Anemia And Nutritional Status of Pre-School Children In North Gaza , Palestine

Bassam Alzain

Abstract :- The most common cause of anemia is a deficiency of iron; but it may also be caused by deficiencies of folates, vitamin B12 and protein. Some anemias are not caused by nutritional factors, but by congenital factors and parasitic diseases such as malaria. This study attempted to estimate the prevalence of anemia and investigate nutritional status among pre-school children in three rural communities of North Gaza government area. A total of 150 children between the ages of 24 - 62 months were randomly selected over a period of six months and prevalence of anaemia was estimated. The World Health Organization (WHO) age-adjusted cut-off for hemoglobin were used to classify anemia. Under- nutrition (stunting, wasting and underweight) was classified according to the National Centre for Health Statistics standards. Heights, weights and Mid Upper Arm Circumference were measured.Haemoglobin levels of children were estimated by cyanmethaemoglobin method. The information regarding their age, sex, clinical condition and kind of the food intak was collected in a Proforma through an interview. Chi-square and t- test was used to assess the relationship of anemia to sex, dietary habits, and nutritional status. The prevalence of anemia was 65.3 % having haemoglobin levels lower than 11g/dl. The percentage of anemic children among male and female children was 35 and 30 respectively and statistical analysis showed that male children were more susceptible to anemia. Malnutrition was patent; 34.0% of the children were stunted, 20.3% wasted and 45.0% underweight. Anaemia was also significantly higher in Jabalia camp than in bait hanon and Bait lahia town pre- school children ($P<0.001$) . Consumption of all the food intake by majority of the children was comparatively less than the recommended dietary allowances . Data on anthropometry revealed that out of total children screened (N=150), mean height and weight in all the age group was significantly ($p<0.05\%$) less than the National Center for Health Statistics standards. The mean MUAC in all the age groups was significantly ($p<0.01\%$) less than the National Health and Nutrition Examination Survey standards. It is concluded that poor anthropometric indices, undernutrition and iron deficiency anemia may be due to lower intake of food than recommended.

Keywords:- food intake ; Haemoglobin ; Anthropometrics; Anemia ; pre- school children.

1 INTRODUCTION

Anemia is a widespread public health problem associated with an increased risk of morbidity and mortality. Anemia is a disease with multiple causes, both nutritional (vitamins and minerals deficiencies) and non-nutritional (infection) that frequently might appear. Unfortunately, there has been little documented progress in the universal fight against anemia and data from WHO showed that 818 million children under the age of five and women affected by anemia, mainly in developing countries [1]. About one million of them die every year. young children (0-4yr) and pregnant woman are most affected with an estimation global prevancy of 43 and 51 % respectively [2].Nutritional anemias occur frequently in both developing and industrialized countries. In industrialized countries, the prevalence of iron deficiency anemia is much lower and usually varies between 2% and 8% [3]. The prevalence of iron deficiency (inclusive of anemic and non-anemic individuals) ranges from 12 to 18% in women in North America, Europe and Asia. The estimated prevalence in South East Asia is 50- 70%. In females of childbearing age in poor countries, prevalence rates range from 23% in South America to 64% in South Asia [4]. A previous study in north Gaza showed that diseases in Palestine nowadays are related to nutrition, whether they are infectious or chronic [5].

- *corresponding author: Dr. Bassam Alzain
- Department of Biology, Faculty of science, Al-Quds Open University, Gaza Strip, Palestine.
- Mobil : +972-59-7777417
- Fax: +97282474422
- E. mail : bzain@qou.edu

