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Prevalence of daily breakfast intake, iron deficiency anaemia and awareness of being anaemic among Saudi school students

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Iron deficiency anaemia is one of most prevalent nutritional disorders worldwide. It is known to affect the health and cognitive ability of children and adolescents. Studies in Saudi Arabia concentrate only on the population of young children and pregnant females or girls. Studies on the whole school student population is lacking. The objectives of this study were to identify the nutritional habits and the prevalence of anaemia among school students in Jeddah, as well as to recognize the students' awareness of their anaemic nutritional status. Data were collected from a sample of Saudi school children in Jeddah City from 42 boys' and 42 girls' schools during the month of April 2000. Data collection was done by an in-person interview to collect socio-demographic factors, nutritional habits, weight and height. Haemoglobin was measured in a sample of 800 students selected at random from both genders and different age groups. Anaemia was defined according to the new WHO cut-off levels for haemoglobin as: blood haemoglobin <11.5 g/dl for the 5–11 years boys and girls; <12.0 g/dl for 12–14 years boys and girls; <12.0 g/dl for 15+ girls and <13.0 g/dl for 15+ years boys. Proportion and 95% confidence intervals (CI) were calculated and significance was considered when the 95% CI did not overlap. Anaemia was reported among 20.5% of school students. Anaemia was more prevalent among students of at least 12 years as compared to the younger age group. Also, anaemia was more marked among governmental school attendees and those born to low-educated mothers. Menstruating girls were at around double the risk of being anaemic than non-menstruating girls. Anaemia was associated with negative impact on school performance and was more marked among those who failed their exams as compared to students with excellent results. Skipping breakfast was reported by 14.9% of students and this habit did not differ by age, sex, body mass index or social class. Skipping breakfast was more marked among students with poor school performance as compared to those with very good or excellent results. Only 34.1% of anaemic school students were aware of being anaemic. Awareness was nearly equal in all age groups and social classes but girls were more aware of their anaemic status than boys. Iron deficiency anaemia appears to be prevalent among school students. At age 12 years and over, low social class and menstruating girls constitute the high-risk groups. Screening is recommended for high-risk groups and school health programs are crucial to improve students' nutritional habits, knowledge and awareness.

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Introduction

Anaemia is a condition in which there is low level of haemoglobin in blood either because there are few red blood cells and/or little haemoglobin in each cell. There are many different types of anaemia but iron deficiency is the most common type. Iron deficiency anaemia is one of the most prevalent nutritional disorders worldwide. It is estimated that around 2.15 billion individuals suffer from iron deficiency anaemia (FAO/WHO, 1992). The risk of anaemia appears as early as childhood for both boys and girls (Dallman *et al.*, 1980) after which it subsides for boys but remains for girls because of menstrual blood loss. Anaemia has been shown to affect mental development and learning capacity. In infancy it may cause a permanent loss of IQ later in life, shortened attention span, irritability, fatigue, difficulty with concentration, lethargy, weakness and increased susceptibility to infection. Consequently, anaemic children tend to do poorly on vocabulary, reading, and other tests (Parker (1989). Poor dietary habits and lack of nutritional awareness among the youth are behind the prevalence of iron deficiency anaemia (Musaiger, 1987). Among these dietary habits is daily breakfast intake with quality and not only quantity of food being important. Several studies have found effects of hunger and poor nutrition on cognitive ability. One such study found that among fourth grade students, those who had the least protein intake in their diets had the lowest achievement scores (ASFSA, 1989). A laboratory study that involved healthy, well-nourished school-aged children found a negative effect of morning fasting on cognitive performance. A test of the speed and accuracy of response on problem-solving tasks given to children who did or did not eat breakfast found that skipping breakfast had an adverse influence on their performance on the tests (Pollitt *et al.*, 1981).

