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Original Article

Frequency and Outcome of Hyponatremia among Elderly Patients

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ABSTRACT

It is widely recognized that eight physiological alterations make elderly people more susceptible to contracting hyponatremia. The frequency and outcome of this condition however, seldom studied and thus merits exploration. **Objective:** To study the frequency and outcome of hyponatremia among elderly patients. **Methods:** The present descriptive case series was conducted from on a group of 207 consented elderly individuals of both sexes at Liaquat university hospital. A survey contains questions about biographical information, socio-demographics, the existence and degree of hyponatremia. The chi-square test was used to examine the relationship between hyponatremia and outcome. The data were analyzed with SPSS version-21.0. **Results:** Males made up 61.8% of the sample, while females made up the remaining 38.2%. The average length of hospitalization was five days (±3 SD). Hyponatremia was present among 59 (28.5%) of the inpatients (43 males and 16 females), out of which a majority (45) recovered and 11 died while the chronic liver disease and diabetes mellitus were common comorbid observed in relation to hyponatremia among elderly population. **Conclusions:** Hyponatremia exists in a substantial proportion of geriatric patients, as determined by meticulous examination and the condition may lead to adverse outcomes.

INTRODUCTION

The aging process frequently results in maladaptation in the organ systems and physiological functions, making the geriatric more prone to imbalances in electrolytes [1-3]. Contributing to these changes are eight physiologic changes, including decreased body water amount, glomerular filtration rate, the urinary concentrating capacity, raised anti-diuretic hormone quantity, atrial natriuretic peptide level, declining aldosterone quantity, decreased thirst central nervous system sensitivity, and decreased free water clearances [4-6]. In addition, diminished intrarenal prostaglandin production may impact elderly people's capacity to excrete water. Additionally, the elderly may be more sensitive to osmotic stimuli, contributing to hyponatremia. However, the majority of elderly individuals retain the ability to dilute their urine, and hyponatremia only arises in the context of rise in water intake and triggering factors [7-9]. In addition to a low-salt diet, elderly individuals with hypertension or heart failure can additionally decrease the amount of protein they consume, which may impair their water

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excretion. Hyponatremia is periodic and varies with the seasons due to diminished renal function, increased sodium losses, decreased consumption of salt, and higher fluid intake. Among all the other electrolyte imbalances, hyponatremia is the commonest in the elderly, and even more so among those who are hospitalized [10]. Hyponatremia is when the amount of sodium in the blood is less than 135 mEq/L (135 mmol/L). It is thought that about 7% of healthy older people have blood sodium levels of 135 mEq per L or less. The prevalence among in-patients may only be higher [11]. Despite the high prevalence, there is little awareness regarding the serious implications and clinical consequences of hyponatremia. The clinical presentation of patients with hyponatremia varies from mild symptoms like lethargy (22.5%) to vomiting (314%) and neurological manifestations such as seizures and altered sensorium (10.4%) [12, 13]. Hyponatremia has been linked to bad things happening to older people. A study of 4,123 elderly people found that 16% of those diagnosed with hyponatremia died in the hospital, while only 8% of individuals with the illness did [14]. The magnitude of this problem is immense and an end to it is nowhere in sight. With a greater proportion of population reaching the age of 60 years and most living longer (due to advanced healthcare facilities), a greater number of individuals are likely to encounter hyponatremia and face its associated morbidity and mortality. There was a scarcity of recent published evidence pertaining to this important matter and research is therefore necessary to explore the matter in depth and assess the frequency and outcome of hyponatremia in the elderly so that we might understand the situation better. This research hopes to fill this knowledge gap. Thus, the objective of the study was to determine the frequency and outcome of hyponatremia in elderly patients admitted at Liaquat University Hospital, Hyderabad.