Thatcher [6] and Amirthaveni and Barikor [7] suggested, that the health of children is dependent upon food intake that provides sufficient energy and nutrients to promote optimal physical, social, cognitive growth and development. Inadequate energy and nutrients have a variety of poor outcomes including growth retardation, iron deficiency anemia, poor academic performance and development of psychosocial difficulties. Infants, preschool age children and women of childbearing age are the groups most affected by iron deficiency [8,9]. Unlike reported figures for protein energy malnutrition and vitamin A deficiency, which are declining, estimates suggest that anemia prevalence rates are increasing [10]. Iron supplementation programmes have been carried out in many places throughout the world over the last two decades. Still, the prevalence of iron deficiency anemia does not appear to be declining [10,11]. Recent research indicates that iron deficiency has very important implications which include poorer learning ability and behavioral abnormalities in children, lower ability to work hard, poor appetite and growth [12] .In developing countries, under nutrition still continues to be a problem which requires long-term planning. Nutritional status of a community can be easily identified by measuring the growth status of pre-school children [13] and for this, anthropometry remains the most practical and useful measure [14] . Anthropometric indices such as weight for age and height for age have been incorporated in growth monitoring programs and cross sectional surveys [15]. The aim of this study was to estimate the prevalence of anemia dou to food intake in three communities in North Gaza Government area of Gaza strip , Palestine.

Specific objectives

1 To estimate the prevalence of anemia among preschool children aged 24-62 months in the three communities of north Gaza.
2 To examine relationship between dietary habits and anemia in the study sample.

3 To identify relationship between anemia and anthropometric indicators.

2 MATERIALS AND METHODS

2.1 Study location
The study was carried out three communities(Beit hanon , Jabalia and Beit lahia towns located in north Gaza Government area of Gaza strip. The towns are good representations of the area because they are well homogenized: there was not much difference in their style of living ,culture and occupations practiced. The three study towns were also chosen for their proximity to the field base. The children were aged 24-62 months old.

2.2 Sample size
A total of 150 Pre-school children, 102 from kindergarten section and 48 children from family centre of The Palestinian Commission for Development and Environment Protection (PEDCOM) were included in the study. The children were chosen randomly from the children attandant family centre and kindergarten section. Prior to the commencement of the study, permission was obtained from child parant or guardian.

2.3 Survey Schedule
The schedule was used to collect the information on general profile, anthropometric status, age , sex, dietary intake, clinical status, haemoglobin status.

2.4 Diet survey
A dietary survey was conducted as prescribed by Swaminathan, [16]. The food consumption frequency was recorded in terms of cereals, pulses, milk and milk products, green leafy vegetable, roots and tubers, fruits, meat and poultry, fats and oils and sugar. The daily dietary recall for three consecutive days was taken and was averaged out for one day. The average daily nutrient intake was calculated with the help of the food composition tables of Gopalan et al., [17].

2.5 Haemoglobin collection and estimation
The blood samples were collected by ante-cubital venipunture, by qualified personnel, into sample tubes containing anti-coagulant (citric acetate) and stored on ice for transport to the laboratory later in the day for the estimation of Haemoglobin. Haemoglobin level of subjects was estimated by using cyanmethaemoglobin method prescribed by INACG [18]. The WHO cut off values published by ICMR Task Force [19] for assessment of anemia in the children was used for the study. Later, the Fib values were classified into 'anemic' and 'non-anemic'. The 'anemic' group had Hb level < 10.9 g and 'non-anemic' group had Hb > 10.9 g. Statistical analysis was done between the two groups.

2.6 Anthropometrics survey
Nutritional status of all the selected children was assessed by measuring body heights (cm) and weights (kg). The mid upper arm circumference (MUAC) measurements were taken following standard procedures and necessary precautions. Laboratory analysis of the samples was done at the hematology laboratory of the Beit Lahia, medical laboratory.

2.7 Height and Weight measurement
Height of each subject was measured in a standing position to the nearest 0.1 cm using non-stretchable steel tape. A personal weighing machine was used to measure the body weight to the nearest 0.5 kg. The individuals were kept under basal condition with minimum clothing and without shoes [20].

