

## JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH

**How to cite this article:**

VEGHARI G, ASADI J, ESHGHINIA S. IMPACT OF ETHNICITY UPON BODY COMPOSITION ASSESSMENT IN IRANIAN NORTHERN CHILDREN. *Journal of Clinical and Diagnostic Research* [serial online] 2009 October [cited: 2009 October 5]; 3: 1779-1783.

Available from

[http://www.jcdr.net/back\\_issues.asp?issn=0973-709x&year=2009&month=October&volume=3&issue=5&page=1779-1783&id=481](http://www.jcdr.net/back_issues.asp?issn=0973-709x&year=2009&month=October&volume=3&issue=5&page=1779-1783&id=481)

## ORIGINAL ARTICLE

## Impact Of Ethnicity Upon Body Composition Assessment In Iranian Northern Children

VEGHARI G\*, ASADI J\*\*, ESHGHINIA S\*\*\*

### ABSTRACT

**Objective:** This study was designed to determine secular growth among rural children between two ethnic groups (Sisstanish and Non-Sisstanish ) in north of Iran.

**Methods:** We chose 20 villages from 118 by cluster and simple sampling. All of 25-60 months old children in this area were considered in this study. Sample size was 1569 cases (632=Sisstanish and 937=Non- Sisstanish). Height, weight and personal identification were recorded by questioner. BMI percentile and under -1sd, -2sd and -3sd from NCHS were used for comparison.  $\chi^2$  test and T.test were used to analyze by software SPSS.

**Results:** Sisstanish children were 900 g lighter and 4.39 cm taller than non-Sisstanish among all of age groups. T.test is significant between two groups based on weight and height ( $P<0.05$ ). Stunting and underweight were observed in Sisstanish group 23% and 5.9% respectively more than in non-Sisstanish by -2sd criterion. There is a significant difference between two groups by stunting ( $P<0.05$ ). Overweight (1.52%) and obesity (12.4%) were shown in Sisstanish group more than in non-Sisstanish group and Statistical differences is significant between them based on obesity ( $P<0.05$ ).

**Conclusion:** Secular growth in two groups is disproportionate and in Non-Sisstanish group is better than Sisstanish group. Sisstanish children suffer from severe height deficit and BMI high. Thereby, malnutrition is the most health problem in rural area in the north of Iran and nutritional intervention is necessary for solving these problems.

**Key Words:** Height, Weight, Children, Ethnic, Iran

\*,\*\*\*Asst. Prof. (Nutrition), \*\*Asst. Prof. (Clinical Biochemistry), Dept. of Biochemistry and Nutrition, Golestan University of Medical Sciences.(Iran).

**Corresponding Author:**

Gholamreza Veghari

Biochemistry and Metabolic Disorders Research Center, Golestan University of Medical Sciences, School of Medicine - Gorgan (IRAN). Tel:+98-171-4421651 Fax:+98-171-4421289. E-mail :grveghari@yahoo.com

### Introduction

Human health depends on both genetics and ecological factors but second factors is more effective than the first one [1],[2].

World children suffer from Protein Energy Malnutrition [3] and UNICEF [4] reported that one-third of children were stunting in development countries in 2000. Obesity is another health problem in world [5]. Several studies in different countries [6],[7],[8],[9] showed obesity trend increases in world. Some agents affect on obesity, such as metabolic factors, low physical activity, high TV watching , computer playing, high calorie diet and high income [9],[10],[11],[12],[13],[14],[15] .

Growth monitoring is one of the important method to detect malnutrition and growth disorders in children [16].Anthropometry is universally

applicable, inexpensive and non-invasive method. It is available to assess of the proportion of size and composition of the human body. It shows both health and nutritional status and it predicts performance of health and survival. Short stature and underweight causes disability. High BMI (Body Mass Index) percentile values in children can help us in identifying and selecting children at risk and in assigning the children who will probably suffer from overweight or obesity in adulthood. This health information can help those children who are at risk and them need close monitoring or intervention.

