Original Article

An Assessment Of Serum Magnesium & It's Association With Spirometry In Bronchial Asthma

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Abstract

Asthma being a significant non communicable disease affecting 300 million people worldwide. It poses a major detrimental health and economic burden. Magnesium is the fourth most abundant cation in our body and the second most common intracellular cation. Magnesium is an important determinant of contraction and relaxation state of bronchial smooth muscle. Deficiency of magnesium can lead to lack of smooth relaxation and can worsen outcomes in asthmatics. The present study was done to evaluate the serum magnesium level & its impact on spirometry in asthmatics.

INTRODUCTION

Asthma is a chronic disease of the airways that present as inflammation and narrowing of the air passages. Common clinical presentation includes breathlessness, cough, and wheeze. It usually manifests during childhood and is commonly associated with other conditions as eczema and hay fever.[1,2]Asthma usually presents with varied severity ranging from very mild to very severe life-threatening disease. Asthma affects all age group, further adding to increase in hospital admissions and economic burden on the families. The disease can be extrinsic (atopy induced) or intrinsic (non atopic). The most common among being the atopic form. Patients with atopy also presents with other manifestations like allegic rhinitis, atopic dermatitis & allergic conjunctivitis. Its characteristic feature is airway hyper-responsiveness, which can be due to various factors. If not managed appropriately, asthma may result in high morbidity and mortality rates.[3,4] Asthma is a common condition, affecting up to 20% of people globally, its prevalence is observed to be higher among developing countries than developed countries. This disease is found to be more common among males than females among children and it affects at extreme age groups due to airway responsiveness and decreased lung functions.[5] Asthma is a fully reversible inflammation of airway, often associated with prior exposure to a triggering agent. The pathophysiology starts with the inhalation of a triggering agent as cold air or pollen, which causes hypersensitivity of airway, leading to inflammation and mucus production. This results in airway resistance, which is more during expiration.[6] Various studies conducted globally have highlighted the role of magnesium levels in chronic respiratory diseases. [7-10]Total body magnesium present in the human body is 25mg; more than half of which is present in the bones; It is the 2nd

abundant cation in the intracellular fluid and only minor amount (1%) is available in the extracellular fluid. It plays a vital role in relaxation of airway, dilatation of bronchus and bronchioles, anticholinergic effects,and stabilization of mast cells.[11] Studies have reported that Hypomagnesemia is correlated with increased airway hyperactivity and poor lung function, thus causing acute exacerbations of lung conditions.[11] Research also states that a poor dietary intake of magnesium is associated with poor pulmonary function, airway hyper-reactivity, and wheezing. High magnesium intake is associated with change for better in symptom score, though not in objective measures of air flow or airway reactivity in stable asthmatic subjects.[12] Magnesium relaxes bronchial smooth muscles and has its effects on respiratory function. Decreased Magnesium levels are have shown to be correlated with reduced respiratory muscle power.[13] A study conducted by Ali AA at al., reported that Decreased Magnesium level was observed in patients with bronchial asthma and also in acute asthmatic episodes compared to controls. The study also reported that Magnesium levels were significantly lower during acute asthmatic episodes compared with stable patients with asthma.[14] A study conducted by Yuvarajan s et al., reported that patients with chronic lung diseases as Bronchial asthma had a significantly lower serum magnesium level when compared to the control. This study also shows high prevalence of hypomagnesaemia and association of hypomagnesaemia with asthma as proved by the correlation between FEV1 and serum magnesium level.[15] Though there are many studies conducted on effects on magnesium levels on Chronic lung diseases, there are very few studies assessing the serum magnesium levels in respiratory conditions and correlating its association with spirometry among patients with asthma, especially in the given study area and setting to assess how far magnesium plays a role in the lung functions of chronic stable asthmatics, and to assess whether levels of magnesium affect the severity of bronchial asthma. Thus this study was designed with objective to assess the relationship between serum magnesium levels and it's correlation with the results of spirometry in bronchial asthma patients.

