NUTRITIONAL EDUCATION FOR MOTHERS OF ANEMIC PRESCOOL CHILDREN

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ABSTRACT

The seriousness of nutritional anemia in children arises from its consequences for health including changes in immune function, growth and cognitive development. WHO recommended large scale nutritional programs to reduce the prevalence of anemia.

The aim of this study was to evaluate the effects of nutritional education on the mothers' knowledge and practices toward their preschool children suffering from anemia.

The study sample included 59 mothers having children of both sexes aged 3-5 y with anemia who were attending to MCH centers at El-Khosous village, Qualiobeya Governorate and El-Waily district, Cairo after referral from the nutritional outpatient clinics where diagnosis and management plans were made.

Three tools were used for data collection:1) an interviewing questionnaire to collect data regarding socio-demographic characteristics of mothers and their children and mothers' knowledge regarding anemia and nutritional requirements; 2) a nutritional assessment checklist about dietary habits and preparation of food items; and 3) a physical examination sheet for the children including anthropometric measurements and biochemical analysis.

The results of the study revealed significant effects of

nutritional education on mothers' knowledge and practices. The study recommended that nutritional education about nutrition of preschool children must be applied on a large scale for all mothers attending with their anemic children to the nutritional clinics.

INTRODUCTION

Iron deficiency is the most prevalent single nutritional deficiency, affecting over 2,000 million people, mostly in the developing world, and about 50% of people with iron deficiency develop iron deficiency anemia.[1] Nutritional anemia is defined as a condition in which the hemoglobin content of the blood is lower than normal as a result of a deficiency of one or more essential nutrients regardless of the cause of such deficiency, and iron deficiency is considered the most common cause of nutritional anemia.[2]

Since iron deficiency can exist without hemoglobin levels being lowered, there are potentially four different situations or populations: those iron anemic and iron deficient, those iron deficient but not (yet) anemic, those anemic but not due to iron deficiency, and those iron replete with normal hemoglobin.[3]

Subjects affected by anemia are, in approximate descending order of severity, pregnant women, preschool children, low-birth-weight infants, other women, the elderly, school-age children and men.[3] Iron deficiency is an important public health issue for children as it is the most common nutritional disorder in early childhood.[5] Children in the age of 1-6 years are known as preschool children, who are further divided more specifically into two groups: 1-3 years known as toddlers, and 4-6 years

referred to as preschool age.[6] The prevalence of iron deficiency anemia in preschool children has been estimated as between 10 and 30%.[4]

Iron deficiency anemia is a leading cause of infant morbidity and mortality worldwide.[5] In children, the seriousness of iron deficiency anemia arises from its consequences for health, including changes in immune function, growth and cognitive development.[7] The effects of iron-deficiency anemia in early childhood were observed in Egyptian children; children who suffered anemia in early childhood had lower IQ scores at school-entry than children who were formerly non-anemic.[3] Longitudinal studies consistently indicate that children anemic in infancy continue to have poorer cognition, school achievement, and more behavior problems into middle childhood.[8]

The effects of iron deficiency in children under 5 years have been widely reported and effects on psychomotor development are well recognized.[4] Numerous studies have demonstrated that even moderate anemia is associated with depressed mental and motor development in children that may not be reversible.[5] A causal link between iron deficiency anemia and delays in child development may be mediated by a variety of direct or indirect pathways; the most obvious are associated decreases in hemoglobin concentration and oxygen delivery to tissues.[9]

Accumulating data have underlined the important long-term health effects that may occur with iron deficiency, and studies continue to confirm the benefits of successful treatment of iron deficiency anemia.[10] As for children >2 y old, the evidence is reasonably convincing and iron treatment are warranted especially in younger children.[8]

In the developing world the prevalence of iron deficiency is due mainly to a low intake of bioavailable iron. However, in this setting, iron deficiency often co-exists with other conditions such as,malnutrition, vitamin A deficiency, folate deficiency, parasitic infestation and infection. Protein energy malnutrition affects from 12% to 60% of children under the age of 5 years in different countries of East Mediterranean and Middle East regions.[11]

Meanwhile, in the developed world iron deficiency is mainly a single nutritional problem.12 The main causes of iron deficiency in our region are: low total iron intake, low bioavailability of the iron consumed, high intake of inhibitors,low intake of enhancers, high birth rates/short birth intervals, and parasitic infestations. [11]

Overall, iron requirements for infants and children are substantially lower than in adults. But since they have lower total energy requirements than adults, they eat less and are thus at greater risk of developing iron deficiency, especially if their dietary iron is of low bioavailability.[3]

Recommended daily dietary intake of iron[13]

infants 7- 12 months	9mg
children 1- 1 years	6- 8 mg
teenagers 12- 18 years	10 - 13 mg
women 19- 54 years	12- 16 mg
54+ year	5-7 mg
men 19+ years	7mg

Iron deficiency is a multifactorial problem that requires multidisciplinary approaches and interaction. It is essential to integrate the efforts of persons and institutions, industry, government, nongovernmental organizations, and civil society. Integrated efforts can effectively and economically address iron deficiency, and other micronutrient deficiencies, throughout the life cycle.[14]

There is a need for action based on a combination of strategies appropriate to the region, i.e.: effective supplementation programmes, effective public education to achieve appropriate dietary modifications, promotion of breast-feeding and adequate complementary feeding, control of parasitic infections, family planning for health, and fortification of suitable foods.[11]

