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Prevalence of Anemia and Related Risk Factors Among 4-11 Months Age Infants in Eskisehir, Turkey

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This aim of study was to determine the prevalence of anemia among infants from 4 to 11 months age and also to evaluate possible related risk factors with anemia. Hemoglobin level was determined by Hemocue hemoglobinometer in capillary blood samples. Anemia was diagnosed if hemoglobin (Hb) concentration was ≤11.0 g dL^{-1}. Study group was occurred 3039 healthy infants (51.4% boy) from 4 to 11 months age, visited primary care centers and accepted study from April 2004 to March 2005 in Eskisehir. The mean age was 6.85±2.57 months. An 81.1% of infants live in urban area and 18.8% of the study population had no health insurance. Prevalence of anemia was found in 40.3% in total study group; 42.2% for boys and 38.3% for girls ($p<0.05$). The highest anemia prevalence was found at 6-7 months infants (46.8%). Prevalence of anemia was higher in for rural area than found in urban area (46.7 and 38.9%, $p = 0.001$) and also higher in children which have no insurance. In results of logistic model, to be boy, 6-7 months age group, living in rural area and had no insurance were important risk factors for anemia. These results suggest that production and application of preventive policies about risk factors for anemia by health policy makers.

Key words: Anemia, prevalence, infant, risk factors, primary care center

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INTRODUCTION

Anemia, defined as the reduction of Hb concentration in the blood, is due, in many developing countries (Scrimshaw, 1991). The existence of anemia may cause growth impairment tendency and to infections, also may cause delayed physical, motor, psychological, behavioral, cognitive and linguistic developmental milestones especially less than two years old. Therefore, severe anemia was associated with increased morbidity and mortality in infants and children (Stoltzfus, 2001; Grantham-McGregor and Ani, 2001; Sachdev *et al*., 2005; Lozoff *et al*., 2006). Iron-deficiency is a major cause of anemia in infants in the worldwide and is most common nutrition deficiency in the worldwide, especially in developing countries (De Pee *et al*., 2002; Meinzen-Derr *et al*., 2006; Dewey *et al*., 2004).

According to Ministry of Health reports (Anonymous, 2004), iron-deficiency anemia was shown in 50% of 0-5 year age group, in 30% of school children and in 50% of breast feeding women. The national iron supplementation is recommended whether the prevalence of anemia is ≥20% of general population and in ≥40% of 6-24 months age children. To provide the iron supplementation is an effective way of preventing and controlling the iron deficiency. So it is very important to perform it as a national policy. Therefore, Health of Ministry started a project called Project of Turkey like Iron to eliminate iron-deficiency problem in March 2004. It has been planned to maintain unpaid iron preparations for prophylaxis to 4-12 months age infants and to treat 13-24 months age anemic children during this project.

The determination of factors that influence the occurrence and maintenance of anemia in a population is fundamental for the implementation of control measures. Study was aimed to determine prevalence of anemia among infants 4 to 11 months age and to evaluate relationship risk factors in Eskisehir, Turkey.

MATERIALS AND METHODS

Eskisehir is a metropol city situated in the Middle Anatolian Region in Turkey. Number of 4-11 months infants is 6227 (83.1% in urban, 16.9% in rural) in 2004 by data of Health Directorship of Eskisehir. Study is a descriptive study. Study group was occurred 3039 healthy infants aged between 4 to 11 months, visited 18 primary care centers from April 2004 to March 2005 in Eskisehir. Participants were determined with two-step sampling method. Volume of sample was calculated 1687 for study (prevalence of anemia, confidence interval and standard error was accepted, respectively, 40, 95 and 2%). But sampling error is higher in cluster sampling than others. Therefore, volume of sampling was increased 2 folds and determined 3374. Infants' 335 (10.1%) was excluded that their families refused to join study.

In this study period, there are 47 primary care centers, 19 out of them are located in the city center (40.4%) and 28 out of them (59.6%) are located in districts. Each primary care centers was accepted a cluster. Infants from the 10 primary care centers in the city center and from 8 primary care centers were enrolled according to the distribution of infant population by living area.

Before the start of this study, physicians who worked in these primary care centers were trained about aims of this study, questionnaire forms including the information about sociodemographic characteristics of infant's family, birth history and infant's nutrition and technical information such as hemoglobin (Hb) concentration measurement. At the first visit to the primary care centers, an interview was performed with mothers and questionnaire forms were completed.

