ORIGINAL ARTICLE

Infections of Children Associated with Malnutrition in Quetta, Pakistan

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ABSTRACT

The study was conducted in Pediatrics Ward, Therapeutic Feeding Center (TFC) of Bolan Medical Complex (BMC)/ Hospital Quetta from December 2007 to March 2008. One hundred (100) children studied among them 80 children were malnourished infected and 20 were selected as well nourished but infected. The age group of children for the study was between 6 to 60 months. Complete general physical and systemic examination of every child was performed. For anthropometric measures Well Come's criterion was followed to find out the type of malnutrition. Laboratory investigations of fifty (50) children were carried out. The number of female malnourished children was higher than male malnourished children. The malnourished children belonged to poor class living in crowded and poor sanitation and 65% of the children were reported as un-immunized and 72% of the children belong to Pushtoon ethnic group. The prevalence of malnutrition was higher in the 6 to 12 months age group. Breast feeding (BF) was exclusively practiced in 29%, while BF along with formula milk was used in 49% of malnourished children. Pneumonia was the major infectious disease caused by Klebsiella Pneumonia in both nourished and malnourished children, while the second major infectious disease was infective diarrhea caused by Enterococci was the major organisms followed by Escherichia coli. Malnutrition was not considered as a medical problem by the people of this area and malnourished children were brought to hospital when they had some other disease. Malnourished children were underweight, followed by Marasmus and the prevalence of Marasmus was higher than Kwashiorkor. Majority of the children including nourished were anemic and had low body mass index (BMI).

Key words: Malnourished, infection.

INTRODUCTION

Malnutrition is responsible for a large proportion of millions of deaths every year in children under five years of age. About 200 million children of preschool age are malnourished world wide. Food low in protein, calories, iron and other nutrients, lead to different types of malnutrition. Poor nutrition occurs in developing countries as well as in more developed areas of the world. As many as 800 million persons worldwide are affected by malnutrition (Maitland et al, 2006).

Protein energy malnutrition (PEM) is the most important and difficult to control (Macallan, 2005). Malnourished children according to Welcome's classification fall into four groups i.e. underweight, Kwashiorkor, Marasmus and Marasmic-Kwashiorkor. Kwashiorkor and Marasmus are two forms of PEM. The distinction between the two forms is based on the presence (Kwashiorkor) or absence (Marasmus) of edema. Marasmus involves inadequate intake of protein and calories, whereas a child with Kwashiorkor has fair-to-normal calorie intake with inadequate protein intake (Maitland et al., 2006).

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Malnourished children cannot maintain natural bodily capacities, such as growth, resisting infections, recovering from disease, learning and physical work. For optimum function, the body requires small amounts of essential nutrients present in diet because the body does not make all the products it needs. There are many micronutrients which play important role in the body and their deficiencies result in variety of diseases. The most important are vitamin A, iron and iodine deficiencies (Shetty, 2006; Kumar et al., 1996).

Malnourished children are especially prone to develop persistent diarrhea, which in turn aggravates the nutritional status. Among the principal causes of deaths in young children, 61% of the deaths are due to diarrhea. Iron deficiency may be caused or worsened by hookworm infestation and a number of other gastrointestinal infections (Cunha, 2000). Approximately 4 million of deaths are due to acute respiratory infection (ARI) in malnourished children (Corapci et al., 2006). In the developing world, epidemiologic factors associated with severe measles include younger age, overcrowding, poor access to health care, pre-existing medical conditions, and malnutrition. The relative contribution of each of the factors in measles morbidity is unclear. However, the role of malnutrition as a contributing

factor to measles has been implicated most markedly and repeatedly by many workers (Schaible and Kaufmann, 2007; Cunha, 2000). Keeping in view the importance of malnutrition in children, present study was conducted to see the relation of malnutrition with infections in children between 6 months to 5 years of age in Quetta city.

MATERIAL AND METHODS

One hundred (100) children were studied in Pediatrics Ward, Therapeutic Feeding Center (TFC) of Bolan Medical Complex Hospital Quetta. Out of them eighty (80) children were malnourished infected (MNI) and twenty (20) were selected as well nourished infected (WNI). The age of children for the study was in between 6 months to 60 months.

Each child's attendant (mostly mothers) was interviewed through a detailed questionnaire. In the questionnaire, after the complete bio-data of the child, there were queries about the chief complaints (reason of admission to the hospital), histories of past illness, medication in the past, past hospitalization. Each mother was asked for birth history in which there were details regarding ante-natal, natal and neo-natal history. Histories of breast feeding, immunization, weaning, development, family and socio-economic were focused in the questionnaire.

