Original Article

RFP Indian Journal of Hospital Infection
Volume 3 Number 1, January - June 2021

Calcium and Phosphorus in Health and Disease: A Hospital based Study from Kashmir

Tahseen Bilal Rather[1], Gulzar Ahmad Bhat[2], Gowhar Rashid[3], Ishrat Parveiz Bhat[4], Syed Mudassar[5]

Abstract

Background: Calcium (Ca) and phosphorus (P) are indispensable micronutrients to human nutrition for their infinite role in structural and transduction processes. They are the molecules of central attraction due to their role in health and predicting the severity of different diseases.

Aims and objectives: Considering their importance in health and disease, study was aimed to document the normal serum levels of calcium and phosphorus in random population who visited the hospital for consultation during March-May 2021.

Methods: A total of 711 subjects were recruited for the analysis of serum Ca and P. samples were analysed on fully automated analyser (Beckman Coulter, AU5800). Both Ca and P levels were measured by kinetic method.

Results: The median age of the participants was 50 years. The overall median serum Ca and P levels recorded in the study population were as 8.9(Interquartile range [IQR=1.40]) and 3.4(Interquartile range [IQR]=1.18). About 4.5% of the study population was deficient in both Ca and P. Females had higher median calcium levels than males (p-value<0.05). A statistically significant association was observed between Ca and different age groups:-<20y,20-40 (P-value<0.003) and 20-40y,>40y40 (p-value<0.001). Further, a weak negative relationship was observed between Ca and Age (r=-0.118, p-value<0.002). Both Ca and P levels were low in 32(4.5%) patients(p-value<0.004).

Conclusion: Our findings revealed, that our population has calcium and phosphorus levels within the normal reference range, but presence of low Ca and P levels in the small portion of our population may be helpful in efficacious management of serious illnesses including several time and money consuming diseases in future.

Keywords: Serum Calcium; Phosphorous; Observational study; Kashmir.

Introduction

Calcium (Ca) is the third most abundant mineral in the nature and was available to the cells from the very beginning at the start of evolution. The basic regulation mechanisms were present at the very earlier stages in prokaryotes and protists.[1] Besides being the most abundant mineral in our body, it is the vital macronutrient required for normal and smooth functioning of the body[2] and influences a large number of both intracellular and extracellular processes. Growth, development, neural conduction and maintenance of bones and stability of cytoskeleton as well as the regulation of various enzymatic activities depends upon the activity of Ca levels in body.[3] In adults the total content of Ca is 1200g, approximately 2% of the total body weight, 98% of which is stored in bones in the form of hydroxyapatite crystals.[4] Any deviations in the calcium homeostasis can lead to grave conditions like malignant arrhythmia or cardiac arrest.[5] Hypocalcaemia is the signature feature of severely ill patients associated with worst clinical outcomes in various ailments including COVID-19 infections[6,2]

Author Affiliation: [1,3,4]PhD Scholar, [2]Post-doctoral Fellow, [5]Professor and Head, Department of Clinical Biochemistry, Sheri-Kashmir Institute of Medical Sciences, Srinagar, Kashmir 190011, India.

Correspondence Author: Syed Mudassar, Professor and Head, Department of Clinical Biochemistry, Sheri-Kashmir Institute of Medical Sciences, Srinagar, Kashmir 190011, India.
E-mail: syed.mudassar@skims.ac.in

while as hypercalcemia is observed in acromegaly, sarcoidosis, hypothyroidism, tuberculosis and proliferative disorders.[4] Like Ca, phosphorus (P) is one of the vital intracellular anion present in cell membrane and plays role in cellular metabolism, including synthesis of adenosine triphosphate and 2,3 diphosphoglycerate, enzyme regulation, signal transduction and in maintaining acid base balance.[7] In humans it is present in amounts of 550-770g with maximum (85%) representation found in bones.

Phosphorus haemostasis is disturbed in impaired renal clearance, catabolic reactions, alcohol abuse, diabetic ketoacidosis, acid-base disturbances.[7] Hyperphosphatemia is observed in chronic kidney disease. In one of the studies, it was mentioned that high serum phosphorus levels are associated with increased risk of atherosclerosis in young adults.[8]

Keeping in view the critical nature of above micronutrients in regulating various metabolic activities and scarcity of available literature in study population, particularly limited data available on random screening of serum P and Ca levels in general population, the study was aimed to assess the normal serum levels of Ca and P in general population who visited to the main tertiary care hospital Sheri-Kashmir Institute of Medical Sciences (SKIMS), from different corners of the Kashmir valley.

