MAGNESIUM STATUS IN HOSPITALIZED ICCU AND NON-ICCU PATIENTS WITH SPECIAL REFERENCE TO WATERBORNE MAGNESIUM

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ABSTRACT

Introduction: Low serum magnesium levels in hospitalized patients, including those with cardiovascular ailments, have been reported by many studies. On the other hand, magnesium therapy is advocated but has not yet been conclusively proved. In our earlier study, an association between waterborne magnesium and hypomagnesemia in healthy subjects was reported. The present study was aimed at the contribution of waterborne magnesium among filtered and non-filtered water users in hospitalized patient. **Methods:** Present study was carried out at SMIMER, Surat. Ethical committee approval was taken. On informed consent, subjects from ICCU and general ward of Medicine unit were selected. Demographic and clinical information was collected. Serum magnesium, cardiac profile, and renal profile were analyzed. Patients with conditions such as kidney, liver, brain, and other critical illness were excluded. The results were expressed as Mean and SD, and appropriate statistical tools were applied to arrive at conclusions. **Results:** Among total 557 subjects including 185 healthy subjects, 93 ICCU and 279 non-ICCU patients, the incidence of hypomagnesemia (serum Mg < 1.7 mg/dl) was 18%, 36%, and 42% was observed respectively. A significant difference (p < 0.01) in serum magnesium between filtered and non-filtered water users in healthy (1.77 ± 0.36 vs 2.01 ± 0.48), ICCU (1.35 ± 0.44 vs 1.72 ± 0.55), and in non-ICCU patients (1.51 ± 0.59 vs 1.77 ± 0.51) was found. No significant difference was observed in other parameters. **Conclusion:** Significant hypomagnesaemia was observed among users of filtered water as compared to nonfiltered water users in all groups (ICCU, non-ICCU and healthy), strongly suggestive of contribution of waterborne magnesium in maintaining normal status in the population and inadequate levels may be correlated to a higher incidence of myocardial infarction as evident from the present study wherein a 42% prevalence of hypomagnesaemia in ICCU patients was found.

Keywords: Magnesium; Waterborne magnesium; ICCU; Non-ICCU hospitalized patients; Cardiovascular diseases; Hypomagnesaemia; Filtered water.

INTRODUCTION

Magnesium is one of the four most common electrolytes in the human body, which is an essential co-factor in more than 300 enzymatic reactions. Magnesium plays a crucial role in the synthesis of compounds involving energy-rich bonds as well as their utilization either by transfer or hydrolysis of the energy-rich bond [1]. Magnesium plays a vital role in cellular energy metabolism, cell replication, and protein synthesis [2].

It is involved in many vital processes, such as cardiac excitability [3], transmembrane ion flux, and neurotransmitter release and gating of calcium ion channels[4]. In many respects, magnesium serves as a physiological antagonist to calcium [5]. The relationship between calcium and magnesium provides information regarding the importance of magnesium in critical care medicine [2]. Various studies have reported low serum and myocardial magnesium and abnormal magnesium tolerance tests in patients with acute myocardial infarction [6-10]. Magnesium therapy has been advocated [11] but the Fourth International Study of Infarct Survival (ISIS-4) mega-study failed to confirm the utility of magnesium therapy [12].

Magnesium deficiency is common among hospitalized patients (7-11%), and it has been found in 20-60% of intensive care unit (ICU) admitted patients [13]. In nearly half of various electrolyte abnormalities, hypomagnesaemia is found to be a comorbid condition [14], which indicates its essential role in ICU patients [2]. Large number of workers have reported regarding the association of several drugs with urinary magnesium wasting [15]. In many instances, the mechanism of action of drugs such as antimicrobial agents, chemotherapeutic agents, diuretics, beta-adrenergic agonists, and others is unclear [16].