General Physical Examination: After interviewing the mother, complete general physical examination of each child was performed. In the general physical examination, condition of the child was observed in which child was seen for either he or she was normal alert, lethargic, drowsy or unconscious. Each child was looked for anemia, jaundice, edema and dehydration. The most specific changes which are more prominent in the malnourished children were observed including skin, eye and hair changes. Vitals of all children were examined which included Pulse, Respiratory rate, Temperature and Blood pressure. In systemic examination the following systems were examined for any disease or abnormality of nervous, cardiovascular, gastrointestinal and respiratory systems. Hematological studies and protein status of 50 children was carried out. Blood was drawn from peripheral vein under aseptic conditions after cleaning skin with 70% alcohol and 2% tincture iodine solution. The blood drawn was taken in different test tubes and processed for the following lab investigations.

Anthropometry: Complete anthropometric measures were determined and Well Come's criteria was followed to find out the type of malnutrition as was used by (Fakhir et al., 1989; Alwar, 1992; Savadogo et al., 2002; Hamidu et al., 2003). Weight of each child was determined in very light clothing by weighing machine (±20 gms). Length for the children below two years was taken in the special measuring chamber, with the child in supine position (lying with the face upward keeping heels close together and arms by sides. The height of children older than two years was measured by standing them in the measuring chamber.

Mid arm circumference (MAC) was measured by placing the tape (standard tape for measuring MAC) around the mid arm. Head circumference was measured by placing the tape firmly over the glabella and supra orbital ridges and wound around the head. Mid chest circumference was measured by placing the measuring tape around the mid chest below the level of nipples. Body Mass Index (BMI) was determined by dividing the weight in kilograms by height of the child in meters square.

Blood Chemistry: Complete blood count (CBC): One ml blood drawn was taken in a CBC test tube containing ethylene diamine tetra acetic acid (EDTA). The CBC was done by Medonic hematology analyzer (Stockholm, Sweden). In the CBC the following parameters were performed. Haemoglobin (Hb), Haematocrit, RBC count, Mean Corpuscles Volume (MCV), Mean Corpuscles Hemoglobin (MCH), Mean Corpuscles Hemoglobin Concentration (MCHC), White Blood Cells (WBC) count, Differential Leukocyte Count (DLC).

Peripheral blood smear of the blood sample left in the CBC tube was stained with Leishman stain and observed under the microscope to determine the Neutrophils, lymphocyte, monocytes, eosinophils and basophils as percentage, Platelets count.

Erythrocytes Sedimentation Rate (ESR): Blood for ESR was taken in an ESR tube containing sodium citrate 3.8%. The blood from the ESR tube was transferred in ESR pipette. Readings were noted after one hour. Malarial Parasites (MP): Thick and thin smears were made on a single slide from the blood of the CBC tube and were stained with Giemsa stain. Then each slide was microscopically examined under oil immersion lens. Protein parameters: Blood (1.5ml) was taken in a test tube containing gel and allowed to clot. The samples were centrifuged on 3000 rpm for 10 minutes and the serum was separated.

. Total protein (TP): For each batch of samples, two standard tubes and one blank tube was prepared. In each tube including sample tubes, 1 ml of Biuret reagent was added. In standard tubes 20 µl standard solution (8g/dl) and 20 µl serum was added to the sample tubes. All the tubes were incubated at 37°C for 10 min. Color changes in the sample and standard tubes were compared with the blank. After tuning Metrolab 1600 (Argentina) to analyze total protein, blank two standards followed by samples tubes were analyzed and the results obtained.

. Serum Albumin (SA): For each batch of samples, two standard tubes and one blank tube was prepared. In each tube, including sample tubes, 1 ml of Bromocresol green reagent was added. In standard tubes 10 µl standard solution (4g/dl) and 10 µl serum was added to the sample tubes. All the tubes were incubated at 37°C for 10 min. Color changes in the sample and standard tubes were compared to the blank. After tuning Metrolab 1600 (Argentina) to analyze serum albumin, blank, two standards, followed by samples tubes were analyzed and the results obtained.

Serum Globulin (SG): Serum Globulin was calculated by subtracting serum albumin from total protein. Albumin/Globulin (A/G) ratio: (A/G) ratio was calculated by dividing serum albumin by globulin.

