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Research Article

Why anaemia in infants can't be solved by iron supplementation alone: Notes from the ethnic underground

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Abstract

Aim: Our objective was to estimate the trends in incidence of anaemia among Israeli infants aged 9 to 18 months.

Methods: This was a cross-sectional retrospective study for the years 2002, 2007 and 2012 in two districts. Data was analyzed for geographic distribution, age, infant's haemoglobin level, ethnic origin, type of clinic where the infants received treatment, iron prescriptions dispensed to each child, and the mother's last haemoglobin level before delivery.

Results: The prevalence in District A for the aforementioned timeline was 16.2%, 9.9% and 8.1%, respectively (P<0.000). Prevalence was significantly higher in the non-Jewish versus the Jewish population. In District B prevalence was 10.8%, 11.6%, and 8.7%, respectively, and significantly higher in the non-Jewish (17.5%, 18.6%, and14.1%) than in the general Jewish population (9.0%, 9.8% and 7.5%). Among the ultra-Orthodox urban Jews, prevalence was 14.5% 14.9 %, and 11.3%, respectively.

Conclusions: Anaemia in infants is multifactorial in origin and depends on both inherent biological as well as environmental factors. Effective early prevention mitigates factors across ethno- and economic divisions.

Current knowledge on the subject: World Health Organization estimates anaemia prevalence at 47.4% and as affecting 293 million young children globally. The highest prevalence is in Africa (67.6%) and South-East Asia (65.5%). In the Eastern Mediterranean, the prevalence is 46% and around 20% in other WHO regions. In the United States, 7% to 9% of toddlers (1 to 3 years old) have iron deficiency, and 2% to 3% have iron deficiency anaemia). In Iran the frequency of IDA was 4% and in Jordan 72%. In Israel the prevalence rate of anaemia in the year 2006 was 15.5%.

Contribution of our study to knowledge: In districts A and B there was a significant decrease in the percentages of prevalence of anaemia through the years 2001-2002, 2006-2007, and 2011-2012. Analysis of the total sample of district A revealed an almost 50% decrease, i.e. from 16.2% to 8.1%. In district B, the percentages in Jews dropped from 9% to 7.5%, in the non-Jews from 17.5% to 14.1%, and in the Ultra-Orthodox from 14.5% to 11.3%.

Introduction

World Health Organization (WHO) estimates anaemia prevalence at 47.4% and as affecting 293 million young children globally. The highest prevalence is in Africa (67.6%) and South-East Asia (65.5%). In the Eastern Mediterranean, the prevalence is 46% and around 20% in other WHO regions [1]. In the United States, 7% to 9% of toddlers (1 to 3 years old) have iron deficiency (ID), and 2% to 3% have iron deficiency anaemia (IDA) [2,3]. In Iran the frequency of IDA was 4% [4] and in Jordan 72% [5]. In Israel the prevalence rate of anaemia in the year 2006 was 15.5% [6].

Among those at risk are children of impoverished

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families, those of Afro-American or Hispanic origin and other immigrant groups, obese children [7], progeny with a history of prematurity, or low birth weight [7], as well as exclusively breastfed infants [8], those on non-iron-fortified formula without iron supplement, or infants introduced to cow's milk before their first birthday. It was demonstrated that a high prevalence of anaemia in pre-school children (12%), causally linked to ID related to dietary factors, is common in areas of socioeconomic deprivation [9]. Iron deficiency anaemia and ID without anaemia during infancy and childhood can have long lasting detrimental effects on neurodevelopment. Since 1985 the Israeli Ministry of Health has adopted recommendations for the prevention of IDA in infants. Around the age of 12 months, a routine Haemoglobin (Hb) screening is also recommended for all infants [10].

The purpose of this study was to use the comprehensive computerized database of the Clalit Health Services (CHS) to analyze contributing factors to anaemia among the population of CHS-insured 9 to 18 month old Israeli infants.

This study is a follow-up to a previous survey conducted in 2006 [6].

Methods

The study was conducted using the data from the years 2002, 2007 and 2012 in two areas (District A) and (District B).

