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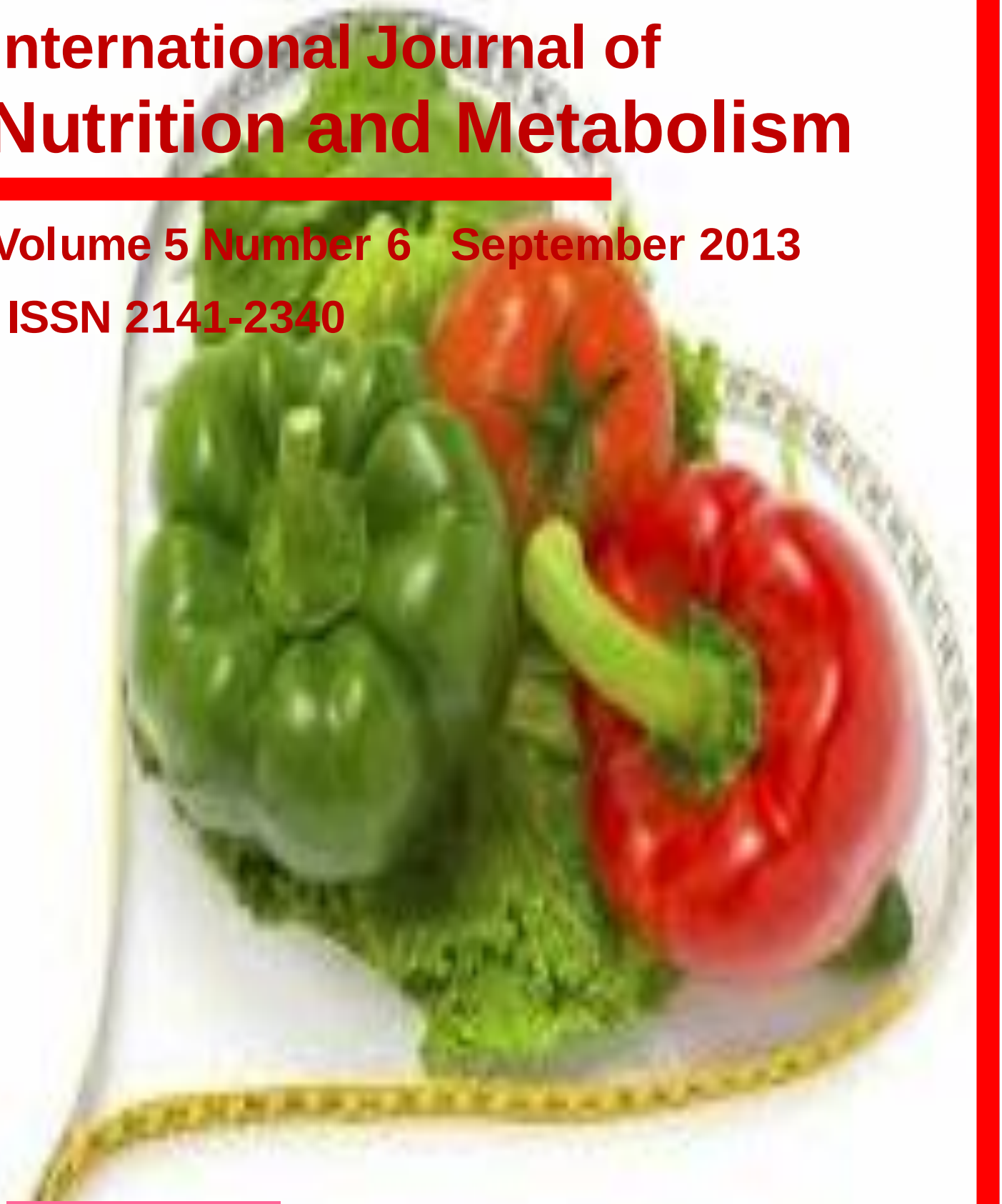

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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

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International Journal of Nutrition and Metabolism

Full Length Research Paper

Efficacy of leaf concentrate as micronutrient fortifier in the supplementary nutrition of Integrated Child Development Services (ICDS)

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Accepted 31 July, 2013

In developing countries like India, micronutrient deficiency especially of iron is most prevalent among children. Besides culminating into anemia, the consequences of iron deficiency are grave and affect the health and quality of life of the people and the nation as a whole. The objectives of this study were to assess the effect of using leaf concentrate (LC), a novel food prepared from the extract of Lucerne grass for supplementation as micronutrient fortifier in the hot meals of Integrated Child Development Services (ICDS) Anganwadi Centres and to assess the impact on hemoglobin levels and morbidity profile of the children, aged 3 to 6 years attending ICDS Anganwadi Centres of Jaipur City. A total of sixty four children of either sex, aged 3 to 6 years were selected from the two Anganwadi Centres (AWC) of Jaipur City. Two AWC were selected randomly from the seven AWC running in a slum area of Jaipur, known as Jawahar Nagar slum. One Anganwadi Centre served as control group and another as experimental group. At each center, 32 children were enrolled. The supplementary feed provided to the two AWC was the same, the only difference was that 3% LC was incorporated in the supplementary nutrition of the experimental centre. Supplementation with LC was continued for a period of 24 months. At baseline blood hemoglobin (Hb), weight, height and morbidity profile were assessed. The hemoglobin levels and the morbidity profile of the children were assessed in every six months, while the weights (kg) and heights (cm) were recorded every third month. The results showed a significant increase in the Hb levels of the experimental group while it decreased in the control group. The difference between the two groups was statistically significant ($p<0.01$). Morbidity profile of the experimental group improved while it remained unchanged in the control group. The anthropometric measurements did not show a significant difference in the two groups.

Key words: Micronutrient, leaf concentrate, integrated child development services (ICDS), morbidity profile.

INTRODUCTION

India has often been referred to as ‘a nation of the young’ and not without reason since India has the second largest child population in the world. About 40% of its population is children under 14 years of age. Children under 5 years constitute about 14% of the population (UNICEF, 2005).

These children constitute one of the most vulnerable segments of our population from the nutritional point of view, because the foundation for a life time health, physical strength and intellectual vitality is laid during this period (Thakar and Patel, 1990). But children are dependent on their families and communities to provide a nurturing environment that will enable them to become healthy and productive adults. From all accounts, an adequate nutrition and sound health go hand in hand. Food continues to be a major determinant of good health throughout the growing years. The balance diet

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provides all the macro and micronutrients.

Micronutrients, especially vitamin A, iodine and iron are essential for sound physical and mental growth and well being of a person. The World Health report published recently by WHO cites these deficiencies as three of the most prevalent and critical nutrient deficiencies in the world. Micronutrient malnutrition affects approximately a billion people worldwide.

Iron deficiency is the most important cause of nutritional anemia and is the most common micronutrient deficiency worldwide; it leads to impairment of health, growth, development and performance. It has been estimated in various studies that 63% of children below 3 years and 45% between 3 and 5 years are found to be anemic. This in turn affects productivity, morbidity and mortality.

Nutritional deprivation robs the children of their ability to cope with stress situations like infection. Superimposed upon a background of under nutrition, the consequences of these episodes of illness are often disastrous leading to major setback in growth and development (Batra and Sood, 2005). With common childhood illness, malnutrition drags millions of children in downward spiral of ill health, poor growth, often an early death. According to UNICEF (2000), children in developing countries may have an average of up to 160 days of illness each year, with 3 to 4 episodes of diarrhea and 4 to 5 illness bouts due to severe respiratory infection. Each infection lowers the nutritional status and leaves the child weaker and more susceptible to further infection. This vicious cycle traps a child in a continuous downward slope.

The protection for growing bodies and minds of young ought to have ‘a first call on society’s resources’. It should be an unwritten principle that the essential needs of children should be given high priority in the allocation of resources and should reach a child at an individual family level.