2.8 Anthropometric assessment for Undernutrition
Anthropometric assessment was conducted to identify children with moderate to severe undernutrition. Two indices were taken as a measure of chronic undernutrition i.e. height for age (stunted) and weight for height (wasted), with reference to NCHS standards of growth and development. 50 percentile was taken as median percentile function. Children found = -2SD from the median on height for age and weight for height were considered as moderate to severe malnourished. Children = -2SD from the median on height for age were considered as stunted and those = -2SD from the medianon weight for height were considered as wasted. Children =50 percentile function on height for age and weight for height were considered as normal.

2.9 Clinical survey
All the selected children were examined for the presence or absence of any clinical signs and symptoms of anemia, including paleness of nails and conjunctiva. The procedure of Gibson [21] was followed for the clinical survey.

2.10 Statistical analysis
Means and standard deviations were calculated. Chi square and paired "t" was used to evaluated the statistical significance using the SPSS software. Regression and correlation analysis to determine the relationship between anemia and wasting stunting and underweight, were carried out . Each of the dependent variables PCV, Hb and MUAC was regressed on the dummy variables of normal, mild-moderate and severe malnutrition as arrived at using the categories of weight for height (W/H), height for age (H/A) and weight for age (W/A). The models allowed us to know if there was any significant difference between the PCV, Hb and MUAC of normal and malnourished children. Given the three categories, two dummy variables were introduced into the regression model to avoid perfect co-linearity of regressors. The category of normal nutritional status was used as the base dummy, in order to allow the directly estimated coefficients of the dummy variables in the model to be estimated as the deviation in the level of the dependent variable of the normal from that of the category in question.

3 RESULTS
On estimation of Hb , 98 of the 150 preschool children (65.3 %) were found to be anaemic (Hb< 11g/dl). Classification of children based on their Hb status showed that out of 80 male children, 53 (35.3%) were classified as anemic. Among 70 female children, 45(30%) were anemic Table 1. Demonstrates a statistically significant gender differentiation in anemia (Chi square - 4.35, p-0.037). Among the 37-49 month old children, mild , moderate and

sever anaemia was most commonly seen (52 of 150) in 40.3, 26.9 and 7.7 per cent respectively Table 2. All school children were enrolled in the study; 40 from Bait hanon , 48 from Bait lahia towns and 62 from Jabalia camp. The overall prevalence of anemia in the three communities is 18.0 %, 21.3% and 26.0% for Bait hanon, Bait lahia, and Jabalia camp respectively (P<0.001) table 3.

TABLE 1
ANEMIA ACCORDING TO SEX

Sex	No.	Anemia	%
Male	**80**	**53**	**35**
Female	**70**	**45**	**30**
Total	**150**	**98**	**65**

TABLE 2
HEMOGLOBIN DISTRIBUTION IN CHILDREN IN DIFFRERNT AGE GROUPS

N o	Age Group (months)	No.	Hemoglobin(g/dl) < 6.0	6.0- 8.9	9.0-10	≤ 11.0	Mean ± SD
1	24-36	48	2 (4.2)	10 (20.8)	14 (29.1)	22 (45.8)	10.16 ± 1.0
2	37-49	52	4 (7.7)	14 (26.9)	21 (40.3)	13 (25.0)	9.40 ± 1.4
3	50-62	50	2 (4.0)	11 (22.0)	20 (40.0)	17 (34.0)	10.01 ± 1.07
	Total	150	8 (5.3)	35 (23.3)	55 (36.6)	52 (34.7)	9.85 ± 1.2

n , number of children
Figures in parentheses are percentages

TABLE 3
PREVALENCE OF ANEMIA IN THREE COMMUNITIES

Community	No.	Anemia (Hb < 11g/dl) No.	%	Non Anemia (Hb <11g/dl) No.	%
Bait hanoon town	40	27	18	13	8.7
Bait lahia town	48	32	21.3	16	10.6
Jabalia camp	62	39	26	23	15.3
Total	150	98	65.3	52	34.7