There are two approaches: primary and secondary prevention (screen and treat).[15] Because of the possible irreversibility of this condition, primary prevention is a more appropriate goal than screening and treatment.[5] For primary prevention, sufficient dietary iron must be available from 4 months of age and throughout the weaning period. Primary prevention can be achieved by giving supplementary iron, by the fortification of foods, and by dietary education changing feeding practice. For secondary prevention in districts or localities where there is severe socioeconomic deprivation, screening programmes should be helpful if they are adequately monitored and are accompanied by continuing efforts at primary prevention. In practice, this would need to be linked with one of the preschool surveillance checks or immunizations. [15]

There are 3 interventions that if implemented successfully are likely to prevent anemia. These include dietary diversification to

foods with more bioavailable iron; fortification of foods targeted to full-term infants and children; and supplementation of the individual. Supplementation should address high risk groups including infants and young children, school-aged children, adolescent girls, women of childbearing age, and pregnant women.[14]

Strategies such as dietary diversification and food fortification have yielded significant results in controlling iron deficiency anemia in developed countries.[9] Dietary diversification involves promotion of a diet with a wider variety of naturally iron-containing foods, especially red meat, poultry and fish. These foods have a high content of highly bioavailable heme iron and thus are most appropriate for infants and children above 6 months of age.[5]

Iron-rich foods in diet include meat and fish as beef, lamb (especially kidneys and liver), veal, poultry, sardines and tuna; fruits as figs, raisins, peaches and prune; vegetables as greens (spinach, lettuce), beans, peas and sweet potatoes; and grains as wholegrain breads.[13] Dietary iron may be considered as being composed of two distinct pools, haem iron and non-haem iron; haem iron is highly available and is found in meat, while non-haem iron is found in plant food and dairy products and comprises the major source of dietary iron.[3]

Absorption of non-haem iron is highly variable, depending on enhancing and inhibiting factors. Figures of 1-20% absorption have been found in various studies of mixed diets, while figures of over 50% have been quoted where the iron was mainly from animal sources. Factors known to stimulate absorption (bioavailability) of non-haem iron are the presence of meat,

poultry, seafood and various organic acids, particularly ascorbic acid (vitamin C). Important iron absorption inhibitors are polyphenols, including tannins, phytate, certain forms of protein and some forms of dietary fiber. Foods that contain these factors and therefore have a strong inhibiting effect on iron absorption include tea, coffee, egg yolk and bran.[3]

Although the iron in human milk is highly bioavailable, the concentration is low, and human milk provides only a very small proportion of iron requirements. After age 6 months nearly all iron must come from complementary foods.[16] When complementary foods are not available; the preventive iron supplementation from 6 to 18 months of age has to be advised.[17]

Iron fortification of staple foods or condiments as cooking salt, directed to the whole population, is a sustainable and low cost-effective approach. Never the less, for infants and young children, iron fortification of complementary food is effective but this food is generally economically inaccessible to populations with limited resources.[17] Strategies to improve the availability of and accessibility to low cost fortified complementary foods can play an important role in behavioral changes necessary to improve the nutritional status of infants and young children.[16]

Vegetable protein sources are often mixed with cereals for complementary feeding. Both contain high levels of phytic acid, so iron absorption may be as low as 2-3%. Complete enzymatic degradation of phytic acid is recommended. If this is not possible, it is recommended that the molar ratio of phytic acid to iron in an iron-fortified food be <1, preferably <0.5.[18] Ascorbic acid is a potent enhancer of non-heme iron absorption that can

overcome the inhibiting effect of phytic acid when present in high enough quantities. However, home prepared complementary foods based on cereals and legumes contain negligible amounts of ascorbic acid unless ascorbic acid-rich foods are mixed with the cereal or consumed at the same time.[19] Compared with water, orange juice will double the absorption of non-haem iron from a breakfast.[15]

These interventions are more effective when they integrate other approaches like the improvement of the nutritional practices, infection control and the promotion of breast-feeding and when coupled with programs aiming to control other micronutrient deficiencies.[17] Feeding behaviors, including breast-feeding, responsive feeding, safe preparation and storage of complementary foods, food consistency and meal frequency, are also critical to ensuring good nutrition during this vulnerable period of development.[16]

Other measures to improve iron status include improved sanitation and hygiene, treatment of parasitic diseases, immunization and other infection control, and improved child spacing. Information, education, and communication activities are crucial to supporting compliance and promoting sustained behaviors that improve iron nutrition.[14] The most effective means of preventing iron deficiency anemia should be through dietary education, emphasizing optimum feeding regimens and adequate weaning and toddler diets, with the use of fortified foodstuffs where appropriate.[4] Nutrition interventions that are well-conceived and well-executed can improve nutritional conditions through belief-mediated pathways, where as disjunctions between community belief systems and nutritional advice have affected intervention activities.[20] Health educators

should understand the influence of differing cultural practices and economic constraints and acknowledge how the receipt and implementation of such information by individuals will be influenced by conflicting advice from other family members (particularly when these are the relevant care givers) and friends.[4]

Food plays an important role in the overall personality of a child and is a way of communicating as it has cultural and social meaning. Care should be taken that, every day, foods from all the five food groups must be given for proper development.[6]

Because of the well-documented squeals of anemia, there is a continuing need to develop strategies and educate caregivers about the prevention and management of iron deficiency anemia.[5] The implementation of national nutrition plans including the control of iron deficiency as one of the priorities and the participation of the public health and education sectors, food industries, the community and the media should contribute to the success of the interventions and to the control of iron deficiency.[17]

AIM OF THE STUDY

The aim of this study was to evaluate the effects of nutritional education on the mothers' knowledge and practices toward their preschool children suffering from anemia.