The government of India has thus initiated several early childhood service programmes to improve the status of children especially the weaker and more vulnerable section of the community (Paladugu, 1994).

Integrated Child Development Services (ICDS) is one of the popular early childhood service aimed to deliver a package of services to millions of children in India, who are caught in the grip of malnutrition, disease, illiteracy, ignorance and poverty (Paladugu, 1994). The government’s ICDS programme reaches 34 million children of age 0 to 6 years and 7 million pregnant and nursing mothers. One of the important tasks of ICDS is to provide supplementary feeding to the children and pregnant and nursing mothers. The aim is to supplement the intake by 300 calories and 8 to 10 g of proteins for children, 600 calories and 20 g of protein for severely malnourished children and 500 calories and 20 to 25 g protein for expectant and nursing mothers.

During the past 15 to 20 years, the state government provided supplementary nutrition in various forms which included raw rations, roasted powders and extruded ‘ready to eat foods’. The extruded food “murmura” was being fed to the children of ages 3 to 6 years for the last 20 years.

Recently, the supreme court of India has ordered to provide hot meals to the children attending ICDS centers. Hot meal is either provided by a Non Governmental Organization (NGO), ‘Akshaya Patra’ or is prepared by the Anganwadi staff at the centre. The only disadvantage of the hot meals provided is that it is not being fortified with micronutrients.

The government/Department of Women and Child Development are considering this issue of fortifying meal with micronutrient. This can be done by adding chemical mixtures of micronutrient but these days WHO is laying stress on food based strategy to combat micronutrient malnutrition. Leaf concentrate (LC), a novel food based natural product, is one option to be used as micronutrient fortifier.

LC is a product made by fractioning Lucerne grass and is perhaps the richest food resource on the earth. It is a medium energy food, equivalent to cheese in its protein content with the essential amino acid pattern as good as meat, fish and cow’s milk and can be compared to the FAO/WHO reference protein. Besides, having good quality protein, LC is the richest source of beta carotene, iron, and folic acid and contains appreciable amount of calcium, copper, zinc and vitamin E (Mathur et al., 2005).

As little as 3 g LC can supply the whole day’s requirements for beta carotene. Thus, it could be used as a fortifier to enrich the meals provided at the Anganwadi Centers *(*AWC). This study was planned to study the efficacy of LC as a micronutrient fortifier and to see the impact of LC incorporation on the blood hemoglobin and morbidity profile of the children attending Anganwadi Centers.

METHODOLOGY

There are two ICDS projects in Jaipur City each having 100 AWC each at different locations. AWC of Jawahar Nagar urban slum were taken as the locale of the study. The slum area is divided into 7 units called *tilas* with AWC in each unit/*tila.* Out of the 7 units/*tilas, tila* 6 and 7 were randomly selected for the study. AWC at both *tila* comprised 32 children in the age group of 3 to 6 years. The children attending AWC of *tila 6* formed the control group while the children attending AWC of *tila 7* were taken as the experimental group. All the children in the age group of 3 to 6 years registered in the AWC were the subjects of the study. Initial haemoglobin levels, weight, height and morbidity profile of the subjects in both AWC were recorded.

In both AWC, the hot meals were provided by the NGO ‘Akshay Patra’ thus the food provided was alike in consistency, taste and nutritive value. The only difference was that the subjects in AWC 6 (control group) were receiving the meals, while 3% LC was incorporated into the meals of the subjects attending AWC of tila 7. The LC was incorporated in the food just before the distribution of the meals and it was assured that the children are having the complete meals regularly. LC incorporated meals were provided to the experimental group for a period of 24 months. The change in

Table 1. Comparison of mean (±1SD) weight, height and hemoglobin levels of subjects at different time interval.

Variable	Baseline	3 months	6 months	9 months	12 months	15 months	18 months	21 months	24 months
Weight (E)	10.0±2.4	10.6±2.5	11.2±2.5	11.7±2.5	12.5±2.4	12.7±2.2	13.2±2.3	13.6±2.3	14.0±2.2
Weight (C)	10.9±2.2	11.4±2.2	11.8±2.2	12.3±2.2	12.8±2.2	12.4±2.4	12.8±2.5	13.2±2.4	13.6±2.5
t-test (p-value)	0.132	0.164	0.255	0.308	0.629	0.554	0.564	0.551	0.501
Height (E)	83.7±10.0	87.5±10.5	90.5±10.0	94.1±10.2	98.1±10.2	94.6±5.8	98.3±6.3	101.1±6.1	104.0±5.8
Height (C)	84.6±10.7	87.9±10.7	91.3±10.8	94.8±10.8	98.1±10.9	94.6±3.9	98.1±4.5	100.7±4.5	103.3±4.3
t-test (p-value)	0.736	0.879	0.747	0.795	0.991	0.988	0.874	0.764	0.611
Hb (E)	10.0±0.43	-	10.8±0.43	-	10.3±1.02	-	10.3±0.84	-	10.3±1.33
Hb (C)	11.0±0.51	-	11.2±0.44	-	10.2±1.42	-	9.01±1.52	-	7.8±1.77

*Significant value, p<0.000.

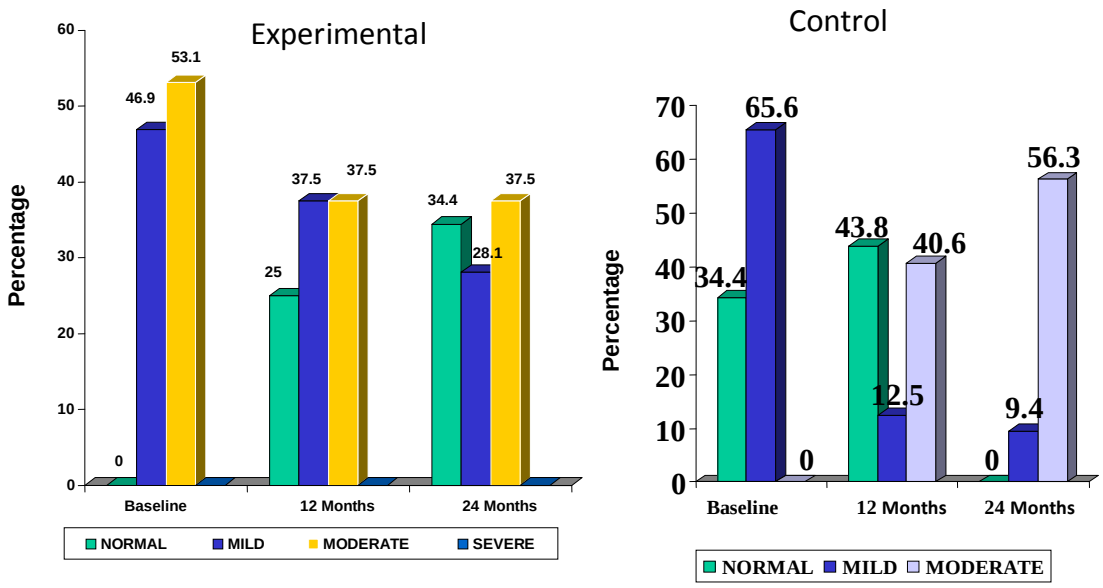

Figure 1. Distribution of subjects according to degree of anemia in experimental and control group.

the heights and weights of the two centres were recorded quarterly while morbidity profile and Hb levels were measured in every 6 months. Weight in kilogram was recorded using spring balance and height in centimeter was recorded using non stretchable tapes. Hemoglobin level was measured using Cynmethhemoglobin method. The blood was drawn by finger prick method by trained technician which was then collected in the heparin coated vials and was transported to the diagnostic centre where the Hb levels were measured through semi automated blood analyzer. The data obtained from the mothers and child care takers for morbidity profile were pooled and analyzed for every 6 months period under reporting. The data of anthropometric measurements, blood hemoglobin and morbidity profile of 24 months of control and experimental group were then tabulated compared and statistically analyzed making use of Statistical Package for Social Sciences (SPSS) version 10.

