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Frequency of Hyponatremia in Adult Patients with Community Acquired Pneumonia Presenting at Pulmonology Ward of Mardan Medical Complex

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ABSTRACT

Background: Hyponatremia is often seen in hospital patients, especially those with respiratory infections. The development of electrolyte imbalances in community-acquired pneumonia happens mainly through when antidiuretic hormone is secreted inappropriately, fluid is lost and pro-inflammatory molecules are released. **Objective**: To determine the frequency of hyponatremia in adult patients with community acquired pneumonia presenting at pulmonology ward of Mardan medical complex. **Study Design**: Cross-sectional study. **Duration and Place of Study**: The study was conducted from July 2024 to January 2025 in the Pulmonology Department of Mardan Medical Complex, Peshawar. **Methodology**: 110 patients aged 25 to 70 years who had verified community-acquired pneumonia took part in the study. The patient was diagnosed based on how they presented and radiological images indicating lobar pattern and consolidation. Those with a history of pregnancy, lactation or lasting issues with their kidney or liver were excluded. Hyponatremia is present when serum sodium is measured at less than 130 mmol/L. **Results:** The mean age of patients was 47.19 ± 11.82 years, with 68 males (61.8%) and 42 females (38.2%). Hyponatremia occurred in 32 patients (29.10%). Advanced age (>50 years) was the strongest predictor with 65.2% hyponatremia rate versus 3.1% in younger patients ($p<0.001$). Elevated BMI (>25 kg/m^2) showed 49.0% versus 13.1% in normal weight patients ($p<0.001$). **Conclusion**: Hyponatremia affects nearly one-third of adults with community-acquired pneumonia, with advanced age, elevated BMI, diabetes mellitus, and hypertension.

INTRODUCTION

Pneumonia is characterized by lung inflammation mainly caused by infectious agents, including bacteria, viruses, fungi, or parasites.[1] It typically brings cough, fever, dyspnea, and chest pain, while its presence is also confirmed by radiographs showing infiltration of the lungs.[2] As the alveoli fill with inflammatory materials, patients are unable to breathe well which causes respiratory distress.[3] Many people, especially the elderly, those with immunocompromised systems and those dealing with chronic illnesses, continue to experience serious infections from pneumonia.[4] The term community-acquired pneumonia (CAP) is used for cases where pneumonia developed outside of medical settings.[5] *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Mycoplasma pneumoniae* are common causes of this condition.[6] CAP ranges from being easy to treat at home to serious and potentially life-threatening conditions that require intensive care. Giving the correct medicines as soon as possible can help patients improve their health. CAP continues to be a major reason for hospitalizations worldwide, so prevention, early detection, and appropriate treatment are still important.[7]

Electrolyte imbalances are common in patients diagnosed with community-acquired pneumonia because of inflammation, reduced volume, and endocrine problems.[8] Inflammation can cause ADH to be released in water-independent ways, meaning the body retains water and fluids may become abnormally diluted.[9] Conditions such as fever, vomiting, and eating less than usual can upset the amounts of sodium and potassium in the body.[10] Improper nutrition can cause cardiac arrhythmias, trouble with thinking and coordination, and organ failure, making it harder for the patient to recover.[11] Community-acquired pneumonia often leads to hyponatremia which might indicate the syndrome of inappropriate antidiuretic hormone secretion (SIADH).[12] When people with CAP have SIADH, their bodies release too much ADH, leading to poor excretion of extra water and a drop in serum sodium levels.[13] Hyponatremia in CAP correlates with a higher chance of worsening illness, longer hospital stays, and greater risk of death.[14] Proper handling of electrolyte disturbances must include recognizing the condition quickly and carefully correcting the amount of sodium while avoiding sudden changes.[15]

A study documented that hyponatremia occurred in

36.11% of adult patients diagnosed with community-acquired pneumonia.[16]

The importance of assessing hyponatremia in Mardan can't be overlooked, because the region has a high rate of respiratory infections and there is not enough data about related electrolyte imbalances. Realizing the frequency of hyponatremia allows doctors to respond early and assist each patient using proper treatment plans for the Mardan population. The research will also close the gap in regional epidemiological data which will help allocate necessary resources for healthcare.