METHODS

The sample size for this descriptive case series was determined using the WHO formula and was 207 elderly in-patients who were treated at the Department of Medicine at the Liaquat University of Medical and Health Sciences in Jamshoro between the months of August 2019 and February 2020 on individuals who were over 60 years, patients from both sexes, and a history of fatigue, vomiting, or convulsions were among the eligibility requirements for the study. The criteria for exclusion for the study were those who did not agree to take part in the trial, as well as patients who had pseudo-hyponatremia. The informed permission of each and every elderly in-patient was obtained prior to the recruitment process, and the non-probability consecutive sampling method was utilized. A venous blood sample measuring 2 cc was drawn into a syringe with a capacity of 5 cc, and it was then delivered for analysis of the serum electrolyte (sodium) level. After doing an examination on the specimen, a senior pathologist who has more than five years of relevant work experience was given the responsibility of writing the final pathology report. Hyponatremia, a blood sodium level of below 135 mEq/L, mild = 130-134 mmol/L, moderate = 125-129 mmol/L, and severe beneath 129 mmol/L, an elderly person as 60 to 80 years while the recovered (improved) outcome as normalization of blood sodium level (above 135 mEq/L) within 7 days of hospitalization whereas the death outcome as demise of the individual (no sign of existence, both pupils fixed and dilated, no heartbeat or breathing, no blood pressure readings recorded). The information was gathered through the use of pre-structured surveys, which had questions concerning fundamental biodata, sociodemographic particulars, and inferences drawn from history taking, clinical examination, and laboratory tests. The researcher was responsible for covering any and all costs associated with laboratory investigations that were pertinent to this study. During the course of the research project, strict confidentiality was upheld, and informed consent was collected in languages that were either nationally or regionally prevalent (depending on the circumstances). All of the procedures were carried out in accordance with medical ethics. SPSS version-20.0 was used to do the analysis on all of the patients' data. When it came to qualitative data, we computed both the frequency and the percentage (%), but when it came to quantitative variables like age, we computed the mean and the standard deviation (SD). The stratification process was carried out while the post-stratification chi-square test was carried out on the variables that were categorical and a p-value of less than ≤0.05 was regarded as being significant in statistical terms.

RESULTS

The average age of the group was 69.00 ± 5.00 while 61.8% of the group was made up of men and 38.2% was made up of women. The mean duration of hospitalization was 5 days (±3 SD). Hyponatremia was present among 59 (28.5%) of the inpatients (43 males and 16 females), out of which a majority (45) recovered. A majority (61.8%) of the sample comprised of males i.e., 128 patients, while females constituted a minority (38.2%) i.e., 79 patients. A greater proportion (nearly 3/4th) of the study participants hailed from urban areas (78.3%). Hyponatremia was present among a considerable proportion i.e., 28.5% of the patients. Among the patients with hyponatremia, the severity was categorized most commonly as moderate, followed by severe and lastly mild. Recovery (in 7 days) was achieved in less than a quarter of the sample. Adverse outcome (mortality) was noted in 18% of the patients. The severity of

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hyponatremia increased with increasing age and more common among males. The results are presented in Table 1-6.

Table 1: Prevalence of hyponatremia V/S age

Age (Years)	Hyponatremia (n = 59)		p-value
	Yes	No	
Up to 65 (n = 51)	08 (15.7%)	43 (84.3)	<0.05*
66 – 70 (n = 79)	18 (22.8%)	61 (77.2%)	
71 – 75 (n = 62)	24 (38.7%)	38 (61.3%)	
76 – 80 (n = 15)	09 (60%)	06 (40%)	
Total (207)	59 (28.5%)	148 (71.5%)	

Table 2: Severity of hyponatremia V/S age

Age (Years)	Severity of Hyponatremia		
	Mild	Moderate	Severe
Up to 65 (n = 08)	04 (50%)	03 (37.5%)	01 (12.5%)
66 – 70 (n = 18)	02 (6.1%)	11 (61.1%)	05 (27.8%)
71 – 75 (n = 24)	04 (16.7%)	12 (50%)	08 (33.3%)
76 – 80 (n = 09)	01 (11.1%)	02 (22.2%)	06 (66.7%)
Total (59)	11 (18.6%)	28 (47.5%)	20 (33.9%)

Table 3: Prevalence of hyponatremia V/S gender

Gender	Hyponatremia		p-value
	Yes	No	
Male (n = 128)	43 (33.6%)	85 (66.4%)	> 0.05
Female (n = 79)	16 (20.3%)	63 (79.7%)	

Table 4: Severity of hyponatremia V/S gender

Gender	Severity of Hyponatremia		
	Mild (n = 11)	Moderate (n = 28)	Severe (n = 20)
Male (n = 43)	08 (18.6%)	21 (48.8%)	14 (32.6%)
Female (n = 16)	03 (18.7%)	07 (43.8%)	06 (37.5%)