RESULTS AND DISCUSSION

A total of 64 subjects; 32 in each arm were analyzed at baseline and after every 3 months for anthropometry and after six months for hemoglobin and morbidity profile.

As shown in Table 1 and Figure 1, the baseline mean Hb levels of experimental and control groups was 10.0 ± 0.43 and 11.0 ± 0.51 g/dl, respectively and the difference was statistically significant (p<0.000). This clearly shows that at baseline, the control group had better Hb levels than experimental group. After six months intervention, there was 8% increase in the Hb levels of the experimental group, while in the control group it was raised just by 1.86%. The rise in Hb was because of LC supplemented diet provided to the experimental group. Thus after 6 months of intervention, the experimental group had Hb levels 10.8±0.43 and control group had 11.2±0.44 g/dl. But after 6 months, the control group was on the higher side with a statistically significant difference (p<0.01). After 12 months of intervention, the Hb levels of experimental group remained unchanged (p>0.05) while

Table 2. Comparison of median (IQR) weight, height and hemoglobin levels of subjects at different time interval.

Variable	Baseline	3 months	6 months	9 months	12 months	15 months	18 months	21 months	24 months
Weight (E)	9.4 (8.5-12.2)	9.9 (9.0-12.9)	10.45 (9.4-13.8)	11.2 (9.9-14.2)	12.0 (11.0-15.0)	13.5 (10.9-14.5)	14.0 (11.1-15.0)	14.3 (11.7-15.5)	14.7 (12.3-16.0)
Weight (C)	10.4 (8.8-13.2)	10.9 (9.3-13.7)	11.4 (9.8-14.0)	11.9 (10.1-14.5)	12.3 (10.6-15.0)	13.0 (10.2-14.5)	13.5 (10.6-15.0)	13.9 (11.1-15.3)	14.2 (11.5-15.8)
Height (E)	80.5 (76.0-92.0)	84.0 (79.3-96.0)	87.0 (83.3-98.8)	90.0 (87.0-103.3)	95.0 (91.0-106)	97.0 (90.3-100)	102.5 (94.0-104)	104.5 (97.0-106)	107.5 (100-109)
Height (C)	87.0 (74.3-93.0)	90.5 (77.3-96.8)	94.0 (80.3-100.8)	97.5 (84.0-104)	101 (87.3-107)	95.5 (92.3-98.0)	98.5 (95.3-98.3)	101 (98-105)	103 (100-107)
Hb (E)	9.90 (9.65-10.3)	-	10.7 (10.5-11.1)	-	10.5 (9.4-11.0)	-	10.3 (9.9-10.8)	-	10.5 (9.0-11.2)
Hb (C)	10.9 (10.8-11.0)	-	11.2 (10.9-11.2)	-	10.45 (9.13-11.3)	-	9.0 (8.03-10.2)	-	7.9 (6.0-9.2)

there was a fall in the Hb levels of the control group making the Hb levels of the two groups almost similar and the difference between the two groups turned insignificant ($p>0.05$). The fall in Hb levels of the control group continued at 18 and 24 months, while Hb level in the experimental group remained unchanged (Table 4). The difference in the Hb levels of the two groups became significantly different after 24 months, thus showing a clear cut impact of the LC.

Distribution of subjects according to grades of anemia showed that at baseline, no subject in theexperimental group was in normal category, 46.9% (n=15) had mild anemia and 53.1% (n=17) had moderate anemia. While in the control group, 34.4% (n=11) was normal and 65.6% (n=21) was mild anemic and no subject had moderate or severe anemia ($p<0.000$) (Table 5).

After 12 months of LC supplementation, the experimental group 25% (n=8) shifted to normal, 37.5% (n=12) had mild anemia and 37.5% (n=12) had moderate anemia. In control group, 43.8% (n=14) became normal, this increment was seen as three of the children were from comparatively well to do families and when they came to know about the anemic status of their children they started giving them special care. 12.5% (n=4) mild anemia, 40.6% (n=13) shifted to moderate anemia and 3.1% (n=1) shifted to severe anemia, except the three cases otherwise of the results are supporting the effect of LC; the number of subjects falling prey to moderate anaemia increased in the control group while there was a constant gradual shift of anemic subjects towards normalization in the experimental group. After 24 months of intervention in experimental group, 34.4% (n=11) shifted to normal, 28% (n=9), mild anemia and 37.5% (n=12) had moderate anemia.

Due to drop in Hb levels in the control group, no subject was in normal category, 9.4% (n=3) were mildly anemic, 56.3% (n=18) were moderate anemia and 34.4% (n=11) had severe anemia ($p<0.000$). The results are in agreement with the study done by Dewan et al. (2007) on children suffering from protein energy malnutrition. The study showed that supplementation of diet with leaf protein concentrate for about two weeks to children with moderate to severe malnutrition produced significant improvement in weight and hemoglobin levels. Analysis of anthropometric data (Table 3) showed that at baseline, the weight of the experimental and control subject was 10.0±2.4 and 10.9± 2.2kg which was statistically not significant ($p>0.05$). Median weight and interquartile range (IQR) (Table 2) showed that the control group had better weight status than experimental group (9.4 IQR 8.5-12.2 vs. 10.4 IQR 8.8-13.2). After 12 months of intervention, the mean weight of both groups became same and no difference in median and IQR was seen. After 12 and 24 months of interval, improved trends in weight of experimental group were seen throughout although the results were not statistically significant. Similar observations were noted for height also. At baseline, the height of the experimental and control subject was 83.7 ± 10.0 and 84.6 ± 10.7 cm which was statistically not significant ($p>0.05$). Median height and IQR showed that the control group had better height status than experimental group (80.5 IQR 76.0-92.0 vs. 87.0 IQR 74.3-93.0). After 12 and 24 months of intervention, the mean height of both groups became same and no difference in median and IQR was seen. Thus, from the results it is clear that the impact of LC supplementation was observed on the physical growth as the experimental group had lower weights and heights initially which became the same/ increased by the end of the study. The change in the physical growth was gradual. The immediate impact was not expected as the food provided for the two groups was isocaloric and isoproteinous. It can be assumed that if the intervention was continued for a longer duration of time, it would have brought significant changes in the anthropometric measurements.

Morbidity profile

Initially morbidity profile for both groups of sub-

Table 3. Percentage (mean ± SD) increase in weight and height at different interval.

Time interval	Experimental	Control	t-test (p-value)
Weight			
Baseline-6 months	12.09±4.45	9.01±2.24	3.46 (0.001)
Baseline-12 months	27.33±14.19	18.09±4.28	3.53 (0.001)
Baseline-18 months	36.68±33.77	20.36±27.62	2.11 (0.04)
Baseline-24 months	46.08±35.40	28.28±28.21	2.23 (0.030)
Height			
Baseline-6 months	8.26±1.93	8.14±1.72	0.270 (0.788)
Baseline-12 months	17.45±4.63	16.26±3.42	1.17 (0.248)
Baseline-18 months	18.48±10.65)	17.55±13.76	0.303 (0.763)
Baseline-24 months	25.40±11.22	23.86±14.48	0.474 (0.637)

Table 4. Percentage increase in hemoglobin at different intervals (mean ± SD, min to max).

Hb	Experimental	Control	t-test (p-value)
Baseline -6 months	8.01±0.34 (7.41 to 8.51)	1.86±1.89 (0.00 to 3.88)	18.13 (0.000)
Baseline -12 months	2.84±10.15 (-16.3 to 25.0)	-7.47±12.8 (-38.5 to 14.6)	3.57 (0.001)
Baseline -18 months	3.29±10.6 (-24.3 to 27.4)	-17.69±14.39 (-46.7 to 12.96)	6.64 (0.000)
Baseline -24 months	3.34±13.45 (-20 to 29.0)	-29.34±16.75 (-60.19 to 3.68)	0.150 (0.000)

Table 5. Distribution of subjects according to grades of anemia.

