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Evaluation of nutritional status of epileptic and non-epileptic patients of Tirupati region

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Abstract
Epilepsy is a chronic neurological disorder affecting both sexes and all ages, with worldwide distribution. Nutrition plays a major role in maintaining positive health in epilepsy. The main objective of the study was to assess the nutritional status of epileptic and non-epileptics subjects of different age groups and sex. Epileptic and non-epileptic patients with an age range of 3 to ≤80 years, below poverty line category were included in the study. This study shows that the diet of all patients with epilepsy was deficient in total calories and calcium. The protein and fat intake (g/day) in both males and females of epileptic group was found to be lower in comparison to the respective levels in non-epileptic group.

Keywords: Epileptic patients, nutrients, non-epileptic patients, nutritional status and epilepsy.

1. Introduction
Epilepsy is a chronic neurological condition in which patients experience recurrent seizures (Rajpura *et al*., 2004 and DeLorenzo *et al*., 2005) [12, 1]. It is characterized by sudden, recurrent excessive electrical neuronal stimulation in the brain, leading to seizures. Epilepsy is one of the most common neurological disorders. India is home to about 10 million people with epilepsy (Sridharan *et al*., 1999) [13]. This being higher in the rural (1.9%) as compared with the urban counterpart (0.6%) (Leonardi *et al*., 2002; Pahl *et al*., 2005 and Gourie-Devi *et al*., 2004) [9, 10, 5]. The burden of epilepsy as estimated using the disability-adjusted life years (DALYs) accounts for 1% of the total burden of disease in the world, excluding that due to social stigma and isolation, that people with epilepsy (PWE) in India face (Jain *et al*., 1998) [8]. This in turn leads to escalation of the disease burden. Epilepsy is not benign, especially if not treated. Injury and death can result from poorly treated or untreated epilepsy.
The main objective of the study was to assess nutritional status of epileptic and non-epileptic individuals of different age groups and sex.

2. Materials and methods
2.1 Selection of subjects – Inclusion and exclusion criteria
Epileptic subjects (n= 459) with an age range of 3 to ≤80 years of both sexes (Males –270 and Females –189), below poverty line category, regularly attending epilepsy clinic of the Super Specialty Hospital Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, patients on anti-epileptic drugs treatment and physically active were included in the study. Patients with comorbid illness such as gastrointestinal illness and chronic liver and kidney diseases were not included in the study. Remaining subjects were (n=243; males –106 and females –137) non-epileptics also belonged to below poverty line category and who were attending other outpatient clinics other than epilepsy were included in the study to compare their general health conditions with epilepsy patients.

2.2 Collection of data on nutritional profile from subjects
The data was collected using personal interview schedule in order to collect information regarding dietary history using 24 hour dietary recall method for 7 days. The information was recorded and kept safe for future reference. The medical information relating to epileptic and non-epileptic patients was collected from Medical records of SVIMS.

2.3 Results and discussion

The total energy, protein, fat, calcium, phosphorous, and phytate intakes were calculated using a published food composition table, detailing the nutritive value of Indian foods (Gopalan *et al.*, 2000) [4]. Mean, standard error and 95% confidence interval in the intake of energy and nutrients of epileptic and non-epileptic groups, irrespective of gender, along with P values are presented in Table 1.

Table 1: Mean Nutrient Intakes of Respondents

Nutrient Intakes (Per Day)	Epileptic Group	Non-Epileptic Group
	(N=459)	(N=243)
Energy (Kcal)	1673 ± 17.67	1880 ± 20.05**
	(1638, 1708)	(1840, 1919)
Protein (g)	18 ± 0.12	20 ± 0.16**
	(17, 18)	(19, 20)
Fat (g)	28 ± 0.30	31 ± 0.37**
	(28, 29)	(30, 31)
Calcium (mg)	271 ± 1.74	288 ± 1.71**
	(268, 275)	(284, 291)
Phosphorus (mg)	491 ± 4.44	528 ± 4.40**
	(482, 499)	(519, 537)
Phytates (mg)	203 ± 1.65**	186 ± 1.42
	(200, 207)	(183, 189)
Phytate-to-Calcium ratio (mg/mg)	0.76 ± 0.01**	0.65 ± 0.01
	(0.74, 0.77)	(0.64,0.66)