In Saudi Arabia most of the studies on nutritional status concentrate on preschool children who are under six years old (Sebai *et al.*, 1981; Serenius & Fourgerson, 1981; Sebai, 1983; Abdullah *et al.*, 1985; Al-Othaimeen *et al.*, 1988), so data on the nutritional status of children and adolescents in the Kingdom are insufficient (Rasheed *et al.*, 1989; El-Hazmi & Warsy, 1999). This has triggered us to perform this study aiming to identify the nutritional habits in the form of daily breakfast intake and the prevalence of anaemia among school students in Jeddah, as well as recognize the students' awareness of their anaemic status.

Material and method

Sample selection

In Jeddah City, there are a total of 692 governmental schools and 327 private schools, around half for boys and half for girls. A study was performed to assess the nutritional and health status of school children in Jeddah with age ranging from 9–21 years (mean 14.0 SD = 2.6). A total of 42 boys' and 42 girls' schools were selected using the stratified sampling technique with proportional allocation to type of school (governmental or private) and educational level. This was followed by random selection of one class in each educational level in the selected schools then all students in the selected classes were considered. A participation rate of around 99.0% was attained. This study included a sample size of 2850 Saudi students for the assessment of nutrition, health and examination. A sample of 800 students were chosen at random from each age group (as classified by World Health Organization (WHO, 1994) for anaemia) and gender for the assessment of iron deficiency anaemia. Blood samples were taken to measure the haemoglobin level among these students.

Data collection

Data were collected during April 2000 by medical students, trained in interviewing skills, and directly supervised by the medical staff. Data were collected from all students by an in-person interview using a structured questionnaire, which included information on socio-demographic factors, self-reported feeding habits, vitamin and iron intake and nutritional status, as well as by direct measurements of weight and height and blood haemoglobin measurements. Mothers' education level was classified into low (no school, primary and attended intermediate school), middle (completed intermediate and secondary schools) and high (attended or completed college and

higher). School grades was classified according to the national school grading classification; fail (<60% of total marks); pass (>60% to <70%); good (>70 to 80%); very good (>80% to <90%) and excellent (>90%). Type of school was taken as a proxy measure for the social class status, since private schools are mainly attended by high social class and governmental schools by low social class in Saudi society. Only Saudi population was selected for the study, so this classification would be valid to a large extent. Students were asked if they suffer from anaemia and if so, its type. Those reporting to have sickle cell anaemia or thalassemia minor as diagnosed by a physician were excluded from the study.

Blood haemoglobin (g/dl) was estimated using Refletron^R (Boehringer Mannheim). A comparative study on a sample of 50 was done in King Abdulaziz University hospital laboratory to estimate the accuracy of Reflectron^R haemoglobin method. Comparison was made using Cell-DYN 3700 system, which measures haemoglobin in the spectrophotometric channel. Throughout the study, Refletron^R scales were calibrated at the beginning of each session and each time they were moved. Similarly, different meters were checked for accuracy of reading on a continuous basis according to the manufacturer's protocol. The new WHO cut-off levels for haemoglobin have been adopted and accordingly anaemia defined for the 5–11 years boys and girls as blood haemoglobin <11.5 g/dl, 12–14 years boys and girls <12.0 g/dl and 15+ years <12.0 g/dl for girls and <13.0 for boys (WHO, 1994).

The weight was measured without shoes and with light clothes using Seca (model 777) personal scale to the nearest 0.1 kg and the height was taken without shoes using standard measuring tape to nearest 0.1 cm. Equipment were recalibrate between each measurement. The body mass index (BMI) was calculated as the weight in kg/(height in m)^2. The measured BMI was classified according to age and gender into underweight (<15th percentile); normal weight (≥15th percentile to <85th percentile); overweight (≥85th percentile to <95th percentile) and obese (≥95th percentile). Reference BMI percentiles were derived from the first National Health and Nutrition Examination Survey (NHANES) (Must *et al.*, 1991). This definition is in accordance with the recommendation of the expert committee on clinical guidelines for overweight in adolescence (Himes & Dietz, 1994) and WHO (1995).