The study population included all CHS-insured infants aged 9 to 18 months for whom Complete Blood Counts (CBCs) were universally performed. The blood samples were analyzed for CBC using Coulter analysis and for the ferritin concentration using a radioimmunoassay [11].

Infants suffering from chronic diseases were excluded. Data included age, gender, ethnic origin, infant's Hb level, mother's last Hb value before delivery, and the number of iron prescriptions dispensed to each child by CHS pharmacies.

This study was approved by the Human Subjects Protection Program of the Clalit Health Services Ethics Board.

The WHO recommends a Hb level of 110 g/dL as a cut-off point for the diagnosis of anaemia in the paediatric population [1]. However IDA was defined as a Hb level of <105 g/dL. The Nelson Textbook of Pediatrics recommends a level of 105 g/dL as the cutoff point for the diagnosis of anaemia in infants aged 9 to 18 months [12].

In those infants with repeat Hb analysis, only the first value was included. Mothers were matched with their children using the database that includes family demographic data. Only the last CBC performed before delivery was included. In our study pregnant women were considered to be anemic if their Hb values were <110 g/dL.

Statistical analysis

The data were analyzed using BMDP software. Continuous variables are expressed as means ± SDs. Pearson's chi-square test or Fisher's exact test was used, as appropriate, for analysis of between-group differences in discrete variables. Analysis of variance was used for continuous variables. A P value of ≤0.05 was considered significant.

Results

Prevalence of anaemia among infants in District A for the aforementioned timeline was 16.2%, 9.9% and 8.1% (percentage from the total sample), respectively (P<0.000). Prevalence was significantly higher in the non-Jewish (21.2%, 11.2%, and 10.1%) compared with the Jewish population (11.1%, 8.7%, and 7.0%) (Table1).

Table 1: Changes over time in prevalence rates of anaemia in Israeli infants aged 9 to 18 months. Percentage with anaemia in District A.

	2001-2002	2006-2007	2011-2012	Critical	
Age (in months)	**P_1**	**P_2**	**P_3**	**P_i - P_j** |	***P*-value**
Characteristics of District A Total sample	16.2% (1351/8337)	9.9% (1139/11539)	c8.1% (1217/15057)	$\|P_1-P_3\|$	<0.001
9 – 12	15.7% (365/2315)	10.7% (527/4946)	8.4% (748/8947)	$\|P_1-P_3\|$	<0.001
12 – 15	16.3% (824/5048)	9.1% (510/5611)	7.9% (405/5147)	$\|P_1-P_3\|$	<0.001
15 - 18	16.6% (162/974)	10.4% (102/982)	6.6% (64/963)	$\|P_1-P_3\|$	<0.001
Ethnicity					
Non-Jews	21.2% (889/4185)	11.2% (496/4438)	10.1% (528/5204)	$\|P_1-P_3\|$	<0.001
Jews	11.1% (462/4152)	8.7% (588/6774)	7.0% (689/9853)	$\|P_1-P_3\|$	<0.001
Gender					
Male	16.4% (703/4278)	10.3% (604/5886)	8.3% (644/7766)	$\|P_1-P_3\|$	<0.001
Female	16% (648/4059)	10.3% (535/5653)	8.3% (573/7291)	$\|P_1-P_3\|$	<0.001
Location					
Urban	15.7% (850/5407)	9.4% (698/7454)	7.5% (708/9400)	$\|P_1-P_3\|$	<0.001
Rural	17.1% (498/2909)	10.8% (439/4048)	9.0% (509/5653)	$\|P_1-P_3\|$	<0.001
Health Centers					
Paediatric Health Centers	14.5% (99/681)	7.3% (76/1048)	7.5% (99/1313)	$\|P_1-P_3\|$	<0.001
General Family Medicine Clinics	16.4% (1252/7656)	10.1% (1063/10491)	8.1% (1118/13744)	$\|P_1-P_3\|$	<0.001

In 2012 the prevalence of anaemia in District A was found to be higher in infants aged 9 to10 months old than in the 11 to 18 month age group. The lowest prevalence of anaemia (7.5%) was found among children treated at designated Paediatric Health Centers.