3.1 Diet and Nutrient Intakes:

The foods consumed daily by all the subjects included cereals, fats and oils and sugar. Regarding the consumption of pulses it was found that a good proportion (71.33%) of the subjects consumed the item daily and 22.66% consumed 4-6 times per week as depicted in Table 4. Consumption of milk and milk products by the subjects was also found to be frequent, 82.66% consumed milk on daily basis whereas, and 12.66% consumed milk 4-6 times per week. Percentage of the children (32%) consuming green leafy vegetables 4-6 times per week was higher than those (19.33%) who were consuming daily. The survey showed that the consumption of roots and tubers was quite frequent in comparison to most of the other foods except cereals, fats and oils and sugar . Majority of the children consumed meat occasionally, only 6.6 % consumed it on daily basis. whereas 10% and of the children consumed poultry on daily basis Table 4 Subjects were used to determine the nutritional status based on underweight and stunting i.e. W/Age and H/A respectively Table 5. 34% of the children were stunted, 20.3% wasted and 45.3% underweight. Underweight was the most prevalent form of malnutrition, while the most severe form was stunting. There was a significant positive correlation between stunting and Underweight (P <0.001). Regression analysis showed that mid-upper arm circumference (MUAC) differed significantly between children with a normal nutritional status and those severely malnourished (P = 0.01).

Table 4
FOOD CONSUMPTION FREQUENCY OF CHILDREN (No. = 150)

Food groups	Daily F	%	4-6 t/w F	%	2-4 t/w F	%	1-2 t/w F	%	Occasionally
Meat	**10**	**6.6**	**20**	**13.3**	**15**	**10**	**13**	**8.6**	**92 1.3**
Poultry	**15**	**10**	**20**	**13.3**	**30**	**20**	**35**	**23.3**	**50 3.3**
fats and oils	**150**	**100**	-	-	- -		-	-	- -
Milk and milk products	**124**	**82.6**	**19**	**12.6**	**7**	**4.6**	-	-	- -
Green leafy vegetables	**29**	**19.3**	**48**	**32**	**32**	**21.3**	**28**	**18.6**	**13 8.6**
Root and tubers	**130**	**86.6**	**8**	**5.3**	**12**	**8**	-	-	- -
Pulses	**107**	**71.3**	**34**	**22.6**	**9**	**6**	-	-	- -
sugar	**150**	**100**	-	-	- -		-	-	- -
Fruits	**9**	**6**	**16**	**10.6**	**23**	**15.3**	**41**	**27.3**	**61 40.6**

Note: t/w = time per week

TABLE 5
TYPE AND DEGREE OF MALNUTEITION

Type of malnutrition	Number
Stunting	**51 (34)**
Wasting	**31 (20.3)**
Underweight	**68 (45.3)**

Figures in parentheses are percentages

3.2 Anthropometric Measurements of Children:

Mean height in all the age group was significantly ($p< 0.05$) lesser than the NCHS standards except in 24-36 months boys and 37-49 months girls where a non significant difference was observed. The mean height in the age group 24-36 months for boys and girls was 94.34 cm and 91.22 cm respectively. Mean height of girls was higher (99.31 cm and 103.43 cm) than boys (97.22 cm and 100.12 cm) in the age groups 37-49 and 50-62 months respectively. The mean weight in all the age groups was significantly ($p< 0.05$) lesser than the NCHS standards except in 24-49 months girls where the difference was insignificant. The difference in weight was more in the age group 50-62 months for both boys (1.90 cm) and girls (1.22 cm) as compared to 24-49 months group. The mean MUAC in all the age groups was significantly ($p< 0.01$) lesser than the NHANES standards. The difference was more in 24-36 year age group (20.04 cm) among boys and 50-62 months age group (24.80 cm) among girls Age and sex wise distribution based on the anthropometric parameters are shown in Table 6, 7 and 8.

