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Hypomagnesemia In Pregnant And Non-Pregnant Women Of Fluoride Rich Groundwater Area Of Gujarat State, India.

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ABSTRACT

Magnesium is fourth most abundant element in the human body and its deficiency can result in a variety of metabolic abnormalities and clinical consequences. Fluoride binds with high affinity to magnesium and form insoluble complex, this may affect intestinal absorption of magnesium. Some study documented hypomagnesemia in pregnancy and pointed out that nutritional deficiency of magnesium may be the cause of hypomagnesemia. In the present study, we aimed to determine the incidence of hypomagnesaemia among hospitalized pregnant and non-pregnant women and find out any association of groundwater fluoride level with incidence of hypomagnesemia. Incidence of hypomagnesemia in pregnant women was also compared between similar studies conducted at Faridabad of Haryana state and Delhi capital of India. Data of Chemical analysis of ground water for fluoride. All results of hypomagnesemia documented in present study compared with similar studies done previously and also compared the results of hypomagnesemia with Groundwater fluoride levels in the previous and current study regions of Gujarat, Haryana and Delhi state of India. A) Incidence of Hypomagnesemia in the present study conducted at Dahod of Gujarat state was 36.19 % in the Hospitalised pregnant women and 33.33% in the hospitalised non-pregnant women and mean ground water fluoride level was 2.03±1.575 mg/dl. B) Incidence of hypomagnesemia in the previous study conducted at Faridabad of Haryana state was 43.16 % and mean ground water fluoride level was 1.54±0.812 mg/dl. C) Incidence of hypomagnesemia in the previous study conducted at Delhi was 4.6% and mean ground water fluoride level was 0.94±0.39 mg/dl. Permissible level of fluoride in drinking water in India is 1mg/dl. In the present study of incidence of hypomagnesemia no significance difference was detected in pregnant and non-pregnant women, this means hypomagnesemia is a general issue and not related only with pregnancy. Study conducted at Faridabad, Fluoride content of groundwater was above the permissible level for drinking (> 1 mg/dl) and incidence of hypomagnesemia were high (36.19 % & 43.16 % respectively). In the study conducted at Delhi, Fluoride content of groundwater was in the permissible level for drinking (< 1 mg/dl) and incidence of hypomagnesemia was only 4.6%. Drinking of Fluoride contaminated water or imbalance of other minerals like nitrate and sulphate of drinking may be the cause Hypomagnesemia.

Keywords: Magnesium, pregnant women, fluoride.

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INTRODUCTION

Among all minerals, Magnesium is the fourth most abundant cation in the body after calcium, sodium, potassium. Magnesium is the second most prevalent intracellular cation after potassium. It is required for the activity of more than 600 enzymes related to the energy metabolism and cell cycle. As magnesium is actively involve is cellular functions like membrane stabilisation and ion transport, its deficiency can result in a variety of metabolic abnormalities and clinical consequences like refractory plasma electrolyte abnormalities and cardiac arrhythmias.

In many observational studies, it was documented that magnesium deficiency may cause loss of appetite, nausea, vomiting, dyslipidaemia, insulin resistance hypertension personality changes and death from heart failure and colorectal cancer. Hypomagnesemia is seen in 2% of general population and 10–24% in hospitalized patients [1, 2]. Hypomagnesemia is 50 - 60 % in patients admitted to intensive care units [3, 4].

This study aimed to determine the incidence of hypomagnesemia among pregnant women admitted in obstetric ward with labour pain and hospitalized women patients in General medicine ward of the tertiary care hospital. All results of present study compare with similar studies done previously [7,8] and also compared the results of hypomagnesemia with Groundwater fluoride levels in the previous and current study regions of Gujarat, Haryana and Delhi state of India [10,14,15].

METHODS

A prospective cohort study conducted during the month of 1 January 2022 to 20 Nov 2023 at tertiary Hospital Dahod, Gujarat state, India. This study involving hospitalized adult non pregnant women under the care of the general internal medicine units and pregnant females with labour pain under the care of obstetric units. Women who required magnesium sulfate during parturition process as therapy were excluded from our study.