Variable	Baseline	6 months	12 months	18 months	24 months
Normal (E)	-	10 (31.3)	8 (25)	4 (12.5)	11 (34.4)
Normal (C)	11 (34.4)	24 (75.0)	14 (43.8)	3 (9.4)	-
Mild anemia (E)	15 (46.9)	22 (68.8)	12 (37.5)	18 (56.3)	9 (28.1)
Mild anemia (C)	21 (65.6)	8 (25.0)	4 (12.5)	9 (28.1)	3 (9.4)
Moderate anemia (E)	17 (53.1)	-	12 (37.5)	10 (31.3)	12 (37.5)
Moderate anemia (C)	-	-	13 (40.6)	15 (46.9)	18 (56.3)
Severe anemia (E)	-	-	-	-	
Severe anemia (C)	-	-	1 (3.1)	5 (15.6)	11 (34.4)
Chi square (p-value)	29.0 (0.000)	12.3 (0.000)	6.68 (0.083)	9.14 (0.02)	26.2 (0.000)

jects was similar. Number of children reporting no fever, colds/coughs and diarrhea in experimental group was 46.9, 68.8 and 71.9% respectively and in the control group 56.3, 46.9 and 75% subjects reported no fevers, colds and coughs and diarrhea, respectively. After 24 months of intervention, the percent of the subjects reporting no illness increased in the experimental group to a significant level while it dropped in the control group. 68.8% of the subjects in the experimental group denied any kind of fevers, colds and cough and 71.9% did not suffer from diarrhea while in the control group, 50% of subjects reported having no fevers, 34.4% of the subjects denied having colds and coughs and 31.3% reported not having diarrhea (Table 6).

After intervention, it was found that the incidences of morbidity among the control group of the subjects were higher than that of the experimental group of children. Three fourths of the experimental children during this period were reported to have not suffered from any illness; the corresponding figure for the control subjects was lower. Moreover, it was observed that the percentage of children for whom three or more than three episodes of illness were reported during this period, too, was higher among the control group children (Table 6). The morbidity data for 6 to 12 and 18 to 24 months were collected during the months of June to December.

Table 6. Illness reported by subjects at different interval.

Time interval	Experimental	Control	t-test (p-value)
10 months	21 (65.6)	24 (75.0)	0.673 (0.411)
18 months	18 (56.3)	26 (81.3)	4.65 (0.03)*
24 months	17 (53.1)	28 (87.5)	9.06 (0.002)**

During the monsoon period in this phase, Jaipur city experience incessant rains, these rains in their wake brought in problems of water logging and epidemics of diarrhea and viral fever. These heavy rains exacted its toll on the health of the study subjects as well, with most of them falling prey to various illness like diarrhea and upper respiratory tract infections. Despite the prevailing environmental conditions, the experimental subjects were able to withstand the stress relatively better than their control counterparts. This could be correlated well with the results of hemoglobin that the hemoglobin levels of the control group were reducing while the subjects of the experimental group were able to maintain their Hb levels. A small-scale study jointly conducted by SOYNICA and the Haematology and Oncology Department found that patients receiving Lucerne leaf concentrate (LLC), when compared with a similar group who did not have this supplement, saw a marked improvement in their haemoglobin indices and had a lower incidence of anaemia and gained weight. Although LLC has other ingredients that could contribute to reducing the infection rate or improving patient response, these were disregarded in this study; but it may be assumed that a patient enjoying better nutritional status and free of anaemia can withstand infection better and tolerate anti-cancer treatment more easily. Deficiency of iron affects the immune system. Various studies have depicted that incidences of illness and diarrhea among iron deficient subjects are more than the iron sufficient subjects (Basta et al., 1979; Batra and Sood, 2005; Hallberg, 2001; Rao, 2007). Evidences have suggested that the immunological alterations occurring in the essential nutrient deficiencies were reversible on replenishment of the respective nutrients (Bhaskaram et al., 1989; Bothwell and Charlton, 1970). Some intervention trials have demonstrated that iron/vitamin A supplementation reduces the incidence of acute respiratory infection (ARI) and gastro-intestinal disorders (GID) (Barreto et al., 1994). Conversely, others have demonstrated that iron supplementation increases the susceptibility to infections and vitamin supplementation does not have any significant effect on morbidity (Beaton et al., 1993; Hussey and Klein, 1990; Ramakrishna et al., 1995). But iron supplements in combination with vitamin A showed a significant reduction in the markers of infection (Bloem et al., 1997; Meija et al., 1977) as both the deficiencies are often co-existent. LC used as a micronutrient fortifier is also a rich source of iron and betacarotene which may have worked in combination to improve the immunity of the experimental subjects.

Conclusion

The findings of this study highlight a decrease in the morbidity and increase in the Hb levels of the subjects receiving LC supplemented hot meals. Both groups of the subjects were receiving isocaloric meals, but the experimental group of the subjects had a better growth than their counterparts in the control group. Improved growth performance of the experimental subjects could be a function of reduced morbidity. LC fortification showed a significant improvement in the Hb levels of the experimental group. With better Hb levels, the cell mediated immunity of the children improved which had a direct impact on the morbidity profile of the children of experimental group in terms of incidence of illness as compared to the children of the control group. Thus, it could be concluded that LC is an effective micronutrient fortifier.

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Assessment of the impact of malnutrition on children at Dilla referral hospital and unity pediatric clinic, Ethiopia

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Severe acute malnutrition (SAM) arises as a consequence of a sudden period of food shortage and is associated with loss of a person's body fat and wasting of their skeleton. Many nutrition are gained from foods, there are basic nutrient essential for the development of human body. Failing in human nutrition causes malnutrition. Malnutrition has great impact on children's physical and mental growth. Malnutrition is the major cause of mortality in infants. The impact has also long term and short term effects as well as the death of individiuals due to malnutition which decreased from 2001 to 2004 at Dilla referral Hospital and also slightly at Unity Pediatric Clinic. To decrease the rate of malnutrition we must create awareness among the population to change their attitude of feeding type by giving house to house manuals on descriptions about balanced diet.

Key words: Children, Dilla referral hospital, Ethiopia, kwashiorkor, malnutrition, nutrition.

INTRODUCTION

Malnutrition in the Ethiopian context has been described as a long-term year round phenomenon due to chronic inadequacies in food intake combined with high levels of illness (National Nutrition Policy Draft, 2003). Malnutrition is the most common health problem affecting both children and adults in Ethiopia. According to Benson (2005), malnutrition is a physical condition or process that results from the interaction of inadequate diet and infection and is most commonly reflected in poor infant growth, reduced cognitive development, anemia, and blindness in those suffering severe micronutrient deficiency, and excess morbidity and mortality in adults and children alike.

Malnutrition remains one of the most common causes of morbidity and mortality among children throughout the world (World Health Organization, 1999). Malnutrition is the underlying cause of one third of the 7.6 million child deaths each year before their fifth birthday. Meeting this challenge is doubly urgent because among children who survive, chronic malnutrition causes devastating and irreversible damage (Chesire et al., 2008). Lack of nutritious food, coupled with infection and illness, means their bodies and brains do not develop properly and at least 170 million children are affected by stunting (Global Monitoring Report, 2012; Amuta et al., 2009; Garba and Mbofung, 2010; Reji et al., 2011). Well over two-thirds of these deaths, which are often associated with inappropriate feeding practices, occur during the first year of life (WHO, 2002). Community based studies done in Ethiopia showed that malnutrition is common (Yimer, 2000; Getaneh et al., 1998).