Data entry and analysis

Data entry and analysis were done using SPSS for windows. Proportions and 95% confidence intervals (95% CI) were calculated. Differences between proportions were considered statistically significant if 95% CI did not overlap,

Results

A total of 800 Saudi Students were enrolled in the study (Table 1). There were 47.0% males and 53.0% females with an age ranging from 9 to 21 years (mean 14.0, SD = 2.6). The majority were from governmental schools (82.1%) and born to housewives (87.3%) while 16.8% were born to highly educated mothers and 25.1% were born when their mothers were below 20 years of age. Consanguinity was reported by 42.4% of students. Around 9.3% of students reported poor school achievement and 31.4% were overweight of which 54.6% were obese.

Regular daily breakfast intake (Table 2) was reported by 85.1% of students. There was no difference in regular daily breakfast intake by gender, social class, or BMI. School achievement appeared to be influenced by breakfast intake as the students with poor school results reported significantly less breakfast intake than those with excellent results. Although there was no significance difference of daily breakfast intake by age groups, there was an inverse trend of decreasing breakfast intake by age groups in years.

Anaemia was detected among 20.5% of students (Table 3). Anaemia was significantly higher among older age groups (12–14 and 15–21 years) as compared to younger students (9–11 years). Anaemia was significantly more prevalent among those attending governmental schools and born to low-educated mothers. Age of menarche among females ranged between 9 to 15 years and anaemia was significantly more marked in menstruating than non-menstruating girls. Although those born to housewives, younger mothers and issue of consanguineous marriage showed higher proportion of anaemia, results did not reach statistical significance. Also, anaemia appeared to be associated with negative impact on school achievement as the

Table 1. Socio-demographic characteristics of Saudi school students in Jeddah, Saudi Arabia 2000

		No.	*%*
Age (years)			
	9–11	145	18.1
	12–14	310	38.8
	15–21	345	43.1
Sex			
	Male	376	47.0
	Female	424	53.0
Type of school			
	Government	657	82.1
	Private	143	17.9
Mother education			
	Low	414	51.8
	Middle	252	31.5
	High	134	16.8
Mother working status			
	Housewife	698	87.3
	Working	102	12.8
Age of mother at child birth (years)			
	10–19	201	25.1
	20–29	482	60.3
	30+	117	14.6
Consanguinity			
	No	461	57.6
	Yes	339	42.4
School grades			
(<60% of the marks)	Fail	27	3.4
(≥60% to <70%)	Pass	47	5.9
(≥70% to <80%)	Good	131	16.4
(≥80% to <90%)	Very good	333	41.6
(≥90%)	Excellent	262	32.8
Body mass index[a]			
(<15th percentile)	Underweight	189	23.6
(≥15th to <85th percentile)	Normal	360	45.0
(≥85th to <95th percentile)	Overweight	114	14.3
(≥95th percentile)	Obese	137	17.1

[a] Based on measured weight and height, body mass index (BMI = weight [kg]/height $[m]^2$) was used to define categories in percentiles, reference BMI percentiles were derived from the first National Health and Examination Survey using the guidelines proposed by the expert committee on clinical overweight for adolescence

proportion of anaemia appeared to decline with better school results, and anaemia was significantly prevalent among the students with poor school results rather than those with very good and excellent results.

As shown in Table 4, anaemia was more prevalent among the students who skipped breakfast or did not eat green vegetables and fruits and increased among those who ate junk food, but results did not reach statistical significance. Around 10.1% of students reported taking multivitamins and 5.3% took iron supplements but most of them were girls of at least 15 years of age and all noted to be previously diagnosed as anaemic and to have medication prescribed by a physician.