After obtaining an informed consent from the enrolled patients and under strict aseptic precaution about 2 ml of venous blood was collected under all aseptic precautions in a plain bulb. For Serum Magnesium level estimation Colorimetric Assay Kit of the Xylidyl Blue Method was used [5].

Serum magnesium levels were performed on Erba 360 Fully Automated Biochemistry Analyzer (Transasia Biomedical Ltd, India).and Vitros 5600 integrated system.

Fluoride level of ground water of Dahod district and Faridabad district taken from data published by central ground water board, government of India.

RESULTS

The normal range for blood magnesium level is 1.7 to 2.2 mg/dL. There is no significant sex and age differences in reference range [6]**.** The present study done on 131 pregnant women admitted in obstetric ward and 231 non pregnant women admitted general medicine ward. About 36.19 % of the pregnant women and 33.33 % of non-pregnant women had hypomagnesemia. The mean serum magnesium level of the pregnant women was 2.4 ± 1.330 mg/dl and non-pregnant women were 1.89 ± 0.407 mg/dl (Table 1-5).

Table 1: Distribution of pregnant women according to serum magnesium levels

Serum magnesium (mg/dl)*	n (%)	Mean ±s.d. (mg/dl)
<1.70	47 (36.19%)	1.51±0.247
1.70-3.60	79 (60.31%)	2.32±0.523
>3.62	05 (3.50%)	3.74±0.142

* Hypomagnesemia: <1.70 mg/dl, Hypermagnesemia: >3.62 mg/dl

Hypomagnesemia is detected in Significant number of pregnant women (36.19%) in present study Conducted at Dahod.

Table 2: Distribution of non-pregnant women without according to serum magnesium levels

Serum magnesium (mg/dl)	n (%)	Mean ±SD (mg/dl)
<1.70	77 (33.33%)	1.51±0.211
1.70-3.60	153 (66.23%)	2.09±0.308
>3.62	01 (0.43%)	3.68±0.000

Hypomagnesemia is also detected in significant number of Non-pregnant Women (33.33%) in present study conducted at Dahod.

Table 3: Significance of Serum Mg levels in pregnant and non-pregnant women.

Serum Magnesium level	Women with pregnancy (n)	Women without pregnancy(n)	P value
Mg/dl	1.51±0.242 (62)	1.51±0.211(76)	0.970

In serum magnesium level measurement, there is no significant difference between pregnancy and non-pregnancy ($p>0.05$). this means that Hypomagnesemia is not related only to pregnancy but related with General population.

Table 4: Significancy of serum Mg levels in pregnant women of Dahod and Faridabad.

Serum mg level	Faridabad, Haryana (n)	Dahod, Gujarat(n)	P value
Mg/dl	1.89±0.54 (113)	1.51±0.247 (62)	<0.001

Significant difference was found in magnesium level of pregnant women between Dahod (Gujarat) and Faridabad (Haryana).

Table 5: Significancy of ground water Fluoride levels at three different study (one current and two past) regions by ANOVA Test. Fluoride level of ground water above 1 mg /dl is not suitable for drinking.

Region	Mean ±SD (mg/dl)	P-Value
Dahod (Gujarat)	2.03±1.575	0.008
Faridabad (Haryana)	1.54±0.812	
Delhi	0.94±0.398	

Significance difference is observed in the mean fluoride level of ground water between Dahod region and Delhi region ($P<0.05$) as well as between Faridabad and Delhi ($P<0.05$) but by Post-hoc Tukey HSD test there is no significance difference between fluoride levels of ground water of Dahod and Faridabad ($p>0.05$).

DISCUSSION

The present study documented 36% pregnant women had deficiency of magnesium. As specific reference with two previous hospital-based studies, one conducted on pregnant women from urban slum communities in Delhi, documented 4.6% of Hypomagnesemia [7]. While other study conducted on pregnant women in a rural community Faridabad, Haryana State of India, documented 43.6 % of hypomagnesemia [8]. Both study pointed out that nutritional deficiency of magnesium may be the cause of hypomagnesemia. Our present study documented 36.19% hypomagnesemia in pregnant Women and 33.33% hypomagnesemia in non-pregnant Women in a rural area of Gujarat and pointing out that incidence of hypomagnesemia is high in both pregnant and non-pregnant women. This means hypomagnesemia is a general issue and not related only with pregnancy.