SUBJECTS AND METHODS

This study was a prospective longitudinal survey.

SITE

The Maternity and Child Health (MCH) centers at El-Khosous

village, Qualiobeya Governorate and El-Waily district, Cairo Governorate.

STUDY SAMPLE

All mothers of anemic preschool children aged 3-5 years from either sex attending to the nutrition clinic of the MCH centers during Sep 2002, who fulfilled the inclusion criteria, were included in the study. The original study sample included 72 mothers along with their anemic preschool children. The inclusion criteria were that the child should not have gross malnutrition or protein energy depletion, has iron deficiency anemia and has been diagnosed and started treatment recently.

TOOLS OD DATA COLLECTION

Three tools were used for collecting data pertaining to this study:

1) Interview questionnaire:

The questionnaire was directed to mothers and was formed of three parts. The first part included data regarding to mothers' socio-demographic characteristics as age, education level, number of and spacing between children and per-capita income. The second part was concerned with the anemic children including sex, age, birth order, history of parasitic infestation or severe infections and duration of breast feeding. The third part explored the mothers' knowledge regarding prevention and control of anemia; and children diet including timing of weaning, types and preparation of complementary food, basic food groups, food rich in iron, nutritional requirements, food hygiene and signs of impaired growth and development. Mother's knowledge

was ranked "poor" if she scored less than 40%, "average" if scored 40% - <70%, and "good" if scored ≥ 70%.

2) Interview and observational checklists:

Data on dietary practices were collected by 24 hour and seven day diet recall methods. These involved interviewing checklists on food offered to the children. For 24 hour recall, data were collected on foods and drinks taken at mealtimes and other daytime snacks. Data on seven day diet recall were obtained by indicating the regularity of consumption of specific foodstuffs being daily, three times weekly, once weekly, or not at all. On the basis of the diet recalled, individual child food scores were calculated from 1 to 7 with the consumption of foods in the following groups: (1) meat/fish; (2) eggs; (3) cereals/bread; (4) green vegetables; (5) lentils; (6) beans/non-green vegetables; and (7) fresh fruit/fruit juice.

The emphasis on determining an "adequate" or "inadequate" diet in terms of iron containing foods was based on the quantity and quality of consumed foods containing haem iron, non-haem iron and vitamin C. An adequate iron food score for data from 24 hour recall was defined as an intake of more than four of the foodstuff groups listed in. For the seven day recall data an intake of more than four of the foodstuff groups at least three times in the week was classed as adequate.

An observational checklist was prepared by the researchers to assess the mothers' practices related to preparing, storing and serving food for their children. The list included 10 items as type and cleanliness of utensils, storage and washing of fresh foodstuffs, freshness of preparations served to children, approaches used to feed the child, and the adequacy of the

quantity of food served. Each mother's practices were scored from 1-10, if the score was 6 or more it was appraised as "satisfactory", if less than 6 it was "unsatisfactory".

3) Physical assessment sheet:

Data on children's growth status was obtained by measuring weight and height with minimum clothing and no shoes. Weight was measured to the nearest 100 g and height was measured to the nearest centimeter following the standardized procedures. The weight and height measurements were converted into weight-for-height percentage of standard for each child using NCHS standards.[21] The children were grouped into different grades of nutrition status using the cut-off points of Waterlow's classifications: weight for height equal to or more than 80% = normal and less than 80% = wasted.[22] low weight for height suggested a recent nutritional deficiency.[23]

The degree of anemia was determined according to the level of hemoglobin concentration (HB%) at the start of treatment according to the child's medical file. HB% equal to or more than 11 gm/dl was considered normal, HB% 9-11 gm/dl = mild anemia, HB% 7-9 gm/dl = moderate anemia, and HB% <7 gm/dl= severe anemia.[24]

INTERVENTION

An informed consent was taken from all mothers participating in the study. Also the researchers obtained the approval of the MCH centers' administrators before conducting the study.

A pilot study was made on a sample of 5 mothers to validate the instruments used and to refine the education program implemented.

All children included in the study, who had parasitic infestation, received the proper medication before starting iron treatment. Iron treatment consisted of a flavored liquid supplement containing 20 mg/ml ferrous sulphate, with a daily dose ranging between 10-70 mg for a period of 1-3 months according to body weight and severity of anemia.[9] Iron supplementation continued till HB% was back to normal range.

Trained 4th year students of the Faculty of Nursing of Ain Shams visited all mothers at home. Each mother was interviewed using the interviewing questionnaire and the diet recall checklists. The observational checklist was also applied during the same visit. Each mother was allocated to a subgroup of 10 mothers and given appointment to attend the educational sessions in the MCH center.

Nutrition education intervention was prepared by the researchers based on review of literature. The education addressed general nutritional knowledge as meaning of good nutrition, the main 5 groups of nutrients and foods containing them, nutritional requirements of preschool children in terms of food type and quantity, and proper food preparation and hygiene. Also education addressed iron deficiency anemia as causes, prevention and control stressing the importance of compliance to treatment and follow up. Education emphasized the importance of breast feeding, timing and quality of complementary feeding, and proper weaning for the prevention of anemia in present or future infants and toddlers in the family.