All values are Mean ± SE; 95 per cent CIs in parentheses; *P***<0.01 (Significance between the same age group of epileptic and non-epileptic groups)

The energy (Kcal/day), protein (g/day), fat (g/day), calcium (g/day), phosphorus (g/day) intakes and phytate-to-calcium ratio (mg/mg) were found to be significantly lower in epileptic group in comparison to non-epileptic group. The difference between epileptic and non-epileptic groups is found to be significant (*P*<0.01) at 1% level. The phytates intake (mg/day) in epileptic group is higher, compared to non-epileptic group. The difference between epileptic and non-epileptic groups is found to be significant (*P*<0.01) at 1% level.

Table 2 and 3 indicates Gender Based Analysis of Epileptic and Non-Epileptic Groups in Terms of Energy and Nutrients intake.

Table 2: A Gender Based Analysis of Epileptic Group in Terms of Energy and Nutrients Intake

Epileptic Group													
Nutrient Intakes (per day)	**Age Group <14 years**		**Age Group 15-18 years**		**Age Group 19-50 years**		**Age Group >50 years**						
	Males	**Females**	**Males**	**Females**	**Males**	**Females**						**Females**	
	(n=33)	**(n=32)**	**(n=44)**	**(n=28)**	**(n=159)**	**(n=102)**	**(n=34)**		**(n=27)**				
Energy (Kcal)	1584 ± 36.18	1502 ± 27.33	1701 ± 63.06	1679 ± 57.77	1720 ± 33.17	1645 ± 36.67	1741 ± 75.14		1671 ± 68.06				
	(1509, 1660)	(1445, 1559)	(1573, 1832)	(1558, 1801)	(1654, 1786)	(1572, 719)	(1585, 1896)		(1521, 1815)				
Protein (g)	27 ± 0.66	26 ± 0.37	28 ± 0.63*	30 ± 0.81	31 ± 0.65**	26 ± 0.40	29 ± 0.95**		24 ± 0.38				
	(25, 28)	(25, 27)	(27, 30)	(29, 32)	(29, 32)	(25, 27)	(27, 31)		(24, 25)				
Fat (g)	18 ± 0.19**	16 ± 0.32	18 ± 0.26**	16 ± 0.50	19 ± 0.24**	17 ± 0.16	18 ± 0.26		18 ± 0.35				
	(17, 18)	(16, 17)	(18, 19)	(15, 17)	(19, 20)	(16, 17)	(18, 19)		(17, 19)				
Calcium (mg)	256 ± 6.28	265 ± 5.95	284 ± 4.35	285 ± 3.55	280 ± 3.33**	265 ± 3.24	265 ± 5.19**		244 ± 3.59				
	(242, 267)	(253, 278)	(275, 293)	(278, 293)	(273, 286)	(258, 271)	(254, 276)		(236, 251)				
Phosphorus (mg)	444 ± 9.38	462 ± 7.99	495 ± 12.24	513 ± 12.86	522 ± 9.33**	466 ± 7.09	479 ± 13.23		469 ± 13				
	(424, 464)	(446, 479)	(469, 520)	(486, 540)	(504, 541)	(451, 480)	(451, 506)		(441, 496)				
Phytates (mg)	211 ± 5.38*	227 ± 5.22	211 ± 3.14	207 ± 4.17	197 ± 3.25	200 ± 3.37	198 ± 5.04		204 ± 5.67				
	(200, 223)	(217, 238)	(205, 218)	(198, 216)	(190, 203)	(193, 207)	(188, 208)		(192, 216)				
Phytate-to-Calcium ratio (mg/mg)	0.83 ± 0.03	0.86 ± 0.02	0.75 ± 0.01	0.73 ± 0.02	0.71 ± 0.01**	0.76 ± 0.01	0.76 ± 0.03*		0.84 ± 0.03				
	(0.78, 0.89)	(0.81, 0.91)	(0.72, 0.78)	(0.69, 0.77)	(0.68, 0.73)	(0.73, 0.79)	(0.70, 0.81)		(0.78, 0.9)				

All values are Mean ± SEM; 95 per cent CIs in parentheses; *P** <0.05 **<0.01 (Significance between males and females within the same age group);

3.1 Energy

The above tables discuss the nutrient energy intake of epileptic and non-epiletic groups and the analysis is done separately for Energy, protein, fat, calcium, phosphorus and phytates intakes and also phytate-to-calcium ratio.