Table 5: Outcome (recovery Vs mortality) among study population

Variables	Frequency (%)
Recovery	
Achieved	45 (76.30%)
Not Achieved	14 (23.70%)
Mortality	
Yes	11 (18.60%)
No	48 (81.40%)

Table 6: Prevalence of hyponatremia V/S spectrum of comorbidity

Comorbidity		Hyponatremia	p-value
Pulmonary Tuberculosis (n = 18)	Yes	02 (11.1%)	< 0.05
	No	16 (88.9%)	
Chronic Liver Disease (n = 41)	Yes	15 (36.6%)	> 0.05
	No	26 (63.4%)	
Congestive Cardiac Failure (n = 13)	Yes	07 (53.8%)	> 0.05
	No	06 (46.2%)	
Acute Cerebrovascular Accident (n = 28)	Yes	03 (10.7%)	< 0.05
	No	25 (89.3%)	
Obstructive Airway Disease (n = 21)	Yes	02 (9.5%)	< 0.05
	No	19 (90.5%)	
Hypertension (n = 77)	Yes	17 (22%)	> 0.05
	No	60 (78%)	
Diabetes Mellitus (n = 64)	Yes	14 (21.9%)	> 0.05
	No	50 (78.1%)	
SIADH (n = 34)	Yes	09 (26.5)	> 0.05
	No	25 (73.5%)	

DISCUSSION

Hyponatremia is a common and serious entity among the elderly in-patients. In parallel with increased prevalence of people reaching the age of 60 years, the prevalence of hyponatremia is also believed to be increasing, worldwide. This descriptive study was performed to evaluate the frequency and outcome of hyponatremia among elderly patients [15]. Hyponatremia may affect people of all ages. However, published evidence states that the elderly individuals are most affected by the condition [16]. This research observes a similar trend. The average age of the people in the sample was 69.00 ± 5.00 years. Looking into the gender paradigm, it is revealed that there was a predisposition towards the male gender with 61.8% of the sample comprising of males while the remaining 38.2% being comprised of females. Literature review reveals that there is conflicting evidence on the matter with some suggesting that the condition is more common in females than in males, while others reporting that more elderly females are admitted for hospital care around the world [17, 18]. Additionally, a greater proportion of the male patients were found to be suffering from hyponatremia than the female patients even when weighed against their individual frequencies, suggesting that males may be more at risk of developing hyponatremia than their female counterparts. Literature too reports synonymous findings [19]. In this research, 78.3% of the study participants belonged to urban areas, while the remaining 21.7% hailed from rural background. Several studies on the prevalence of individuals admitted for hospital care have demonstrated the importance of residence on the likelihood of needing hospital care [20, 21]. Our findings, backed by research, show that the incidence of hyponatremia rises with age and sex [22]. These results corroborate other published research linking hyponatremia to an elevated disease burden risk [23, 24]. Our study found people who had medical issues that require them to take drugs that have been linked to hyponatremia. Our findings corroborate previous research linking the use of thiazides, ACE inhibitors/ARBs, SSRIs, TCAs, carbamazepine, and lamotrigine to hyponatremia. This, though a unique approach is supported by the findings of studies that take a more in-depth approach [25, 26]. It had been difficult to determine if hyponatremia is only a sign of illness progression or whether hyponatremia is actually detrimental to hospitalized patients, despite the fact that both hyponatremia and its implications have been linked to negative outcomes. Hyponatremia has been shown to be a