Ethiopia is the second most populous country in Africa, at nearly 84 million. Approximately 14% are children under five years of age Central Statistics Agency (2012). Population projection according to the Ethiopia Census 2007. These children and their mothers suffer disproportionately from the poor health and nutrition situation in the country. In fact, malnutrition is the

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underlying cause of 57% of child deaths in Ethiopia (SCUK, 2009), with some of the highest rates of stunting and underweight in the world. Worldwide trends show that malnutrition and lack of sanitation contribute to over half of all under-five deaths (UNICEF, 2012). Nutrition is the provision of adequate energy and nutrient to the cells for them to perform their physiological function of growth, reproduction, defense and repairs (WHO, 1999). Diseases that are caused due to malnutrition include: Marasmus, kwashiorkor, anemia, goiter, hypernatremia, hypokalemia and vitamin deficiency (Grover and Eele, 2009).

Children malnutrition is the single biggest contribution to under five mortality due to greater susceptibility to infection and show recovery from illness. Children who do not reach optimum size as adult may have less physical capacity for works. Their brains are affected and they are at greater risk of infection which kills many children during their early years (Susskind, 2009).

Kwashiorkor is one of the most acute protein malnutrition disease in the world. It is also said to be a protein calories malnutrition similar to marasmus, but what sets it apart from marasmus is the presence of edema that is typically seen in the feet. Other signs of this disease include a distended abdomen, an enlarged liver, thinning hair which is normally end up (coarse) in texture, loss of teeth, skin depigmentation and dermatitis. Children suffering from this condition normally end up developing irritability and anorexia (Holmes, 2007).

Interventions could focus on helping households use their resources more effectively to improve the nutritional status of their children as well as on increasing a household's resources (Strauss and Thomas, 1995). A nutrition assessment carried out in 2007 at St. Peter's hospital in Addis Ababa where the hospital have been offering antiretroviral treatment (ART) indicated that 35 to 40% of registered pre-ART clients had a body mass index (BMI) of less than 18.5 kg/m^2 (mild malnutrition) and 20% had a BMI of less than 17 kg/m^2 (moderate malnutrition) (www.fantaproject.org).

A study done in Southern Nations Nationalities and Peoples Regional state attested that 45% of the children were stunted, 42% underweight and 12% wasted (Yimer, 2000). Similarly in Jimma town, the prevalence of underweight, wasting and stunting were 36, 9 and 36%, respectively (Getaneh et al., 1998). Malnutrition is an important public health problem in Ethiopia; however, little information is available on risk factors for severe acute malnutrition (SAM) (Amsalu and Tigabu, 2008). As Amsalu and Tigabu reported and confirmed in 2008 that the association of severe acute malnutrition to inappropriate infant and young child feeding practices and also to reduce childhood malnutrition, due emphasis should be given in improving the knowledge and practice of parents on appropriate infant and young child feeding practices.

From this point of view, the present study was designed to conduct at Southern Nations Nationalities and Peoples Regional state particularly at Dilla referral hospital and Unity Pediatric Clinic, to obtain a better understanding of the key determinants of child malnutrition in Ethiopia and their relative importance, which is also of importance in its own right. This study was designed to determine the prevalence of malnutrition and its impact among children in Dilla town and surrounding and also to create awareness to the society that support to identify cultural setting and child care which are commonly practiced in Dilla town and surrounding. Additionally, this study was conducted to intimate families and children with the knowledge of malnutrition and its impact, that is, it causes and how to combat malnutrition.

METHODOLOGY

Description of study area and population

Description of the institution Dilla University is located at Dilla town, Gedeo Zone of the Southern Region of Ethiopia; it is 365 km south of the capital, Addis Ababa. The current Dilla University emerged from the Dilla College of Teacher Education and Health Science. The study was conducted at Dilla town, it is the capital city of Gedio zone situated 365 km south of Addis Ababa, Ethiopia. The city has longitude and latitude of 6° 24' 36'' N, 38° 18' 38'' E with an elevation of 1,570 meters above sea level. It is lowland and greenish area with different fruit production, and it is also a rift vally zone.

Data collection

Observation

In the area of Dilla town, so many children were observed under malnutritional status. From this point of view, the date was collected through observation.

Interview

The data was secondary collected through interview the parents. During the in-depth interview, a snowball sampling technique was used and the triggering points were included, such as mode of eating and balance diet knowledge.

Questioner: Structured and self administered questionnaire consisting of background information. The questions were prepared by the researcher for the fulfillment of the paper and the questions answered by professional experts.

Ethical clearance: The study protocol was reviewed and approved by Dilla University, Biology Department Staff members. Before data collection, an informed consent was obtained from respondents. Privacy and confidentiality were also maintained throughout the data collection, analysis, and manuscript preparation. The target of the research was in line with the objectives of research.

Method of data analysis

Research design is mainly a qualitative data collection method complemented by quantitative data collection approach that

Table 1. Malnutrition cases in Dilla referral hospital

Year	Sex	Total patient children	Malnutrition case (%)	Child (%) under 5 year	Child (%) 6-10 year	(%) Unknown	(%) Death
	Male	508	207 (18.12)	90 (7.88)	60 (5.25)	50 (4.37)	38 (3.32)
2001	Female	564	151 (13.32)	118 (10.33)	98 (8.5)	49 (4.29)	19 (1.663)
	Total	1142	358 (31.34)	208 (18.21)	158 (13.83)	99 (8.66)	57 (4.99)
	Male	549	197 (20.18)	80 (8.19)	60 (6.14)	48 (4.91)	13 (1.33)
2002	Female	427	127 (13.01)	135 (13.83)	49 (5.02)	32 (3.27)	29 (2.97)
	Total	976	324 (33.19)	215 (22.02)	109 (11.16)	80 (8.19)	42 (4.303)
	Male	642	285 (23.98)	193 (16.24)	92 (7.74)	34 (2.86)	20 (1.68)
2003	Female	546	117 (9.84)	82 (6.9)	32 (2.94)	38 (3.19)	18 (1.51)
	Total	1188	402 (33.83)	275 (23.14)	127 (10.69)	72 (6.06)	38 (3.19)
	Male	504	191 (22.55)	148 (17.47)	43 (4.90)	21 (2.47)	8 (0.94)
2004	Female	340	128 (15.11)	103 (12.16)	25 (2.85)	39 (4.60)	14 (1.65)
	Total	847	319 (37.66)	251 (29.63)	68 (7.76)	60 (7.08)	22 (1.85)
	Male	2203	880 (21.56)	511 (12.53)	255 (6.25)	153 (3.75)	79 (1.93)
Grand total number	Female	1877	529 (12.96)	438 (10.73)	204 (5)	158 (3.87)	80 (1.69)
	Total	4080	1409 (34.53)	949 (23.25)	459 (11.25)	311 (7.62)	159 (3.89)

The number in the bracket is put in precent (%).

provides information about malnutrion. The collected data analyses and interpreted by statically tools through graphs, figure, percentage, and table.

RESULTS AND DISCUSSION

A total of 4,463 and 4,080 patient in Unity Pediatric Clinic and Dilla referral hospital participated in the study, respectively. Majority of the patients were men followed by female. There are three children per family as ratios were observed, not all families have ability to fulfill their child needs. So, many children are faced with the impact of malnutrition. But these children are out patient. In the body of children were found big stomachs. The common lack of nutrition is as a result of protein deficiency due to difficult in the purchase of food items like, milk, egg and meat. So the reason why children suffer from malnutrition is due to protein and calcium deficiency.