Hemocue hemoglobinometer was determined hemoglobin levels in capillary blood sample. Anemic infant was considered if Hb concentration is ≤11.0 g dL^{-1} (WHO, 2001). Height measures were performed with measure in horizontal position and weight measures were performed with nan baby weightbridge. Anthropometric measures were compared with normal values of the similar healthy infants for age/sex groups. The National Center for Health Statistics (NCHS) data were used for body weight and height standards (Hamill *et al*., 1979). Thin, normal, overweight and obese were accepted by ideal body weights (respectively, <90% of ideal body weight, 90-110, 110-119 and >120%). Infant's birth weights were achieved from documents of primary care centers. Infants were defined as low birth weight whether his/her birth weight was <2500 g and they were accepted high birth weight whether his/her birth weight was >4000 g.

Chi-square test, t-test and analysis of variance were done for single variable analysis. Considering anemia as on independent variable and multiple variable analyses (logistic regression) was done to determine dependent variables that predict development of anemia. For multiple variable analysis models, variables were accepted if the p-values are ≤0.01 in single variable analysis. Values were considered to be statistically significant if the $p<0.05$.

RESULTS

In study period, 1563 (51.4%) boys and 1476 (48.6%) girls, total 3039 infants were enrolled. The mean age was

Table 1: Hb concentrations by infants' sociodemographic characteristics

Variables	Hb concentration (g dL^{-1}) X±SD*	Statistical analysis
Gender		
Girl	11.03±1.03	
Boy	10.93±1.06	t = 2.638; p = 0.008
Age groups (months)		
4-5	11.01±1.04	
6-7	10.83±0.98	
8-9	10.99±1.06	
10-11	11.00±1.07	F = 3.637; p = 0.012
Living area		
Rural	10.91±1.05	
Urban	11.00±1.04	t = 1.84; p = 0.06
Insurance		
Yes	11.02±1.05	
No	10.84±1.02	t = 3.643; p = 0.000

*: X = The mean Hb concentration, SD = Standard Deviation

Table 2: Hb concentrations by infants' birth weight, type of nutrition and ideal body weight

Variables	Hb concentration (g dL^{-1}) X±SD*	Statistical analysis
Birth weight		
Low	10.62±1.20	
Normal	10.99±1.02	
High	11.07±1.16	F = 10.09; p = 0.000
Type of nutrition		
Breast-fed	11.00±1.03	
Mixed-fed	10.97±1.03	
Formula-fed	10.98±1.10	F = 0.279; p = 0.757
Ideal body weight		
Thin	10.97±1.02	
Normal	10.95±1.08	
Overweight	11.04±0.98	
Obese	11.08±0.98	F = 2.185; p = 0.088

*: X = The mean Hb concentration, SD = Standard Deviation

Table 3: Results of Logistic model of variables associated with anemia in infants

Variables	Prevalence of anemia (%)	Odd's ratio	95% confidence interval	p-value
Age groups (months)				
10-11	39.3	1.00		
8-9	37.3	0.94	0.75-1.18	0.595
6-7	46.8	1.41	1.10-1.81	0.008
4-5	40.3	1.08	0.88-1.32	0.447
Gender				
Girl	38.3	1.00		
Boy	42.2	1.17	1.01-1.36	0.035
Living area				
Urban	38.9	1.00		
Rural	46.7	1.36	1.13-1.64	0.001
Insurance				
Yes	38.4	1.00		
No	48.7	1.45	1.21-1.75	0.000
Birth weight				
Normal	40.1	1.00		
Low	45.8	1.26	0.91-1.75	0.169

6.85±2.57 months. Age groups were not significant by gender (χ^2 = 1.73; p = 0.629). An 81.1% of infants live in urban area and 18.8% of the study population had no health insurance (Table 1). Mean birth weight was 3259.7±488.6 g. 196 infants (6.4%) had a history of low birth weight and the ratio of high birth weight was 6.0% (182 infants). Eight hundred and fifty four infants (28.1%) are breast-feeded, 549 infants are formula-fed and 1636 (53.8%) infants had been received breast feeding with formula. According to weight for height, malnourished, normal, overweight and obese were determined in, respectively 14.6% (n = 443), 56.9% (n = 1730), 16.2% (n = 491) and 12.3% (n = 375) (Table 2).

Prevalence of anemia was 40.3%. Prevalence of anemia was 42.2% for boys and 38.3% for girls (χ^2 = 4.75; p = 0.029). Prevalence of anemia was changed by age groups. The highest anemia prevalence was found at 6-7 months infants (46.8%) and 8-9 months infants had the lowest prevalence (37.3%), (χ^2 = 10.73; p = 0.013). Prevalence of anemia was found in 46.7% for rural, 38.9% for urban (χ^2 = 11.57; p = 0.001). Prevalence of anemia was found in 48.7% for infants which have no health insurance and 38.4% for infants with health insurance (χ^2 = 20.45; p = 0.000). Prevalence of anemia was found in 45.8% for low birth weight infants and 39.9% for normal birth weight infants and 42.9% for high birth weight infants (χ^2 = 2.59; p = 0.274). Prevalence of anemia was determined in 39.1% for breast-fed infants and 37.3% for formula-fed and 42.0% for mixed-fed infants (χ^2 = 4.45; p = 0.108). Being anemic was not associated with ideal body weight (χ^2 = 5.542; p = 0.136) (Table 3).