Though magnesium deficiency is common in the various populations, many patients with magnesium deficiency and hypomagnesaemia remain asymptomatic. Signs and symptoms of magnesium deficiency are usually not seen until serum magnesium

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decreases to 0.5 mmol/L or lower. In a study from Mumbai, India, it was reported that hypomagnesaemia was associated with a high mortality rate in critically ill patients with high prevalence, and with a high rate of ventilator support [17].

In many clinical situations, the actual relevance of hypomagnesaemia can be challenging to evaluate; this is mainly in the frail elderly [18].

In our previous study, we have observed high prevalence (17%) of hypomagnesaemia in healthy subjects [19], consuming different types of drinking water, including filtered and non-filtered water sources.

Patients admitted to ICCU units are mostly critically ill with severe cardiac diseases. The present study was taken up by looking into the role of magnesium in cardiac diseases and prevalence of its acute deficiency particularly in the patients with critical illness and avenues available to maintain adequate levels of this element. Another pertinent point while carrying out this study was whether serum magnesium itself independently associated or only a marker or representative of comorbidity in critically ill patients admitted to ICCU units.

MATERIAL AND METHODOLOGY

Study design: An observational analytical study

Ethical approval: Institutional ethical committee approval was duly obtained. Inform consent was obtained from the participants.

Study location: Present study was carried out in the Biochemistry Department, SMIMER

Study duration: One year.

Sample size: The present study was carried out for the period of one year during which total 557 subjects were included in the study; comprising 185 healthy subjects, 93 subjects admitted to ICCU unit, and 279 subjects admitted to general ward (non-ICCU).

Inclusion criteria: Patients admitted to the ICCU unit, and general ward of Medicine department were selected for the study. Both ICCU and non-ICCU subjects were admitted for either or both diabetes and cardiovascular diseases. Based on acute clinical symptoms, patients were diagnosed for cardiovascular diseases and were admitted.

Exclusion criteria: Patients with other conditions such as kidney, liver, brain, and other critical illnesses and suffering from infective diseases were excluded from the study.

Methodology

On hospitalization, detailed information of these patients regarding demographic data, diet, dietary habits, family history, past, and present clinical history

was obtained as part of clinical procedures. Either on the same day or next day after hospitalization, fasting blood samples were collected in the morning for magnesium and other biochemical investigations. Healthy subjects were selected randomly from hospital, and college staff, and from society. Healthy subjects were without any present or past history of disorders.

After 15 hours of overnight fast after the last dinner, blood samples were collected by standard procedures for biochemical investigations: magnesium, cardiac profile, and renal profile. All biochemical investigations were estimated by using standardized methods (20-30) on ERBA XL autoanalyzer, Transasia Biomedical Pvt. Ltd. Mumbai within 4 to 6 hours of collection of samples. Internal and external quality checks were strictly followed for these investigations, and statistical data was well within required levels for SD and CV (Coefficient of variance).

Statistical analysis: Results are expressed as Mean and SD, and appropriate statistical tools are used, such as t test and correlations to arrive at conclusions.

RESULTS

A total of 557 subjects were assessed for magnesium status in three groups: 93 ICCU hospitalized patients, 279 were Non-ICCU hospitalized patients, and 185 were healthy subjects. Table 1 shows the distribution of these subjects as per their lifestyle, diet type, and type of water usage for drinking. Among healthy subjects, 32% and 68% of subjects were using filtered and non-filtered water respectively. Whereas among ICCU and non-ICCU subjects, 11 and 12% were filtered water users, and 89 and 88% were non-filtered water users. Both in healthy controls and hospitalized patients (ICCU and non ICCU), the number of urban subjects (>82%) were much more than rural subjects (<18%).

Table 2 presents the data regarding the levels of serum calcium and magnesium in all three groups. Hypomagnesaemia of 18%, 42%, and 36% was observed in healthy subjects, ICCU hospitalized patients, and Non-ICCU hospitalized patients, respectively.