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proxy for root pathology instead of an independent harmful condition, according to recent evaluations of small inpatient populations with hyponatremia. Although we do not investigate the root causes of the undesirable results we observe, we do aim to find some sort of correlation in our study [27-29]. We also show that those with hyponatremia with no other known medical problems have a higher mortality rate than those with the same demographics with normonatremia. Hyponatremia has been associated with a significantly higher likelihood of mortality in all participants, even after taking into account age, sex, comorbidities, and other factors which may affect death rates. This suggests that there is an adverse effect of a chronic hypotonic state above that of the underlying illness. Similar findings have been seen in other studies [30, 31]. Smaller studies conducted recently on older individuals in community settings have found similar links between hyponatremia and all-cause death. Our research is one of very few to show that hyponatremia is clinically significant and increases the risk of death in a large in-patient group of the elderly [32, 33]. Our findings add to the increasing amount of proof that mild hyponatremia is not benign, and they call attention to the need for more research into the association among chronic hyponatremia and adverse outcomes, as well as the possibility that increased monitoring for hyponatremia in ambulatory healthcare environment as well as therapy of these individuals may improve outcomes [34, 35]. The hyponatremia was observed as 11.1%, 24.7% and 51% in the study by Jastaniah *et al.*, [36], Zhang *et al.*, [37] and Jain *et al.*, [26] whereas the mortality was observed as 11.7%, 17.4% and 19% in the study by Zhang *et al.* [37], Ioannou *et al.*, [38] and Shapiro *et al.*, [39]. In the study by Dash *et al.*, the most prevalent comorbidity was hypertension (63%), and the presence of multiple comorbidities was associated with hyponatremia (p=0.001) [40]. Even though the longer hospital stays (p=0.001) and a greater death rate was not possible to demonstrate (p=0.699). Using a public hospital provided us with many benefits, one of which was an extensive group that was generally representative of the population. However, our study was limited by time and only measured serum sodium once, so the results do not reflect shifts in clinical practice. Because blood osmolality was not monitored, pseudo-hyponatremia and dilutional hyponatremia had to be detected by indirect means. The general prevalence of hyponatremia was reduced by excluding participants with pseudohyponatremia and dilutional hyponatremia from the subset of individuals with hyponatremia. However, this did not substantially alter the general statistics.

CONCLUSIONS

It is possible, after giving the matter significant thought, to reach the conclusion that hyponatremia affects a sizeable percentage of older persons and the condition may lead to adverse outcomes.

Authors Contribution

Conceptualization: HA, IK
Methodology: HA, MKS, SJ
Formal Analysis: HA, MAL, IK, MKS
Writing-review and editing: HA, MAL, MKS, SJ, SR, SZAS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCES

[1] Liamis G, Rodenburg EM, Hofman A, Zietse R, Stricker BH, Hoorn EJ. Electrolyte disorders in community subjects: prevalence and risk factors. The American Journal of Medicine. 2013 Mar; 126(3): 256-63. doi: 10.1016/j.amjmed.2012.06.037.

[2] Hawkins RC. Age and gender as risk factors for hyponatremia and hypernatremia. Clinica Chimica Acta. 2003 Nov; 337(1-2): 169-72. doi: 10.1016/j.cccn.2003.08.001.

[3] Upadhyay A and Jaber BL. Madias Ne. epidemiology of hyponatremia. Semin Nephrol. 2009 May; 29: 227-38. doi: 10.1016/j.semnephrol.2009.03.004.

[4] Lindner G, Pfortmüller CA, Leichtle AB, Fiedler GM, Exadaktylos AK. Age-related variety in electrolyte levels and prevalence of dysnatremias and dyskalemias in patients presenting to the emergency department. Gerontology. 2014 Aug; 60(5): 420-3. doi: 10.1159/000360134.

[5] Renneboog B, Musch W, Vandemergel X, Manto MU, Decaux G. Mild chronic hyponatremia is associated with falls, unsteadiness, and attention deficits. The American Journal of Medicine. 2006 Jan; 119(1): 71-e1.doi: 10.1016/j.amjmed.2005.09.026.

[6] Hoorn EJ, Rivadeneira F, van Meurs JB, Ziere G, Stricker BH, Hofman A, *et al*. Mild hyponatremia as a risk factor for fractures: the Rotterdam Study. Journal of Bone and Mineral Research. 2011 Aug; 26(8): 1822-8. doi: 10.1002/jbmr.380.

[7] Renneboog B, Sattar L, Decaux G. Attention and postural balance are much more affected in older than in younger adults with mild or moderate chronic hyponatremia. European Journal of Internal Medicine. 2017 Jun; 41: e25-6. doi: 10.1016/j.ejim.2017.02.008.

DOI: https://doi.org/10.54393/pjhs.v4i07.921

[8] Gosch M, Joosten-Gstrein B, Heppner HJ, Lechleitner M. Hyponatremia in geriatric inhospital patients: effects on results of a comprehensive geriatric assessment. Gerontology. 2012 Jun; 58(5): 430-40. doi: 10.1159/000339100.