Several micronutrients such as zinc, iron, iodine, selenium, vitamin A, B<sub>12</sub> and B<sub>9</sub> take part as the ingredient of some enzyme, hormone and their activities. Lack of above nutrients can be effect on the bodies metabolism and physical growth trend [17],[18]. Sayari [19] studies showed the high prevalence of malnutrition among Iranian children in 1996 and 1998. He reported that in comparison with 28 provinces, Golestan children's weight and height were in the first and thirteenth rank, respectively.. There isn't any concord between the trend of height and weight growth. Another study

[20] showed that children suffer from stunting more than wasting in this region. Obesity in Iranian children is as a health problem, too [21]. We carried out this study among 25-60 months age children in a rural area of Gorgan (Golestan province center). Gorgan district is a capital city and located in mountain-side in north of Iran and south east of Caspian Sea. The most of people living in this area are farmer and several ethnic groups living in this region. The main ethnic groups are: Fars(native), Turkman and Sisstani..of 9576 of people living in this area are 25-60 months age [22]. Sisstanish people who had immigrated from south-east to north of Iran about 30 years ago. Due to the restriction in executing epidemiological projects, there was not any study on the secular growth differentiation between ethnic groups in this area up till now; therefore it was necessary to design a research project about it. The aims of this study is to examine the trend of secular growth , underweight , stunting and BMI status among 25-60 months age children between two ethnic groups.

## Material and Methods

This study is a descriptive-crossectional that carried out in villages of Gorgan (North of Iran). Villages were chosen by cluster and simple sampling. We have chosen 20 villages from 118. All of the 25-60 months age children were chosen as a sample. Data was collected by health system staffs in this region. The number of samples was 1569 cases (632=Sisstanish and 937=Non-Sisstanish). Height, weight and birth date were recorded. Children's height was measured in a standing posture without shoe and 4 parts of body (heel, scapula, back of the head) attached to the wall. The weight, without clothes and shoes, was measured with scales confirmed by WHO. Weight and Height were measured with 0.1 kg and 0.1 cm accuracy [23]. The collected data was compiled and fed into computer and the Statistical Package for Social Sciences Package version 13, was used to analysis. The National Centers for Health Statistical (NCHS) [24],[25] standard was used for comparison the groups. Under 2 standard deviation (-2SD) from median of normal community (NCHS) computed as a start point of malnutrition (26,27) .Anthropometric Indexes in this study were defined following scale: Underweight: weight-for-age. Stunting: Height-for-age. BMI: weight-for -height square.

The BMI percentiles [28],[29] were used to classify subjects as follows: under weight, <5<sup>th</sup> BMI percentiles; healthy weight, 5<sup>th</sup>-84<sup>th</sup> BMI

percentiles; overweight, 85<sup>th</sup>-94<sup>th</sup> BMI percentiles; or obese, ≥95<sup>th</sup> BMI percentiles.

In this study the ethnicity was defined as follow: Sisstanish ethnic group: This group have immigrated from Sisstan and Bluchestan province (Locate in South east of Iran) to this area are residing in a particular rural area. Non-Sisstanish ethnic group: People who are resided in this region since long time ago. Chi-2 test and T.test were used for comparison of frequency and mean of groups respectively. Statistical significance was defined as P-value <0.05.

## Results

Sisstanish boys are 900 g lighter and 4.7 cm shorter than non-Sisstanish boys [Table/Fig 1] .The mean of BMI is more than in Sisstanish group (0.5 kgm<sup>-2</sup>). There is a statistical significant differences between two ethnic groups based on weight and height in all of age groups as well as for all boys ages combined. T,test is significant only in 37-48 months old based on BMI criteria.(P<0.05).

Sisstanish girls are 400 g lighter and 4.1 cm shorter than non-Sisstanish girls .The mean of BMI is more than in Sisstanish group (0.5 kgm<sup>-2</sup>). There is a statistical significant differences between two ethnic groups from 37 months age by weight and from 31 months based on height and BMI in 37-48 months age .(P<0.05).