As compared to healthy subjects, almost all biochemical parameters were found to be significantly altered in ICCU patients with significant hypomagnesaemia (p-value < 0.05) (Table 3). A significant difference (p = 0.00) in the serum magnesium levels was observed in hospitalized patients of both ICCU (1.68 ± 0.55) and non-ICCU (1.73 ± 0.53) separately and also in both together (1.72 ± 0.53) compared to healthy subjects (1.93 ± 0.46). Similarly, serum calcium, HDL cholesterol levels were significantly lower among hospitalized subjects in both ICCU and non-ICCU compared to healthy subjects. Whereas plasma glucose, serum creatinine, cholesterol, triglycerides, CPK, and CK-MB levels were significantly higher among ICCU

Table 1. Demographic data of study groups

Description	Healthy Subjects n (%)	ICCU patients n (%)	NON-ICCU patients n (%)
Subjects (n)	185	93	279
Males	94 (51%)	58 (62%)	133 48%)
Females	91 (49%)	35 (38%)	146 (52%)
Vegetarians	113 (61%)	53 (57%)	161 (58%)
Non-vegetarians	72 (39%)	40 (43%)	118 (42%)
Smoking	29 (16%)	41 (44%)	82 (29%)
Alcohol	23 (12%)	17 (18%)	43 (15%)
Filtered water users	60 (32%)	10 (11%)	35 (12%)
Non-filtered water users	125 (68%)	83 (89%)	244 (88%)
Rural	33 (18%)	5 (5%)	20 (7%)
Urban	152 (82%)	88 (95%)	259 (93%)
Age (Years)	38 ± 17	54 ± 16	51 ± 13
BMI (kg/m^2)	23.57 ± 4.68	25.82 ± 4.35	25.61 ± 4.80

Table 2. Magnesium, calcium status in healthy subjects, ICCU and Non-ICCU patients

Description	Healthy Subjects (185)	ICCU patients (93)	NON-ICCU (279)	All ICCU + Non-ICCU (372)
Calcium (mg/dl)	9.45 ± 1.18	8.73± 1.01	8.92 ± 0.92	8.77 ± 0.94
Magnesium (mg/dl)	1.93 ± 0.46	1.68 ± 0.55	1.73 ± 0.53	1.72 ± 0.53
Hypomagnesaemia n (%)	33 (18%)	39 (42%)	101 (36.1%)	(139)37.4%

and non-ICCU hospitalized subjects compared to healthy subjects.

Table 4 presents the comparison of other biochemical parameters, including magnesium between filtered water users and non-filtered water users in healthy subjects. No significant difference in serum calcium and other biochemical parameters was observed between filtered and nonfiltered water users. Table 5 shows the comparison of biochemical parameters, including magnesium between filtered water users and non-filtered water users in ICCU subjects. No significant difference was observed between filtered and nonfiltered water users.

Table 6 shows the comparison of biochemical parameters, including magnesium between filtered water users and non-filtered water users in Non-ICCU hospitalized patients. Similar to healthy and ICCU subjects in non-ICCU subjects also no significant difference was observed in various biochemical parameters between filtered and nonfiltered water users.

One common observation was that, in all these groups, serum magnesium levels were significantly low among filtered water users as compared to non-filtered water users (p-value < 0.05). Serum calcium ranged from 6.2 to 14.0 mg/dl, 6.0 to 11.80 mg/dl and 6.50 to 12.50 mg dl in healthy subjects, ICCU subjects, and non-ICCU subjects, respectively. Whereas serum magnesium ranged from 0.46 to 3.00 mg/dl, 0.20 to3.00 mg/dl, and 0.20 to 3.60 mg/dl in healthy, ICCU and non-ICCU subjects respectively. Among all these groups, no significant difference was found between lipid and renal profile markers between filtered and non-filtered water users.

Table 7 shows the incidence of hypomagnesaemia among filtered and non-filtered water users in study groups: healthy subjects, ICCU, and non-ICCU subjects. Incidence of hypomagnesaemia was predominantly and significantly (p = 0.040, p = 0.001) high among filtered water users across the groups and ranged from 27% in healthy subjects to almost 90% in ICCU patients, on the other hand, the incidence of normomagnesemia was prevalent among non-filtered water users.