The intervention was implemented by the researchers in the MCH centers over two sessions, a week apart, delivered to each subgroup of mothers. Video cassettes, posters and leaflets were

utilized to deliver the information using open discussion method. Mothers had the opportunity and were encouraged to discuss the specific information.

Home visit was repeated 6 months after implementation by a different nursing student. The third part of the questionnaire and the checklists were reapplied by the nurse students. Also anthropometric measures and HB% was repeated at the end of the 6 months. The data collected (post-test) were compared to those collected before implementation of the intervention (pre-test) to assess the influence of the nutrition education.

The collected data were tabulated and analyzed using computer software Microsoft Excel. Chi square test was used to determine statistical significance of observed differences between pre-test and post-test results. The confidence level chosen for the study was 95% at a p value of 0.05.

RESULTS

The study sample was recruited in Sep, 2002 when 72 mothers along with their anemic children who fulfilled the selection criteria were included in the sample. Weight and height of children were measured at selection and the pretreatment HB% was recorded. The trained nursing students finished the initial home visit and application of instruments (pre-test) in Oct-Nov, 2002. Implementation of the intervention was completed in Nov, 2002 and the follow up home visits were executed in May-June 2003. The final study sample was 59 mothers and their 59 anemic children as 13 mothers were excluded from the original sample due to failure to attend the interventional sessions or to conduct the follow up home visit.

Table [1] shows the distribution of mothers according to their

socio-demographic characteristics. As regards to age, 42.4% aged 20-<30y and 30.5% aged 30-<40y. the remaining mothers divided between the youngest and oldest age groups (15.3% and 11.9%). The mean age was of mothers was 27.2y (SD 4.2).the majority of mothers (57.6%) attended part or the entire primary schooling only, and further 18.6% were illiterate. The majority (71.2%) had poor economic status as their per capita annual income was <800 pounds.

Only 11.9% of mothers had 1-2 children, while 45.8% had 3-4 and 42.4% had >4 children. The spacing between deliveries was <2y for the majority (59.3%) of them. Also, 71.2% of mothers had children other than those included in the study who suffered of anemia either concomitantly or in the past. Furthermore, 61% of mothers had a history of anemia themselves.

Some of the characteristics of the children included in the study are shown in table [2]. Males constituted 57.6% of the sample and rest were females. The majority (61%) aged 4-5y and 39% aged 3-4y, mean age was 52.77 [SD 5.8]. only 13.6% of them were never breast-feed, while the rest were breast-feed for varying periods. The majority of the children had a present or past history of parasitic infestation or severe infections.

Table [3] presents the grade of nutrition state of the study children as abstracted from the weight for height percentage of standards according to Waterlow's classification. Those graded as "normal" were 57.6%, while the rest were graded as "wasted". The same table shows the distribution of the children according to the degree of anemia. More than half of them (52.5%) had moderate anemia, about one third (30.5%) had severe anemia, and 16.9% had mild anemia. When the degree of anemia was

distributed according to the grade of nutrition (table 4), it was found that among the "wasted" children 44% had severe anemia and 40% had moderate anemia. On the other hand, among the "normal" grade, only 21% had severe anemia and 62% had moderate anemia. Never the less, the differences in distribution of the degree of anemia according to the grade of nutrition were statistically insignificant.

Table [4] shows also the distribution of the degree of anemia according to children characteristics. The differences in degree of anemia distribution according to the child's sex were minor and insignificant statistically. When the distribution according to age was considered, it was observed that the older age group had worst degree of anemia compared to the younger age group. Among the 48-60m age group, 36% had severe anemia and 58% had moderate anemia, while the percentages among the 36-<48m age group were 22% and 43% respectively. Those with mild anemia constituted only 6% of the older group while they were 35% of the younger group. These differences were statistically significant.

Also the child's birth order among other children in the family had a significant influence on the distribution of the degree of anemia. The incidence of severe anemia among the first born children was three folds of that among the second born or next born (60%, 20% and 21% respectively). The opposite occurred regarding to the incidence of mild anemia as it was 7% among first born children, 16% among second born and 26% among next born.

As for the breast feeding duration, it was found that the highest incidence of severe anemia (63%) was among children

who were never breast feed, then came the incidence among those breast feed for <1y (48%) then those who were feed for >2y duration (33%). By far, the least incidence of severe anemia was among children breast feed for 1-2y duration. These clear differences were also statistically significant.

Present or past history of parasitic infestation or severe infections had also strong association with the incidence of severe anemia. Children with positive history had more than four folds incidence of severe anemia than those who had not. On the contrary, only 6% of children with positive history had mild anemia, while the incidence was 58% among those with negative history. Again the differences were statistically significant.

The distribution of the children's degree of anemia according to their mothers' socio-demographic characteristics is shown in table [5]. Mothers' level of education had a clear and significant association with the distribution of the degree of anemia. The higher is the level of education, the less is the incidence of severe anemia among children; and more is the incidence of mild anemia. The percentage of severe anemia among children of illiterate mothers was three folds of that among mothers with primary schooling and nine folds of that among mothers with intermediate education.