METHODOLOGY

This cross-sectional study was conducted from July 2024 to January 2025 in the Pulmonology Department of Mardan Medical Complex, Peshawar. The sample consisted of 110 adult patients diagnosed with community-acquired pneumonia based on clinical presentation and radiographic findings. The sample size was calculated using the WHO calculator, considering a prevalence of hyponatremia of 36.11%,[16] a 95% confidence interval, and a 9% margin of error.

Patients aged 25 to 70 years, of either gender, with confirmed community-acquired pneumonia characterized by cough, sputum production, fever ≥ 38°C, and chest X-ray showing lobar pattern and air space consolidation were included. Those who were pregnant or lactating, or had chronic renal or liver disease were excluded from the study. Prior to enrollment, ethical approval was obtained from the hospital's ethics committee and the CPSP Karachi research board. Informed written consent was secured after explaining the study objectives and assuring participants of minimal risk.

Demographic data such as age, gender, body mass index, education, occupation, socioeconomic status, and residence were collected. Medical histories including diabetes and hypertension were recorded. Patients exhibiting symptoms suggestive of hyponatremia—headache, fatigue, and nausea—underwent serum sodium measurement. Blood samples were aseptically drawn from peripheral veins without tourniquet application and analyzed by the hospital laboratory. Serum sodium levels below 130 mmol/L were indicative of hyponatremia. All procedures were supervised by a consultant with over five years of post-fellowship experience. Patient data were systematically documented using a structured questionnaire.

Data analysis was performed using SPSS version 25. Continuous variables were summarized using mean ± standard deviation or median with interquartile ranges after testing for normality via the Shapiro-Wilk test. Categorical variables were expressed as frequencies and percentages. Potential confounding factors were addressed through stratification, followed by chi-square or Fisher's exact tests, with a significance threshold set at $p < 0.05$.

RESULTS

The demographic characteristics of the 110 participants revealed a predominantly middle-aged population with a mean age of 47.19 ± 11.82 years, mean weight of 71.17 ± 8.38 kg, mean height of 1.69 ± 0.08 m, and mean BMI of 24.85 ± 1.53 kg/m^2 indicating normal weight status, while serum sodium levels averaged 132.71 ± 5.22 mmol/L suggesting borderline hyponatremia in the overall cohort. The study population demonstrated a male predominance with 68 males (61.8%) compared to 42 females (38.2%), and was primarily urban-based with 80 participants (72.7%) residing in urban areas versus 30 (27.3%) in rural settings. Socioeconomic stratification revealed that the majority belonged to middle class with 61 participants (55.5%), followed by lower class 28 (25.5%), and upper class 21 (19.1%), indicating representation across different economic strata. Professional distribution showed diverse occupational backgrounds with office workers comprising the largest group at 38 (34.5%), followed by other professions 26 (23.6%), manual laborers 24 (21.8%), and business professionals 22 (20.0%). Educational assessment indicated that three-quarters of participants were educated 82 (74.5%) while one-quarter remained uneducated 28 (25.5%). Comorbidity analysis revealed that approximately one-quarter had diabetes mellitus 29 participants (26.4%) and slightly more than one-quarter had hypertension 31 participants (28.2%), representing significant burden of metabolic and cardiovascular comorbidities in this pneumonia cohort (as shown in Table 1).

Table 1

Patient Demographics (N = 110)

Variable	Mean ± SD / n (%)
Age (years)	47.19 ± 11.82
Weight (kg)	71.17 ± 8.38
Height (m)	1.69 ± 0.08
BMI (kg/m^2)	24.85 ± 1.53
Serum Na (mmol/L)	132.71 ± 5.22
Gender	
Male	68 (61.8)
Female	42 (38.2)
Residential Status	
Rural	30 (27.3)
Urban	80 (72.7)
Socioeconomic Status	
Lower class	28 (25.5)
Middle class	61 (55.5)
Upper class	21 (19.1)
Profession	
Office work	38 (34.5)
Business	22 (20.0)
Labour	24 (21.8)
Other	26 (23.6)
Education	
Educated	82 (74.5)
Uneducated	28 (25.5)
Diabetes	
Yes	29 (26.4)
No	81 (73.6)
Hypertension	
Yes	31 (28.2)
No	79 (71.8)

The primary outcome analysis demonstrated that nearly one-third of patients with community acquired pneumonia developed hyponatremia, with 32 participants (29.10%) experiencing this electrolyte disturbance while 78 participants (70.90%) maintained normal sodium levels (as shown in Table 2).

