	241 (40.8)	23 (45.1)	0.650
Cardiovascular disease	**154 (24.0)**	**203 (31.6)**	**0.003**	**178 (30.1)**	**25 (49.0)**	**0.009**
Cerebrovascular disease	**12 (1.9)**	**50 (7.8)**	**< 0.001**	43 (7.3)	7 (13.7)	0.169
Kidney diseases	**61 (9.5)**	**141 (22.0)**	**< 0.001**	130 (22.0)	11 (21.6)	1.000
Liver diseases	**104 (16.2)**	**166 (25.9)**	**< 0.001**	151 (25.5)	15 (29.4)	0.662
Respiratory diseases	298 (46.4)	328 (51.1)	0.105	297 (50.3)	31 (60.8)	0.194
Gastrointestinal diseases	**131 (20.4)**	**167 (26.0)**	**0.021**	152 (25.7)	15 (29.4)	0.682

Bold font: $P < 0.05$.

temperature might be the main reason for the seasonal variation. We also found that the serum potassium concentrations in April (Spring) 2020 and April 2021 were comparable to those in January of the same years, whereas the serum potassium concentrations in April 2019 were lower than those in January of the same year. In contrast, air temperatures during the three years were similar. Therefore, we speculate that this may be due to lifestyle changes after the coronavirus disease (COVID-19) outbreak in 2020. People may have reduced the frequency of outdoor activities to avoid infection and their diets may have been adjusted to enhance their health. Therefore, we believe that activity duration and diet also affect serum potassium concentrations.

The 10 patients who had more than five test results had serum potassium concentrations within the normal range. There was no apparent seasonal trend, suggesting that other factors affected serum potassium concentrations in our study population.

We analyzed the sociodemographic influencing factors—including residential area, sex, age, and occupation—and showed that individuals in northern Taizhou had higher serum potassium concentrations than did individuals in southern Taizhou and men had higher concentrations than women did. Serum potassium concentrations increased with age in participants aged > 50 years. Multivariable logistic regression analysis suggested that high temperatures, male sex, advanced age, and residence in the southern region were risk factors for serum potassium abnormalities. Owing to differences in dietary habits, residents in southern Taizhou consume more sodium and less potassium, leading to regional differences. Studies have shown that the aldosterone concentration in women is higher than that in men [18], and it was speculated that women excreted more potassium than men do. Additionally, potassium intake decreases with age, especially in women [19], suggesting that blood potassium is related to sex and age, supporting the findings of this study.

In this study, the serum potassium concentrations of chemical and telecommunications workers were lower than those of individuals with other occupations, which might be related to higher working environment temperatures. The seasonal trends in serum potassium concentrations of medical and transportation staff were similar, with the lowest concentrations found in July and similar concentrations found in other months. This may be related to their high-pressure working environment, with the secretion of thyroid hormones, dopamine, and adrenal hormones being increased [20], affecting aldosterone secretion and serum potassium concentrations [21]. Teachers exhibited a distinct pattern of change, having lower serum potassium concentrations in January than did individuals in other professions. This could be attributed to the heightened physical activity of teachers during the winter break.

In a Dutch cohort of 5200 adults aged > 55 years, the incidence of mild hypokalemia was approximately 3% [22]. In our study, the incidence of serum potassium abnormalities was 1.49%, and hypokalemia accounted for the majority (approximately 1.37%). Analysis of the clinical factors influencing serum potassium concentration showed that hypertension and cardiovascular disease were more common in individuals with abnormal serum potassium concentrations. Studies have shown that both hypokalemia (<3.5 mmol/L) and hyperkalemia (>5.5 mmol/L) increase the risk of adverse events due to heart failure, related complications, and drug use [13]. In addition, studies have found that among patients with hypertension, 15.8% and 7.3% have hypokalemia and hyperkalemia, respectively, suggesting a correlation between abnormal potassium concentration and hypertension [23].

The proportion of patients with hyperkalemia and diabetes was higher among those with abnormal serum potassium concentrations compared to the normal ones. As both potassium and glucose homeostasis involve acute insulin regulation, there may be an interaction between the two systems [24]. Hyperkalemia is a common electrolyte disorder that increases the risk of death, particularly in patients with chronic kidney disease, diabetes, or heart failure [25]. We also found a negative correlation between serum potassium and blood glucose concentrations in individuals with hypokalemia. Studies have found that a low potassium intake is significantly associated with the risk of diabetes [26], supporting the findings of this study.

