

Anemia as a Public Health Issue in Mashhad, Iran: Evidence from the First Population-Based Study

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Received: 2 Jul. 2014; Accepted: 25 Dec. 2014

Abstract- Anemia is one of the main conditions that impose an adverse impact on the socioeconomic state of any country; however, evidence on the prevalence of anemia is scant in Northeastern Iran. This study was conducted to determine the overall and age- and sex-specific prevalence of anemia in the city of Mashhad, Iran. In a cross-sectional, population-based survey, 1675 individuals aged 1-90 years (29.1 ± 18.5 years) were selected from approximately 2.4 million residents by a multistage cluster sampling method during May to September 2009. Blood samples were evaluated to determine erythrocyte indices and anemia was defined according to hemoglobin (Hb) levels based on World Health Organization (WHO) guidelines. The prevalence of anemia was 9.7% with considerable difference between both sexes; 6.2% and 12.7% in males and females, respectively ($P < 0.001$). The higher prevalence of anemia was detected in females of 15-54 and ≥ 65 years old (16% and 12.5%, respectively). However, the higher rates were observed in males 65 years and older as well as boys below 5 years old (16.3% and 14.6%, respectively). Current findings show that anemia is a considerable public health problem in the population of Mashhad, Iran, especially among the pre-school children, adult women and the elderly. Great attention should be paid to the pre-school boys who are more affected by anemia than what was previously assumed.

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Acta Medica Iranica, 2015;53(3):186-190.

Keywords: Anemia; Prevalence; Public Health; Iran

Introduction

Anemia is a worldwide public health problem with a global prevalence of 24.8% affecting 1.62 billion people (1). The adverse effects of anemia on mental, physical performance, and work capacity necessitate a careful assessment of anemia prevalence in any population to control this issue (2). According to the report of World Health Organization (WHO) in 2005, Iran as a member of Eastern Mediterranean Region (EMR) was placed in a moderate group regarding anemia prevalence of 35% and 33% among pre-school children and non-pregnant women, respectively (1,3). Most of the studies in Iran have showed that the frequency of anemia in the country is 20-30 percent (4). However, the method applied in the majority of these studies was facility based sampling and the study groups were confined to a specific age and sex group. For instance, a study by Keikhaei *et al.*, showed that the prevalence of anemia was 43.9% in

children aged 6-59 months living in urban and rural areas of Ahwaz, Southwest Iran (5). The prevalence of anemia among adolescent school girls of Kermanshah in west of the country was 21.4% in 2006 (6). A prevalence of 21 percent for anemia among non-pregnant 18-35 years-old women in Gorgan, North Iran, is indicated by another study in 2000 (7). It seems that general population-based studies that include all age and sex groups for the determination of the prevalence of anemia in Iran are scarce. In a study among the citizens of Tabriz, Northwest Iran, the anemia prevalence was 9.7% in 2007 (8).

In this paper, the overall as well as age- and sex-specific prevalence of anemia was reported in Mashhad, the second large city of Iran, located in the northeast of the country. Data on complete blood cell counts was provided from the participants in a project conducted to identify the prevalence of some viral infections in the general population of the city (9,10).

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It should be declared that no data was found on the prevalence of anemia in this area. Thus, the results would assist in the development of a general insight into the current status of anemia in the region.

Materials and Methods

In a cross-sectional study, from approximately 2.4 million residents of Mashhad, 1675 individuals aged between 1-90 years were selected by multistage cluster sampling between May and September 2009. The samples were acquired from all the 12 municipality areas of the city including 40 districts. The sampling method was described in details elsewhere (9). Briefly, from every district, one subdivision and from each subdivision, some blocks were chosen randomly. Then, at least 20 households were selected in each block, from which one person was included in the study. By this method, approximately equal ratios of both sexes as well as ten percentiles for the age according to the 2006 census were involved. The pregnant women were not included in this survey. Informed consent was obtained from all the participants according to the approval of Research and Technology Deputyship of Iranian Academic Center for Education, Culture and Research (ACECR) regarding methodological and ethical issues.

The venous blood samples were obtained from each individual and evaluated by the cell counter, SYSMEX KX-21N (Japan), to determine Hb, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell volume distribution width (RDW).