Socio-demographic factor associated with malnutrition in Dilla referral hospital

As indicated in Table 1, the malnutrition prevalence was 31.34% in 2001, 33.19, and 33.83% in 2002 and 2003, respectively. This is almost similar to 37.66% in 2004. Concerning sex, a greater number of malnourished subjects were found in the group of the male, 207 (18.12), 197 (20.18), 285 (23.98), 191 (22.55) and followed by female, 151 (13.32), 127 (13.01), 117 (9.84), 128 (15.11) in Dilla referral hospital at 2001 to 2004, respectively. Regarding Child under 5 years, a greater number of malnourished subjects were found in the group of the female, 118 (10.33), 135 (13.83) followed by male 90 (7.88), 80 (8.19) at 2001 to 2002, respectively, while in 2003 to 2004, the greater number of malnourished subjects were found in the group of the male, 193 (16.24), 148 (17.47) followed by female, 82 (6.9), 103 (12.16) in Dilla referral hospital, respectively.

In the case of children bewteen 6 to 10 years, the greater numbers of malnourished subjects were found in the group of the male, 60 (6.14), 92 (7.74), 43 (4.90), followed by female, 49 (5.02), 32 (2.94), 25 (2.85) between 2002 and 2004. On the other hand, female was greater than male, 98 (8.5), 60 (5.25) between 2001 at 2001, respectively. The incidence of underweight children has been consistently reported at about 45%, which compares with an average incidence of underweight children in Sub Saharan Africa in the nineties of 33 percent (World Bank, 2000). Similarly, surveys in Ethiopia have consistently found more than half the children fewer than five stunted, with stunting rates most often attaining more than 60% (Christiaensen and Alderman, 2001).

Marasmus

As indicated in Figure 1, the chiid had marasmus

Figure 1. The child with marasmus malnutrition at Dilla referral hospital, 2013.

malnutrition in 2013 in Dilla referral hospital. So this child had very thin body and some spot like infecion was observed on the skin due to deficiency of vitamins and other minerals. Marasmus is a form of protein-energy malnutrition occurring chiefly among very young children in developing countries, particularly under famine conditions, in which a mother's milk supply is greatly reduced (http://www.britannica.com/EBchecked/topic/363838/marasmus). Marasmus is the most common form of acute malnutrition in nutritional emergencies, and in its severe form, can very quickly lead to death if untreated. It is characterised by severe wasting of fat and muscle which the body breaks down to make energy (http://www.unicef.org/nutrition/training/2.3/4.html). Marasmus, on the children, for reasons not entirely understood, develops thinness without oedema. This condition is called marasmus (http://conflict.lshtm.ac.uk/page_116.htm).

Socio-demographic factor associated with malnutrition in Unity Pediatric Clinic

As indicated in Table 2 that malnutrition has 31.62% in grand total and death show 3.33% and unknown or Longley adverse effect show almost 7.81% in comparison and contrast in the years 2001 to 2004. There is only difference in 2001 it shows 33.02% a little bit higher than others. All others show similarity it is approximately 31%. With regard to sex, a greater number of malnourished subjects were found in the group of the male, 241 (20.92), 230 (18.02) followed by the female, 150 (13.02), 230 (18.02) from 2001 to 2002 in Unity Pediatric Clinic, respectively. While from 2003 to 2004, the greater numbers of malnourished subjects were found in the group of the female, 200 (18.38), 171 (18.05) followed by male 123 (11.30), 124 (13.09) in Unity Pediatric Clinic, respectively.

A community based study done in Jimma, Ethiopia showed that children with malnutrition lived in a household with low monthly income (Getaneh et al., 1998). As indicated in Figure 2, the highest number of malnutrition prevalence among under 5 year children in Dilla referral hospital was 23.52% at 2001 while the lowest number of malnutrition prevalence among under 5 year children was at 2002, 14.24%. The number of malnutrition prevalence among 6 to 10 year young children in Unity pediatric clinic from 2001 to 2004 were increasing, 18.21, 22.02, 23.14 and 29.09%, respectively. The cumulative number of malnutrition prevalence among under 5 year children was highest at 2004, 25.05%. While the lowest cumulative number of malnutrition prevalence among under 5 year children was 18.13% at 2002. As reported also, the effect of a large family size with overcrowding and inadequate spacing has been implicated as a risk factor for severe malnutrition in different studies as well (Haidar et al., 2005; Ighogboja, 1992; Henry et al., 1993; Odunayo and Oyewole, 2006).

As shown in Figure 3, the greatest number of malnutrition prevalence among 6 to 10 years old children were 17.39% in 2002 in Dilla referral hospital, and in

Table 2. Malnutrition cases in Unity Pediatric Clinic.

Year	Sex	Total patient children	Malnutrition case (%)	Child under 5 year (%)	Child 6-10 year (%)	Unknown (%)	Death (%)
2001	Male	588	241 (20.92)	130 (11.28)	61 (5.29)	41 (3.55)	13 (1.12)
	Female	564	150 (13.02)	141 (12.23)	69 (5.98)	18 (1.56)	15 (1.31)
	Total	1152	391 (33.02)	271 (23.52)	130 (10.41)	59 (5.12)	28 (2.4)
2002	Male	627	230 (18.02)	100 (7.8)	43 (3.36)	38 (2.97)	44 (3.44)
	Female	649	173 (13.55)	84 (6.58)	179 (14.02)	52 (4.02)	29 (2.27)
	Total	1276	403 (31.58)	184 (14.42)	222 (17.39)	90 (7.05)	73 (5.72)
2003	Male	542	123 (11.30)	100 (9.19)	49 (4.5)	55 (5.05)	9 (0.8)
	Female	546	200 (18.38)	115 (10.56)	59 (5.42)	52 (4.77)	14 (12)
	Total	1088	323 (29.68)	215 (19.76)	108 (9.92)	107 (9.83)	23 (2.11)
2004	Male	507	124 (13.09)	100 (10.55)	40 (4.22)	30 (3.16)	13 (1.36)
	Female	440	171 (18.05)	99 (10.45)	46 (4.85)	23 (6.65)	12 (1.26)
	Total	947	295 (31.15)	199 (21.01)	96 (10.13)	93 (9.8)	25 (2.63)
Grand total number	Male	2264	118 (16.08)	430 (9.63)	193 (4.32)	164 (3.62)	79(1.7)
	Female	2199	694 (15.55)	439 (9.83)	353 (7.90)	185 (4.14)	70(1.56)
	total	4463	1412 (31.63)	869 (19.47)	546 (12.23)	349 (7.81)	149(3.33)

The number in the bracket is put in percent.

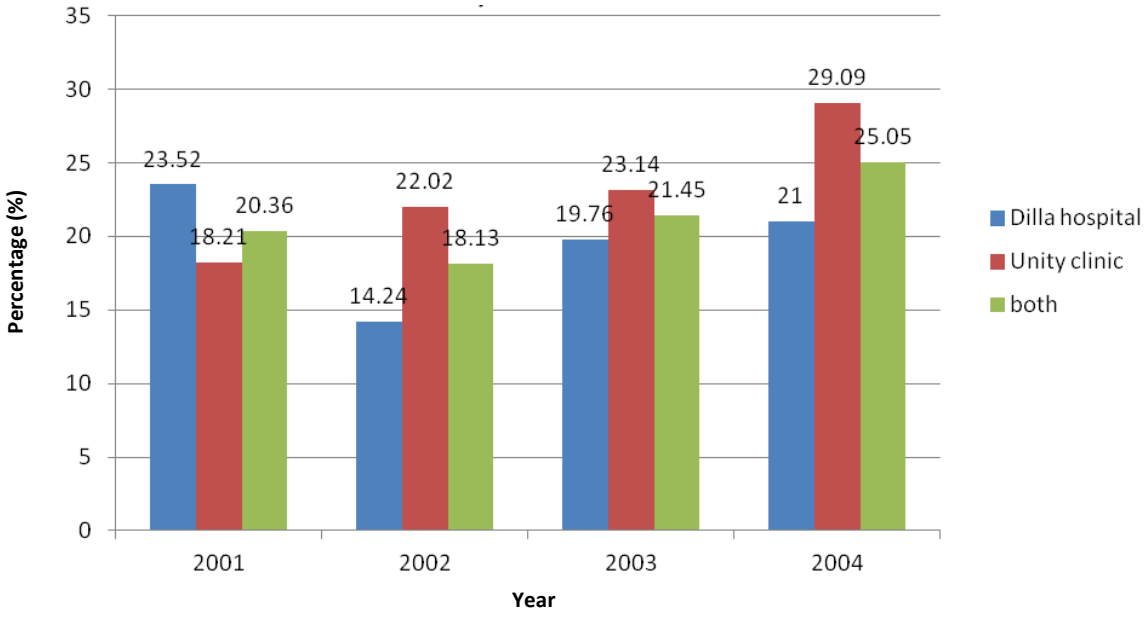

Figure 2. Malnutrition prevalence among under 5 year children in Dilla referral hospital and Unity pediatric clinic from 2001-2004.