As regards to the history of anemia among mothers, it was observed that the percentage of children with mild anemia among mothers with positive history was a quarter of that among mothers with negative history (8% and 30% respectively) and the percentage of moderate anemia was much higher among former mothers (61%) than the latter (39%). Never the less, these observed difference had no statistical significance. Also,

although the percentage of severe anemia among children of mothers with per capita annual income <800 pounds was double and the percentage of mild anemia was less than half that among mothers with income >800 pounds, yet the differences were statistically insignificant.

The number of children in the family, per se, did not have a significant influence on the distribution of the degree of anemia. Meanwhile, the spacing between children had a significant influence. When the spacing was <2y, the percentage of children with severe anemia was 43% while it was 9% for mild anemia. On the other hand, when spacing was >2y the percentage of severe anemia was 13% and of mild anemia was 29%.

Table [6], in its first part, shows the distribution of the degree of anemia among children according to their mothers' knowledge scores regarding to prevention and control of anemia, proper children feeding including weaning and complementary foods, basic food groups, food rich in iron, nutritional requirements, food hygiene and signs of impaired growth and development. The incidence of severe anemia among children of mothers with poor knowledge was almost double than that among children of mothers with average knowledge, in contrast to incidence of mild anemia among children of mothers with poor knowledge that was one ninth of the incidence among mothers with average knowledge. Only one mother had good knowledge and her chilled suffered of mild anemia. The differences were statistically significant.

The same table showed the distribution of the degree of anemia according to children's diet adequacy as shown by either the 24h or the 7d diet recall checklists. All children with severe

anemia fell into the category of inadequate diet in both lists. Children who had adequate diet suffered from either mild or moderate anemia, but no severe anemia. Meanwhile children with inadequate diet had about 40% severe anemia, about 50% moderate anemia and only 7% mild anemia. These differences were statistically significant. The differences when distribution was done according to food handling practices were minor and insignificant statistically.

Table [7] presented the influence of the nutrition education intervention on the areas that were tackled; knowledge, diet adequacy mainly as regards to iron supply, and food handling practices. There was striking improvement in all areas that carried high statistical significance. As for mothers' knowledge before intervention, only 1.7% had good knowledge and 27.1% had average knowledge while 6 months after the intervention 18.6% had good knowledge and 61% had average knowledge. Also before intervention, mothers who offered adequate diet to their children according to either the 24h or the 7d recall list were 25.4% or 22% respectively. These percentages came up to 62.7% after intervention. As well, mothers who had satisfactory food handling practices were 32.2% before and 54.2% after intervention.

Finally, we compared the distribution of the degree of anemia and the grade of nutrition of the study children at the beginning of the study and the end of implementation (about 9 month difference) as shown in table [8]. The children who were wasted before the study compromised 57.6% but this came down to 35.6% after the study. None of the children has normal HB% before the study (anemia was an inclusion criterion), but after the

study 40.7% had normal HB%. The percentage of severe anemia dropped from 30.5% to nil. The percentage of mild anemia was doubled and that of moderate anemia was halved. The improvement in both the grade of nutrition and the degree of anemia was highly significant.

DISCUSSION

The aim of this study was to evaluate the effects of nutritional education on the mothers' knowledge and practices toward their preschool children suffering from anemia. The tools applied to the study population of mothers and anemic children were designed to collect qualitative data describing the characteristics of mothers that might influence the nutritional state of their children, mothers' knowledge and practices pertaining to this issue, the adequacy of diet offered to children regarding mainly iron content and bioavailability, and the degree of anemia and grade of nutrition among children.

In this study, the "weight for height" percentage of standards was used to grade the nutrition state. Weight for height is a sensitive indicator of current nutrition status and of the degree of wasting.[25] Results of the pre-intervention assessment [table 3] indicated that 42.4% of the children were "wasted". Analysis of effect of under-nutrition indicated that numerous factors affect child nutrition with a maximum effect on weight for height and lead to wasting; stunting or underweight.[25] Iron-deficient youngsters may not gain enough weight, as they have problems with feeding and digestion.[13]

On the other hand, more than half (57.6%) of the anemic children were categorized as "normal". This observation pointed to fact that diet containing enough calorific and protein content

would not necessarily provide the child with required iron either in amount or bioavailability. It was stated that in the developed world iron deficiency is mainly a single nutritional problem without other manifestation of malnutrition.[12]

The results [table 3] showed that 30.5% of the children had severe anemia, while 16.9% had mild anemia. This finding shows that parents did not seek medical advice for their children early in the course of anemia as they were not aware of the manifestations and also because the symptoms of mild anemia were minimal. There was no significant difference in the distribution of the degree of anemia between boys and girls [table 4]. This was explained by the fact that both sexes had similar growth rates and nutritional requirements at this age group.[6]

It was observed in this study [table 4] that the severity of anemia was significantly more in the older age group. This could be explained that older children had suffered of the nutritional deficiency for a longer time than younger children allowing the severity of anemia to build up. Also it was observed that the first born children had tendency toward severe anemia than the second or third born. This finding agreed with Shah et al[26] results that showed that malnutrition was most prevalent in first-order children and the prevalence rate decreased gradually to reach it lowest value in late-order children. On the other hand, the results of Ezzat et al[27] contradicted this as they stated that anemia was least prevalent in first-order children and highest in fifth-order or later children and that the prevalence of severe anemia was highest in children from the latter group as compared with first-order children.