TABLE 6
MEAN HRIGHT OF CHILDREN

Boys					girls			
Age Results (Months) NCHS std	Obs. n=80	50th perc. mean(cm)	NCHS std.	Results	70	Obs.	50th perc. mean(cm)	
24-36	26	94.34±5.23	78	NS	22	91.22±4.21	80.2	S*
37-49	26	97.22±6.43	84.5	S*	26	99.31±6.01	86.3	NS
50-62	28	100.12±3.20	90.4	S**	22	103.43±5.21	92.5	S*

Significant=S* (at 5%), Significant=S** (at 1%), Non significant=NS

TABLE 7
MEAN WIGHT OF CHILDREN

Boys					girls			
Age Results (Months) NCHS std	Obs. n=80	50th perc. mean(cm)	NCHS std.	Results	70	Obs.	50th perc. mean(cm)	
24-36	26	14.3±2.80	12.01	S**	22	13.5±3.23	11.8	NS
37-49	26	17.6±3.19	15.2	S**	26	17.7±5.19	10.9	NS
50-62	28	19.3±3.92	18.3	S**	22	20.0±3.53	13.9	S**

Significant=S* (at 5%), Significant=S** (at 1%), Non significant=NS

TABLE 8
MEAN MUAC OF CHILDREN

Boys					girls			
Age Results (Months) NCHS std	Obs. n=80	50th perc. mean(cm)	NCHS std.	Results	70	Obs.	50th perc. mean(cm)	
24-36	26	94.34±8.23	95	S**	22	96.22±2.21	90	S**
37-49	26	97.22±9.43	101	S**	26	93.31±6.01	86.3	S**
50-62	28	100.12±14.20	112	S**	22	100.43±5.21	92.5	S**

Significant=S* (at 5%), Significant=S** (at 1%), Non significant=NS
Percentile = perc.

4 DISCUSSION

The present study estimated the prevalence of anemia among preschool children aged 24-62 months in the three communities of north Gaza blocks to be 65.3% taking the cut–off hemoglobin level of < 11g/dl . These findings are similar to other findings carried out locally; a study conducted by Central Bureau of Statistics (CBS) 2010 participatory information collection studies, the prevalence rate of malnutrition among children under five was 41.6% and the rate of increase in the Gaza Strip reached 59.0% and reached their highest level ratios in the northern Gaza, reaching 29.6% compared with the rest of the provinces [22]. It has been reported that preschool children (<6years) and adolescents (>15 years) during growth spurts have the greatest physiological demands for iron and are at highest risk of iron deficiency anemia [23]. When compared to the two other communities studied, Jabalia camp had a higher prevalence of anemia. The mean age of children in this community is 1.75 years, and this may explain the reduced hemoglobin concentration in these children most of whom are in their period of rapid growth spurts. This high rate may be indicative of the fact that the diet of the preschoolers is not adequate for their iron needs. The anemia most frequently encountered in pediatrics is iron deficiency anemia [24- 26]. The disease is most often due to low intake of dietary iron and with low iron absorption [27]. Reduced purchasing power [28] and consumption of antagonists [29-30] to iron absorption are the basic reasons for the low iron intake. In the present study a survey on the dietary habits revealed that most of the households were on a similar dietary pattern, having low quantity of iron rich foods like fruits (6%), meat (6.6%), and poultry (10%). Most of the children were taking meat occasionally and green leafy vegetables on alternate days. Half of the children were in the habit of eating poultry. But this consumption was not regular and the quantity was low when compared to the recommended daily intake. , while a different study conducted in Gaza in 2005 found that 12% of adolescent students aged 12-18 years ate meat and chicken daily [31]. The difference in the results of these studies may be due to the different age groups and gender that has been tackled, or may be due to the deterioration of the Gazian economic circumstances in the last seven years. The present study showed that, there was a direct relationship between meat consumption and incidence of anemia. In this study anemia is reported among most of age group children. This means the anemia present among the group of children we studied was due to low iron sufficiency of food and hence could be corrected by modifying the dietary pattern. There was a significant difference in anemia pattern between boys and girls. Male children were more susceptible to anemia. Farming is the major occupation and only crops that are likely to yield some income are planted. The level of income of family breadwinners is also low, judging by their houses and the yield from their farms. Their financial access to meat and other good animal sources of iron is therefore very limited.

