ASSESSMENT OF ANTHROPOMETRIC PROFILE OF EPILEPTIC CHILDREN AND ADOLESCENTS OF TIRUPATI REGION

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ABSTRACT
Nutritional anthropometry is a rapid, inexpensive and non-invasive means of determining short and long term nutritional status at different ages and levels. Relationship between malnutrition, morbidity, mortality and child development is well recognised in developing countries. Growth retardation has been observed in children suffering from epilepsy and it may be more common in untreatable cases. Although epilepsy is a prevalent disorder during childhood, there is still little knowledge regarding its effects on growth and nutrition of affected patients. The aim of the present study was to assess the nutritional status of epileptic and non-epileptic children and adolescents utilizing anthropometric measurements. Data from the present study reveals that epileptic children had slightly lower weight and BMI levels. Other anthropometric measurements observed were found to be within cut off levels. Participants of the study belonged to below poverty line background which could be the contributory reason for them to develop short-term malnutrition.

KEY WORDS: Nutritional anthropometry, nutritional status, epilepsy, non-epileptic children and adolescents.

INTRODUCTION

Malnutrition and epilepsy affect the developing brain of children which has been confirmed by studies on rodents and have shown adverse effects of poor nutritional status on the release of neurotransmitters, brain size reduction and alteration in brain's ability to reorganise itself and form new neural connections (Gietzenet al., 1996; Nunes et al., 2000; Nunes et al., 2002; Crepin et al., 2009; Hemb et al., 2010; Porto et al., 2010). Seizures have a marked effect on cell genesis in the brain but the effect is age-dependent. In more mature brains, a brief period of seizures results in neurogenesis (Parent et al., 1997) but in the case of neonates, multiple seizures supress neurogenesis (Holmes et al., 1998; McCabe et al., 2001).

Growth impedance has been observed in children suffering from epilepsy and causes may be multifactorial such as frequent seizures reduce child's wake time causing reduction of total energy intake, use of certain antiepileptic drugs for long periods of time which may result in body weight changes, loss of appetite, change in cognitive function and also interfere in nutrient absorption (Reiter et al., 2004; Volpe et al., 2007).There are various factors which affect bone turnover in patients with epilepsy. These include immobilization due to brain paralysis, restricted physical activity caused by convulsions, poor nutrition, vitamin D deficiency, and use of anti-epileptic drugs (Seth, 2004; Gissel et al., 2007; Shellhaas and Joshi, 2010).

Childhood and puberty are the critical periods of bone mineralization. Studies have reported that life style in epilepsy patients is also responsible for poor bone health. Individuals suffering from epilepsy lead a sedentary and indoor life style with reduced sunlight exposure which provokes seizures and risk during seizures. Epileptic patients with these conditions are frequently associated with vitamin D deficiency (Handerson, 1997; Nakken and Tauboll, 2010; Santosh et al., 2014).There is a growing awareness on the use of anti-epileptic drugs (AEDs) on bone health in people with epilepsy. Studies have reported deleterious effects of these drugs which results in reduced bone mineral density as they directly affect osteoblasts responsible for the bone formation (Farhat et al., 2002; EI-Hajj et al., 2008) which results in reduced bone mineral density, abnormalities in calcium metabolism and results in rickets and osteomalacia in children and adults, respectively (Feldkamp et al., 2000; Sato et al., 2001; Andress et al., 2002; Pack,2003; Boluk et al., 2004; Berqvist et al., 2008).

Anthropometric assessment is a rapid, inexpensive and non-invasive means of determining short and long term nutritional status. Relationship between malnutrition, morbidity, mortality and child development is well recognised in developing countries. There are very few evidences which prove that malnutrition increases the risk of epilepsy and also influence of epilepsy on nutritional status of children (Bertoli et al., 2006; Crepin et al., 2007; Hemb et al., 2010; Porto et al., 2010). Therefore, present study was carried out to assess the nutritional status of epileptic children and adolescents using anthropometric measurements.

MATERIALS AND METHODS
Selection of subjects:-

A total of 199 epileptic and non-epileptic patients with an age range of <14 and15-18 years of both sex, belonging to below poverty line section were randomly selected from Super Specialty Hospital, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati. Out of the total number, 137 (Boys–77 and Girls–60) who were regularly attending epilepsy clinic of SVIMS and who were treated exclusively for epilepsy alone, without any comorbidities were included in the study. Migrants from other regions, children with a history of genetic or metabolic conditions, children being treated with special diets for diabetes or phenylketonuria; enteral or parenteral nutrition; motor limitations; acute infections; could not have their anthropometric measurements taken due to the use of orthopaedics appliances or body abnormalities, and children parents and/or guardian who had not authorized their participation in the study were excluded. Selected children were being treated with AEDs at the time of study.

The remaining subjects were 63 non-epileptics (Boys-31 and Girls-31) within the same age group attending other outpatient clinics other than epilepsy were included in the study to compare their general health conditions with epilepsy patients with reference to the various parameters used for the study.Children who had any disease that causes significant nutritional impairment (cancer,chronic infections) or metabolic alterations (hyper and hypothyroidism), on special diets (diabetes, phenylketonuria, celiac disease or lactose intolerance), using corticosteroids, had degenerative neurological alterations, used enteral or parenteral nutrition were excluded from the study. Data was collected from 2007 until 2009.