The RDA (Indian Council of Medical Research, 2010) [7]. For intake of energy for males and females is 2730 kcal and 2230 Kcal, respectively. The energy intake (Kcal/day) in both males and females of epileptic group is lower compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (*P*<0.01) at 1% level.

In the present study the percent adequacies in epileptic group are 62% and 73% and in non-epileptic group are 71% and 84% respectively. Thus, compared with RDA, the intake of energy of epileptic and non-epileptic males and females is lower. It can

be seen that the energy intake of non-epileptic group is higher than the epileptic group.

The mean intake of energy by males in epileptic group is higher in all age groups. In non-epileptic group it is higher in males except in 15-18 age group. The difference between the males and females is found in 19-50 age group of non-epileptic group is found to be significant (P<0.01) at 1% level. This is due to AED intake which in turn leads to loss appetite (Dreizen S., 1990) [2].

Table 3: A Gender Based Analysis of Non-Epileptic Group in Terms of Energy and Nutrients intake

Non-Epileptic Group																
Nutrient Intakes (per day)	**Age Group <14 years**				**Age Group 15-18 years**				**Age Group 19-50 years**				**Age Group >50 years**			
	Males		**Females**		**Males**		**Females**		**Males**		**Females**		**Males**		**Females**	
	(n=16)		**(n=17)**		**(n=15)**		**(n=14)**		**(n=46)**		**(n=85)**		**(n=29)**		**(n=21)**	
Energy (Kcal)	1748 ± 62.89		1711 ± 80.42		1998 ± 69.86		2083 ± 33.98		2010 ± 48.77**		1776 ± 33.05		1989 ± 52.51		1878 ± 51.69	
	(1614,	1882)	(1541,	1881)	(1848,	2148)	(2010,	2156)	(1912,	2109)	(1710,	1842)	(1881,	2096)	(1770,	1985)
Protein (g)	30 ± 1.47		29 ± 1.35		33 ± 1.33*		36 ± 0.71		33 ± 1.09**		28 ± 0.42		33 ± 1.05**		27 ± 1.06	
	(27,	34)	(26,	32)	(30,	35)	(34,	37)	(31,	36)	(27,	29)	(30,	35)	(25,	30)
Fat (g)	19 ± 0.34		18 ± 0.40		20 ± 0.47		20 ± 0.38		21 ± 0.30**		19 ± 0.31		20 ± 0.44		19 ± 0.50	
	(18,	20)	(18,	19)	(19,	21)	(19,	20)	(21,	22)	(18,	20)	(19,	20)	(18,	20)
Calcium (mg)	275 ± 6.07		286 ± 6.32		301 ± 4.24		314 ± 6.42		292 ± 3.57		289 ± 2.80		280 ± 5.56		269 ± 4.73	
	(262,	288)	(272,	299)	(292,	310)	(300,	328)	(285,	299)	(283,	294)	(269,	292)	(259,	279)
Phosphorus (mg)	478 ± 11.99		505 ± 16.32		569 ± 18.80		556 ± 12.06		557 ± 8.86**		511 ± 6.75		532 ± 13.47		540 ± 18.19	
	(452,	503)	(470,	539)	(529,	610)	(530,	582)	(539,	575)	(497,	524)	(504,	559)	(502,	578)
Phytates (mg)	191 ± 6.03		195 ± 7.69		195 ± 5.83		192 ± 2.37		183 ± 1.92		188 ± 1.80		179 ± 5.60		173 ± 7.01	
	(178,	204)	(179,	212)	(183,	208)	(187,	197)	(180,	187)	(185,	192)	(168,	191)	(158,	187)
Phytate-to-Calcium ratio (mg/mg)	0.70 ± 0.03		0.69 ± 0.03		0.65 ± 0.02		0.61 ± 0.01		0.63 ± 0.01*		0.66 ± 0.01		0.65 ± 0.006		0.65 ± 0.19	
	(0.63,	0.77)	(0.63,	0.75)	(0.60,	0.70)	(0.60,	0.63)	(0.61,	0.65)	(0.64,	0.67)	(0.64,	0.66)	(0.61,	0.69)