Materials and Methods

A total of 711 patients were analysed for serum Ca and P during March-May 2021. The analysis was done on fully automated analyser (Beckman Coulter, AU5800). Serum Ca and P levels were measured by kinetic method. The reference ranges of serum Ca and P ranged from 8.5-10.8mg/dL and 2.5-4.5mg/dL respectively. Statistical analysis was done on SPSS v26. The median age of the participants was 50 years (IQR=30). The overall median serum levels of Ca and P in patients were documented as 8.9(IQR=1.40) and 3.4(IQR=1.18) mg/dL respectively.

Results

The median age of the participants was 52 years. The overall median serum levels of Ca and P were recorded as 8.9 and 3.4 mg/dl (table 1). Among 711 patients, 394 (55%) were males and 317 (45%) were females. A statistically significant association was observed between gender and serum Ca (p-value<0.05) (table 2). Similarly, there was also a statistically significant association noted between Ca and different age groups; <20y,20-40 (P-value<0.003) and 20-40y,>40y (p-value<0.001(table 3).

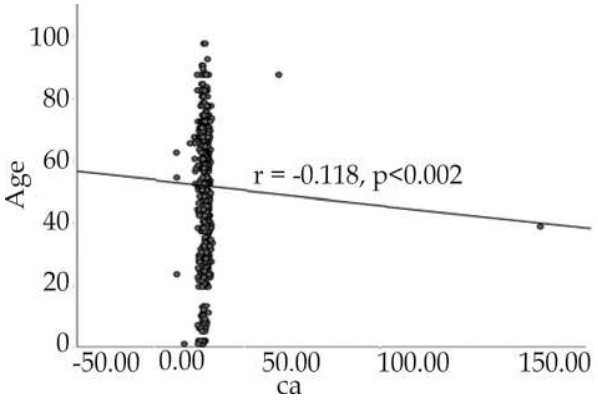

Fig. 1: Representing weak -ve correlation between age and calcium.

Table 1: Median age, Calcium (Ca) and Phosphorus (P) level in our population.

	Age	Ca(mg/dL)	P(mg/dL)
Median	52	8.9	3.4
Interquartile range	30	1.40	1.18

Table 2: Comparison of Ca and P with Gender.

Ca			
Gender	**N**	**Mean rank**	**P- value**
M	394	342.26	<0.05
F	317	373.08	
P			
M	394	344.41	>0.05
F	317	370.40	

Table 3: Comparison of serum calcium and serum phosphorus levels with different age groups in our population.

Ca			
Age	**N**	**Mean rank**	**P- value**
<20	52	85.81	<0.003
20-40	181	125.96	
20-40	181	378.75	<0.001
>40	478	311.54	
<20	52	233.52	>0.05
>40	478	268.86	
P			
<20	52	118.45	>0.05
20-40	181	116.32	
20-40	181	348.98	>0.05
>40	478	322.85	
<20	52	283.12	>0.05
>40	478	268.32	

Table 4: Stratification of serum Ca and P into different groups and there combination.al effect in our population.

		Ca			Chi 2; p-value
		low	**normal**	**high**	
P	low	32(4.5%)	52(7.3%)	2(0.3%)	
	normal	146(20.5%)	362(50.9%)	9 (1.3%)	25.58, <0.001
	high	57(8%)	49(6.9%)	2 (0.3%)	

Further, a weak negative relationship was observed between Ca and Age (r=-0.118, p-value<0.002). On further stratification, we found that both Ca and P levels were low in 32(4.5%) patients, high in 2(0.3%) subjects. Additionally, 362(50.9%) study subjects had both Ca and P in normal range. While as 57(8%) participants were recorded as those subjects who had high serum P levels but low Ca levels. Furthermore, 2(0.3%) subjects were those in which serum Ca levels were documented as high with low serum P levels. (P-value<0.001) (Table 4).

Discussion

Ca and P have regulatory roles in metabolic and signalling pathways.[9,10] There are many studies in our population that assess Ca and P status in relation with various disease.[11,12] The status of Ca and P varies in health and disease.[13] Hypophosphatemia is seen in severe respiratory diseases as observed in various published reports.[14-16] Abnormal Ca levels are also seen in viral induced diseases.[17]

In our study, we found that Sr. Ca and P levels were in normal reference range in most of the study subjects. Low levels of serum Ca and P were also present in a small group subjects. However, we could not find any study, due to very limited data that could validate these results, because our study was aimed at a general assessment of Ca and P in random population that did not included a particular disease as done in previous researches worldwide.[18-20] Low phosphorus levels are associated with mortality in haemodialysis patients as reported elsewhere.[21] A recent study also revealed a low levels of serum Ca and P in severe COVID-19 infection.[9] Our findings also showed a weak inverse relationship of Ca with age. This may be due to malabsorption of calcium in old age due to the deficiency of vitamin D as reported by various studies earlier.[22,23] The limitation of the study was that no proper follow-up was adopted, with no idea about the illness of the subjects.