Anthropometric measurements:-

Anthropometric measurements used for assessing the nutritional status include height, weight, body mass index (BMI), waist circumference, hip circumference and waist to hip ratio. Measurements from the selected subjects were taken by following standard procedures given by Jelliffe (1966). Weight (kg) was assessed using a mechanical platform scale with a precision of 0.1 kg. Subjects were asked to position themselves barefoot, with an erect posture, feet close together and arms alongside the body, on the centre of the scale, wearing the least amount of clothes possible. For height (cm) measurement, wall mounted stadiometer accurate to 0.1 cm was utilized. The subjects were asked to maintain an erect posture with arms alongside the body and held-up head, looking at a fixed spot on the same level of the eyes, barefoot and feet close together and in parallel. Weight and height measurements were then used to calculate BMI of the patients expressed as kg/m^2.

Waist and hip circumferences (cm) were measured using a measuring tape. Waist circumference was measured at the most lateral contour of the abdomen while hip circumference was measured at the widest portion of hips. Waist to hip ratio was calculated by dividing waist circumference by hip circumference. Anthropometric measurements were always taken by the same researcher or under her supervision by a trained personal.

Statistical analysis:-

Statistical analysis of the data was also performed using a two-way ANOVA calculation with Duncan's pair wise comparisons between groups. The results were considered significant at $p<0.05$ and $p<0.01$ levels.

RESULTS AND DISCUSSION

Anthropometric measurements of epileptic and non-epileptic boys and girls are presented in Table 1 and 2. Growth of an individual is dependent on inherited genetic potential and available nutrition. Progress of growth is assessed by weight and height measurements in comparison to standard values for the population. Height is affected only by long term nutrition deprivation and is considered an index of chronic or long term malnutrition. Similarly, rapid weight loss in children is considered as an indicator of potential malnutrition as body weight indicates the body mass which is a composite of all body constituents like water, minerals, fat, protein, bone etc. (Srilakshmi, 2002; Eastwood, 2003). Children and adolescencents with epilepsy have poor and irregular feeding practices due to recurrent seizures which affects their nutritional pools and thereby overall development.

The mean heights of epileptics belonging to both sex and age groups were slightly higher and visible than non-epileptics. However, the present study has not found significant difference in weight between children with epilepsy and non-epileptic group. Similar finding has been reported by Bertoli et al., (2006) in epileptic and control groups. Below 14 years of age, epileptic and non-epileptic boys had weight of 29 and 30 kg and height of 140 and 137 cm, respectively which is comparable to the reference values (ICMR, 2010). Similar observation was made with epileptic and non-epileptic girls of the same age group.

At the pubertal growth spurt, boys grow 20 cm in height and 20 kg in weight which is higher than seen in girls at the same stage. In general, girls begin their pubertal stage approximately 2 years earlier than boys but still their linear growth continues into late teens for females and early twenties for males (Mahan and Krause's, 2000). Surprisingly, epileptic and non-epileptic boys and girls of 15-18 years age group showed increment by 20 in height and weight. However, the observed weights for boys and girls were found to be slightly lower in comparison to weight of 55 and 52 kgs for Indian standard boys and girls in the age group of 15-18 years, respectively (ICMR, 2010) whereas children below 14 years had body weight within the reference range. Many studies have shown relationship between the use of anti-epileptic

drugs and body weight which is depended on the type of drug used for the therapy (Bergen et al., 1995; Klein et al., 2008). Weight loss in epileptic children has been associated with use of anti-epileptic drugs such as felbamate and topiramate (Cilio et al., 2001; Bray et al., 2003).

Certain studies have confirmed the association of insufficient height gain in children with epilepsy to long-term malnutrition, epileptic seizures, use of anti-epileptic drugs and hormonal changes (Tada et al., 1986; Victoria, 1992). The present study showed no effect of epilepsy and epilepsy related complications on the stature of the both boys and girls in both age groups which could be due to short-term malnutrition and less number of epileptic seizures as height is an indicator of past health rather than present health.

Body mass index is a standard way of classifying people on the basis of their height and weight (Webb, 2002). Slightly higher BMI values were observed in non-epileptics than epileptic boys and girls of 15-18 years group whereas <14 years boys and girls showed almost similar BMI values. Non-epileptic girls of 15-18 years age group had significantly ($p<0.01$) higher BMI value (21) than epileptics (18) and placed themselves at 50th and 10th percentile, respectively according to revised Indian Academy of Paediatrics (IAP) growth charts (2015). This is an indicator for non-epileptic girls as they are on higher scale of becoming overweight and obese.