Blood culture: Two ml of blood was taken in test tube containing EDTA. Each blood sample was inoculated into a culture bottle containing 20 ml of nutrient broth and incubated at 37°C for 24 hours. After 24 hours culture bottles were observed for turbidity. Bottles not showing turbidity were incubated for up to 10 days to declare them as negative. The broth showing growth was streaked onto BHI agar to obtain discrete colonies. Motility test for all the colonies was performed. Gram's staining of each single colony was performed. Gram positive cocci were tested for catalase activity. The samples which were catalase positive were tested for coagulase test. Catalase positive but coagulase negative samples were tested for mannitole fermentation. Catalase negative Gram positive cocci were streaked onto blood agar and after 24 hours incubation looked for any hemolysis. Samples that showed partial hemolysis (α hemolysis) were tested for optochin. Samples that showed no hemolysis (γ hemolysis) were inoculated into broth containing 6.5% NaCl for salt tolerance test. Those samples which grew on 6.5% salt broth were tested for mannitol and lactose fermentation tests and inoculated into litmus milk to observe the reduction of litmus milk. Gram negative rods were tested for oxidase activity and those which showed no activity were streaked onto MacCkonkey agar. Red colonies on Mackonkey agar were tested for Indole, Voges Proskaur (VP), Methyl Red (MR) and Beta- galactosidase (ONPG) and streaked onto EMB agar. Yellow or white colonies were inoculated onto Triple Sugar Iron agar (TSI) slant. Both surface and butt inoculation were done. Samples which showed no hydrogen sulphide production were further tested for Citrate utilization test, Gelatinase, VP, MR, Indole, ONPG, Catalase, Urease, Indole, Xylose fermentation, Mannitole fermentation, Mannose fermentation, Maltose fermentation, Sucrose fermentation, Ornithine decarboxylation and Lysine decarboxylation tests.

RESULTS AND DISCUSSION

The study was conducted in Pediatrics Ward, Therapeutic Feeding Center (TFC) of Bolan Medical Complex (BMC)/ Hospital Quetta from December 2007 to March 2008. One Hundred (100) children admitted during the period were studied. Among them 80 children were malnourished and infected while, 20 were selected as well nourished but infected. The age group of children for the study was between 6 to 60 months. Majority of the malnourished children belonged to poor class living in crowded houses with poor sanitation. As this study was conducted in government hospital and the majority of the children admitted to these hospitals belong to either poor or lower middle class with compromised nutritional status. Similar results revealed by (Hamidu et al., 2003; Shetty, 2006; Muller and Micheal, 2005).

The number of female (54%) malnourished children was higher than male (46%) malnourished children which are in agreement with the results of Noorani et al. (2005) and Singh et al. (2006) in Jodhpur district of Rajasthan, India, while it differs with the results of Matee et al. (1997), Mitra et al. (2007) and Bachou et al. (2006) according to them malnutrition had greater prevalence in male children. The most probable cause for this can be the female majority in the general population of the area of study and up to some extent the negligence in the nutrition of female children because of abhorrence towards them in this community.

Greatest number of malnourished children in the present study belonged to the Pushtoon ethnic group. The reason for this can be the Pushtoon population that inhabits in the nearby localities and the afghan refugee's children living in the sub urban areas of the city belong to Pushtoon ethnic group. The Baloch ethnic group that comprises a major part of this area's population was also smaller in number in this study, because Baloch populations live in far-off areas from the present locality of the study that prevent bringing their children to Quetta. The ethnic groups like Punjabi and Urdu speaking in this area are found to be better in health, education and are well aware of the importance of nutrition.

Children in the present study reported as un-immunized was (65%). This is in agreement with Alwar (1992) advising vaccination. Bhaskaram (1992) studied that malnourished children not vaccinated and also showed concern in the success of vaccination in malnourished children. It can be explained that the children in this study belonged to poor and uneducated families having a misconception that the materials used for vaccination contains contraceptive aimed for family planning. There are other reports showing partially

immunization in other studies as Hamidu et al. (2003) reported 53% of children were partially immunized.

The prevalence of malnutrition was higher in the 6 to 12 months age group which is in agreement with the study of Hamidu et al. (2003); however, Mahapatra et al. (2000) reported that the prevalence of malnutrition was lower in this age group. This may be due to delayed weaning time or poor quality of weaning and the majority of women in this community become re-pregnant and cease breast feeding to their children.