[9] Hoorn EJ, Liamis G, Zietse R, Zillikens MC. Hyponatremia and bone: an emerging relationship. Nature Reviews Endocrinology. 2012 Jan; 8(1): 33-9. doi: 10.1038/nrendo.2011.173.

[10] Sajadieh A, Binici Z, Mouridsen MR, Nielsen OW, Hansen JF, Haugaard SB. Mild hyponatremia carries a poor prognosis in community subjects. The American Journal of Medicine. 2009 Jul; 122(7): 679-86. doi: 10.1016/j.amjmed.2008.11.03.

[11] Sterns RH. Disorders of plasma sodium—causes, consequences, and correction. New England Journal of Medicine. 2015 Jan; 372(1): 55-65. doi: 10.1056/NEJ Mra1404489.

[12] Verbalis JG, Goldsmith SR, Greenberg A, Korzelius C, Schrier RW, Sterns RH, *et al*. Diagnosis, evaluation, and treatment of hyponatremia: expert panel recommendations. American Journal of Medicine. 2013 Oct; 126(1): S1-42. doi: 10.1016/j. amjmed. 2013.07.006.

[13] Wald R, Jaber BL, Price LL, Upadhyay A, Madias NE. Impact of hospital-associated hyponatremia on selected outcomes. Archives of Internal Medicine. 2010 Feb; 170(3): 294-302. doi: 10.1001/ archintern med.2009.513.

[14] Mohan S, Gu S, Parikh A, Radhakrishnan J. Prevalence of hyponatremia and association with mortality: results from NHANES. The American Journal of Medicine. 2013 Dec; 126(12): 1127-37. doi: 10.1016/j. amjmed.2013.07.021.

[15] Kogiso T, Tokushige K, Hashimoto E, Ikarashi Y, Kodama K, Taniai M, *et al.* Safety and efficacy of long-term tolvaptan therapy for decompensated liver cirrhosis. Hepatology Research. 2016 Mar; 46(3): E194-200. doi: 10.1111/hepr.12547.

[16] Yan L, Xie F, Lu J, Ni Q, Shi C, Tang C, Yang J. The treatment of vasopressin V2-receptor antagonists in cirrhosis patients with ascites: a meta-analysis of randomized controlled trials. BMC Gastroenterology. 2015 Dec; 15(1): 1-3. doi: 10.1186/s12876-015-0297-z.

[17] Mannheimer B, Skov J, Falhammar H, Calissendorff J, Lindh JD, Nathanson D. Sex-specific risks of death in patients hospitalized for hyponatremia: a population-based study. Endocrine. 2019 Dec; 66(3): 660-5. doi: 10.1007/s12020-019-02073-x.

[18] Harbeck B, Lindner U, Haas CS. Low-dose tolvaptan for the treatment of hyponatremia in the syndrome of inappropriate ADH secretion (SIADH). Endocrine. 2016 Sep; 53(3): 872-3. doi: 10.1007/s12020-016-0912-y.

[19] Berl T and Rastegar A. A patient with severe hyponatremia and hypokalemia: osmotic demyelination following potassium repletion. American Journal of Kidney Diseases. 2010 Apr; 55(4): 742-8. doi: 10.1053/j.ajkd.2009.12.024.

[20] Snell DM and Bartley C. Osmotic demyelination syndrome following rapid correction of hyponatraemia. Anaesthesia. 2008 Jan; 63(1): 92-5. doi: 10.1111/j.1365-2044.2007.05341.x.

[21] Tavare AN and Murray D. Central pontine myelinolysis. New England Journal of Medicine. 2016 Feb; 374(7): e8. doi:10.1056/NEJMicm1504134.

[22] Singh TD, Fugate JE, Rabinstein AA. Central pontine and extrapontine myelinolysis: a systematic review. European Journal of Neurology. 2014 Dec; 21(12): 1443-50. doi: 10.1111/ene.12571.

[23] Elisaf MS, Liamis G. Treatment of hyponatremia: what the clinician needs to know. Journal of Nephrology Research. 2015 Jun; 1(1): 19-21. doi: 10. 17554/j.issn.2410-0579.2015.01.2.

[24] Spasovski G, Vanholder R, Allolio B, Annane D, Ball S, Bichet D, *et al*. Clinical practice guideline on diagnosis and treatment of hyponatraemia. Nephrology Dialysis Transplantation. 2014 Apr; 29(2): i1-39. doi: 10.1093/ndt/gfu040.