Only 34.1% of anaemic school students were aware of being anaemic (Table 5). Girls were significantly more aware than boys of their anaemic status. Although the proportion of students who were aware of being anaemic improved by increase in age and maternal

Table 2. Regular daily breakfast intake by different socio-demographic factors among Saudi school students in Jeddah, Saudi Arabia 2000

		Regular daily breakfast intake		
		Total	*%*	*(95% CI)*
All students		800	85.1	82.6–87.6
Age (years)				
	9–11	145	89.0	83.9–94.1
	12–14	310	87.4	83.7–91.1
	15–21	345	81.4	77.3–85.5
Sex				
	Male	376	87.0	83.6–90.4
	Female	424	83.5	80.0–87.0
Type of school				
	Government	657	84.6	81.8–87.4
	Private	143	87.4	82.0–92.8
Mother education				
	Low	414	84.8	81.3–88.3
	Middle	252	86.1	81.8–90.4
	High	134	84.3	74.1–90.4
Mother working status				
	Housewife	698	84.4	81.5–87.3
	Working	102	83.3	76.1–90.5
School grades				
(zero to <70% of the marks)	Fail/pass	74	73.0	62.9–83.1
(≥70% to <80%)	Good	131	84.0	77.7–90.3
(≥80% to <90%)	Very good	333	86.2	82.5–89.9
(≥90%)	Excellent	262	87.8	83.8–91.8
Body mass index[a]				
(<15th percentile)	Underweight	189	89.9	85.6–94.2
(≥15th to <85th percentile)	Normal	360	86.1	82.5–89.7
(≥85th to <95th percentile)	Overweight	114	82.5	75.5–89.5
(≥95th percentile)	Obese	137	78.1	71.2–85.0

CI = confidence interval.

[a] Based on measured weight and height, body mass index (BMI = weight [kg]/height [m]^2) was used to define categories in percentiles, reference BMI percentiles were derived from the first National Health and Examination Survey using the guidelines proposed by the expert committee on clinical overweight for adolescence.

educational level, results did not reach statistical significance. Lack of awareness did not differ by type of school or by working status of the mother.

Discussion

The purpose of the present study was twofold: to assess the prevalence of iron deficiency anaemia and the contributing nutritional habits in the form of daily breakfast intake among school students and to assess the awareness of being anaemic among anaemic school children. The prevalence of anaemia in our sample was 20.5%. It is very difficult to compare these results with the previous few studies performed in the Kingdom (Al-Othaimeen *et al.*, 1988; Rasheed *et al.*, 1989; EL-Hazmi & Warsy, 1999), as they either used only female gender, a different definition of anaemia or only a specific age group. Yet the overall prevalence of anaemia reported among Saudi school students ranged from 24.8% to 26.4%. Our figure is, however, similar to those reported from other developing countries that ranged from 16.5% to 62.6% (Abidoye & Akande, 2000; Jackson & Al-Mousa, 2000; Lwambo *et al.*, 2000), but much less than those reported for the indus-

Table 3. Prevalence of anaemia among Saudi school students in Jeddah, Saudi Arabia, 2000

		Anaemia		
		Total	*%*	*95% CI*
All students		800	20.5	17.7–23.3
Age (years)				
	9–11	145	10.3	5.4–15.2
	12–14	310	20.6	16.1–25.1
	15–21	345	24.6	20.1–29.1
Sex				
	Male	376	18.4	14.5–22.3
	Female	424	22.4	18.3–26.4
Type of school				
	Government	657	22.2	19.0–25.4
	Private	143	12.6	7.2–18.0
Mother education				
	Low	414	27.3	23.0–31.6
	Middle	252	14.7	10.3–19.1
	High	134	10.4	5.2–15.6
Mother working status				
	Housewife	698	20.8	17.8–23.8
	Working	102	18.6	11.0–26.2
Age of mother at child birth (years)				
	10–19	201	22.4	16.6–28.2
	20–29	482	20.1	16.5–23.7
	30+	117	18.8	11.7–25.9
Consanguinity				
	No	461	17.4	13.9–20.9
	Yes	339	24.8	20.2–29.4
School grade				
(zero to <70% of the marks)	Fail/pass	74	33.8	23.0–44.6
(≥70% to <80%)	Good	131	24.4	17.0–31.8
(≥80% to <90%)	Very good	333	18.6	14.4–22.8
(≥90%)	Excellent	262	17.2	12.6–21.8
Body mass index[a]				
(<15th percentile)	Underweight	189	20.1	14.4–25.8
(≥15th to <85th percentile)	Normal	360	21.1	16.9–25.3
(≥85th to <95th percentile)	Overweight	114	14.0	7.6–20.4
(≥95th percentile)	Obese	137	24.8	17.6–32.0
Menarche				
	Non-menstruating	78	11.5	4.4–17.9
	Menstruating	346	24.9	20.3–29.5

CI = confidence interval.

