Journal of Taibah University Medical Sciences (2016) 11(1), 72–76

Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Original Article

The association between dmft index and haemoglobin levels in 3–6 year-old Saudi children with anaemia: A cross sectional study

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Received 30 August 2015; revised 18 November 2015; accepted 22 November 2015; Available online 5 January 2016

الملخص

أهداف البحث: إن العلاقة بين مستوى الهيموجلوبين وانتشار تسوس الأسنان معروفة، ولكن المعلومات المتوفرة قليلة عن العلاقة بين مستوى الهيموجلوبين ومقياس التسوس، والأسنان المفقودة والمحشوة في السعودية. تهدف هذه الدراسة لتقييم العلاقة بين مستوى الهيموجلوبين لدى عينة عشوائية من الأطفال ومعدل تسوس، وفقد الأسنان وحشوها في السعودية.

طرق البحث: تمت هذه الدراسة المقطعية على مدى ١١ شهرا خلال الفترة من مايو ٢٠١٤م وحتى إبريل ٢٠١٥م لعدد ١٦٠ طفلا من الزائرين لمستشفى طب الأسنان بجامعة الملك عبدالعزيز - جدة - السعودية. تم تقسيمهم إلى مجموعتين: المجموعة الأولى بدون فقر الدم والمجموعة الثانية الذين تم تشخيصهم بمرض فقر الدم. وتم قياس نسبة تسوس الأسنان بواسطة استخدام مقياس التسوس، والأسنان المفقودة والمحشوة. وبعد ذلك تم التحليل الإحصائي لتقييم العلاقة بينهما في البحث.

النتائج: ضمت الدراسة ١٦٠ طفلا، ولوحظ أن الأطفال ذوي مستوى متدني من الهيموجلوبين في الدم (المجموعة الثانية) يعانون من نسبة أعلى في تسوس الأسنان بالمقارنة بالأطفال غير المصابين بفقر الدم (المجموعة الأولى) حسب مقياس التسوس، والأسنان المفقودة والمحشوة.

الاستنتاجات: نتائج هذا البحث تبين أن الأطفال الذين لديهم مستويات متدنية للهيموجلوبين في الدم لديهم احتمالية عالية للإصابة بتسوس الأسنان. بينت نتائج البحث أهمية القيام بحملة صحة عامة تركز على الوعي بصحة الفم والوقاية من فقر الدم وعلاجه.

الكلمات المفتاحية: فقر الدم لدى الأطفال؛ تسوس الأسنان؛ مقياس التسوس والأسنان المفقودة والمحشوة؛ مستوى الهيموجلوبين بالدم

Abstract

Objectives: The relation between haemoglobin levels and the prevalence of dental caries is well-recognized; however, relatively little information is available regarding the decayed, missing and filled teeth (dmft) index in relation to haemoglobin levels in KSA. The objective of this study was to assess the association between the haemoglobin levels and the dmft index in a random sample of paediatric dental patients who visit a teaching hospital in KSA.

Methods: This 11-month cross sectional study was conducted at King Abdulaziz University Hospital, Jeddah, KSA from May 2014 to April 2015. A total of 160 children with dental caries were divided into 2 groups: non-anaemic and anaemic groups. The prevalence of caries was measured using the dmft index and was compared between the two groups. Statistical analyses were performed using the chi-square tests at a 0.05% significance level.

Results: One hundred-sixty subjects were recruited in this study. Children with lower mean haemoglobin levels (anaemic children) had significantly higher mean dmft

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Peer review under responsibility of Taibah University.

ELSEVIER Production and hosting by Elsevier

 http://dx.doi.org/10.1016/j.jtumed.2015.11.008

indices (11.20 ± 2.6) than the non-anaemic children (9.66 ± 1.2%, $p < 0.05$).

Conclusion: This study suggests that children with lower haemoglobin levels may be prone to develop dental caries. This study emphasizes the need for public health campaigns regarding oral hygiene and the prevention and treatment of anaemia.