Stunting in Sisstanish boys based on -1sd ,-2sd and -3sd is 36%,24% and 8.6.% more than Non-Sisstanish boys respectively and Chi-2 test is significant between two groups in all of criteria (P<0.05) [Table/Fig 2] .Underweight in Sisstanish boys based on -1sd ,-2sd and -3sd is 24%, 4.3% and 0.3% more than Non-Sisstanish boys respectively and Chi-2 test is significant between two groups in all of criteria (P<0.05).

(TableFig 1)The comparison of mean and standard deviation of weight ,height and BMI by sex, age and ethnicity in north of Iran.

Age (Mo)	Non_Sisstanish							Sisstanish								
	Male				Female			Male			Female					
	No	WT(Kg)a	HT(cm)b	BMI	No	WT(Kg)e	HT(cm)f	BMI	No	WT(Kg)a	HT(cm)b	BMI	No	WT	HT(cm)f	BMI (kgm <sup>2</sup> )
25-30	65	13.3(1.7)	89.1(4.2)	16.7(1.5)	64	12.1(1.7)	86.1(6.6)	16.3(1.4)	56	12.3(1.2)	84.7(3.6)	17.1(1.4)	42	11.9(1.1)	84.6(5.2)	16.7(2.2)
31-36	114	14.1(1.5)	93.5(4.7)	15.2(1.3)	91	12.9(1.3)	90.4(7.2)	16.3(5.5)	51	12.9(1.3)	89.2(5.4)	16.3(2.0)	68	12.5(1.8)	88.1(5.4)	16.2(2.2)
37-42	82	14.7(1.6)	97.0(4.7)	15.6(1.3)c	63	14.4(1.8)	96.4(4.9)	15.4(1.4)k	43	13.8(1.4)	92.1(5.6)c	16.4(1.6)	61	13.4(1.5)	91.0(5.0)	16.1(1.5)k
43-48	102	15.7(1.4)	100.3(4.7)	15.6(1.6)d	84	15.0(1.9)	98.9(4.8)	15.3(1.5)l	65	14.8(1.6)	94.8(5.8)d	16.5(1.7)	57	14.3(1.6)	93.7(8.1)	16.7(3.9)l
49-54	57	16.2(1.9)	102.8(5.5)	15.3(1.3)	67	16.2(1.8)	103.3(4.7)	15.2(1.3)	44	15.5(1.6)	99.1(5.5)	15.8(1.4)	47	14.7(1.8)	97.4(5.9)	15.5(1.6)
55-60	84	17.2(1.7)	106.5(4.6)	15.2(1.3)	64	17.2(2.8)	106.8(5.1)	15.1(1.8)	43	15.9(1.2)	102.9(4.3)	15.0(1.2)	55	15.3(1.7)	100.5(6.6)	15.2(1.6)
Total	504	162(2.0)	98.1(7.2)	15.8(1.5)	433	14.5(2.6)	96.7(9.0)	15.6(2.9)	302	14.1(1.9)	93.4(7.8)	16.3(1.7)	330	13.7(2.0)	62.6(8.0)	16.1(2.4)

WT=Weight HT=height BMI=Body Mass Index ( )=standard deviation  
 a= T.test is significant between two groups in all of ages (P<0.001)  
 b=T.test is significant between two groups in all of ages (P<0.001)  
 c= T. T.test is significant between two groups (P<0.005)  
 d= T.test is significant between two groups (P<0.001)  
 e= T.test is significant between two groups from 37 months old and combined age (P<0.001)  
 f=T.test is significant between two groups from 37 months old and combined age (P<0.001)  
 k= T.test is significant between two groups (P<0.001)  
 l= T.test is significant between two groups (P<0.001)

(TableFig 2)The comparison of malnutrition between tow ethnic groups by stunting and underweight among 25-60 mounths old children in north of Iran.