MATERIALS AND METHODS:

1.Study design: Hospital based-Cross sectional study.

2.Study setting: Department of respiratory medicine, Meenakshi medical college hospital & research institute, Kanchipuram, Tamilnadu.

3.Study duration: January 2020 to September 2021.

4. Statistical analysis

5.Sample size :80

Inclusion criteria:

- Patients diagnosed with asthma .
- Age more than 14 years of age.
- Asthmatic patients with coexisting comorbidities like diabetes and hypertension.

Exclusion criteria:

- Patients with chronic obstructive pulmonary disease.
- Critically ill patients with asthma.
- Patients <14 years.
- Patients diagnosed with chronic kidney disease & chronic liver diseases.
- Patients with chronic diarrhoealdiseases , malabsorption syndromes.
- Pregnant women
- Patients who underwent gastric resection surgeries.

RESULTS

In this Hospital based-Cross sectional study, conducted among patients with bronchial asthma > 14 years of age attending Chest OPD in the Department of Respiratory Medicine, MMCHRI, 80 study participants were included, following the inclusion and exclusion criteria.

Table 1: Age of the study participants

	No.s	Minimum	Maximum	Mean	Std. Deviation
AGE	80	22	76	48.32	12.846
Total	80				

The age of the study participants aged from 22-76 yrs, with a mean of 48.32 yrs and standard deviation of 12.84.

Table 2: Distribution of study participants according to the age

Variable		Frequency	Percent (%)
Age (yrs)	< 30	8	10.0
	31-45	31	38.8
	46-60	21	26.3
	>61	20	25.0
	Total	80	100.0

In this study, majority (38.8%) of study participants belonged to the age group of 31-45 year, followed by(26.3%) belonging to the age group of 46-60 year and (25%) belonging to the age group> 61 yrs.

Distribution of study participants according to Gender

In this study, majority of the study participants were male 62.5%, followed by female 37.5%.

Table3: Distribution of study participants according to Gender(N=80)

Variable		Frequency	Percent (%)
Gender	Female	30	37.5
	Male	50	62.5

	Total	80	100.0

Descriptive statistics of Serum Magnesium

The distribution of Sr Magnesium levels among study participants varied from 0.30 to 2.20mg/dl, with a mean value of 1.23 and standard deviation of 0.53.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Serum Magnesium	80	.3000	2.2000	1.236250	.5323090
Valid N (listwise)	80				

Distribution of study participants according Serum Magnesium mg/dl (N= 80)

Distribution of study participants according serum Magnesium, considering the normal range of Sr.Mg 1.5- 2.5 mg/dl, < 1.5 were 63.7%; and 1.5- 2.5 were 36.3%.

Table5: Distribution of study participants according Serum Magnesium(N= 80)

Variable		Frequency	Percent
Serum Magnesium	<1.5	51	63.7
	1.5-2.5	29	36.3
	>2.5	0	0
	Total	80	100.0

Assessing the lung function test among the study participants

Spirometry was done among all the study participants to assess the lung function test.
Parameters recorded included Force expiratory volume in first second (FEV1), which varied from 53-96, with a mean value of 73.06 and standard deviation of 10.43. The FEV1/FVC varied from 44-95, with a mean of 70.31 and standard deviation of 11.58; The Peak expiratory flow rate ranged from 43-94, with a mean value of 74.75 and standard deviation of 11.51.

Table.6. Assessing the lung function test among the study participants

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
FEV1	80	53	96	73.06	10.430
FEV1/FVC	80	44	95	70.31	11.589

PEFR	80	43	94	74.75	11.513
Valid N (listwise)	80				

Spirometry was done among all the study participants to assess the lung function test.
Parameters recorded included Force expiratory volume in first second (FEV1), which varied from 53-96, with a mean value of 73.06 and standard deviation of 10.43. The FEV1/FVC varied from 44-95, with a mean of 70.31 and standard deviation of 11.58; The Peak expiratory flow rate ranged from 43-94, with a mean value of 74.75 and standard deviation of 11.51.