Also table [4] showed that the incidence of severe anemia was highest in children who were never breast feed then who were breast feed for less than one year, then those feed for more than two years and least in those feed for 1-2 years. The first two subgroups have received bottle feeding of cow's milk preparations that is lower iron concentration than mother's milk.[15] Children who continued breast feeding for more than two years consumed lesser amount of iron rich foods than those weaned off breast feeding at 2y age or less.

In this study, about 80% of children had history of parasitic infestation or severe infections [table2]. This agreed with *Stoltzfus*[2-9] who stated that helminthic infections were prevalent among anemic children. The incidence of severe anemia among those with positive history was four times more than that among children with negative history. Parasitic infestations and severe infections as diarrheal diseases increase blood losses and decrease intake and absorption of nutrients. This result was consistent with publications that mentioned that parasitic infestations are contributory factors in developing anemia.[11-12] Also the incidence of severe anemia among this study children was doubled among wasted than normal children. Children, whose nutrition grade was normal, received diet that was enough for normal growth both in quantity and quality except for iron content or bioavailability. Meanwhile, wasted children received food of inadequate quality and quantity that predisposed to severer degree of anemia.

When the association between mothers' characteristics and the distribution of the degree of anemia was examined [table 5], the level of mothers' education had a significant association with the

degree of anemia. The incidence of severe anemia decreased with the rise of education level. The same result was stated in the literature frequently.[2,9,25,27] Also the incidence of severe anemia was doubled in children coming from families of the lower income group than in those of higher income. This result was consistent with the literature.[2,9,20,25,27] Despite that women in more favorable economic circumstances, and who have more education, tend to feed their children a higher quality diet, yet education plays a role in nutritional outcomes above and beyond the effects of differential wealth..[20]

Spacing between children had a significant influence on the distribution of the degree of anemia. Children of mothers who had history of spacing <2 years had incidence of severe anemia triple that when spacing was >2 years. Short spacing between children depletes the iron stores of mothers and may cause low iron stores for the child at birth. Also short spacing does not allow mothers to breast feed their children for the required period of 2 years, that predisposes children to severe forms of anemia as indicated before.

This study has analyzed the association between the distribution of the degree of anemia and mothers' dietary knowledge, adequacy of diet offered to children and mothers' food handling practices [table 6]. The results revealed that the association was highly significant with the former two variables, but insignificant with the third variable. Logically, the higher was the dietary knowledge of mothers, the less was the degree of anemia. The same inter-relation was revealed as regards to diet adequacy according to either the 24 hour or the seven days diet recall outcomes. Regarding food handling practices, although the

association was statistically insignificant, it is worth mentioning that the incidence of severe anemia was considerably higher (35%) when practices were unsatisfactory than when they were satisfactory (21%).

Six month after the nutritional education intervention was implemented, data about mothers' knowledge and practices and children's diet adequacy were recollected to be compared to the data collected before intervention. The six month gap was intended to make sure that the outcomes of the post-intervention assessment expressed the retained knowledge and the constant practices that were gained from the intervention. The comparison outcomes [table 7] were considered as indicators to the effect of the intervention on these variables.

As regards to mothers' dietary knowledge, the percentage of mothers with good knowledge increased 11 folds (from 1.7% to 18.6%), and that with average knowledge increased more than two folds (from 27.1% to 61%). The percentage of mothers who offered adequate diet to their children post-intervention were about two and half times that in pre- intervention according to both the 24h and 7d diet recall data. The improvement achieved regarding knowledge was greater than that regarding diet adequacy. This was explained by that low economical stat and influence of other family members (as grand mothers or mothers in law) could have imposed constraints in applying the gained dietary knowledge to improving the diet adequacy. Pelto[20] stated that material or economic variables appear to have been enabling or constraining factors that affected the potential for beliefs, knowledge or culture to play a significant role. Still the improvement achieved regarding both knowledge and diet adequacy was of high statistical significance.

As regards to food handling practices, mothers with satisfactory practices increased from 32.2% pre-intervention to 54% post intervention. The improvement was statistically significant too. The improvement was not very big as many factors that influence food handling might be difficult to change due to socio-economic reasons as the presence of refrigerator to preserve foods or the availability of proper cooking and storage utensils. Also the frequency of meals, how they are served to children and approaches in feeding them would have been influenced by children behaviors and personality of adults who are offering the meals. Food refusal is common in this age and may influence the actual iron intake when compared with the diet offered.4 Preschool is the age when the children become busy with their play and pay no attention to the eating pattern and have a short attention span and are easily distracted from eating.[6]

At the end of the study, the grade of nutrition and the degree of anemia were measured again with about nine month interval. The comparison between the distribution of these two parameters before and after intervention [table 8] revealed big improvement that was statistically significant. The percentage of wasted children came down from 57.6% to 35.6%. The HB% rose up to normal range in 40.7% of children, while none of the children who were not yet cured had severe anemia. The iron supplementation therapy and anti-helminthic treatment given to children played a major part in this highly significant improvement of course. Still, the improvement achieved in mothers' dietary knowledge, diet adequacy and food handling practices should have played an important role in achieving and maintaining the gained improvement in these two parameters.