The improved rates of infant anaemia over the 12 year span of the study, together with the drop in anaemia with age for the years 2011-2012, reflect the different positive factors at work simultaneously. These comprise the national iron

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supplementation program, plus the more varied food choices available to the growing infant beyond the immediate neonatal period.

In an associated study from another region (District B) less data was available, but differences were found in prevalence of anaemia according to ethnic and socioeconomic background (Table 2).

A correlation was found between the presence of anaemia in infants and the presence of anaemia found in their mothers. Thus, infants born to anaemic mothers are more prone to develop IDA than infants born to mothers who have a satisfactory iron balance. In our study, the incidence of IDA in infants born to anaemic mothers was significantly higher (10%) than in infants born to non-anaemic mothers (7.3%, P<0.000). A significant difference was also found between non-Jewish (11.7%) and Jewish anaemic infants born to anaemic mothers (8.5%, P<0.002).

The impact of nutritionally disadvantaged mothers extends well beyond the pregnancy, and their poor nutritional legacy impacts on the future ability of the child to achieve his innate potential.

Table 2: Changes over time in prevalence rates of anaemia in Israeli infants aged 9 to 18 months. Percentage with anaemia in District B.

Characteristics of District B	2001-2002	2006-2007	2011-2012
Total Sample	10.8% (656/6044)	11.6% (1027/8802)	8.7% (1089/12463)
Non-Jews	17.5% (151/864)	18.6% (150/808)	14.1% (114/809)
Jews	9.0% (409/4536)	9.8% (618/6279)	7.5% (670/8952)
Orthodox	14.5% (93/641)	14.9% (255/1709)	11.3% (304/2701)

Discussion

Anaemia is common among Israeli infants mainly from a low *socioeconomic status* background. The decrease in prevalence over time among these infants could be attributed to several causes, such as the strict criteria that was used for establishing cut-offs, as well as to the national program for the prevention of IDA in infants. In addition, feeding infants with iron-fortified cereals is commonplace, as is the adherence to recommended prophylactic iron supplementation.

We found that the lower incidence among infants treated in health centers attended by paediatricians may be related to the higher awareness of these physicians regarding the importance of preventing IDA in infants. In our study, there was a clear correlation between maternal Hb levels tested before delivery, and the frequency of IDA in their offspring.

In an associated study from a different, more urbanized population, a comparison of anaemia rates among infants from non-Jewish, Ultra-Orthodox Jewish, and the general Jewish (more affluent) backgrounds, revealed that anaemia was more common in infants in the Ultra-Orthodox Jewish and non-Jewish populations (Table 2). The reasons for this vary, and include ethnic, genetic, and environmental factors, and especially among poorer families with low access to iron supplementation.

Multiparty, frequent deliveries, and prolonged breastfeeding in Israel, are more common in the non-Jewish and the Ultra-Orthodox Jewish groups. This may partially explain the differences between the three populations studied [13].

Further studies are needed to identify the causes of the high rate of anaemia in the absence of ID, such as hemoglobinopathy, infections, and the lack of nutritional factors other than iron. More significant efforts should be made among the non-Jewish population to analyze the causes of IDA in this group. Thereafter, special efforts should be made to minimize the prevalence of anaemia.

Currently, such a program, based on recent studies, is being prepared and implemented in the CHS.

In addition, we have developed several quality indicators for the assessment and treatment of anaemia in infants. We also believe that screening for ID and IDA should be carried out early in a child's development (i.e., at 9 months of age) when prevention is essential for better developmental outcomes.

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Disclosures and declarations

Ethics: This study was approved by the Human Subjects Protection Program of the CHS Ethics Board. Informed consent: was not required for this study

Prof. Lutfi Jaber and Dr. Gary Diamond had joint responsibility for protocol development, patient screening, enrollment, outcome assessment, preliminary data analysis and contributed to the writing of the manuscript.

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