The association between FEV1 levels and Serum Magnesium levels

In this study, majority of the study participants had serum magnesium levels < 1.5 mg/dl; on studying the association of FEV1 and Serum Magnesium levels, we observed statistically significant association with chi value 47.8 and p value 0.01; i.e., ($p< 0.05$).

Table 7: The association between FEV1 levels and Serum Magnesium levels

FEV1	Serum magnesium		Total	P value
	<1.5mg/dl	1.5-2.5mg/dl		
53	1	0	1	0.01
54	1	0	1	
55	1	0	1	
56	2	0	2	
57	1	0	1	
58	1	0	1	
59	2	0	2	
61	4	0	4	
62	1	0	1	
63	4	0	4	
64	3	0	3	
65	2	0	2	
66	1	0	1	
68	1	0	1	
69	3	0	3	
70	1	1	2	
71	2	2	4	
72	1	0	1	
73	5	2	7	

	74	2	1	3	
	75	3	2	5	
	76	1	0	1	
	77	1	1	2	
	79	4	2	6	
	80	0	2	2	
	81	1	4	5	
	82	0	1	1	
	83	1	0	1	
	84	0	1	1	
	87	0	1	1	
	88	0	3	3	
	89	0	1	1	
	90	1	0	1	
	91	0	2	2	
	93	0	1	1	
	94	0	1	1	
	96	0	1	1	
Total		51	29	80	

Association between FEV1/FVC levels and Serum Magnesium levels

In this study, majority of the study participants (51) had serum magnesium levels < 1.5 mg/dl; on studying the association of FEV1/FVC and Serum Magnesium levels, we observed statistically significant association with chi value 47.4 and p value 0.018; i.e., ($p< 0.05$)

Table 8 : To study the association between FEV1/FVC levels and Serum Magnesium levels

FEV1/FVC		Serum magnesium		Total	P value
		<1.5mg/dl	1.5-2.5 mg/dl		
	44	1	0	1	0.018
	52	1	0	1	
	53	3	0	3	
	54	3	0	3	
	56	2	0	2	

57	1	0	1	
59	5	0	5	
60	3	0	3	
61	2	1	3	
63	3	0	3	
64	2	2	4	
65	2	0	2	
68	4	0	4	
69	1	3	4	
70	3	0	3	
71	3	2	5	
72	0	1	1	
73	1	1	2	
74	2	2	4	
75	1	0	1	
76	0	1	1	
77	1	2	3	
78	1	0	1	
79	0	3	3	
80	1	0	1	
81	0	1	1	
82	0	1	1	
84	1	1	2	
85	1	0	1	
86	1	1	2	
87	0	1	1	
89	1	3	4	
91	0	1	1	
92	1	0	1	
93	0	1	1	
95	0	1	1	
Total	51	29	80	

Association between PEFR levels and Serum Magnesium levels

In this study, majority of the study participants had serum magnesium levels < 1.5 mg/dl; on studying the association of PEFR and Serum Magnesium levels, however, we observed no statistically significant association with chi value 38.1 and p value 0.185; i.e., ($p > 0.05$).

Table 9: To study the association between PEFR levels and Serum Magnesium levels

PEFR		Serum magnesium		Total	P value
		<1.5mg/dl	1.5-2.5 mg/dl		
	43	1	0	1	0.185
	51	1	0	1	
	54	1	2	3	
	56	1	0	1	
	59	3	0	3	
	60	1	0	1	
	61	2	0	2	
	62	2	0	2	
	63	1	0	1	
	64	3	0	3	
	65	1	1	2	
	67	1	0	1	
	69	2	0	2	
	70	3	0	3	
	71	3	0	3	
	73	5	3	8	
	74	2	1	3	
	75	1	0	1	
	76	0	1	1	
	78	2	0	2	
	79	4	2	6	
	80	1	0	1	
	81	3	4	7	
	82	1	1	2	