DISCUSSION

Magnesium is an alkaline metal, available to humans by two major sources, water, and food. Magnesium is mainly intracellular with almost half of the stored magnesium is found in muscles and soft tissues. It is

Table 3. Laboratory values of biochemical parameters in ICCU patients

Description	A	B	p value	C	p value
	Healthy Subjects (185)	ICCU patients (93)	(A&B)	ICCU+Non-ICCU	(A & C)
FBS (mg/dl)	89.50 ± 18.56	130.45 ± 88.98	0.00	143.22 ± 88.04	0.00
RBS (mg/dl)	94.48 ± 19.49	166.44 ± 102.12	0.00	163.30 ± 95.11	0.00
Creatinine (mg/dl)	0.76 ± 0.18	1.18 ± 0.72	0.00	0.93 ± 0.54	0.00
Cholesterol Total (mg/dl)	171.26 ± 35.23	152.41 ± 47.54	0.00	169.73 ± 44.94	0.75
Triglycerides (mg/dl)	126.11 ± 66.77	139.02 ± 69.73	0.14	148.84 ± 68.80	0.00
HDL Cholesterol (mg/dl)	44.48 ± 11.55	33.82 ± 10.87	0.00	37.23 ± 10.53	0.00
LDL Cholesterol (mg/dl)	101.36 ± 30.03	91.38 ± 41.76	0.02	102.72 ± 40.90	0.74
Protein Total (g/dl)	7.41 ± 0.64	6.46 ± 0.85	0.00	7.13 ± 0.84	0.00
Albumin (g/dl)	4.54 ± 0.60	3.75 ± 0.57	0.00	4.10 ± 0.56	0.00
CPK Total (U/L)	101.76 ± 46.26	226.86 ± 436.22	0.00	131.88 ± 234.44	0.95
CK-MB (U/L)	34.25 ± 19.69	81.46 ± 158.86	0.05	89.25 ± 266.12	0.47
Calcium (mg/dl)	9.45 ± 1.14	8.73 ± 1.01	0.00	8.87 ± 0.94	0.00
Magnesium (mg/dl)	1.93 ± 0.46	1.68 ± 0.55	0.00	1.72 ± 0.53	0.00
Systolic P (mmhg)	124.45 ± 7.80	129.29 ± 22.92	0.01	128 ± 16	0.08
Diastolic P (mmhg)	81.38 ± 5.43	83.89 ± 9.44	0.01	83 ± 8	0.05
BMI (kg/m^2)	23.53 ± 4.69	25.82 ± 4.35	0.00	25.66 ± 4.69	0.00

Table 4. Biochemical parameters in filtered and non-filtered water users among healthy subjects

Parameter	Filtered water users	Non-filtered water users	p-value
Number	60	125	
RBS (mg/dl)	89.63 ± 13.49	95.35 ± 22.75	0.07
Creatinine (mg/dl)	0.75 ± 0.22	0.77 ± 0.17	0.49
Cholesterol Total (mg/dl)	172.48 ± 38.87	170.68 ± 33.49	0.74
Triglycerides (mg/dl)	121.96 ± 62.79	128.10 ± 68.75	0.56
HDL Cholesterol (mg/dl)	45.14 ± 11.19	44.16 ± 11.75	0.59
LDL Cholesterol (mg/dl)	102.80 ± 33.59	100.66 ± 28.29	0.87
Calcium (mg/dl)	9.45 ± 1.18	9.45 ± 1.12	1.0
Magnesium (mg/dl)	1.77 ± 0.36	2.01 ± 0.48	< 0.01
Systolic P (mmhg)	125.20 ± 7.21	122.90 ± 8.77	0.08
Diastolic P (mmhg)	81.79 ± 4.60	80.53 ± 6.82	0.19
BMI (kg/m^2)	23.85 ± 4.78	22.98 ± 4.45	0.22

mainly excreted through urine with the minor amount by sweat and intestinal secretion. Magnesium is the most precious element in view of cardiac health.