Trowbridge[14] stated that information, education, and communication activities are crucial to supporting compliance and promoting sustained behaviors that improve iron nutrition. The most effective means of preventing iron deficiency anemia should be through dietary education, emphasizing optimum feeding regimens.[4]

CONCLUSION

Iron deficiency anemia is still having high prevalence among preschool children worldwide. Because of the well-documented adverse sequelae of anemia on children development and growth, there is a continuing need to develop strategies to educate mothers about the prevention and management of iron deficiency anemia.

The results of this study indicated that the nutritional education intervention directed to mothers of anemic preschool children was effective in significantly improving their dietary knowledge. Also the intervention succeeded in improving the adequacy of diet offered to these children. The improvement achieved in both knowledge and diet adequacy was statistically highly significant. The intervention also a statistically significant improvement in the mothers' food handling practices.

The improvement achieved was retained by mothers 6 months after the intervention. This promises that it would be permanent and would influence the dietary practices of these mothers with their other children. Also, the newly gained knowledge and practices might be conveyed by mothers to their peers.

The intervention participated in inducing and maintaining improvement in the nutritional and anemic state of the study

children. This indicated that nutrition interventions that are well-conceived and well-executed can improve nutritional conditions of preschool children.

RECOMMENDATIONS

- Integrated multidisciplinary approaches and interaction are needed to effectively and economically address the problem of iron deficiency anemia.
- Nutrition education interventions should be directed to mothers nationwide to prevent occurrence of iron deficiency anemia among children.
- Health educators should understand iron nutrition and deficiency in young children, and be able to handle the influence of differing cultural practices and economic constraints.
- There is a need for effective supplementation programs directed specially for high risk groups as preschool children.
- There is a need for effective public education to achieve appropriate dietary modifications, promotion of breast-feeding and adequate complementary feeding, control of parasitic infections, and family planning for health.
- Local industries should be encouraged to produce iron fortified complementary food that is economically accessible to populations with limited resources.

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TABLE 1

SOCIO-DEMOGRAPHIC

CHARACTERISTICS OF MOTHERS

	N	%
AGE	<20y	9 15.3%
	20- <30 y	25 42.4%
	30- <40 y	18 30.5%
	≥40 y	7 11.9%
EDUCATION	illiterate	11 18.6%
	primary	3 57.6%
	Intermediate	12 20.3%
	university	2 3.4%
NUMBER OF CHILDREN	1 or 2	7 11.9%
	3 or 4	27 45.8%
	> 4	25 42.4%
SPACING	<2 y	35 59.3%
	>2 y	24 40.7%
HISTORY OF OTHER ANEMIC CHILDREN	yes	42 71.2%
	No	17 28.8%
HISTORY OF MATERNAL ANEMIA	yes	36 61.0%
	No	23 39.0%
PER CAPITA INCOME	<800 lb/y	42 71.2%
	>800 lb/y	17 28.8%

TABLE 2

CHARACHTERISTICS OF ANEMIC CHILDREN

		N	%
SEX	male	34	57.6%
	female	25	42.4%
AGE	36- <48 m	23	39.0%
	48- 60 m	36	61.0%
BIRTH ORDER	first	15	25.4%
	second	25	42.4%
	≤third	19	32.2%
BREAST FEEDING DURATION	never	8	13.6%
	< I y	21	35.6%
	1- 2 y	24	40.7%
	> 2 y	6	10.2%
PARASITIC INFESTATION	yes	47	79.7%
OR SEVERE INFECTIOS	no	12	20.3%

TABLE 3

PHYSICAL ASSESSMENT OF CHILDREN

		N	%
GRADE OF NUTRITION	wasted	25	42.4%
	normal	34	57.6%
DEGREE OF ANEMIA	normal	0	0.0%
	mild	10	16.9%
	moderate	31	52.5%
	severe	18	30.5%

TABLE 4

DISTRIBUTION OF THE DEGREE OF ANEMIA ACCORDING TO CHILDREN CHARACHTERISTICS AND GRADE OF NUTRITION

		Degree Of Anemia						row total	x^2test
		mild		miderate		severe			
		n= 10	%	n = 31	%	n = 18	%		
Sex	male	6	18%	18	53%	10	29%	34	x^2=0.06
	female	4	16%	13	52%	8	32%	25	p=0.97
	total	10	17%	31	53%	18	31%	59	insihgnficant
Age	36-<48 m	8	35%	10	43%	5	22%	23	x^2 = 8.61
	48-60 m	2	6%	21	58%	13	36%	36	p = 0.01
	total	10	17%	31	53%	18	31%	59	significant
Birth Order	first	1	7%	5	33%	9	60%	15	x^2 = 935
	second	4	16%	16	64%	5	20%	25	p = 0.05
	≥ third	5	26%	10	53%	4	21%	19	sighnificant
	total	10	17%	31	53%	18	31%	59	
Breast Feeding Duration	never	1	13%	2	25%	5	63%	8	x^2 = 17.87
	< 1y	3	14%	8	38%	10	48%	21	p = 0.02
	1-2y	5	21%	18	75%	1	4%	24	significant
	> 2y	1	17%	3	50%	2	33%	6	
	total	10	17%	31	53%	18	31%	59	
Parasitic Infestation or Severe Infectins	yes	3	6%	27	57%	17	36%	47	x^2 = 18.71
	no	7	58%	4	33%	1	8%	12	p = <0.001
	total	10	17%	31	53%	18	31%	59	significant
Grade Of Nutrition	wasted	4	16%	10	40%	11	44%	25	x^2 = 0.14
	normal	6	18%	21	62%	7	21%	34	p = 3.91
	total	10	17%	31	53%	18	31%	59	insighificant