[25] Filippatos TD, Liamis G, Elisaf MS. Ten pitfalls in the proper management of patients with hyponatremia. Postgraduate Medicine. 2016 Jul; 128(5): 516-22. doi: 10.1080/00325481.2016. 1186488.

[26] Jain AK and Nandy P. Clinico-etiological profile of hyponatremia among elderly age group patients in a tertiary care hospital in Sikkim. Journal of Family Medicine and Primary Care. 2019 Mar; 8(3): 988. doi: 10.4103/jfmpc.jfmpc_32_19.

[27] Akash C and Badiger R. Epidemiology of Hyponatraemia Among Elderly Patients with Lower Respiratory Tract Infection. The Journal of the Association of Physicians of India. 2020 Jan; 68(1): 80. doi:10.3329/bjm.v31i1.44748.

[28] Zheng Y, Zheng FP, Li H. The prevalence and causes of hyponatremia in hospitalized patients. Chinese Journal of Internal Medicine. 2020 Jan; 59(1): 29. doi: 10.3760/cma.j.issn.0578-1426.2020.01.005.

[29] Tay CL, Myint PK, Mohazmi M, Soiza RL, Tan MP. Prevalence and documented causes of hyponatraemia among geriatric patients attending a primary care clinic. Medical Journal of Malaysia. 2019 Apr; 74(2): 121-7.

[30] Buffington MA and Abreo K. Hyponatremia: A Review. Journal of Intensive Care Medicine. 2016 May; 31(4):

DOI: https://doi.org/10.54393/pjhs.v4i07.921

223-36. doi: 10.1177/0885066614566794.
[31] Burst V. Etiology and epidemiology of hyponatremia. Disorders of Fluid and Electrolyte Metabolism. 2019 Jun; 52: 24-35. doi: 10.1159/000493234.
[32] Danziger J, Lee J, Mark RG, Celi LA, Mukamal KJ. Do Hyponatremia or its underlying mechanisms associate with mortality risk in observational data? Critical Care Explorations. 2020 Jan; 2(1): e0074. doi: 10.1097/CCE.0000000000000074.
[33] Peri A. Morbidity and mortality of hyponatremia. Disorders of Fluid and Electrolyte Metabolism. 2019 Jan; 52: 36-48. doi: 10.1159/000493235.
[34] Mohottige D, Lehrich RW, Greenberg A. Hypovolemic hyponatremia. Disorders of Fluid and Electrolyte Metabolism. 2019 Jan; 52: 93-103. doi: 10.1159/000493240.
[35] Peri A. Management of hyponatremia: causes, clinical aspects, differential diagnosis and treatment. Expert Review of Endocrinology & Metabolism. 2019 Jan; 14(1): 13-21. doi: 10.1080/17446651.2019.1556095.
[36] Jastaniah N, Sagim RA, Sanyour RM, Alamri DM, Bajandouh RH, Shaheen EA, *et al*. A Retrospective Chart Review: The Prevalence of Hyponatremia Among Elderly Inpatients in a Tertiary Care Centre in Saudi Arabia. Cureus. 2022 Mar; 14(3). doi: 10.7759/cureus.22960.
[37] Zhang X and Li XY. Prevalence of hyponatremia among older inpatients in a general hospital. European Geriatric Medicine. 2020 Aug; 11: 685-92. doi: 10.1007/s41999-020-00320-3.
[38] Ioannou P, Panagiotakis S, Tsagkaraki E, Tsioutis C, Fragkiadakis K, Gikas A, *et al*. Increased mortality in elderly patients admitted with hyponatremia: a prospective cohort study. Journal of Clinical Medicine. 2021 Jul; 10(14): 3059. doi: 10.3390/jcm10143059.
[39] Shapiro DS, Sonnenblick M, Galperin I, Melkonyan L, Munter G. Severe hyponatraemia in elderly hospitalized patients: prevalence, aetiology and outcome. Internal Medicine Journal. 2010 Aug; 40(8): 574-80. doi: 10.1111/j.1445-5994.2010.02217.x.
[40] Dash Sc, Sundaray Nk, Rajesh B, Pagad T. Hyponatremia in Elderly In-Patients. Journal of Clinical & Diagnostic Research. 2019 Feb; 13(2). doi: 10.7860/JCDR/2019/39957.12554.