According to the definitions of anemia by WHO, (1) the Hb thresholds were 110 g/l and 115 g/l for children 1–4.9 and 5–11.9 years old, respectively, 120 g/l for

children 12–14.9 years old and non-pregnant adults women, and finally 130 g/l for male adults. Anemia was further categorized as mild ($Hb > 10$ g/dl but below the cut-off point), moderate (Hb between 7-10 g/dl) and severe ($Hb < 7$ g/dl) (11).

In addition, age and sex-based values of MCV, MCH, and MCHC were applied to distinguish patients with hypochromic microcytic anemia (12), among that the distinction of iron deficiency from other causes was performed using the RDW levels. RDW is the most sensitive parameter for the diagnosis of iron deficiency anemia (IDA) (13) and has been introduced as an effective tool in a large number of samples (14). However, several studies employed various cut-off points for RDW in the detection of IDA and reported different sensitivity and specificity rates ranged from 61.3-98.8% and 51-92.5%, respectively (13-17). We considered the highest normal values of RDW, 14.5% in children and adults, (14) as the cut-off point for the detection of IDA (18).

Results

From 1675 participants with a mean age of 29.1 ± 18.5 years, 915 (54.5%) were female, 76.6% above 15 years old and 6.3% under 5 years old. one-hundred sixty three persons (9.7%) were anemic, from whom 139 subjects (85.3%) had mild anemia; no severe case was detected. Ninety-five (58.3%) had hypochromic microcytic anemia. It should be mentioned that nine cases had hypochromic anemia with MCV levels near lower normal limit; all of them were ≥ 15 years old and classified as hypochromic-microcytic type. In patients with hypochromic-microcytic anemia, 42.9 percent ($n=70$) had high RDW levels which could be assumed to have IDA.

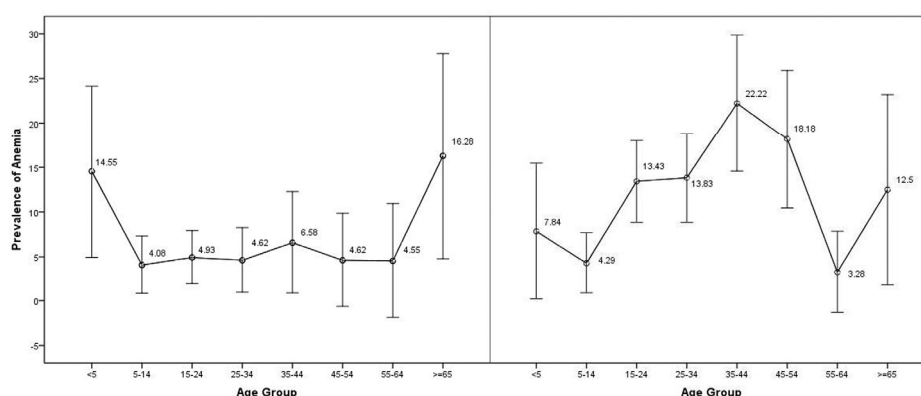


Figure 1. Prevalence of anemia in different age groups in male (left) and female (right).

Anemia in females was two times more prevalent than in males (12.7% vs. 6.2%, $P<0.001$), however, no difference was observed in both sexes regarding anemia severity. Furthermore, there was a significant association between the prevalence of anemia and age ($P<0.001$). Even though the higher prevalence of anemia was detected in females of 15-54 and ≥ 65 years old (16% and 12.5%, respectively), males 65 years old and older as well as boys below 5 were the most frequent group of males (16.3% and 14.6%, respectively; Figure 1). On the other hand, neither age nor sex had meaningful association with type of anemia.

Discussion

According to WHO (1), the current study revealed that anemia in the general population of Mashhad, Iran with a prevalence of 9.7 percent is a mild public health problem. However, the condition is more prominent in some age and sex groups. The frequency of anemia was significant for the pre-school children. Nevertheless, the prevalence in our population was considerably lower than the one reported by WHO for Iran and the other countries of EMR (1). Except nations such as Pakistan, Iraq, Syria, Yemen, and Oman in which anemia was a severe public health problem; other countries of this region similar to Iran were classified in the moderate group. In Pakistani pre-school children, the prevalence of anemia was reported to be as high as 51% in 2001 (19). In 2004, 42% of pre-school children had anemia according to the report of Health Ministry of Oman (20).