The commonest form of malnutrition in the children studied was underweight (45.0%) followed by stunting (34.0%) and wasting (20.3%).The prevalence of stunting in this study (34%) was similar to that estimated in the 4th World Nutrition Situation Report for the West African sub-region (34.9%). The estimated prevalence of underweight in this

study is higher than the current rate for West Africa (36.5%) [32]. Even though underweight affects fewer children globally than stunting [32], West Africa has seen an increase of 0.32% per year in recent years. Wasting is not as common as stunting and underweight in any region of the world and a similar pattern was observed in the results of this study. West Africa has a wasting prevalence of 15.5% and in this study, 20.3%. There has been a substantial increase in wasting among West African children, and this increase could explain the high rate of underweight in these countries. Chronic malnutrition appeared to be a more pressing problem than acute malnutrition as indicated by the levels of stunting and underweight compared to the levels of wasting, and the higher prevalence of anemia in preschool children. It is necessary therefore, to educate the mothers in this study area on the importance of feeding their children appropriately from their early life. There were significant differences in the MUAC of normal children and wasting and underweight children, suggesting that MUAC could be accurately used for rapid assessment of on-going malnutrition in specific populations, since it will be easier to establish local standards. The significant correlation between MUAC, underweight and wasting also supports this argument. The high prevalence of anemia among the children surveyed could be related to the inadequate diet, poor socio economic status, unhygienic environment and lack of parent's education. Efforts by the public health workers in the family centre of (PEDCOM) to Encouraging mothers to attend health education seminars, which include personal hygiene and nutrition programs to be held in the center to reduce the proportion of anemia among children, which emerged during this study.

5 CONCLUSION

It is concluded that poor anthropometric indices, under nutrition and iron deficiency anemia may be due to lower intake of food than recommended.

ACKNOWLEDGMENTS

I am highly indebted to Dr.Jamel Hamoda Director of the Laboratory of Beit Lahia, medical for his pedestal support, precious suggestions and valuable cooperation The author gratefully acknowledges the staff and children who come to the family center and kindergarten Farah and Marah of the Palestinian Authority for Development and Environmental Protection (PEDCOM).

REFERENCES

[1] World Health Organization, WHO Global Database on Anemia. Worldwide prevalence of anemia (1993–2005) Edited by Bruno de Benoist, Erin McLean, Ines Egli and Mary Cogswell , (2008).

[2] Uberoi Is , DeSweemer C, Taylor CE. A study of anemia among rural preschool children . Indian J Med Res . 69: 448-56, 1972.

[3] Latham M. Human Nutrition in the developing world. FAO Publications, Rome, 1997.

[4] UN/ACC/SCN. Second report on the world nutrition situation. Global and regional reports. Geneva, 1985.

[5] Abudayya A, Thoresen M, Abed Y, Holmboe - Ottesen G, Overweight, stunting and anemia are public health problems among low socioeconomic groups in school adolescents (12-15 years) in the North Gaza Strip. Science direct, Nutrition Research 27 (12):762-771,(2007).

[6] Thatcher, R.W . Maturation of the human .frontal lobes. Physiological evidence for staging. Dev Neuropsychol., 7: 397-419,1998.

[7] Amerithaveni, M. and C.W. Barikor. Nutritional status of Meghalayan pre-school children. The Ind. J. of Nutr. and Dietetics, 32: 262, 2002.

[8] Dallman PR, Reeves JD. Laboratory diagnosis of iron deficiency anemia. In Iron Nutrition in infancy and childhood. Nestle Nutrition. 12- 20, 1984.