	83	1	1	2	
	84	1	1	2	
	86	0	1	1	
	87	0	2	2	
	88	0	1	1	
	89	1	3	4	
	90	1	0	1	
	91	2	1	3	
	93	0	3	3	
	94	0	1	1	
Total		51	29	80	

DISCUSSION

Age of the study participants

The age of the study participants aged from 22-76 yrs, with a mean of 48.32 yrs and standard deviation of 12.84. In this study, majority (38.8%) of study participants belonged to the age group of 31-45 year, followed by (26.3%) belonging to the age group of 46-60 year and (25%) belonging to the age group> 61 yrs. This finding is similar to the study conducted by Das Sk et al[7] where the age of the study participants ranged from 13 years to 71 years with mean age of 42.7 years. Asthma in this study is found to be more common in female and mostly affects the younger age group (<30 years) in both sexes.

Distribution of study participants according to Gender

In this study, majority of the study participants were male 62.5%, followed by female 37.5%. A.A.Ali et al[14] noted in their study as males constitute 80% of the patients and 75% of the control group. Das SK[7] noted among the study subjects 18 (36%) were males and 32 (64%) were females Malapatti et al[60] in their study observed among 25 Healthy cases 44% are Males whereas 56% are Females, & in patient category 48% were males & 52% were females.

Descriptive statistics of Serum Magnesium

The distribution of Sr Magnesium levels among study participants varied from 0.30 to 2.20mg/dl, with a mean value of 1.23 and standard deviation of 0.53. Distribution of study participants according serum Magnesium, considering the normal range of Sr.Mg 1.5- 2.5 mg/dl, < 1.5 were 63.7%; and 1.5- 2.5 were 36.3%. This finding is similar to the following studies: YuvarajanS et al[15] in their study showed about 35(87.5%) patients were found to have hypomagnesaemia and their serum magnesium value ranged between 0.70 and 1.4 mg/dl. Rest 5(12.5%) patients had normal serum magnesium level. Revyakina et al[61] observed among the study subjects observed the concentration of magnesium in blood serum of the examined children, it was found that in patients with bronchial asthma and obesity, a reduced content of this mineral was observed in 15 (65.2%) patients. The average magnesium concentration was 0.66±0.02 mmol/l at a rate of 0.7-1.2 mmol/l. Das et al[7] in their study noted 14 (28%) patients were found to have hypomagnesemia and their serum magnesium value ranged between 0.91 and 1.6 mg/dl. Rest 36 patients (72%) had normal serum magnesium level. Shaikh MN et al[50] in their study shows prevalence of hypomagnesemia in different grades of asthma, mild persistent: 1.86 ± 0.07 mg/dL (23.3%), moderate persistent: 1.70 ± 0.07 mg/dL (45%), and severe persistent: 1.53 ± 0.09 mg/dL (31.7%). This data shows that serum levels of magnesium decrease with the increase in disease severity. Their levels are highest in mild

form of asthma while lowest in severe persistent asthma. Malapatti et al[60] noted the levels of Serum Mean & SD of Magnesium concentration of patients was 131.5 ± 24.7 µg/L where as Healthy were 131.3 ± 19.3 µg/L.

Assessing the lung function test among the study participants

Spirometry was done among all the study participants to assess the lung function test. Parameters recorded included Force expiratory volume in first second (FEV1), which varied from 53-96, with a mean value of 73.06 and standard deviation of 10.43. The FEV1/FVC varied from 44-95, with a mean of 70.31 and standard deviation of 11.58; The Peak expiratory flow rate ranged from 43-94, with a mean value of 74.75 and standard deviation of 11.51. This finding is similar to the study conducted by Chakrabort A and Barman S[62] where the mean± standard deviation of FEV1 for asthmatics and non-asthmatics is 1.85± 0.50 liter and 2.92± 0.93 liter respectively. The difference is statistically significant (p<0>0.05). The mean± standard deviation of PEFR (Lit/sec) for asthmatics is 3.03± 0.81 and that for non-asthmatics 6.01± 2.16. The value is less in asthmatics and the difference is statistically significant (p<0>FVC, FEV1, FEV1%, PEFR were lower in asthmatics as compared to the controls. FEV1, FEV1% and PEFR were showing significant difference, whereas FVC did not show any significant difference between the two groups. These findings may show that asthma being a chronic inflammatory disease has ongoing tissue injury and repair which may result in irreversible fibrotic changes in the airways leading to decline in lung functions. FEV1, FEV1% and PEFR were significantly lower in the asthmatics than the non-asthmatics. However the FVC in asthmatics was lower but not significant.