DISCUSSION

Prevalence of anemia was higher (40.3%) in our study group. Studies carried out in different parts of the Turkey and carried out from different countries have shown conflicting results regarding the prevalence of anemia. In some studies from other countries, prevalence of anemia was higher (15-21), similar (25, 26) or lower (22-24) than present study (Kocak *et al*., 1995; Sila *et al*., 2001; Dangour *et al*., 2002; Hadler *et al*., 2002; Antunes *et al*., 2002; Morasso Mdel *et al*., 2003; Uchimura *et al*., 2003; Spinelli *et al*., 2005; Bogen *et al*., 2001; Lozoff *et al*., 2003; Sibeko *et al*., 2004; Lehmann *et al*., 1992). Differences between the studies may be explained with characteristics of study populations.

In some studies, the mean Hb concentration was determined higher in boys, 6-7 months age, had uninsurance families and low birth weight infants. However, some studies were reported any association between gender and anemia (Osorio *et al*., 2001; Le Cessie *et al*., 2002; Soh *et al*., 2004), being a boy was determined as a risk factor for anemia in our study population. Like this study, Spinelli *et al*. (2005) reported that male gender is a risk factor for anemia in their study population including 2715 infants aged between 6 to 12 months in Brazil. Morasso Mdel *et al*. (2003) also reported that anemia prevalence is also higher in boys in their

study population consisting 414 children aged between 6 and 24 months in Argentina. Wieringa *et al.* (2007) suggested that in especially the second half of infancy, iron requirements for boy infants are approximately 0.9 mg day^{-1} higher than for girl infants.

In spite of, some studies were reported any association between age and anemia (De Pee *et al.*, 2002; Hadler *et al.*, 2002; Soh *et al.*, 2004), being 6-7 months age group was determined as a risk factor for anemia in our study population. Ratio of breast feeding alone was in 61.8% for 4-5 months age group, decreasing in 8.5% for 6-7 months age group and more decreasing in 1.5% for >7 months age group. The reason why being 6-7 months age group is a risk factor for anemia, may be considered as decreased breast feeding and insufficiency of feeding with formula in this age group. Exclusive breast-feeding is protective against iron deficiency for infants <6 months of age.

However, Villalpando *et al.* (2003) reported any association between rural-urban and anemia we found that being anemia increased by being living in rural area like other previous studies (Spinelli *et al.*, 2005; Osorio *et al.*, 2001). Sayyari *et al.* (2006) reported that the prevalence of anemia was significantly higher in rural than urban areas in Iranian children aged between 2 to 12 years. Lack of health insurance may indicate low socioeconomic conditions and may be considered as an indirect indicator for not to be able to reach health care services adequately. Being infants of family which have no health insurance was determined as a risk factor for anemia in present study.

Being low birth weight was increased risk of anemia (Spinelli *et al.*, 2005; Lehmann *et al.*, 1992; Le Cessie *et al.*, 2002). Morasso Mdel *et al.* (2003) reported that prevalence of anemia was determined higher in had <3000 g birth weight. To our study, low birth weight infants was determined that had low Hb concentration, but multiple variable analysis could not find association being low birth weight and anemia. In other studies Shebab *et al.* (2001) and Murila *et al.* (1999) reported any association between low birth weight and anemia like our studies. We were also reported any association between body weight and anemia. Antunes *et al.* (2002) reported any association between anthropometric measures and anemia. Gur *et al.* (2005) reported that the overall prevalence of anemia was found to be 27.6% in school-children aged between 6 to 16 years old and there was no significant relationship between the prevalence of anemia and the students age, gender, parents' educational level and employment and monthly family income. Only the number of family members and malnutrition were risk factors for anemia. We could not determine association between types of nutrition and prevalence of anemia. Probably, relation between types of nutrition and anemia could not be determined because of variation of age groups, different types of nutrition and type of study. Willows *et al.* (2000) reported that prevalence of anemia was lower in breast feeding alone. Pizarro *et al.* (1991) reported that prevalence of anemia was higher in feeding with cow milk.

As a conclusion; anemia is an important public health problem in Eskisehir. These results suggest that production and application of preventive policies about risk factors for anemia by health policy makers. Infants are susceptible to anemia-especially iron deficiency-due to their increased needs for rapid growth and the relatively low iron content of their diets. Prevention strategies against anemia is fundamental when we consider the potential threat of long term reversible or irreversible complication of anemia.

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