In the present study observed that malnutrition was not considered as a medical problem by the people and malnourished children were brought to hospital when they had some other disease. Majority of the parents didn't know that their children were malnourished and even admissions to the Therapeutic Feeding Centre were from other wards on referral basis. The results of anthropometry are given in Table 1 Malnourished children were underweight (41%), Marasmus (31%), Kwashiorkor was (5%) and Marasmic Kwashiorkor was present in (3%). The results are in line of (Kumar et al. 1996; Mahapatra et al. 2000; Bloss et al. 2004; Perez et al. 2006; Mitra et al. 2007). In some studies only Marasmus and Kwashiorkor were taken into consideration and in other Marasmic Kwashiorkor was also considered. Hamidu et al. (2003); Noorani et al. (2005); Najera et al. (2004) showed that the principle clinical form of malnutrition was Marasmus. However, the results of Alwar (1992) revealed that the prevalence of Marasmus was higher than the underweight. The only strong reason for this could be that he studied only those malnourished children who had measles. While, Shimeles and Lulseged (1992) showed greater number of children had Marasmic Kwashiorkor as compare to Kwashiorkor.

Breast feeding, that protects children against infections and severe malnutrition (Muller and Micheal, 2005), was not practiced and formula milk was used in greater number of malnourished children. It is in agreement with Hamidu et al. (2003). Poor quality formula milk available in large supply bags, cheaper in price, was used by low economic groups. Preparation of different formula milk was not up to mark and extremely diluted milk was given to the children. Fresh milk from wet market in most of the cases and milk adulterated for dilution at different levels was further diluted by the parents for feeding.

Table-1: Mean with SEM Mid Arm Circumference (MAC), Head Circumference (HC) and Body Mass Index (BMI) of children aged (6-60) months

Anthropometry	Nourished	Underweight	Marasmus	Kwashiorkor	Marasmic Kwashiorkor
MAC (Cm)	13.55^{a}±0.305	11.39^{b}± 0.197	10.06^{c}±0.241	11.51^{b}± 0.387	8.9^{d}± 0.592
HC (Cm)	43±1.04	42.62±0.487	40.64±0.76	43.6±1.166	40.33±2.603
BMI	18.11^{a}±0.402	14.96^{b}±0.368	12.73^{c}±0.361	15.16^{b}±0.686	12.11^{c}±0.454

**Mean with different superscript show significant difference (p < 0.05).*

Table-2: Incidence of infectious diseases in Hospitalized children

Disease	Nourished	Underweight	Marasmus	Kwashiorkor	Marasmic Kwashiorkor
Pneumonia	14	29	18	0	1
Inf. Diarhea	1	5	9	4	1
Malaria	3	1	1	0	0
TB	1	1	2	0	1
Pneu & ID	1	2	0	1	0
Maningitis	0	1	0	0	0

Table-3: Mean Hb, SA, SG, A/G ratio, TP, Leucocytes, Neutrophils, Lymphocytes and ESR of Hospitalized Children

Parameters	Nourished	Underweight	Marasmus	Kwashiorkor	Marasmic Kwashiorkor
Hb g/dl	11.65^{ab}±0.69	10.205^{a}±5.05	8.68^{ab}±0.25	6.66^{b}±0.44	8^{ab}±1.00
SA g/dl	4.47^{a}±0.09	4.00^{b}±0.06	3.33^{c}±0.03	2.3^{e}±0.20	2.55^{d}±0.15
SG g/dl	2.97^{a}±0.07	2.8^{b}±0.04	2.62^{c}±0.08	1.8^{d}±0.20	1.6^{e}±0.10
A/G Ratio	1.15±0.06	1.44±0.04	1.29±0.05	1.31±0.21	1.6±0.19
Total Protein g/dl	7.44^{a}±0.07	6.79^{b}±0.03	5.96^{c}±0.07	4.1^{d}±0.28	4.15^{d}±0.05
Leucocytes (%)	12.35^{a}±1.10	12.65^{a}±0.77	10.73^{a}±0.90	4.33^{b}±0.64	5.00^{b}±0.20
Neutrophils (%)	57.3±4.26	58.72±3.52	52.87±2.80	54.00±19.51	55.50±15.50
Lymphocytes(%)	34.8±4.18	35.36±3.28	40.06±2.83	38.33±18.33	38±16.00
ESR	8.3^{d}±1.04	17.50^{c}±2.01	22.56^{b}±1.54	30.66^{a}±2.90	30.5^{a}±2.50

***** *Mean with different superscript show significant difference (p < 0.05).*

The weaning of the children was not started at proper time. It was found that majority of the children were weaned very late. Some of the children were started weaning after one year and some children were not even there after. These results are not in agreement with the results of Cunha (2000) and

Hamidu et al. (2003) reported that children are weaned early. The possible reasons for this could be the lack of health education, the unavailability of weaning food and customarily children are given only milk up to certain age.