Table 2

Frequency of Hyponatremia

Hyponatremia	Frequency	% age
Yes	32	29.10%
No	78	70.90%

Comprehensive stratified analysis revealed several highly significant demographic and clinical associations with hyponatremia development: age emerged as the strongest predictor with patients over 50 years showing dramatically higher hyponatremia rates at 30 cases (65.2%) compared to only 2 cases (3.1%) in younger patients ≤50 years ($p<0.001$), indicating that advancing age substantially increases hyponatremia risk. Body mass index demonstrated another critical association where overweight patients with BMI >25 kg/m^2 exhibited 24 cases (49.0%) of hyponatremia compared to only 8 cases (13.1%) in normal weight patients with BMI ≤25 kg/m^2 ($p<0.001$), suggesting that excess body weight predisposes to electrolyte imbalance. Professional categories showed significant variation in hyponatremia prevalence with a clear gradient from office workers having the lowest incidence at 4 cases (10.5%), business professionals with moderate risk at 6 cases (27.3%), manual laborers showing higher susceptibility at 10 cases (41.7%), and other professions demonstrating the highest risk at 12 cases (46.2%) ($p=0.007$), potentially reflecting differences in physical demands, environmental exposures, or healthcare access across occupational groups. Pre-existing diabetes mellitus emerged as a major risk factor with diabetic patients showing markedly elevated hyponatremia rates at 20 cases (69.0%) versus only 12 cases (14.8%) in non-diabetic individuals ($p<0.001$), highlighting the complex interplay between metabolic disorders and electrolyte homeostasis. Similarly, hypertensive patients demonstrated substantially higher hyponatremia incidence with 21 cases (67.7%) compared to 11 cases (13.9%) in normotensive patients ($p<0.001$), suggesting that cardiovascular comorbidities significantly influence sodium regulation during pneumonia. Conversely, several demographic factors showed no statistically significant associations with hyponatremia development including gender distribution with males showing 16 cases (23.5%) and females 16 cases (38.1%) ($p=0.102$), socioeconomic status across lower class 10 cases (35.7%), middle class 14 cases (23.0%), and upper class 8 cases (38.1%) ($p=0.281$), educational status with educated individuals having 22 cases (26.8%) versus uneducated having 10 cases (35.7%) ($p=0.371$), and residential status comparing rural areas 12 cases (40.0%) to urban areas 20 cases (25.0%) ($p=0.123$), indicating that these sociodemographic variables do not significantly influence hyponatremia susceptibility in community acquired pneumonia patients (as shown in Table 3).

Table 3

Association of Hyponatremia with Demographic Factors

Demographic Factors	Category	Hyponatremia		P-value
		Yes n (%)	No n (%)	
Age (years)	≤50	2 (3.1)	62 (96.9)	<0.001*
	>50	30 (65.2)	16 (34.8)	
Gender	Male	16 (23.5)	52 (76.5)	0.102
	Female	16 (38.1)	26 (61.9)	
BMI (kg/m^2)	≤25	8 (13.1)	53 (86.9)	<0.001
	>25	24 (49.0)	25 (51.0)	
Socioeconomic Status	Lower class	10 (35.7)	18 (64.3)	0.281
	Middle class	14 (23.0)	47 (77.0)	
	Upper class	8 (38.1)	13 (61.9)	
Education	Educated	22 (26.8)	60 (73.2)	0.371
	Uneducated	10 (35.7)	18 (64.3)	
Profession	Office work	4 (10.5)	34 (89.5)	0.007*
	Business	6 (27.3)	16 (72.7)	
	Labour	10 (41.7)	14 (58.3)	
	Other	12 (46.2)	14 (53.8)	
Residential Status	Rural	12 (40.0)	18 (60.0)	0.123
	Urban	20 (25.0)	60 (75.0)	
Diabetes	Yes	20 (69.0)	9 (31.0)	<0.001
	No	12 (14.8)	69 (85.2)	
Hypertension	Yes	21 (67.7)	10 (32.3)	<0.001
	No	11 (13.9)	68 (86.1)	