Ethnicity	No	Female N(%)						No	Male N(%)					
		Underweight			Stunting				Underweight			Stunting		
		-1sd a	-2sd b	-3sd c	-1sd e	-2sd f	-3sd g		-1sd h	-2sd k	-3sd c	-1sd l	-2sd m	-3sd n
Sisstanish	330	157(47.4)	36(10.9)	5(1.5)	189(57.3)	104(31.5)	41(12.4)	302	140(46.4)	19(6.3)	2(0.7)	169(56.0)	92(30.5)	29(9.6)
Non_Sisstanish	433	118(27.3)	16(3.7)	3(0.7)	93(21.5)	30(6.9)	8(1.8)	504	112(22.4)	10(2.0)	2(0.4)	103(20.4)	33(6.5)	5(1.0)
Overall	763	275(36.0)	52(6.8)	8(1.1)	282(37.0)	134(17.6)	49(6.4)	806	253(31.4)	29(3.6)	4(0.5)	271(33.7)	125(15.5)	34(4.2)

a = X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 b= X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 e = X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 f= X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 g= X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 h = X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 k = X<sup>2</sup> is significant between two ethnic groups (P<0.002)  
 l= X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 m= X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 n = X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 c= There is no enough subject for X<sup>2</sup> test.

(Table/Fig 3) The comparison of BMI distribution among 25-60 mounths old children in north of Ir an on based of NCHS percentils

Ethnicity	Male N(%)					Female N(%)				
	No	<5% a	5-84%	85-94%	95%< b	No	<5% c	5-84%	85-94%	95%< d
Sisstanish	302	103(34.1)	80(26.5)	42(13.9)	77(25.5)	330	90(27.4)	90(27.3)	22(6.7)	128(38.9)
Non_Sisstanish	504	220(43.7)	146(28.9)	53(10.5)	85(16.9)	433	176(40.6)	123(28.5)	28(6.4)	106(24.5)
Overall	806	323(40.1)	226(28)	95(11.8)	162(20.1)	763	266(34.7)	213(27.9)	50(6.6)	234(30.7)

a= X<sup>2</sup> is significant between two ethnic groups (P<0.007)  
 b= X<sup>2</sup> is significant between two ethnic groups (P<0.003)  
 c= X<sup>2</sup> is significant between two ethnic groups (P<0.001)  
 d= X<sup>2</sup> is significant between two ethnic groups (P<0.001)

Stunting in Sistanish girls based on -1sd, -2sd and -3sd is 35.6%, 24.6% and 10.6% more than Non-Sistanish girls respectively and Chi-2 test is significant between two groups in all of criteria ( $P < 0.05$ ). Underweight in Sistanish girls based on -1sd, -2sd and -3sd is 27.3%, 7.2% and 0.8% more than Non-Sistanish girls respectively and Chi-2 test is significant between two groups in -1sd and -2sd criteria ( $P < 0.05$ ). There is insufficient number about -3sd for  $\chi^2$  test by underweight.

BMI > 95% in Sistanish boys is 8.6% and BMI equal 85-94% is 3.4% more than non-Sistanish. BMI > 95% in Sistanish girls is 14.4% and BMI equal 85-94% is 0.3% more than non-Sistanish. Statistical differences is significant between two groups based on BMI > 95% ( $P > 0.05$ ) [Table/Fig 3].

## Discussion

Stunting and underweight are two health problems among northern children of Iran. They suffer from stunting more than underweight. Overweight and obesity are other problems in this area. Other researchers reported under and over nutrition in their studies [30],[31],[32],[33]. Sayri [19] study on the under 5 years old children among 28 provinces in Iran showed that Golestan province has the 1<sup>st</sup> and 13<sup>th</sup> ranks by weight and height growth respectively. Shykhholeslam [34] and Rounaghi [35] founded trace elements deficiency in some areas of Iran. Prevalence of malnutrition in Sistanish group is higher than Non-Sistanish group. Other studies [33],[36],[37],[38] showed that ethnic groups in a community have nutritional variety together. Several factors, like culture, economy, literacy, food habit and poor health can effect on nutritional situation in an area [32], [33], [38].