Studies in various cities of Iran have reported different rates of anemia in children. For instance, in a thorough survey of Iranian population in 1999, of the 4170 children aged 2-6 years in rural and urban areas, 10.8% were diagnosed with anemia (21). Another study in urban and rural areas of Ahwaz, showed that 43.9% of children aged 6-59 months had anemia (5). In Kharameh, a city in Fars Province, Southern Iran, the prevalence of IDA among children 6 months to 5 years old was 19.7% in 2002 (22). This variation might be partly related to the difference in socioeconomic status of populations, as this may affect the nutritional situation of the people including children.

Another important point to be noticed is that the prevalence of anemia in pre-school children was considerably higher among boys. While IDA was previously proposed to have the highest prevalence in this age group, yet the finding that boys are affected

more or are at greater risk has been greatly neglected so far. Some studies from various countries have suggested being a boy as a risk factor for anemia (23, 24). Vendt *et al.*, found that boys had a tendency to have lower ferritin concentrations than girls (25), while Wieringa *et al.*, suggested that iron requirements for boy infants are higher than girls (26). In another study conducted on healthy British infants aged between 4- 9 months, no sex difference in Hb levels was observed at eight months of age, but in a follow-up of the same infants at 18 months age, significantly lower Hb was observed in boys that suggests a greater risk of iron deficiency development for boys (27,28). Domellof *et al.*, reported a 10 fold higher risk of anemia among boys in infancy. They proposed sex difference in fetal iron accretion and genetics and hormonal factors as causes for increased risk of iron deficiency (23).

The lower prevalence of anemia in males over 5 years was consistent with the findings of previous studies. In male blood donors in Kurdistan, Western Iran, the prevalence of anemia was 4% in 2007 (29). On the other hand, some evidence confirms that the prevalence of anemia in Iranian adult males is much higher than current results. According to the report of Iranian Health Ministry in 2001, the prevalence of anemia in 16-21 and 45-61-year-old males was 16.3% and 10%, respectively (30). The prevalence of anemia in the other countries of EMR was also much higher than the result of this study, ranging from 20-56%, however, the prevalence in males was much lower than that of females in their countries (31). In Oman, as an example, the prevalence of anemia in males was approximately one-third of the prevalence in females (12% vs. 39%) in 2004 (20).

Furthermore, this study showed that anemia in adult non-pregnant women of Iran is a considerable health problem. While anemia in countries such as Iraq, Yemen, and United Arab Emirates in EMR is a severe problem, other countries of this region like Iran, reported to have moderate situation (1). Report of Health Ministry of Iran in 2001 showed that the prevalence of anemia in non-pregnant women of 14-21 and 50-61 years old was approximately 19 percent (30). As mentioned above, a considerable difference in the anemia prevalence has been observed in different cities of Iran due to different socioeconomic status. For example, the prevalence of anemia among adolescent school girls of Kermanshah (2006) (6), and Zahedan and Rasht (1996-1997) (32), was nearly 21, 17.4 and 11 percent, respectively. In non-pregnant 18-35 years-old

women of Gorgan in 2000, the prevalence was 20% (7).

Physiologically prone to anemia due to menstruation and iron loss, females in childbearing age suffer from anemia much more than the others. Consistently present study confirmed that among all the population, non-pregnant women in child-bearing age had the highest prevalence of anemia, among which 35-45 years old females had a moderate problem. On the other hand, lower prevalence of anemia in younger females can be explained by considering the role of the current national iron supplementation program (33), which is conducted nationally in more than 90% of secondary and high schools girls. The afterward surge might be due to the depletion of iron resources of the body and the lack of replenishment. Pregnancy consequences might superimpose a greater burden on females that is obvious with the peak occurring between 35- 55 years (Figure 1). By the introduction of menopause, the iron loss is no longer a considerable issue, and that is why the lowest prevalence of anemia is seen in this time. The following increment in the prevalence of anemia might be a result of coincident chronic disease or nutritional deficiencies (34). Similarly, this could explain why frequency of the condition rises sharply after 65 years in males.

In conclusion, the prevalence of anemia in females of 35-55 and boys below 5 years old as well as the elderly is higher than other groups. This fact should persuade those in charge of public health to include also these age groups in current iron supplementation programs.

Acknowledgement

This study was supported financially by the Iranian Academic Center for Education, Culture & Research (ACECR), Mashhad Branch, Mashhad, Iran. We appreciate the personnel of the Clinical Laboratory of the ACECR-Mashhad for their great participation and co-operation in the conduction of the current investigation.

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