Different indicators were found to be related to serum potassium concentrations in individuals with hyperkalemia and hypokalemia. For hyperkalemia, serum potassium concentrations positively correlated with creatinine concentrations and negatively correlated with eGFR. The opposite correlation was found for hypokalemia, indicating a correlation between abnormal serum potassium concentrations and decreased renal function. Studies have shown that decreased renal function is the leading risk factor for hyperkalemia. When the eGFR was ≤ 11, the hyperkalemia incidence was reported as 6.4% [27]. In

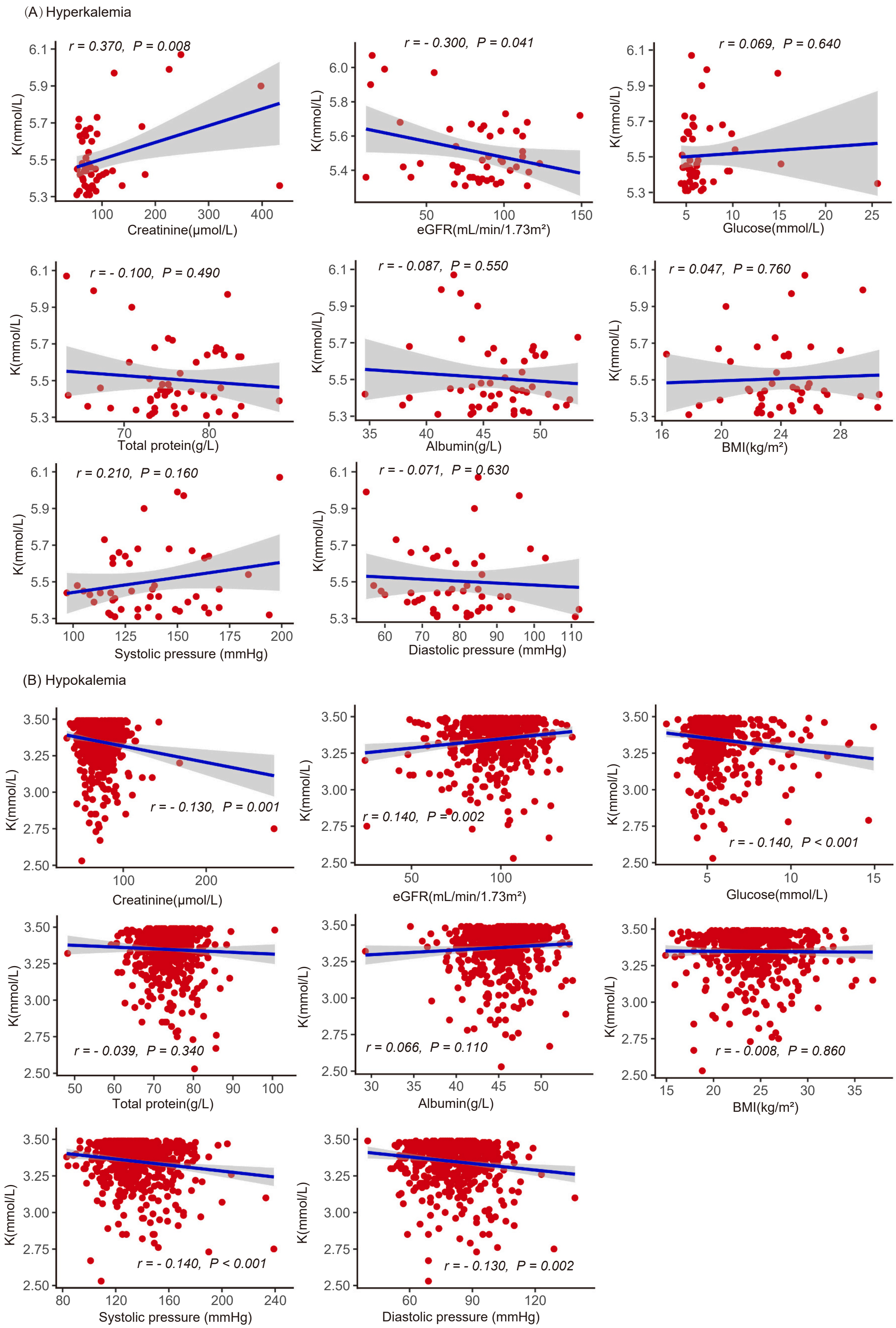

Fig. 5. Correlation between serum potassium concentration and other clinical and laboratory indicators in the hyperkalemia and hypokalemia groups. (A) Hyperkalemia group. (B) Hypokalemia group. The correlation coefficients and P values were obtained using Pearson correlation analysis.

(A)

ID	K(mmol/L)
A001	3.36
A002	3.39
A003	3.34
A004	3.46
A005	3.48
A006	3.44
A007	3.29
A008	3.45
A009	3.49
A010	3.40
A011	5.72
A012	3.37
A013	3.46
A014	3.46
A015	3.39
A016	3.46
A017	3.44

(B)