All values are Mean ± SE; 95 per cent CIs in parentheses; P * <0.05 **<0.01 (Significance between males and females within the same age group);

3.2 Protein

The RDA (Indian Council of Medical Research, 2010) [7]. for intake of protein for males and females is 60 g and 55 g, respectively. Protein requirements vary with age, physiological status and stress. The protein intake (g/day) in both males and females of epileptic group is lower compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (P<0.05 and <0.01) at 5% and 1% levels.

The percent adequacies in epileptic group are 48% and 49% and in non-epileptic group are 53% and 55% respectively. Thus, compared with RDA, the intake of protein of epileptic and non-epileptic males is lower and of females belonging to both the groups is higher.

The mean intake of protein by males in epileptic and non-epileptic groups is higher than in females except in 15-18 age groups. The difference between the males and females in epileptic and non-epileptic groupsis found to be significant except in <14 years age group (P <0.05 and <0.01) at 5% and 1% levels.

3.3 Fat

The RDA (Indian Council of Medical Research, 2010) [7]. for intake of fat for males and females is 20 g. The fat intake (g/day) in both males and females of epileptic group is lower compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (P <0.05 and <0.01) at 5% and 1% levels.

The percent adequacies in epileptic group are 93% and 83% and in non-epileptic group are 101% and 95%, respectively. Thus, compared with RDA, the intake of fat of epileptic males and females is lower. However, the fat intake of non-epileptic males is adequate and of females is slightly lower, compared with RDA.

The mean intake of fat by males in epileptic and non-epileptic groups is higher than in females of the respective groups. The difference between the males and females in epileptic group is found to be significant (P<0.01) at 1% level except in >50 years age group. In non-epileptic group it is found to be significant (P<0.01) at 1% level in 19-50 age group only.

3.4 Calcium

The RDA (Indian Council of Medical Research, 2010) [7]. of intake of calcium for males and females is 600 mg. The calcium intake (mg/day) in both males and females of epileptic group is lower compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (P <0.05 and <0.01) at 5% and 1% levels.

The percent adequacies in epileptic group are 45% and 44% and in non-epileptic group are 48% and 48%, respectively. Thus, compared with RDA, the intake of calcium of epileptic and non-epileptic males and females is lower.

The mean intake of calcium by males in epileptic group is higher than in females except in <14 years and 15-18 years age groups. The difference between the males and females of epileptic group in 19-50 and > 50 age groups is found to be significant (P<0.01) at 1% level. The intake of the same by males in non-epileptic group is higher than in females except in <14 years and 15-18 years age groups. No significant difference is found between the males and females of non-epileptic group.

Gueguen and Pointillart reveal that Calcium absorption can be reduced because it binds to fiber, phytate or oxalate in the intestine. Phytate or phytic acid is found in grains, nuts and seeds and can bind with calcium making it less absorbable by forming insoluble complexes and reducing its bioavailability (Gueguen and Pointillart, 2000) [6]. Intake of a diet (such as Ragi) rich in phytate (inositol hexaphosphate) retards the