Mean of weight and height of Sistanish children is lower than Non-Sistanish but obesity in Sistanish group is higher than Non-Sistanish. Danubio [39], Freedman [40] and Ogden [8] in United States reported the difference in prevalence of obesity among ethnic groups. Wickramasinghe [41] in his study showed that genetic factors effect on secular growth and we should consider them in anthropometry. Rush [42] recommended using FFM (Free Fat Mass) instead of BMI in field study. Fredriks [43],[44] believes that separate Growth Chart is necessary for Moroccan and Turkish children that living in Netherlands.

The results of this study showed that Sistanish children are overweight and obese, despite high prevalence of stunting. Further studies are necessary

for growth monitoring with regard to ethnicity in this region. Several micronutrients, like zinc, iron, iodine, selenium, vitamin A, B12 and B9 take part in structure of some enzymes, hormones and their activities. Lack of mentioned nutrients can change the body metabolism and physical growth trend [17],[18],[45]. Somatic growth in boys is better than girls. Others [46],[47] reported that prevalence of malnutrition in girls is higher than boys.

Finally, this study shows that underweight, stunting and obesity are as health problems among children in north of Iran. Various races have different nutritional problems. Nutritional status in non-Sistanish group is better than Sistanish. With regard to high prevalence of under nutrition and high prevalence of obesity among Sistanish children, BMI criteria doesn't have an enough acceptability to determine obesity in population with height deficit. Although malnutrition resulting from height failure in Sistanish children is higher than non-Sistanish children, but high prevalence of obesity among Sistanish children is a question that we should answer it. We don't know what causes this problem. We suppose that Sistanish children are either genetically shorter in stature, malnourished or some combination of these factors when are compared to the non-Sistanish children. These data show that comparisons of anthropometric measurements with an international standard, like NCHS standard, is only a part of the view that healthcare professionals and nutritionists must take. Local ethnic, genetic and other factors are also at play and need to be emphasized before proper healthcare measures can be under taken.

## Acknowledgment

The author would like to thank all the medical and administrative staff working in Primary Health Care Centers for their valuable assistance during the field study.

## References

- [1] Ganz ML. Family health effects: complements or substitutes. *Health Econ.* 2001; 10(8):699-714.
- [2] Mata LJ. Child malnutrition and deprivation-observations in Guatemala and Costa Rica. *Food Nutr (Roma)* 1980; 6(2):7-14.
- [3] Robbins JM, Khan KS, Lisi LM, Robbins SW, Michel SH, Torcato BR. Overweight among young children in the Philadelphia health care centers: incidence and prevalence. *Arch Pediatr Adolesc Med* 2007; 161(1):17-20.
- [4] WHO. Physical Status: The use of and Interpretation of Anthropometry. Geneva: World Health Organization. 1995.
- [5] Maffei C, Consolaro A, Cavarzere P, Chini L, Banzato C, Grezzani A, Silvagni D, Salzano G, De Luca F, Tato L. Prevalence of overweight and obesity