Findings from our study is similar to the study conducted by Khaleel Nagarchi et al[63] where the results show that decrease of FVC and FEV1 values in all the age groups asthma patients and there is no much difference in FVC and FEV1 values in controls with different age groups. This results shows that asthma is causing the damage of fibrotic tissue of lung and causing the decrease lung function when age is increasing and it is causing the irreversible fibrotic tissue change resulting the decrease in lung functions.

The association between FEV1 levels and Sr Magnesium levels

In this study, majority of the study participants had sr magnesium levels < 1.5 mg/dl; on studying the association of FEV1 and Sr Magnesium levels, we observed statistically significant association with chi value 47.8 and p value 0.01; i.e., (p< 0.05) This finding is similar to the study conducted by YuvarajanS et al[15] where they found that there was a linear relationship between serum magnesium level and FEV1. As the FEV1 decreased, there was an associative decrease in serum magnesium levels.nA.A.Ali et al[14] noted FEV1 was significantly decreased in patients with exacerbation than in stable asthmatics, (pvalue< 0.001) and the mean of FEV1 in stable asthmatics was 61.68 ± 6.78 and in exacerbation was 40.18 ± 9.06.

The association between FEV1/FVC levels and Sr Magnesium levels

In this study, majority of the study participants (51) had sr magnesium levels < 1.5 mg/dl; on studying the association of FEV1 and Sr Magnesium levels, we observed statistically significant association with chi value 47.4 and p value 0.018; i.e., (p< 0.05).This finding is similar to the study conducted by A.A.Ali et al[14] where they showed that FEV1/FVC ratio was significantly decreased in patients with exacerbation than in stable asthmatics, (pvalue = 0.001) and the mean of FEV1/FVC ratio instable asthmatics was 56.80 ± 7.48 and in exacerbation was47.48 ± 9.58.

The association between PEFR levels and Sr Magnesium levels

In this study, majority of the study participants had sr magnesium levels < 1.5 mg/dl; on studying the association of PEFR and Sr Magnesium levels, however, we observed no statistically significant association with chi value 38.1 and p value 0.185; i.e., (p > 0.05). This finding is similar to the study conducted by Yuvarajan Set al[15] noted the mean (SD) serum magnesium concentration in asthmatic patients was significantly lower than that obtained in the control with p<0.001. Revyakina[5] showed statistically significant decrease in the magnesium level in children suffering from asthma and obesity was noted, compared with the level in children with obesity (0.66 [0.57; 0.73] vs 0.71 [0.67; 0.73] mmol/l, p<0.05). A.A.Ali et al[14]. in their study serum magnesium levels were

significantly decreased in asthmatic patients compared with the control ones, (pvalue< 0.001) and the mean of serum Mg levels in asthmatic patients was 1.55 ± 0.34 and in control 2.12 ±0.20 mg/dl.

Conclusion

The study concluded that serum magnesium levels were significantly low in patients with bronchial asthma. Serum magnesium had an linear association with lung functions as measured through spirometry (FEV1& FEV1/FVC) . Whereas PEFR had no significant association with serum magnesium in our study. Since the serum magnesium levels has an significant association with lung functions& severity of asthma , this can also be used as a biomarker in assessment of the disease. Correction of hypomagnesemia should be considered as a part of management in patients presenting with asthma .

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