The desirable limit of Fluoride in water, as per Bureau of Indian Standards (BIS), is 1ppm (parts per million) or 1 mg/L [9]. In India, Fluorosis has been reported to occur even at 1.5 mg /L Fluoride, therefore the BIS standard 1.0 mg /L is the upper limit.

Published Data of chemical analysis of ground water of Dahod district and Faridabad district from central ground water board, government of India, show that there is significantly high level of Fluoride present in the ground water Dahod (2.03±1.575 mg/dl) and Faridabad District (1.54±0.812) while low level of fluoride is detected in groundwater of Delhi (0.94±0.398) [10] as well as one study titled as "Water quality in urban slum- study in Delhi," done by FORCE as a part of water AID India supported by Swatch Dilli swasth Dilli project, documented that Fluoride content of 77.14% of Ground water sample of Delhi slum area contain less than 1 mg/dl of Fluoride. This study pointing out that there is more hypomagnesemia risk due to dinking of fluoride rich contaminated water in Dahod and Faridabad District while less in delhi slum communities.

Table 6: Distribution of percentage of Hypomagnesemia according to location of study conducted and risk of fluoride contaminated drinking water.

Sr. No	Study		Location of study conducted and Institution name.	% of Hypomagnesemia Documented	Probability of drinking of Fluoride contaminated water. (based on chemical analysis data)
01	Kapil et. al. [7]		Urban slum communities, Delhi Under All India Institute of Medical Sciences, Delhi, India.	04.60%	Very Low
02	Pathak et.al [8]		Village community of Faridabad, Haryana state, India Under All India Institute of Medical Sciences, Delhi, India	43.60%	High
03	Present study	Pregnant women	Village community of Dahod, Gujarat state around tertiary care hospital, Zydus Medical College and Hospital Dahod, Gujarat, India	36.19%	High
		Non pregnant women	Village community of Dahod, Gujarat state around tertiary care hospital, Zydus Medical College and Hospital Dahod, Gujarat, India	33.33%	High

Fluoride present in drinking water form insoluble, intestinal non-absorbable complex of magnesium and fluoride [10-13], Which may be the cause of hypomagnesemia.

Ground water of both Dahod (Gujarat) and (Faridabad (Haryana) is heavily contaminated with Fluoride and Imbalance of other minerals are also noticed [14-15]. This High Ground water Fluoride level related well with high incidence of hypomagnesemia 43.6%in study conducted at Faridabad and 36.19% in pregnant women and 33.33.% in nonpregnant women in Study conducted at Dahod. Significant difference was found in magnesium level of pregnant women between Dahod (Gujarat) and Faridabad (Haryana) this may be due to there is difference in ground water fluoride level between Dahod (2.03±1.575 mg/dl) and Faridabad (1.54±0.812 mg/dl).

About 77.14 % of Ground water samples of slum area of Delhi contain Fluoride less than 1 mg/dl and surface water of lakes contain 0.94±0.398 mg/dl of mean fluoride. This normal fluoride corelated with low incidence of hypomagnesemia (4.6%) in pregnancy.

Magnesium deficiency during pregnancy affects placental morphology, fetal development and subsequent outcomes in the offspring.[16]. Maternal under nutrition can adversely affect nutrient transport across the placenta [17-19], that may result in foetal growth restriction and contribution to the programming of disease in later life [20, 21]. Our present study shows, Drinking of fluoride contaminated groundwater is very important risk factor of hypomagnesemia.

CONCLUSION

The incidence of hypomagnesemia is may be higher in the present study possibly due to the drinking of fluoride contaminated water(>1 mg/L) or the imbalance of other minerals like nitrate, sulphate in Ground water above or below the permissible limit for drinking, which affects the intestinal absorption of magnesium.

Due to variation in geological composition of minerals from region to region, there is big difference in content of minerals in ground water. Data analysis of chemical composition of ground water published by government of India [14,15], and region wise setting of RDA for magnesium may be the one solution to handle hypomagnesemia. But permanent solution will be the establishment of Community Reverse Osmosis (RO) water purification plant and permanent removal the dependency of groundwater for drinking in rural and tribal area of India.

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