- in 2- to 6-year-old Italian children. *Obesity* 2006;14(5):765-9.
- [6] Sanna E, Soro MR, Calo C. Overweight and obesity prevalence in urban Sardinian children. *Anthropol Anz* 2006; 64(3):333-44.
- [7] Valerio G, D'Amico O, Adinolfi M, Munciguerra A, D'Amico R, Franzese A. Determinants of weight gain in children from 7 to 10 years. *Nutr Metab Cardiovasc Dis* 2006;16(4):272-8.
- [8] Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA* 2006; 295(13):1549-55.
- [9] Shields M. Overweight and obesity among children and youth. *Health Rep* 2006; 17(3):27-42.
- [10] Ng C, Marshall D, Willows ND. Obesity, adiposity, physical fitness and activity levels in Cree children. *Int J Circumpolar Health* 2006; 65(4):322-30.
- [11] Kang HT, Ju YS, Park KH, Kwon YJ, Im HJ, Paek DM, Lee HJ. Study on the relationship between childhood obesity and various determinants, including socioeconomic factors, in an urban area. *J Prev Med Pub Health*. 2006;39(5):371-8.
- [12] Sanigorski AM, Bell AC, Kremer PJ, Swinburn BA. Lunchbox contents of Australian school children: room for improvement. *Eur J Clin Nutr* 2005; 59(11):1310-6.
- [13] Frank DA, Neault NB, Skalicky A, Cook JT, Wilson JD, Levenson S, Meyers AF, Heeren T, Cutts DB, Casey PH, Black MM, Berkowitz C. Heat or eat: the Low Income Home Energy Assistance Program and nutritional and health risks among children less than 3 years of age. *Pediatrics* 2006; 118(5):e1293-302.
- [14] Wang Y, Zhang Q. Are American children and adolescents of low socioeconomic status at increased risk of obesity? Changes in the association between overweight and family income between 1971 and 2002. *Am J Clin Nutr* 2006; 84(4):707-16.
- [15] WHO. Obesity : Preventing and managing the global epidemic .World Health organization ; Geneva 1998.
- [16] Behrman K. Nelson textbook of pediatrics, 15<sup>th</sup> ed . New York , Saunders Company; 1996 .
- [17] Pinhas-Hamiel O, Newfield RS, Koren I, Agmon A, Lilos P, Phillip M. Greater prevalence of iron deficiency in overweight and obese children and adolescents. *Int J Obes Relat Metab Disord* 2003; 27(3):416-8.
- [18] Pinhas-Hamiel O, Doron-Panush N, Reichman B, Nitzan-Kaluski D, Shalitin S, Geva-Lerner L. Obese children and adolescents: a risk group for low vitamin B12 concentration. *Arch Pediatr Adolesc Med* 2006;160(9):933-6.
- [19] Sayari AA, Sheykholeslam R, Naghavi M, Abdollahi Z, Kolahdouz F, Jamshid Beygi E. Surveying different types of malnutrition in children under 5 years old in urban and rural areas, Iran, 1998. *Pejouhandeh Quarterly Resarch Journal*. 2001; 20(5): 409-16
- [20] Veghari Gh.R, Ahmadpour M, Vakili MA. Assessment of height and weight in children under 6 years in rural areas of organ, 1998. *Journal of Mazandran University of Medical Sciences*. 2003; 34 (12): 72-66.
- [21] Azizi F , Allahverdian S, Mirmiran P, Rahmani M, Mohammadi F. Dietary factors and body mass index in a group of Iranian adolescents: Tehran lipid and glucose study-2. *Int J Vitam Nutr Res* 2001; 71(2):123-7.
- [22] Statistical Center of Iran .Population and Housing Census. Available from :[www.sci.org.ir](http://www.sci.org.ir)
- [23] Rosalind S. G. Anthropometric assessment of Growth in: Principles of nutritional Assessment .Oxford university press. 1990.
- [24] Ogden CL, Flegal KM, Carroll MD , Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA* 2002; 288(14):1728-32
- [25] WHO. Measuring change in nutritional status. WHO ; Geneva :1983.
- [26] Sidibe T, Sangho H, Traore MS, Konate FI, Keita HD, Diakite B, Coulibaly H, Traore B. Management of Malnutrition in Rural Mali. *J Trop Pediatr*. 2007; 53(2):142-3.
- [27] Vonk R, de Kleuver M, le EH, Voorhoeve HW. Growth of under five-year-old children in Kyeni, Kenya. *Trop Geogr Med* 1993; 45(4):175-8.
- [28] Leonard MB, Shults J, Wilson BA, Tershakovec AM, Zemel BS. Obesity during childhood and adolescence augments bone mass and bone dimensions. *Am J Clin Nutr*. 2004; 80(2):514-23 .
- [29] 29- Krebs NF, Jacobson MS. Prevention of pediatric overweight and obesity. *Pediatrics*. 2003; 112(2):424-30.
- [30] Bellamy C. The state of the worlds children .Oxford University Press. Unicef, p:208. 1998.
- [31] Kwena AM, Terlouw DJ, de Vlas SJ, Phillips-Howard PA, Hawley WA, Friedman JF, Vulule JM, Nahlen BL, Sauerwein RW, ter Kuile FO. Prevalence and severity of malnutrition in pre-school children in a rural area of western Kenya. *Am J Trop Med Hyg* 2003; 68(4 Suppl):94-9.
- [32] Menegolla IA, Drachler Mde L, Rodrigues IH, Schwingel LR, Scapinello E, Pedrosa MB, Leite JC. Nutritional status and social determinants of child height in the Guarita Indigenous Territory, Southern Brazil. *Cad Saude Publica* 2006; 22(2):395-406.
- [33] Sanchez-Perez HJ, Hernan MA, Rios-Gonzalez A, Arana-Cedeno M, Navarro A, Ford D, Micek MA, Brentlinger P. Malnutrition among children younger than 5 years-old in conflict zones of Chiapas, Mexico. *Am J Public Health* 2007; 97(2):229-32.
- [34] Sheikholeslam R, Kimiagar M, Siasi F, Abdollahi Z, Jazayeri A, Keyghobadi K, Ghaffarpour M, Noroozi F, Kalantari M, Minaei N, Eslami F, Hormozdyari H. Multidisciplinary intervention for reducing malnutrition among children in the Islamic Republic of Iran. *East Mediterr Health J* 2004; 10(6):844-52.
- [35] Larrea C, Kawachi I. Does economic inequality affect child malnutrition? The case of Ecuador. *Soc Sci Med* 2005; 60(1):165-78.
- [36] Ronaghy HA, Halsted JA. Zinc deficiency occurring in females. Report of two cases. *Am J Clin Nutr* 1975; 28(8):831-6.
- [37] Callaghan AL, Moy RJ, Booth IW, DeBelle G, Shaw NJ. Incidence of symptomatic vitamin D deficiency. *Arch Dis Child* 2006; 91(7):606-7.
- [38] Renzaho AM, Gibbons C, Swinburn B, Jolley D, Burns C. Obesity and undernutrition in sub-Saharan African immigrant and refugee children in Victoria, Australia. *Asia Pac J Clin Nutr* 2006; 5(4):482-90.
- [39] Danubio ME, Amicone E, Vargiu R. Height and BMI of Italian immigrants to the USA, 1908-1970. *Econ Hum Biol* 2005 ;3(1):33-43.
- [40] Freedman DS, Khan LK, Serdula MK, Ogden CL, Dietz WH. Racial and ethnic differences in secular trends for childhood BMI, weight, and height. *Obesity (Silver Spring)* 2006;14(2):301-8.
- [41] Wickramasinghe VP, Cleghorn GJ, Edmiston KA, Davies PS. Impact of ethnicity upon body