[a] Based on measured weight and height, body mass index (BMI = weight [kg]/height [m]^2) was used to define categories in percentiles. Reference BMI percentiles were derived from the first National Health and Examination Survey using the guidelines proposed by the expert committee on clinical overweight for adolescence.

trialized countries that ranged from 2% to 8% (Cook *et al.*, 1986; Nelson *et al.*, 1993; Olsson *et al.*, 1995; Eskeland & Hunskaar, 1999).

Children are continuously growing and changing every day and a nutritional breakfast provides the sugar, starch, protein, fat, fiber, vitamins and minerals, especially iron and vitamin C, necessary to ensure the sustained release of energy. Skipping breakfast was reported by 14.9% of school students and was

Table 4. Prevalence of anaemia by dietary habits, vitamin and iron intake and school grades among Saudi school students in Jeddah, Saudi Arabia, 2000

		Anaemia		
		Total	*%*	*95% CI*
Regular breakfast intake				
	No	119	27.7	19.7–35.7
	Yes	681	19.2	16.2–22.2
Daily green vegetables intake				
	No	205	23.9	18.1–29.7
	Yes	595	19.3	16.1–22.5
Eat fruits at school as snack between meals	No	224	22.8	17.3–28.3
	One serving	435	20.5	16.7–24.5
	> one serving	141	17.0	10.8–23.2
Eat junk food between meals as Snack	No	55	18.2	8.0–28.4
	Yes	645	23.9	20.6–27.2
Eat junk food at school				
	No	85	18.8	10.5–27.1
	Yes	715	20.7	17.7–23.7
Multivitamins				
	No	719	19.9	17.0–22.8
	Yes	81	25.9	16.4–35.4
Iron				
	No	758	19.8	17.0–22.6
	Yes	42	33.3	19.0–47.6

CI = confidence interval.
Junk food: chocolate, potato chips, cakes and soft drinks.

similar in all age groups, both genders and different social classes. Similar results obtained from a previous study done among girls aged from 7–14 years in Riyadh, Saudi Arabia revealed that 16.5% of the girls did not take breakfast at home and depended on snacks offered in the school canteen, which consisted mostly of biscuits, chocolate bars, potato chips and carbonated cola drinks (Al-Othaimeen *et al.*, 1999). Previous studies have documented that eating breakfast gives children a boost to achieve better learning and cognitive ability (Leibel & Greenfield, 1981; ASFSA, 1989; Wyon *et al.*, 1997). Our results were equivalent to these studies as school achievement was found to improve among students who reported higher proportions of daily breakfast intake. The proportion of students who reported eating breakfast daily was significantly higher among students with excellent results as compared to those who failed or just passed their exams. As the cultural habits in the Gulf countries are nearly identical, skipping breakfast is a known practice by some individuals in this area of the world due to late waking, not being accustomed to having breakfast, not being hungry in the morning or disliking the food served (Musaiger & Gregory, 1992; Musaiger, 1994).

Proper nutrition during childhood and adolescence is important for establishing good health. Numerous studies have attributed iron deficiency anaemia to the change in dietary habits (Andersson, 1991). The food habits of the Saudi population has changed drastically during the past two decades with increased incomes as a result of oil revenue. The traditional diet, which consisted of dates, milk, rice, brown bread, fresh vegetables and fish, has changed with the introduction of junk food and less green vegetables and fruits (Musgrave *et al.*, 1981; Stults *et al.*, 1982; Farthing, 1991). This not only exists in the Kingdom but also in the surrounding Gulf countries (Musaiger & Gregory, 1992; Musaiger, 1994).