Various clinical studies reported regarding the prevalence of hypomagnesaemia in hospitalized patients, including those admitted in intensive care units. Prevalence varied from 7 to 52% as per various reports [20-24]. Whereas some workers reported an incidence of hypomagnesaemia in hospitalized patients up to 12% and as higher as up to 60% in patients in the intensive care unit [23, 25]. Nornoha and Matuscheake (2002) observed variation in the incidence of hypomagnesaemia from 20 to 65% in hospitalized

Table 5. Biochemical parameters in filtered and non-filtered water users among ICCU patients

Parameter	Filtered water users	Non-filtered water users	p-value
Number	10	83	
RBS (mg/dl)	146.30 ± 31.62	168.88 ± 107.40	0.15
Creatinine (mg/dl)	0.99 ± 0.28	1.21 ± 0.75	0.09
Cholesterol Total (mg/dl)	145.00 ± 45.71	153.30 ± 47.95	0.60
Triglycerides (mg/dl)	138.06 ± 76.57	139.14 ± 69.37	0.97
HDL Cholesterol (mg/dl)	34.41 ± 13.64	33.75 ± 10.59	0.89
LDL Cholesterol (mg/dl)	82.94 ± 33.36	92.39 ± 42.72	0.43
CPK Total (U/L)	178.40 ± 95.46	232.70 ± 460.62	0.36
Calcium (mg/dl)	8.66 ± 0.89	8.74 ± 1.02	0.81
Magnesium (mg/dl)	1.35 ± 0.44	1.72 ± 0.55	<0.05
Systolic P (mmhg)	139.40 ± 25.25	128.07 ± 22.49	0.20
Diastolic P (mmhg)	86.20 ± 12.45	83.61 ± 9.07	0.54
BMI (kg/m^2)	25.70 ± 3.88	25.83 ± 4.42	0.92

Table 6. Biochemical parameters in filtered and non-filtered water users among NON-ICCU patients

Parameter	Filtered water users	Non-filtered water users	p-value
Number	36	243	
RBS (mg/dl)	146.30 ± 31.62	168.88 ± 107.40	0.15
Creatinine (mg/dl)	0.77± 0.22	0.86± 0.46	0.25
Cholesterol Total (mg/dl)	184.25± 35.19	174.21± 43.49	0.19
Triglycerides (mg/dl)	158.81± 72.20	151.13± 67.81	0.53
HDL Cholesterol (mg/dl)	40.68± 12.17	38.03± 09.84	0.14
LDL Cholesterol (mg/dl)	113.53± 30.78	105.46± 41.10	0.26
CPK Total (U/L)	97.36± 41.74	100.65± 83.91	0.82
Calcium (mg/dl)	8.84± 0.87	8.94± 0.93	0.58
Magnesium (mg/dl)	1.51 ± 0.59	1.77 ± 0.51	<0.05
Systolic P (mmhg)	131.17± 15.20	127.67 ± 13.03	0.14
Diastolic P (mmhg)	84.39± 11.36	83.13± 6.18	0.32
BMI (kg/m^2)	26.37± 3.95	25.50± 4.91	0.31

critically ill patients [2]. Rubeiz et al. (1983) reported that hypomagnesaemia in intensive care patients was associated with increased mortality [26]. The present study comprised of 557 individuals, of which 185 were healthy controls devoid of any disorders and 93 patients afflicted with various types disorders (diabetes and cardiovascular diseases) admitted to ICCU unit and 279 non-ICCU but hospitalized patients.