- composition assessment in Sri Lankan Australian children. *J Paediatr Child Health* 2005;41(3):101-6.
- [42] Rush EC, Puniani K, Valencia ME, Davies PS, Plank LD. Estimation of body fatness from body mass index and bioelectrical impedance: comparison of New Zealand European, Maori and Pacific Island children. *Eur J Clin Nutr* 2003; 57(11):1394-401.
- [43] Fredriks AM, van Buuren S, Jeurissen SE, Dekker FW, Verloove-Vanhorick SP, Wit JM. Height, weight, body mass index and pubertal development reference values for children of Turkish origin in the Netherlands. *Eur J Pediatr* 2003;162(11):788-93.
- [44] Fredriks AM, van Buuren S, Jeurissen SE, Dekker FW, Verloove-Vanhorick SP, Wit JM. Height, weight, body mass index and pubertal development references for children of Moroccan origin in The Netherlands. *Acta Pediatr* 2004; 93(6):817-24.
- [45] Singh M. Role of micronutrients for physical growth and mental development. *J Pediatr* 2004;71:59-62
- [46] Vailay j, Rai MK. The National Nutrition Scene: an analysis of results of two national surveys. *Indian Pediatr* 1996; 33(4):305-12.
- [47] Setswe G. Prevalence and risk factors for malnutrition among children aged 5 years and less in the Lefaragatlha village of Bophuthatswana. *Curations* 1994;17(3):33-5.