Table 5. Awareness of being anaemic among Saudi school students in Jeddah, Saudi Arabia, 2000

		Anaemia		
		Total	*%*	*95% CI*
All students	164	34.1	26.9–41.4	
Age (years)				
	9–11	15	26.7	4.3–49.0
	12–14	64	29.7	18.5–40.9
	15–21	85	38.8	28.5–49.2
Sex				
	Male	69	21.7	12.0–31.5
	Female	95	43.2	33.2–53.1
Type of school				
	Government	146	35.6	27.8–43.4
	Private	18	22.2	3.0–41.4
Mother education				
	Low	113	35.4	26.6–44.2
	Middle	37	32.4	17.3–47.5
	High	14	28.6	4.9–52.2
Mother working status				
	Housewife	145	35.2	27.4–42.9
	Working	19	26.3	6.5–46.1

Iron deficiency anaemia did not statistically differ by age, gender, maternal working status and body mass index. However, anaemia was significantly more prevalent among governmental school attendees and students born to low-educated mothers. Also, anaemia was significantly higher among menstruating girls. Students' school performance improved with decline in proportion of detected anaemia and was significantly less among students with very good and excellent results as compared to those with fail/poor results, which confirms the negative impact of anaemia on learning and intellectual ability that was previously documented (Musgrave *et al.*, 1981; Stults *et al.*, 1982; ASFSA, 1989; Parker, 1989; Anderson, 1991; Farthing, 1991; Musaiger & Gregory, 1992; Musaiger, 1994). Although anaemia was more marked among students who skipped breakfast and those who didn't eat green vegetables, or who ate junk food, results did not reach statistical significance. The food served in school canteens has improved drastically during the last two years: no carbonated cola drinks, potato chips, chocolate bars or fatty biscuits are now allowed to be sold there. This regulation has been forced by the school nutrition department at the Ministry of Education, and this may have led to the non-significant association found in this study between anaemia and daily breakfast intake. The proportion of anaemia was less among those who ate fruits, and declined with the increase in the number of fruit servings, but results still did not reach statistical significance. Around 10.1% of students took vitamins and 5.3% took iron but all were anaemic and most of them were girls of at least 15 years. Awareness of being anaemic was only reported by 34.1% of actually anaemic school students, which shows that a considerable proportion of students are not actually aware of their nutritional status. Lack of awareness was similar in all age groups and social classes. Girls were more aware of being anaemic than boys, which could be explained by the care given to girls by their families and community especially after the start of menstruation.

The results of this study propose guidelines for screening for anaemia and improving nutritional habits among school students. As school students of at least 15 years of age, menstruating girls, born to low-educated mothers and of low social class are at higher risk of being anaemic. It is reasonable to support screening

for iron deficiency anaemia in high-risk groups only, due to expense, logistics and effort constraints. To improve the health and nutritional status of school students, school health programs should be implemented to focus on the improvement of nutritional habits and quality and quantity of the diet. Moreover, school health and nutrition programs directed towards school students and their parents are crucial to help them recognize the healthy nutritional habits and the body's requirements from the different nutrients. Eating breakfast daily and the intake of foods rich in iron such as meat, fish, chicken and legumes should be encouraged. Foods enhancing iron absorption such as fruit juice should also be advocated. School canteens should take a leading role in providing a nutritious snack to improve the nutritional quality of food consumed by students in schools. Future studies should look at the quality as well as quantity of food intake at nreakfast and in school canteens with regard to school performance, especially after the new roles for school food canteens in the Kingdom.

In conclusion, the burden of suffering from iron deficiency anaemia in school students appears high especial among those of at least 15 years of age, girls, and born to low-educated mothers. Unhealthy feeding habits such as skipping breakfast, which get worse as age increases in this age group, eating less vegetables and fruits and more junk foods appear to be prevalent among school students. Most actually anaemic students are not aware of their nutritional status. Screening for iron deficiency anaemia should be directed to high-risk groups and school programs should be implemented to improve awareness on healthy feeding habits.

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