The incidence of disease in hospitalized children given in table (2); Pneumonia (62%) was the major infectious disease in both nourished and malnourished children. It was 70% in nourished and (60%) in malnourished children. The infective diarrhea was second major infectious disease that was (20%) amongst all the children (5% in nourished and 24% in malnourished children). This is in agreement with the results of (Cunha, 2000; Reinert, 1993; Victora et al., 1999), in which pneumonia was the major infectious disease in malnourished children. Same sort of result was shown by Ozkan and Olgun (1995), in which the prevalence of pneumonia was higher (43%) followed by infective diarrhea (13%). The study of Bryce et al. (2005) also produced the same results with pneumonia as major infection and followed by infective diarrhea in malnourished children. Similarly, Najera et al. (2004) in a study reported that in nourished infected children pneumonia was the major infection (33%). Shimeles and Lulseged (1992), showing that 63% of the malnourished children in Ethiopia had pneumonia. The results of the present study are not in agreement with Hamidu et al. (2003) reported, infective diarrhea was major infectious disease (41.6%) followed by malaria (21.7%) in malnourished children, however, Najera et al. (2004) indicated that in malnourished children, the prevalence of infective diarrhea was higher (40%) followed by pneumonia (26.66%). In other studies as by Caulfield et al. (2004) and Maitland et al. (2006) showed infective diarrhea was the major infectious disease in malnourished children.

There were fourteen (14) isolates from 50 children with 9 (64%) Gram positive and 5 (36%) gram negative organisms. In pneumonia, Klebsiella pneumoniae was the major organism followed by Streptococcus pneumoniae and Staphylococcus aureus. In infective diarrhea, Enterococci were the major organisms followed by Escherichia coli. There was one isolate of Staphylococcus epidermidis. According to Reinert (1993), the pathological agents in pneumonia were Pneumococci, Hemophilus and Stephylococci. Bachou (2006) showed that Staphylococcus aureus and Streptococcus Pneumonia were the main Gram positive organisms. In another study by Maitland et al. (2006), 35% isolates were Streptococcus pneumoniae, 12% Escherichia coli, 8% Staphylococcus aureus and other streptococcus spp. A, B and D. Noorani et al. (2005) reported that 33.3% of the Gram positive organisms were coagulase negative Staphylococci and in studies by Reed et al. (1996) Gram negative enteric bacilli were the major organisms isolated.

The findings of the present study reveals that malnutrition in children is one of the major problem , especially in children of low socio-economic groups of the society as well as the awareness regarding the malnutrition and its implication on the health is very much limited and even not consider as a health related problem.

The blood chemistry (Hb, SA, SG, A/G ratio, TP, Leucocytes, Neutrophils, Lymphocytes and ESR) are presented in table (3). In present study (86%) of the children were anemic, (96% of the malnourished and 50% of the nourished children were anemic). The mean hemoglobin level in nourished children was 11.65 g/dl and in malnourished children it was 8.34 g/dl. This is in correspondence with Najera et al. (2004), who showed that 87% of malnourished children were anemic with the mean hemoglobin 8.0 g/dl and 25% of nourished children were anemic with the mean hemoglobin level of 12.0 g /dl. According to Nahani et al. (1976) and Ambrus (2004), hemoglobin level was not affected by malnutrition.

The mean serum total protein in nourished children was within normal range (6.6 to 8.7 g/dl) It was 5.25 g/dl in malnourished children and 4.74 g/dl in severely malnourished children, Shimeles and Lulseged (1992), showed that mean serum total proteins in severely malnourished was below 5.0 g/dl.

The mean serum albumin level in nourished and underweight children was normal (3.8 to 5.0) but low in severely malnourished children and was 2.30 g/dl in Kwashiorkor category. Heimburger and Weinseir (1997) reported that serum albumin dropped below 2.8 g/dl in Kwashiorkor type of malnutrition.

The mean Neutrophils and the lymphocytes percentage were in normal ranges (35% to 80% and 15% to 50% respectively) in all nourished and malnourished children. The mean total leukocyte count was higher than normal (3.5 to 10.0/ dl) in nourished and underweight children. It was slightly higher in Marasmus whereas in Kwashiorkor, it was in the lower normal range. This is in agreement with the results of (Ambrus, 2004; Rikimaru et al., 1998) and according to Schaible and Kaufman (2007) that the cells become functionally defective in malnutrition.

CONCLUSION

Pneumonia was the major infectious disease caused by Klebsiella Pneumonia in both nourished and malnourished children, while the second major infectious disease was infective diarrhea caused by Enterococci was the major organisms followed by Escherichia coli. Malnutrition was not considered as a medical problem by the people of this area and malnourished children were brought to hospital when

they had some other disease. Malnourished children were underweight, followed by Marasmus and the prevalence of Marasmus was higher than Kwashiorkor. Majority of the children including nourished were anemic and had low BMI.

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