2004 the number of malnutrition prevalence among 6 to 10 years old children was lowest in Unity pediatric clinic, 7.08%. The malnutrition prevalence among 6 to 10 years old children in Unity pediatric clinic from 2001 to 2004 decreased, 31.23, 11.39, 10.69, and 7.08%, respectively. The cumulative number of malnutrition prevalence among

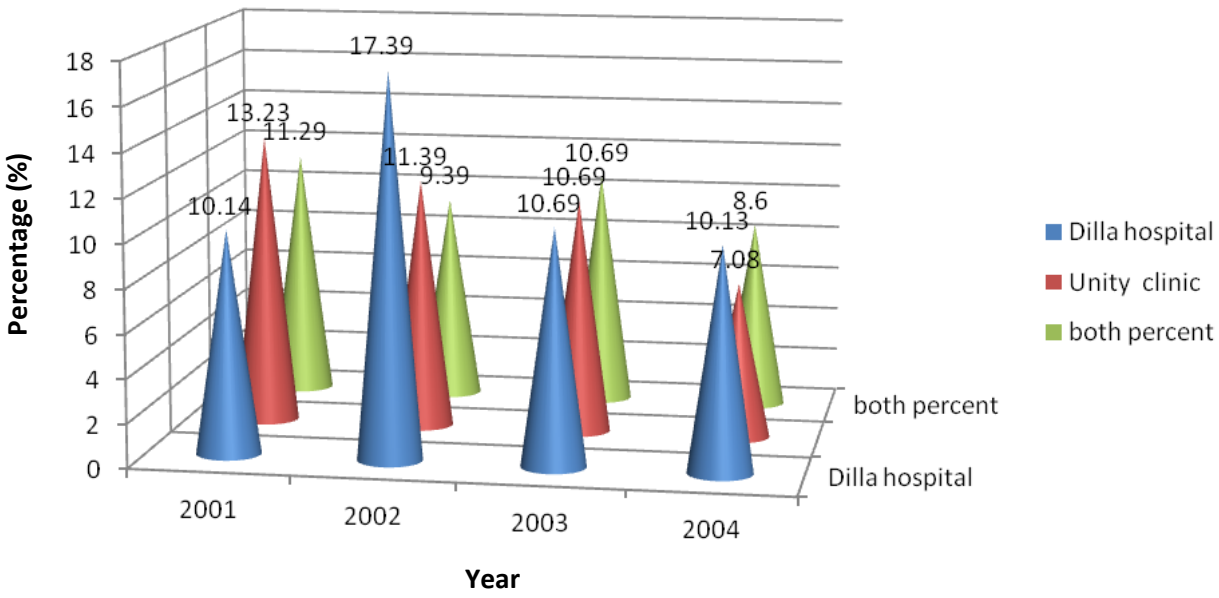

Figure 3. Malnutrition prevalence among 6-10 year young children in Dilla referral hospital and Unity pediatric clinic from 2001-2004.

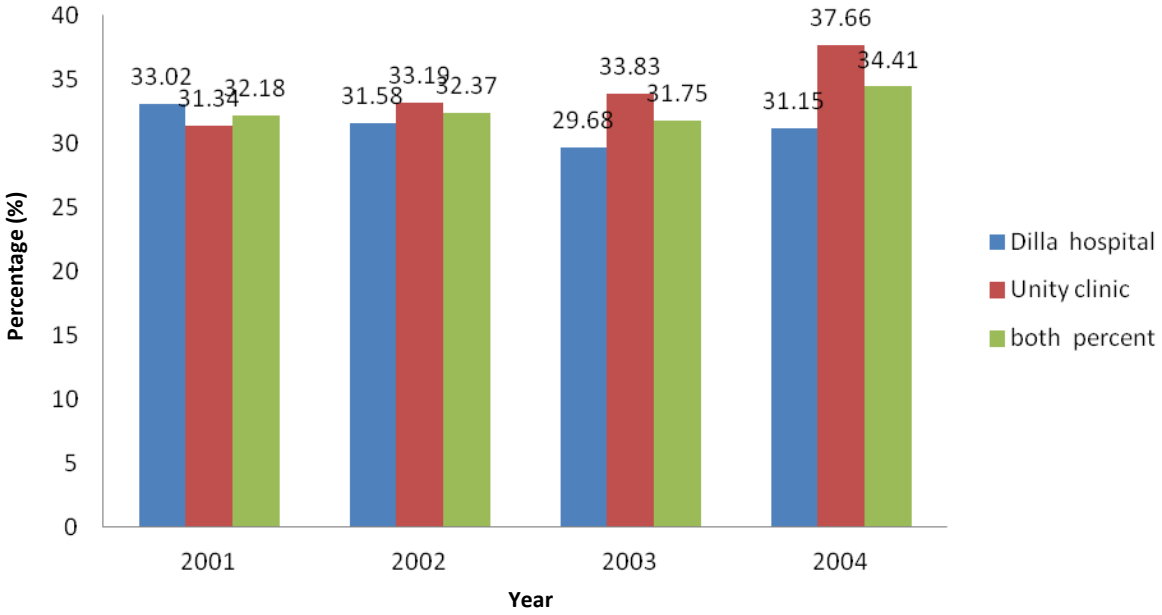

Figure 4. Malnutrition prevalence among 6 to 10 years in 2001 to 2004 between two areas, Dilla referral hospital and Unity pediatric clinic.

6 to 10 years old children were lowest in 2004, 8.60% while the highest cumulative number of malnutrition prevalence among 6 to 10 years old children were in 2003, 11.29%.

As indicated in Figure 4, the malnutrition prevalence in 2001 in Dilla referral hospital was greater than in Unity pediatric clinic, 33.02 and 32.34%, respectively, while at 2002 to 2004, the malnutrition prevalence was found at Unity pediatric clinic followed by Dilla referral hospital, 33.19, 33.83 and 37.66% and 31.58, 29.68 and 31.15%, respectively. The greater malnutrition prevalence was in 2004, 34.41% while low malnutrition prevalence at 2003,

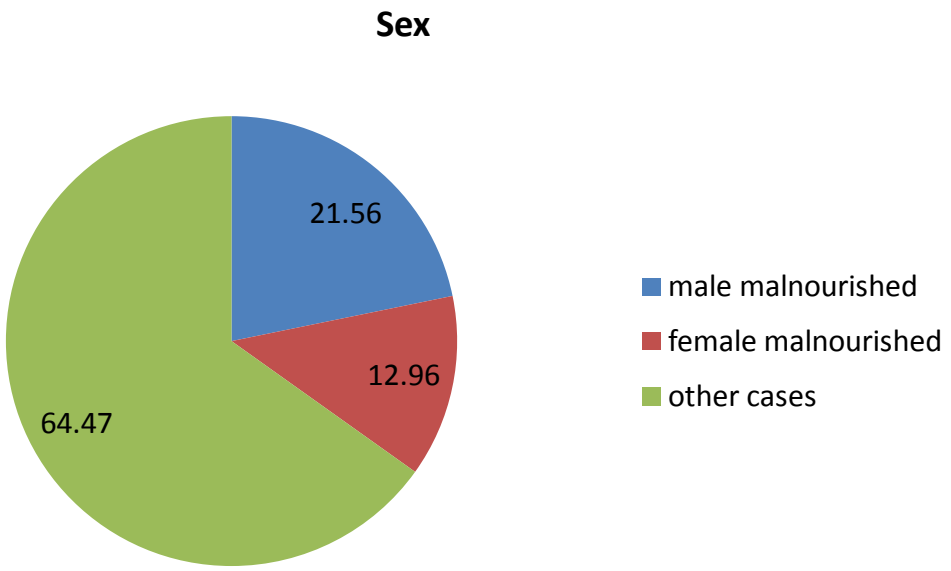

Figure 5. Estimation of malnutrition among other problems faced in children (from 2001 to 2004), and female to male comparison in unity pediatric clinic.