All the participants belonged to below poverty line background which could be the contributory reason for reduced energy and nutrient intake and kept their BMI under controlled levels. Epileptic patients are more prone to have high BMI as their physical mobility is restricted due to recurrent seizures and use of certain anti-epileptic drugs for long periods of time which results in body weight gain and other complications. Known possible causes for early malnutrition in children includes socio-economic conditions, working parents, family income, purchasing power, diet (quantity and quality), and school level are the main predictors of child's nutritional status (Engstrom and Anjos, 1999; Mohsena et al., 2010; Gutheil and Nunes, 2013). Studies have confirmed association between low BMI and epileptic children (Reiter et al., 2004; Volpe et al., 2007) which puts them on higher risk of developing malnutrition. Additionally, this is supported by an Indian study which claims connotation between epilepsy and low BMI (Hemb et al., 2010).

Generally, waist and hip circumference are used to assess obesity. In epileptic and non-epileptic groups, the mean waist and hip circumference were high for boys <14 years age group in comparison to girls. A significant ($p<0.01$) increase in the circumferences of boys and girls of 15-18 years age group was observed in both epileptics and non-epileptics. Non-epileptic boys and girls of 15-18 years age group had slightly

higher waist and hip circumferences in comparison to epileptics. However, the cut off levels for waist and hip circumference of epileptic and non-epileptic boys and girls groups of all age groups was within the cut off levels (ICMR, 2010).

Waist: hip ratio of higher than 1.0 is a predictor for risk of developing cardiovascular and diabetes. In addition, individuals with fat distributed as apple shape have higher risk of atherosclerosis, diabetes, hypertension, and hyperlipidaemia than individuals with pear shape (Eastwood, 2003). In the present study, epileptic boys had slightly higher waist to hip ratio of 0.87 in the age group of 15-18 years in comparison to other epileptic groups. Similar observation was made in non-epileptics boys and girls of both age groups. Significant ($p<0.01$) difference was observed between epileptic boys and girls of 15-18 years age group. Overall, waist by hip ratio of boys and girls of both age groups was found to be in cut-off levels according to reference values. However, non-epileptics of both age groups, and epileptic boys of 15-18 years had slightly higher ratio than others which reveals that they are at the risk of developing cardiovascular disorders, diabetes and related complications.

CONCLUSION

Epilepsy impairs the growth of children physically as well as mentally. Epileptic patients are more prone to have high BMI as their physical mobility is restricted due to recurrent seizures and use of certain anti-epileptic drugs for long periods of time which results in gaining body weight and other complications. All the participants belonged to below poverty line background which could be the contributory reason for reduced energy and nutrient intake which kept their BMI and weight under controlled levels. It is a vicious cycle where malnutrition further affects the developing brain of the epileptic child, imbalance in bone turnover metabolism, immobilization, restricted physical activity, poor energy and nutrient intake, vitamin D and calcium deficiency. Therefore, there is a pressing need for nutritionists and food industries to come together and develop certain low cost and easily available products in the market which can take care of their higher nutritional needs and benefit them during the course of medical treatment and later on as they are highly prone to develop bad eating habits due to convulsions, bone related imbalances, protein loss due to immobilization and vitamin D and calcium deficiency duo to less exposure to sun light.

Table 1. Anthropometric measurements of epileptic subjects

Parameters	Epileptics			
	<14 years		15-18 years	
	Boys (n=33)	Girls (n=32)	Boys (n=44)	Girls (n=28)
Height (cm)	140 ± 3.72	133 ± 3.88	164 ± 1.52**	155 ± 1.35
Weight (Kg)	29 ± 1.86	27 ± 1.76	48 ± 1.07**	43 ± 1.11
BMI (Kg/m²)	17 ± 0.55	16 ± 0.77	18 ± 0.3	18 ± 0.53
Waist circumference (cm)	54 ± 1.28	50 ± 2.03	64 ± 0.95	65 ± 0.99
Hip circumference (cm)	66 ± 2.95	62 ± 2.86	73 ± 1.3	79 ± 1.85**
Waist-to-hip ratio (cm/cm)	0.83 ± 0.02	0.82 ± 0.01	0.87 ± 0.01**	0.83 ± 0.02

All values are Mean ± SE;
p * <0.05 and p **<0.01 (Significance between the males and females of same age in epileptic group)

Table 2. Anthropometric measurements of non-epileptic subjects

Parameters	Non-epileptics			
	<14 years		15-18 years	
	Boys (n=16)	Girls (n=17)	Boys (n=15)	Girls (n=14)
Height (cm)	137 ± 5.22	129 ± 3.75	157 ± 1.41**	150 ± 1.75
Weight (Kg)	30 ± 2.62	31 ± 1.91	48 ± 0.7	48 ± 1.6
BMI (Kg/m²)	15 ± 0.75	16 ± 0.47	19 ± 0.42	21 ± 0.46**
Waist circumference (cm)	59 ± 2.48	56 ± 1.95	67 ± 1.25	69 ± 1.41
Hip circumference (cm)	68 ± 2.87	64 ± 2.58	78 ± 1.17	80 ± 1.45
Waist-to-hip ratio (cm/cm)	0.87 ± 0.01	0.88 ± 0.01	0.87 ± 0.01	0.87 ± 0.01

All values are Mean ± SE
p * <0.05 and p **<0.01 (Significance between the males and females of same age in non-epileptic group)

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