In ICCU patients, there were 39 subjects who had hypomagnesaemia (42%) with serum magnesium level of 1.16 ± 0.37 mg/dl compared to the level of 2.05 ± 0.31mg/dl in the normomagnesaemic subjects. Prevalence of hypomagnesaemia was higher than the prevalence reported by some workers [2, 25, 27] Limaye et al. [17] observed hypomagnesaemia in 51% of patients admitted to MICU in the tertiary care hospital in the city of Mumbai. In the present study, an

Table 7. Incidence of hypo- and normo-magnesaemia among filtered and non-filtered water users across the groups of healthy, ICCU, and Non-ICCU subjects

Group/ Subgroup	Filtered water users % (n)	Non-filtered water users % (n)	P value
Healthy Subjects (n=185)			
Hypomagnesaemia	27% (16)	14% (17)	0.040
Normomagnesemia	73% (44)	86% (107)	
ICCU subjects (n=93)			
Hypomagnesaemia	90% (9)	36% (30)	0.001
Normomagnesemia	10% (1)	64% (53)	
Non-ICCU subjects (n=279)			
Hypomagnesaemia	60% (21)	32% (79)	0.001
Normomagnesemia	40% (14)	68% (164)	

incidence of 42% of hypomagnesaemia was observed, though slightly lower than that of reported value by Limaye et al. [17] from Mumbai but comparable to the studies reported from elsewhere. On follow up of discharged patients, we have found that six patients out of 93 from ICCU unit expired within a month after discharge from ICCU unit. Thus, a mortality rate of 6.5% was recorded.

Hypomagnesaemia in ICU patients was reported to be associated with an increased rate of mortality [26]. A two-fold increase in the mortality rate was reported in ICU patients with hypomagnesaemia compared to normomagnesaemia. Chernow et al [25] observed 41% mortality in hypomagnesaemic subjects compared to only 13% of mortality rate in normomagnesaemics subjects. Rubeiz et al [26] reported 46% mortality rate in hypomagnesaemic subjects whereas this rate was 25% in normomagnesaemic subjects. Safavi et al (2007) [28] found 55% incidence of mortality in hypomagnesaemic subjects and 35% in normomagnesaemic subjects. Limaye et al [17] had observed 51% of mortality rate in hypomagnesaemic subjects compared to 31% in normomagnesaemic subjects. Guerin et al [29] had found no difference in the mortality rate between the hypomagnesaemic and normomagnesaemic subjects who were admitted in the ICU ward. The mortality rate was 18 and 17 percent in hypo and normomagnesaemics respectively. In the present study, six patients died out of the total admitted patients to the intensive cardiac care unit, and among them three had hypomagnesaemia ranging from 0.8 to 1.6 mg/dl, two patients had serum magnesium levels between 1.7 to 1.8 mg/dl, and only one patient had magnesium level above 2.0 mg/dl. The overall mortality rate of ICCU patients after discharge was 6.5 %, when we look at individual patients 50% of these deceased patients had magnesium in the range of 0.6 to 1.6 mg/dl, a clear condition of hypomagnesaemia whereas two deceased patients had magnesium at the lower strata of normal range (1.7 to

1.8 mg/dl), as the cut off level for normomagnesaemia is 1.7 mg/dl.

Only one of six diseased patients had above 2.0 mg/dl, considered to be having adequate magnesium levels. The results of the present study are in correlation with the findings reported by Limaye et al. [17] from Mumbai, the western part of India like our region. The results of both the studies from India are in a comparable range to the mortality rate reported from other parts of the world. Higher mortality rate observed in the case of hypomagnesaemia may be due to accompanied hypokalemia and cardiac arrhythmia or may be due to septic shock, which is a common cause of deaths in ICCU patients. One more point to be considered here is that in our study we have included subjects with only cardiovascular and diabetes, whereas various other studies included patients with other critical illnesses like infective conditions and cancers etc. in addition to cardiovascular diseases.

Dabbagh et al. [30] concluded from his study that daily magnesium supplementation index higher than 1 gm/day is associated with lower mortality rates in critically ill patients. This effect was not found to be independent and may be related to the severity of illness. If supplementation helps in the decrease of mortality rate among critically ill patients, it can further be explored by incorporating changes in lifestyle, and one such change can be the use of clean water by using appropriate water filters which maintain the original electrolytes present in the water to have better magnesium status.