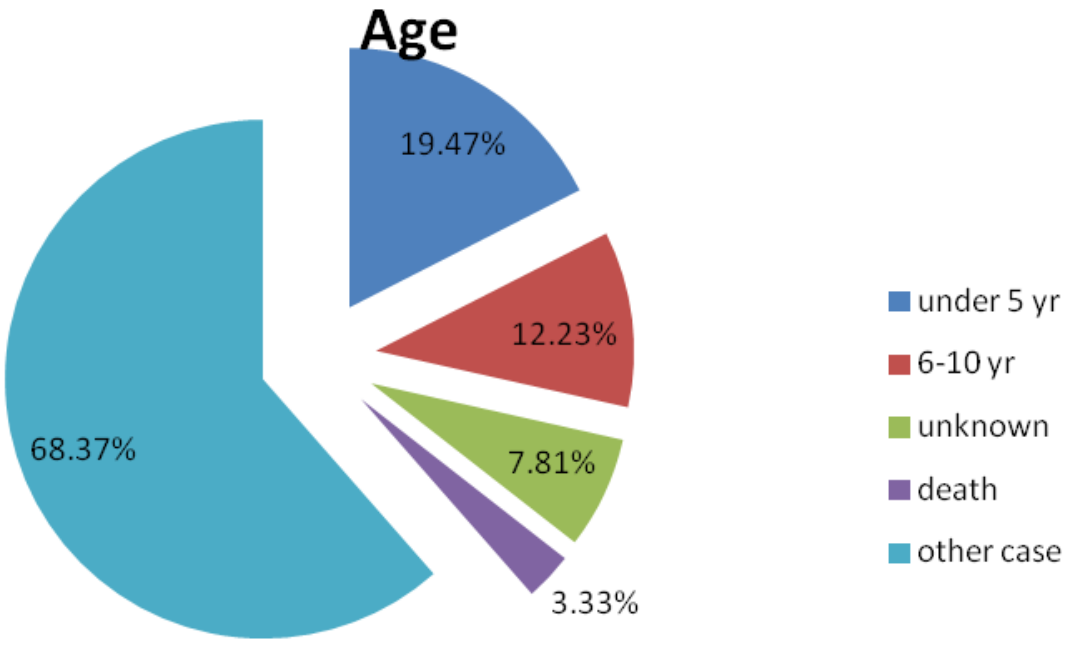

Figure 6. Estimation of malnutrition impact and age difference among malnourished children in Dilla referral hospital (2001 to 2004).

31.75%. Malnutrition is insufficient, excessive, or imbalanced consumption of protein, energy, or micronutrients (vitamins and minerals).

As indicated in Figure 5, the male showed a little bit greater than female, male, 21.56 and 12.96%, respectively. Similarly, malnutrition amongst boys is consistently larger than malnutrition amongst girls, that malnutrition in rural areas is higher than in urban areas and that children in households with better educated women are better nourished (Christiaensen and Alderman, 2001).

As shown in Figure 6, unknown mean in these cases of long term effect of malnutrition was shown to be 7.81% and death was 3.33%. The highest number of malnutrition was found at under 5 years to be 19.47%, and other cases was 68.37% with other disease. On the

Figure 7. The child with oedema malnutrition at Dilla referral hospital 2013. Children with edema should always be classified as having severe acute malnutrition.

other hand, the challenges are many, 44% of children are stunted, 10% wasted and 29% underweight (Central Statistical Agency, 2011).

Kwashiorkor

As indicated in Figure 7, the child was with edema on his leg, so this is a very serious problem at Dilla town as observed in the diseased child in 2013 in Dilla referral hospital. This indicates that children did not obtain the balance diet food and also consumed only type of food like carbohydrate, and were deficiet of protein. Some children with acute protein-energy malnutrition develop oedema. Oedema is an accumulation of fluid in the tissue, especially the feet and legs. Such children may not lose weight when developing acute protein-energy malnutrition because the weight of this excess oedema fluid counterbalances the weight of lost fat and muscle tissue. These children may look fat or swollen. Such children have kwashiorkor. Oedema (also known as dropsy or fluid retention) is swelling caused by the accumulation of abnormally large amounts of fluid in the spaces between the body's cells or in the circulatory system. It is most common in feet, ankles, and legs. It can also affect the face and hands (http://umm.edu/health/medical/altmed/condition/edema).

Conclusion

Based on results, it was concluded that the infant mortality and extended unknown adverse effect was caused mainly by malnutrition. According to these results, malnutrition shows almost 34% among other problems faced in children. Infant mortality and long term effect (unknown) in children is a burning issue. From these two health centers, Dilla Referral Hospital and Unity Pediatric Clinic, child mortality was from 3.33 to 3.89%. So, looking at this research result, it is concluded that malnutrition have a role in child mortality. And also, it has extensive adverse effect of 7.62 to 7.81%, this has great impact in a country's economy. Furthermore, malnutrition from other diseases has high proportion.

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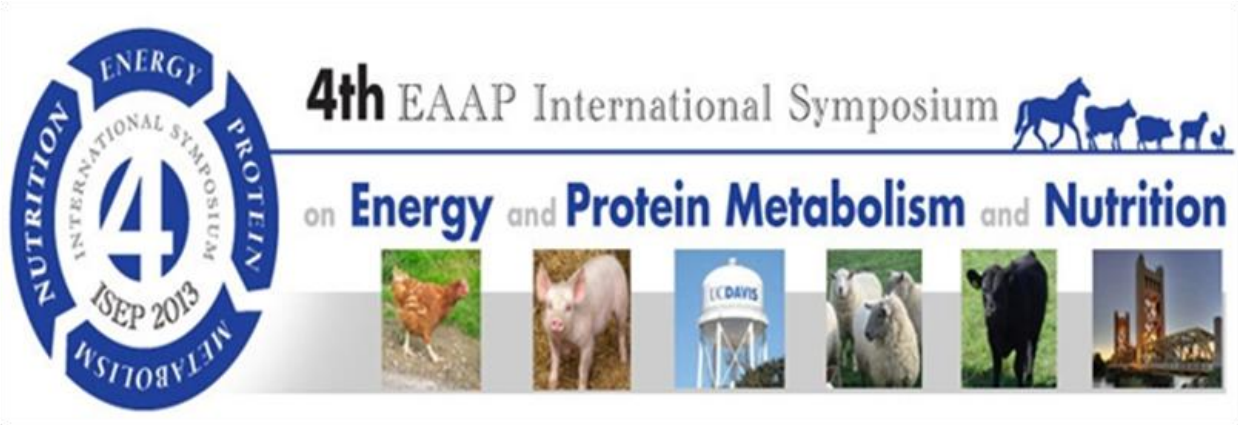

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