*Fischer Exact Test

DISCUSSION

The present study demonstrates a substantial prevalence of hyponatremia (29.10%) among adult patients with community acquired pneumonia, which aligns with previous literature reporting electrolyte disturbances in 20-40% of hospitalized pneumonia cases. This high frequency can be attributed to the complex pathophysiological mechanisms underlying pneumonia-associated hyponatremia, including syndrome of inappropriate antidiuretic hormone secretion (SIADH), volume depletion, and inflammatory cytokine release that disrupts normal sodium homeostasis.

The striking association between advanced age (>50 years) and hyponatremia development (65.2% vs 3.1%, $p<0.001$) reflects age-related physiological changes including decreased renal concentrating ability, altered baroreceptor sensitivity, and increased susceptibility to SIADH due to enhanced ADH responsiveness in elderly patients. The significant correlation with elevated BMI (>25 kg/m^2) resulting in higher hyponatremia rates (49.0% vs 13.1%, $p<0.001$) can be explained by obesity-related alterations in body water distribution, increased inflammatory cytokine production, and potential insulin resistance effects on renal sodium handling.

The profound association between diabetes mellitus and hyponatremia (69.0% vs 14.8%, $p<0.001$) can be attributed to diabetic nephropathy, osmotic diuresis, medication effects, and impaired glucose-mediated water handling mechanisms. Similarly, the strong correlation with hypertension (67.7% vs 13.9%, $p<0.001$) may result from antihypertensive medication effects, particularly thiazide diuretics and ACE inhibitors, along with underlying cardiovascular-renal dysfunction that compromises sodium regulation during acute illness.

The prevalence of hyponatremia in our study (29.10%) aligns closely with existing literature demonstrating the substantial burden of this electrolyte disturbance in pneumonia patients. Edmonds [17] reported that hyponatremia prevalence reaches up to 29% of patients

with pneumonia, which is remarkably consistent with our findings. Similarly, pediatric studies have shown comparable rates, with Mandal et al. [18] and Sukhani et al. [19] both reporting 21% prevalence in children with community-acquired pneumonia. This consistency across different age groups and populations suggests that hyponatremia represents a universal complication of pneumonia regardless of demographic variations.

The mechanisms underlying hyponatremia in pneumonia, as described by Edmonds [17], involve syndrome of inappropriate antidiuretic hormone secretion (SIADH) triggered by inflammatory cytokines, stress, nausea, and hypoxemia - factors that would be equally present in our adult population and could explain the similar prevalence rates observed.

Our study identified age as the strongest predictor of hyponatremia development, with patients over 50 years showing dramatically higher rates (65.2%) compared to younger patients (3.1%, p<0.001). This finding is supported by Emektar et al. [20] who found that hyponatremic COVID-19 patients were significantly older (65 vs 62 years, p=0.002), and multivariate analysis revealed advanced age as an independent predictor of hyponatremia (OR 0.98, p=0.041). The age-related vulnerability to hyponatremia likely reflects physiological changes in older adults, including altered renal function, increased susceptibility to SIADH, and reduced adaptive mechanisms for maintaining sodium homeostasis during acute illness.

Our study revealed striking associations between pre-existing comorbidities and hyponatremia development. Diabetic patients showed markedly elevated hyponatremia rates (69.0% vs 14.8% in non-diabetics, p<0.001), while hypertensive patients demonstrated substantially higher incidence (67.7% vs 13.9% in normotensives, p<0.001). These findings are corroborated by Emektar et al. [20] who reported significantly higher rates of diabetes (45.1% vs 24.1%, p<0.001) and hypertension (55.9% vs 39.8%, p<0.001) in hyponatremic compared to normonatremic patients. The strong association with diabetes may reflect the complex interplay between metabolic disorders and electrolyte homeostasis, potentially involving altered fluid regulation, medication effects, or underlying pathophysiological mechanisms that predispose diabetic patients to sodium imbalance during acute infections.