Further, we divided these study groups according to the type of water used for drinking and daily usage like cooking of food. These groups were divided into filtered water users and non-filtered water users. Filtered water users were utilizing various types of water filters to get clean water or to get soft water from hard ground water. The incidence of hypomagnesaemia was significantly high among filtered water users

compared to non-filtered water users as 27% v/s 14%, 90% v/s 36%, and 60% v/s 32% in healthy, ICCU and non-ICCU subjects respectively (Table 7). We observed significantly low serum magnesium levels in filtered water users as compared to non-filtered water users among all the groups viz: healthy subjects, ICCU patients and NON-ICCU hospitalized patients (p-value <0.05) (Table 4, 5 & 6). But no significant difference in hypomagnesaemia was observed between ICCU and NON-ICCU hospitalized patients. These observations indicate that there is an association between serum magnesium status and nutritional quality of drinking water used by the study subjects in terms of magnesium content.

Approximately 20 years ago, based on the available epidemiologic findings, the incidence of ischemic heart disease was highest among subjects from geographic regions of soft drinking water [31]. Of the minerals that are deficient in soft water, magnesium is the only element that is consistently lower in cardiac muscles of IHD victims [21, 32]. Durlach [33] suggested that magnesium has a pre-eminent role amongst the numerous variables involved in the universe with the correlation between cardiovascular morbidity and mortality and the hardness of drinking water. Anderson [34,35] examined the incidence of acute and non-acute IHD in hard and soft water areas. Some workers [36] observed an association between water hardness and cardiovascular disease mortality, but these findings are questionable and need further research. Interesting observations were obtained when a study of finding water hardness and the levels of calcium and magnesium in these water samples from various sources and treatments was carried out. 60 to 80% fall in total hardness and calcium, magnesium concentrations in water samples after filtration by various types of filters used by households to get purified water both in rural and urban areas of Surat was observed. Thus, rural ground water (unfiltered) and municipal piped water, which is prepared as per standards, becomes soft after the process of household filtration. In the case of bottled mineral water, the mineral content for calcium and magnesium was very negligible and almost nil, which is also used by the population for drinking and cooking purposes [19].

Body receives magnesium through food and water, but waterborne magnesium has great impact as a source of magnesium. First, the most significant factor is its bioavailability, almost 30% higher than food magnesium [37]. Water borne magnesium is directly available to the cells and tissues without any natural inhibitors for its absorption, unlike food magnesium. In our previous study, it was postulated that if sufficient supply of water borne magnesium is ensured that can fulfill the RDA for magnesium, less dependence will be on food borne magnesium. In such a scenario, even if less availability of food borne

magnesium due to processing and cooking, water borne can take care of maintaining adequate body magnesium levels [19]. In a study by Leurs et al. [48] in the subgroup of men with a low dietary magnesium intake, a significant inverse association was found between tap water magnesium level and stroke mortality. This inverse association was not significant for IHD mortality. This observation supports our hypothesis of the role of waterborne magnesium in the status of hospitalized ICCU patients. Of course, large sample size is required to get a definitive conclusion regarding mortality and body magnesium status and status of waterborne and dietary magnesium

CONCLUSION

Forty two percentage prevalence of hypomagnesaemia was observed among ICCU patients. It supports the earlier findings that hypomagnesaemia in ICCU patients may be a significant comorbid factor, hence the necessity of supplementation of magnesium to maintain magnesium balance for better clinical outcomes in ICCU patients. The high mortality rate was observed in hypomagnesaemic patients compared to normomagnesaemic patients based on outcome of mortality findings, though our data was not very large to come to definitive conclusions.

Significant hypomagnesaemia was observed among filtered water users in all the categories of subjects, strongly suggestive of the role of waterborne magnesium in maintaining magnesium status of the population. It implies the necessity of applying caution in selecting an appropriate filter for the collection of water for drinking and household purposes.

The present study also suggests that it is necessary to make mandatory to include the analysis of serum magnesium in all the hospitalized patients and particularly in the patients admitted in critical care units and dialysis units etc.

Conflict of Interest: Declared none

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