Acknowledgement

The authors are thankful to the technical staff of the department of clinical biochemistry SKIMS for processing the samples.

Conflict of interest: None

Source of Funding: None

References

1. Carafoli E, Krebs JJJoBC. Why calcium? How calcium became the best communicator. 2016;291(40):20849-20857.
2. Goldstein DAJCMTH, Physical,, edition LEr. Serum calcium. 1990.
3. Ciosek Ż, Kot K, Kosik-Bogacka D, Łanocha-Arendarczyk N, Rotter IJB. The Effects of Calcium, Magnesium, Phosphorus, Fluoride, and Lead on Bone Tissue. 2021;11(4):506.
4. Bushinsky DA, Monk RDJTL. Calcium. 1998;352(9124):306-311.
5. Schmitz T, Thilo C, Linseisen J, et al. Low serum calcium is associated with higher long-term mortality in myocardial infarction patients from a population-based registry. 2021;11(1):1-8.
6. Sun J-K, Zhang W-H, Zou L, et al. Serum calcium as a biomarker of clinical severity and prognosis in patients with coronavirus disease 2019. 2020;12(12):11287.
7. Barash Y, Klang E, Soffer S, et al. Normal-range emergency department serum phosphorus levels and all-cause mortality. 2021;97(1144):83-88.
8. Foley RN, Collins AJ, Herzog CA, Ishani A, Kalra PAJJotASoN. Serum phosphorus levels associate with coronary atherosclerosis in young adults. 2009;20(2):397-404.
9. Yang C, Ma X, Wu J, et al. Low serum calcium and phosphorus and their clinical performance in detecting COVID-19 patients. 2021;93(3):1639-1651.
10. Civitelli R, Ziambaras KJJEI. Calcium and phosphate homeostasis: concerted interplay of new regulators. 2011;34(7 Suppl):3-7.
11. Masood H, Narang A, Bhat I, Shah GJIJPP. Persistent limb pain and raised serum alkaline phosphatase the earliest markers of subclinical hypovitaminosis D in Kashmir. 1989.
12. Khandare AL, Gourineni SR, Validandi VJEm, assessment. Dental fluorosis, nutritional status, kidney damage, and thyroid function along with bone metabolic indicators in school-going children living in fluoride-affected hilly areas of Doda district, Jammu and Kashmir, India. 2017;189(11):1-8.
13. Peacock MJCJotASoN. Calcium metabolism in health and disease. 2010;5(Supplement 1):S23-S30.
14. Fiaccadori E, Coffrini E, Fracchia C, Rampulla C, Montagna T, Borghetti AJC. Hypophosphatemia and phosphorus depletion in respiratory and peripheral muscles of patients with respiratory

failure due to COPD. 1994;105(5):1392-1398.

15. Campos-Obando N, Lahousse L, Brusselle G, et al. Serum phosphate levels are related to all-cause, cardiovascular and COPD mortality in men. 2018;33(9):859-871.
16. Aubier M, Murciano D, Lecocguic Y, et al. Effect of hypophosphatemia on diaphragmatic contractility in patients with acute respiratory failure. 1985;313(7):420-424.
17. Deng B, Zhang S, Geng Y, et al. Cytokine and chemokine levels in patients with severe fever with thrombocytopenia syndrome virus. 2012;7(7):e41365.
18. Levin A, Bakris G, Molitch M, et al. Prevalence of abnormal serum vitamin D, PTH, calcium, and phosphorus in patients with chronic kidney disease: results of the study to evaluate early kidney disease. 2007;71(1):31-38.
19. Zhen D, Liu L, Guan C, Zhao N, Tang XJB. High prevalence of vitamin D deficiency among middle-aged and elderly individuals in northwestern China: its relationship to osteoporosis and lifestyle factors. 2015;71:1-6.
20. Fiaccadori E, Coffrini E, Ronda N, et al. Hypophosphatemia in course of chronic obstructive pulmonary disease: prevalence, mechanisms, and relationships with skeletal muscle phosphorus content. 1990;97(4):857-868.
21. Lertdumrongluk P, Rhee CM, Park J, et al. Association of serum phosphorus concentration with mortality in elderly and nonelderly hemodialysis patients. 2013;23(6):411-421.
22. Bullamore J, Wilkinson R, Gallagher J, Nordin B, Marshall DJTl. Effect of age on calcium absorption. 1970;296(7672):535-537.
23. Nordin BC, Need AG, Morris HA, O'Loughlin PD, Horowitz MJTAjocn. Effect of age on calcium absorption in postmenopausal women. 2004;80(4):998-1002.