While our study focused on prevalence and risk factors, the literature consistently demonstrates that hyponatremia is associated with worse clinical outcomes in pneumonia. Edmonds [17] cited a large retrospective study showing that pneumonia patients with hyponatremia had statistically higher rates of ICU admission (10.0% vs 6.3%, p<0.001), mechanical ventilation (3.9% vs 2.3%, p=0.01), longer hospital stays (7.6 vs 7.0 days, p<0.001), and higher mortality trends. This pattern is further supported by pediatric studies where Mandal et al. [18] and Sukhani et al. [19] both reported significantly higher mortality in hyponatremic children with pneumonia (33.3% vs 2.5% and 33% vs 2.5% respectively, with odds ratios of approximately 19 in both studies).

Rajanna et al. [21] demonstrated a significant inverse correlation between sodium levels and CURB-65 scores, with patients having sodium levels <125 mg/dl presenting with CURB-65 scores of 4 (30%), while those with high sodium levels (>135 mg/dl) had CURB-65 scores of 1 (75%). This suggests that hyponatremia serves as a reliable biomarker for pneumonia severity, which has important implications for risk stratification and management decisions.

Our study found no significant gender association with hyponatremia development (23.5% in males vs 38.1% in females, p=0.102), which contrasts with some literature findings. Emektar et al. [20] reported that hyponatremia was more frequent in males (61% vs 49.4%, p=0.005), with male gender being an independent predictor (OR 1.71, p=0.003). This discrepancy may reflect differences in study populations, underlying comorbidities, or pneumonia etiology between our community-acquired pneumonia cohort and their COVID-19 patients.

The literature reveals important distinctions between community-acquired and hospital-acquired hyponatremia. Khalil et al. [22] found that while community-acquired hyponatremia was more frequent in ICU settings, it was associated with significantly worse outcomes, including higher mortality (35.2% vs 10.5%) and shorter survival time (17.09±0.55 vs 20.0±1.12 days, p=0.043) compared to hospital-acquired hyponatremia. This suggests that the timing and context of hyponatremia development have important prognostic implications.

Bibi et al. [23] reported that hospital-acquired hyponatremia occurred in 27.7% of pediatric patients, with 96.7% of affected patients receiving hypotonic maintenance fluids, highlighting the iatrogenic component of hospital-acquired hyponatremia that differs from the pathophysiological mechanisms seen in community-acquired cases like those in our study.

Several limitations should be acknowledged in interpreting our findings. This was a single-center study conducted at one tertiary care facility, which may limit the generalizability of results to other healthcare settings, populations, or geographic regions with different demographic characteristics, disease patterns, or clinical practices. The cross-sectional design precluded assessment of temporal relationships and causality between risk factors and hyponatremia development. Our sample size, while adequate for detecting significant associations, may have been insufficient to identify smaller effect sizes or interactions between variables. Additionally, we did not collect data on medication use, particularly diuretics, antidepressants, or other drugs known to affect sodium homeostasis, which could have influenced our results.

CONCLUSION

Our study has concluded that hyponatremia is a common electrolyte disturbance in adult patients with community-acquired pneumonia, affecting nearly one-third of the study population. Advanced age emerged as the strongest predictor of hyponatremia development, with patients over fifty years demonstrating dramatically higher susceptibility. Pre-existing comorbidities, particularly diabetes mellitus and hypertension, were significantly associated with increased hyponatremia risk, highlighting the complex interplay between metabolic disorders and

electrolyte homeostasis during acute respiratory infections.

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***Author's Contribution**

Each contributor has provided significant input to this publication, outlined as follows:

Dr. Muhammad Abdullah directed the research framework design, manuscript preparation, and clinical facility information gathering.

Dr. Sajjad Ali participated in publication creation, research planning, and statistical evaluation and explanation.

Dr. Imtiaz Ahmad contributed to data collection methodology, result validation, and manuscript review processes.

Dr. Zeeshan Bahadur assisted with research implementation, analysis verification, and editorial refinement activities.

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