absorption of calcium from the gut. Inositol hexaphosphate forms chelates with divalent cat-ions of calcium and reduces the absorption of calcium from the gut. The inadequate dietary calcium intake is noteworthy when viewed in the milieu of high phytate-to-calcium ratio coupled with low serum 25(OH) vitamin D levels. Studies by Panwar and Punia (2000) [11]. Have shown that the calculated values for all nutrients are significantly higher than the analytic values. Hence, subjects with a calculated low intake of calcium with the background of a diet that contains foods high in phytates, as in the current study, may be more calcium deficient than calculated from dietary intake data. In a setting where the diet of the population is already low in calcium, the effect of AED can further accelerate the bone loss. Gao *et al*., in their study shows that only 42% of the patients consumed milk and milk products which is the principal source of dietary calcium. Non-dairy sources of food cannot meet the requirement of calcium (Gao *et al*., 2006) [3]. This study shows that there was a positive correlation with calcium and phytate intake, the phytate-to-calcium ratio is high in epileptic patients, which will further hinder the bioavailability of available calcium. Low calcium intake increases PTH which increases conversion of 25(OH) vitamin D to 1, $25(OH)_2$ D_3 which, in turn, stimulates the intestinal calcium absorption. In addition, 1, $25(OH)_2$ D_3 induces its own destruction by increasing 24-hydroxylase. In this way a high-phytate or a low calcium diet leads to vitamin D deficiency.

Low dietary calcium leads to decreased plasma calcium which triggers secondary hyperparathyroidism leading to osteoclast activity and calcium release from bone. With aging, there is reduced intestinal calcium absorption, increased bone resorption than formation. Moreover, the demand of calcium is increased in women in the childbearing age group.

3.5 Phosphorus

The RDA (Indian Council of Medical Research, 2010) [7]. of the intake of phosphorus for males and females is 600 mg. The mean phosphorus intake (mg/day) in both males and females of epileptic group is lower compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (P <0.05 and <0.01) at 5% and 1% levels.

The percent adequacies in epileptic group are 81% and 80% and in non-epileptic group are 89% and 88%, respectively. Thus, compared with RDA, the intake of phosphorus of epileptic and non-epileptic males and females is higher.

The mean intake of phosphorus by males in epileptic group is higher than in females except in <14 years and 15-18 years age groups. The difference between the males and females in epileptic group in 19-50 age group is found to be significant (P<0.01) at 1% level. The intake of the same by males in non-epileptic group is higher than in females except in <14 years and >50 years age groups. The difference between the males and females in non-epileptic group in 19-50 age group is found to be significant (P<0.01) at 1% level.

3.6 Phytates

The mean phytates intake (mg/day) in both males and females of epileptic group is higher compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (P<0.01) at 1% level.

The mean intake of phytates by males in epileptic group is lower than in females except in 15-18 years age group. The difference between the males and

Females in epileptic group in <14 age group is found to be significant (P<0.05) at 5% level. The intake of the same by males in non-epileptic group is lower than in females except in 15-18 years and >50 years age groups. No significant difference is found between the males and females in non-epileptic group.

3.7 Phytate-to-Calcium Ratio

As phytates interfere with the absorption of calcium, phytate calcium ratio was calculated. The mean Phytates-to-calcium ratio (mg/mg) in both males and females of epileptic group is higher compared to the respective levels in non-epileptic group. The differences between epileptic and non-epileptic groups are found to be significant (P<0.01) at 1% level.

The phytates-to-calcium ratio by males in epileptic group is lower than in females except in 15-18 years age group. The difference between the males and females in epileptic group in 19-50 and >50 age groups is found to be significant (P <0.01 and <0.05) at 1% and 5% level, respectively. The intake of the same by males in non-epileptic group is higher than in females in <14 and 15-18 years age groups. Significant difference (P<0.05) is found between males and females in non-epileptic group in 19-50 age group at 5% level.

4. Conclusions

Nutrition plays a major role in maintaining the bone health. This study shows that the diet of all patients with epilepsy was deficient in total calories and calcium. In the present study the daily dietary calcium intake by both epileptic and non-epileptic groups are low compared to that of RDA by the ICMR for the Indian population. Our study showed that women aged between 19-50 years were grossly deficient in their dietary calcium intake. The importance of dietary calcium needs to be emphasized in women in their life cycle as this affects not only their health and nutrition but also that of their offspring. Further bone loss is accelerated in postmenopausal women and old age. The consumption of energy and nutrient intakes in non-epileptic males and females are higher compared to the epileptics. Yet, the consumptions of both the groups are below the RDA for energy and nutrients.

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