TABLE 5

DISTRIBUTION OF THE DEGREE OF ANEMIA ACCORDING TO MOTHERS' SOCIO-DEMOGRAPHIC CHARACTERISTICS

		Degree Of Anemia						row total	x^2test
		mild		miderate		severe			
		n= 10	%	n = 31	%	n = 18	%		
EDUCATION	lliterate	1	9%	2	18%	8	73%	11	x^2=19.38
	Primary	4	12%	21	62%	9	26%	34	p = 0.01
	intermediate	4	33%	7	58%	1	8%	41	significant
	university	1	50%	1	50%	0	0%	2	
	total	10	17%	31	53%	18	31%	59	
NUMBER OF CHILDREN	1 or 2	2	29%	4	57%	1	14%	7	x^2 = 7.17
	3 or 4	6	22%	16	59%	5	19%	27	p = 0.13
	> 4	2	8%	11	44%	12	48%	25	Insignificant
	total	10	17%	31	53%	18	31%	59	
SPACING	<2 y	3	9%	17	49%	15	43%	35	x^2 = 8.12
	>2 y	7	29%	14	58%	3	13%	24	p = 0.02
	total	10	17%	31	53%	8	31%	59	significant
HISTORY OF MATERNL ANEMIA	yes	3	8%	22	61%	11	31%	36	x^2 = 5.34
	no	7	30%	9	39%	7	30%	23	p = 0.07
	total	10	17%	31	53%	18	31%	59	Insignificant
PER CAPITA INCOME	<800 lb/y	5	12%	22	52%	15	36%	42	x^2 = 3.48
	>800 lb/y	5	29%	9	53%	3	18%	17	p = 0.18
	total	10	17%	31	53%	18	31%	59	Insignificant

TABLE 6

DISTRIBUTION OF THE DEGREE OF ANEMIA ACCORDING TO MOTHERS' KNOWLEDGE, DIET ADEQUACY AND FOOD HANDLING PRACTICES

		Degree Of Anemia						row total	x^2test
		mild		miderate		severe			
		n= 10	%	n = 31	%	n = 18	%		
MOTHERS' KNOWLEDGE	Poor	2	5%	25	60%	15	36%	42	x^2 =17.54
	average	7	44%	6	38%	3	19%	16	p = 0.002
	good	1	100%	0	0%	0	0%	1	significant
	total	10	17%	31	53%	18	31%	59	
DIET ADEQUACY ACCORDIN TO 24H DIET RECALL	adequate	7	47%	8	47%	0	0%	15	x^2 = 16.62
	inadequate	3	7%	23	52%	18	41%	44	p = <0.001
	total	10	17%	31	53%	18	31%	59	significant
EIET ADEQUACY ACCORDINGTO 7D DIET RECALL	adequate	7	54%	10	77%	0	0%	13	x^2 = 20.37
	inadequate	3	7%	21	46%	18	39%	46	p = <0.001
	total	10	17%	31	53%	18	31%	59	significant
FOOD HANDLING PRACTICES	satisfactory	4	21%	11	58%	4	21%	19	x^2 = 1.25
	unsatisfactory	6	15%	20	50%	14	35%	40	p = 0.53
	total	10	17%	31	53%	18	31%	59	Insignificant

TABLE 7

EFFECT OF THE INTERVENTION ON MOTHERS' KNOWLEDGE, DIET ADEQUACY AND FOOD HANDLING

		Bedfore Intervention		After Intervention		x^2test
		n	%	n	%	
MOTHERS' KNOWLEDGE	Poor	42	71%	12	20.3%	x^2 =32.69
	average	16	27%	36	61.0%	p = <0.001
	good	1	1.7%	11	18.6%	significant
	total	59	100%	59	100.0%	
DIET ADEQUACY ACCORDING TO 24H DIET RECALL	adequate	15	25%	37	62.7%	x^2 = 16.64
	inadequate	44	74%	22	37.3%	p = <0.001
	total	59	100%	59	100.0%	significant
DIET ADEQUACY ACCORDING TO 7D DIET RECALL	adequate	13	22.0%	37	62.7%	x^2 = 19.99
	inadequate	46	78.0%	22	37.3%	p = <0.001
	total	59	100.0%	59	100.0%	significant
FOOD HANDLING PRACTICES	satisfactory	19	32.2%	32	54.2%	x^2 = 5.84
	unsatisfactory	40	67%	27	45.8%	p = 0.016
	total	59	100.0%	59	100.0%	significant

TABLE 8

COMPARISON OF THE DEGREE OF ANEMIA AND GRADE OF NUTRITION BEFORE AND AFTER THE INTERVENTION

		Bedfore Intervention		After Intervention		x^2test
		n	%	n	%	
GRADE OF NUTRITION	Wasted	34	57%	21	35.6%	x^2 =5.76
	normal	25	42.4%	38	64.6%	p = 0.016
	total	59	100.0%	59	100.0%	significant
DEGREE OF ANEMIA	normal	0	0.0%	24	40.7%	x^2 = 50.90
	mild	10	16.9%	20	33.9%	p = <0.001
	moderate	31	52.5%	15	25.4%	significant
	severe	18	30.5%	0	0.0%	
	totlal	59	100.0%	59	100.0%	