[9] UN/ACC/SCN. Controlling iron deficiency. ACC/SCN state-of-the-art series. Geneva ACC/SCN, (Nutrition policy discussion paper no. 9.), 1991

[10] UN/ACC/SCN. Second report on the world nutrition situation. Global and regional reports. Geneva, 1985.

[11] FGN/UNICEF The nutritional status of women and children in Nigeria. UNICEF. Lagos, 1994.

[12] Latham M. Human Nutrition in the developing world. Food and Agricultural Organization Publications Rome 12-36,1997.

[13] Report on the National Nutrition Monitoring Bureau surveys- Nutritional status of a rural population, National Nutrition Monitoring Bureau, National Institute of Nutrition . 26, 1996.

[14] Jelliffe DB. The assessment of nutritional status of a community.WHO, Geneva, Monograph series No. 53, 1996.

[15] Gorstein J. Assessment of nutritional status : Effects of different methods to determine the age on the classification of undernutrition. Bu// WHO; 67(2) : 143-150,1989.

[16] Swaminathan, M. Essentials of Food and Nutrition 2nd Edition, Bappco Publication, 2: 337-338,2002.

[17] Gopalan, C., Ramasastri, B. V. and Balasubramanian, S. C. Nutritive Value of Indian Foods. NIN (ICMR) Hyderabad, 94, 2002.

[18] INACG. Measurement of iron status International National Anemia Consultative Group: Washington, D.C., pp: 45, 1985.

[19] Indian Council of Medical Research. Micronutrient deficiency disorder in 16 districts of India. Report of an ICMR task force study-district of nutrition project, New Delhi, pp: 78-89, 2001.

[20] World Health Organization. Measuring change in Nutritional Status. Guidelines for assessing the nutritional impact of supplementary feeding programs for vulnerable groups. Geneva,1993.

[21] Gibson, R.S., 1990. Principles of Nutritional Assessment', Oxford University Press, New York, Oxford, 257: 577-855.

[22] Central Bureau of Statistics annual Altgarira. Children of Palestine - the issues and statistics. Series statistics of the Child (No. 13). Ramallah –Palestine,(2010).

[23] Crawley J. Reducing the burden of anemia in infants and young children in malaria -endemic countries of Africa: from evidence to action. Am J Trop Med Hyg 2004; 71:25- 34, (2004)

[24] Dommergues JB, Bader-Meunier B. Nutritional anemia in children, Revue du Praticien; 39(24) : 2117- 2121,1989.

[25] Giebel NH, Suleymanova D and Evans GW. Anemia in young children of the Muynak District of Karakalpakistan, Uzbekistan : prevalence, type and correlates. Am J Public Health; 88 : 805-807, 1998.

[26] Simmons WK and Gurney JM. Nutritional anemia in English speaking Caribbean and Suriname. Am J Clin Nutr 1982; 35 (2) : 327-337.

[27] Cook JD. Nutritional anemia ASDC. J Dentistry for Children. 50 (4): 305- 308, 1983.

[28] Arya A and Devi R. Pattern of nutritional deficiencies in pre-school children as influenced by family income. Indian J Nutr Dietet; 34 : 185-187,1997.

[29] Kohlmeier L, Mendez M, Shalnova S, Martinchik A, Chakraborthy H and Kohlmeier M. Deficient dietary iron intake among women and children in Russia : Evidence from Russian longitudinal monitoring survey. Am J Public Health; 88: 576-580, 1998.

[30] National Research Council. Recommended dietary allowances (RDA) 10th Edition. Washington DC; National Academy Press, 1989.

[31] Al Sabbah H, Vereecken C, Kolsteren P, Abdeen Z, Maes L. Food Habits and Physical Activity Patterns among Palestinian Adolescents: findings from the national study of the Palestinian schoolchildren (HBSC-WBG 2004) Public Health Nutrition 10(7): 739-746,(2007).

[32] UN /ACC/SCN. 4th report on World nutrition Situation ACC/SCN, Geneva, 2000.