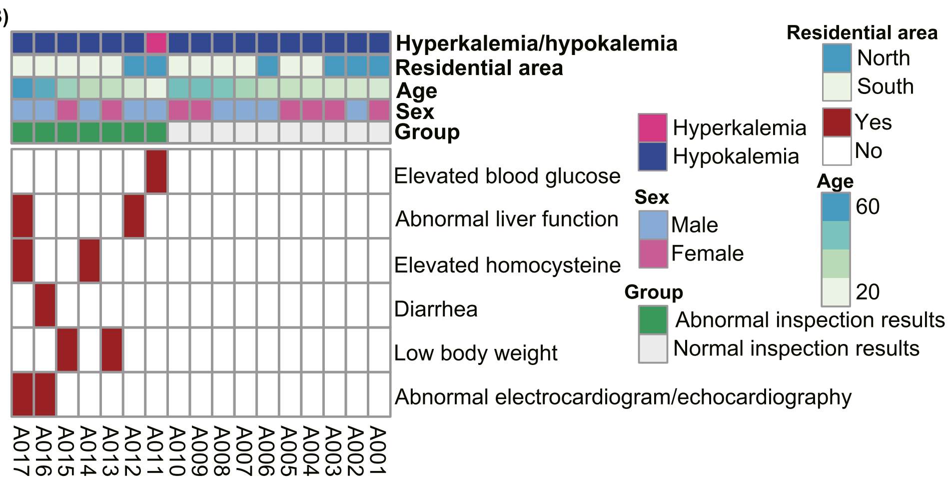

Fig. 6. Inspection results for 17 participants with abnormal serum potassium concentrations and without previously confirmed underlying diseases. (A) Serum potassium concentrations in 17 participants. (B) Other abnormal inspection results.

addition, the kidneys play a crucial role in maintaining systemic potassium homeostasis, and there is a reciprocal relationship between potassium and the kidneys that regulates potassium balance; potassium also affects renal function [28].

In addition, among individuals with hypokalemia, serum potassium concentrations negatively correlated with blood pressure. However, among patients with hyperkalemia, this correlation was not observed. Insufficient potassium intake is associated with hypertension [29]. Concomitant hypertension and hyperkalemia are more commonly observed in type II pseudo-hypoaldosteronism (PHAII) caused by mutations in the serine/threonine kinases WNK1 and WNK4 [30]. In this study, the highest serum potassium concentration among individuals with hyperkalemia was 6.07 mmol/L, and none were diagnosed with PHAII.

Recent research on serum potassium has mainly focused on the mechanisms of serum potassium homeostasis [24], the relationship between serum potassium concentration and food intake [31,32], and the association between serum potassium concentration and disease occurrence and development [33,34]. However, there is a lack of systematic evaluation of the sociodemographic and clinical factors influencing serum potassium concentrations in healthy individuals undergoing physical examinations.

The strength of this study is the large number of records collected over three years, resulting in a large amount of data. Furthermore, the data cover all four seasons and 1 year before and after the COVID-19 pandemic, as well as sociodemographic information, including temperature and humidity during physical examination, sex, age, residential area, occupation, and underlying disease information, comprehensively exploring the influencing factors of serum potassium concentration. The results of this study are significant for physicians dealing with individuals with abnormal serum potassium concentrations in terms of self-care to avoid worse outcomes.

This study also had some limitations. First, because the design was retrospective, we could not collect and analyze information on exercise style and amount, dietary habits, drug use, toxicity, and other social features of the participants who underwent physical examination. Second, due to incomplete records in terms of occupation and underlying diseases, we only included documented physicians in the relevant sections. Third, there was no related medication information for the participants with underlying diseases, which may have affected serum potassium concentrations, possibly causing bias.

5. Conclusions

Sociodemographic and clinical factors can affect serum potassium concentrations. High temperature, older age, male sex, residence in southern Taizhou, and chemical, telecommunications, and transport occupations were associated with a higher risk of serum potassium abnormalities.Clinical factors including hypertension, cardiovascular disease, and diabetes can also affect serum potassium concentrations. During daily self-care, it is important for individuals with abnormal potassium concentrations to avoid exposure to relevant sociodemographic risk factors and seek medical attention as soon as possible to screen for diseases, such as hypertension, cardiovascular disease, and diabetes.

Ethics approval and consent to participate

The research related to human use has been complied with all the relevant national regulations, institutional policies and in accordance the tenets of the Helsinki Declaration, and has been approved by the Ethics Committee of Taizhou Hospital in Zhejiang Province.

Consent for publication

Not applicable.

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CRediT authorship contribution statement

Jing Wang: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Visualization, Writing – original draft. **Jing Zheng:** Data curation, Investigation, Methodology, Resources, Software, Writing – original draft. **Yijun Chen:** Data curation, Methodology, Resources. **Tong Sun:** Data curation, Methodology, Resources. **Yufen Zheng:** Investigation, Methodology. **Minya Jin:** Conceptualization, Investigation, Methodology. **David Law:** Conceptualization, Methodology. **Donglian Wang:** Conceptualization, Investigation, Methodology, Project administration, Supervision. **Bo Shen:** Conceptualization, Investigation, Methodology, Project administration, Supervision. All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Declaration of Competing Interest

None.

Acknowledgements

Not applicable.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.csbj.2023.11.044.

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