Keywords: Anaemic children; Dental caries; dmft index; Haemoglobin level

Introduction

Nutritional anaemia is the most common form of malnutrition and includes a lack of minerals and nutrients, such as folic acid, iron, copper and vitamins A, B, C, and E.[1] Furthermore, iron deficiency anaemia (IDA), which is defined as circulating haemoglobin with insufficient iron, represents 90% of all types of anaemia worldwide.[2] Although the iron deficiency prevalence has declined in recent years, it remains an important paediatric public health issue.[3] The World Health Organization has determined haemoglobin levels at which concentration healthcare providers can confidently diagnose anaemia. These concentrations are 11 g/dL or below in patients aged 5 years or younger, 11.5 g/dL or below in patients aged 5–11 years and less than 11 g/dL in elderly patients.[4] Several studies have demonstrated that the prevalence of anaemia among children in developing countries is 40%.[5]

Dentistry has an obvious role in preventing medical and dental complications for anaemic children.[6] These medically compromised patients are more vulnerable to systemic and dental diseases that require modified treatment plans.[7] However, psychological problems, genetic defects and infection are manifestations commonly encountered in anaemic children.[8] The lifestyle and continuous hospitalisation of anaemic children raises the prevalence of dental caries as a result of improper oral hygiene and the continuous use of specific medications.[9]

Tang et al. (2013) described severe early child caries (S-ECC) in relation to nutritional factors among pre-school children in Taiwan in a clinical study. The researchers state that 46% and 9% of the children with S-ECC were recognized as being iron deficient and anaemic, respectively.[10] Thus, children with S-ECC were at greater risk for anaemia and iron deficiency. Similarly, Sadeghi et al. (2012) examined 204 children aged 24–71 months and found that there was no significant difference between genders with respect to early child caries (ECC); however, there was a statistically significant inverse association between ECC and serum iron levels.[11] However, the objective of this study is to determine whether there is an association between haemoglobin levels and the dmft index in a sample of Saudi Arabian children.

Materials and Methods

Study design and subject identification

This study was approved by the Ethics in Research Committee at King Abdulaziz University, dental hospital (KAUFD, proposal No.010-15), KSA. The investigation was designed as a cross-sectional study. The sample consisted of 70 children (40 males and 30 females) with clinical and laboratory diagnoses of iron deficiency anaemia who visited King Abdulaziz University, medical department, and 90 non-anaemic children (50 males and 40 females) from the same hospital. Children who had other causes of anaemia rather than an iron deficiency were eliminated from the sample. All of the children had a similar socioeconomic level. Then, the children were invited to KAUFD for dental screening. Parents were provided with consent forms and approved participation in this study.

Inclusion and exclusion criteria

The inclusion criteria were paediatric anaemic patients aged 3–6 years who could tolerate intra-oral examination. However, the exclusion criteria were other systemic diseases or factors that precluded oral examination. Moreover, children who had permanent teeth were excluded from the study to avoid chronologic overlapping.

Dental examination

The children were examined at KAUFD by a single examiner. The two groups were examined by the decay-missing-filled teeth (dmft) index to assess the distribution of dental caries on the primary teeth without assessing the DMFT (number of decayed permanent teeth, missing teeth, and teeth that were filled) index. However, during the clinical investigation, the patient was examined in the dental clinic under a medical light, using a sharp probe, cotton rolls, and a dental mirror. In addition, all types of dental caries such as cavitation or catching with the sharp probe were considered and examined in relation to haemoglobin levels, in accordance with the World Health Organization (WHO) criteria. Data on caries prevalence in relation to the haemoglobin level were collected through previously validated studies. The gender, age, haemoglobin level and dmft index of patients were assessed.

Statistical analysis

The statistical test that was used for this analysis is a simple descriptive measurement. Therefore, the variables were measured by means and standard deviations. In addition, the test assessed via counts and percentages. Furthermore, to establish a relation between categorical variables, the Chi-Square test was used, whereas the Independent *t*-test was used to compare the study variables of two grouped means. The Pearson Correlation was used to check the dependency of two continuous variables and to interpret either

positive or negative *r* correlation values between haemoglobin levels and by gender. For each test, normality was assumed using Levene's test for homogeneity of variance. However, in the case of unequal variance, a Welch *t*-test was used as an alternative for the independent *t*-test. A *p*-value <0.05 was the criterion for rejecting the null hypothesis. The data were entered into Microsoft Office Excel Services 2007 (Microsoft Corporation, Redmond, WA, USA) spreadsheet, and IBM SPSS (Statistical Package for Social Sciences) version 22 was used for all statistical calculations.

Results

A total of 160 children were included in this cross-sectional study. The two groups (anaemic 70 children and non-anaemic 90 children) had caries in their primary teeth. In total, 56.3% of the participants were male, and 43.8% were female. The mean age of all children who participated in the study was 5 years. However, there were no significant differences in mean age ($p = 0.85$) between the two groups. Furthermore, the mean dmft index for the two groups was (10.43 ± 0.2). Analytical data illustrates that the mean of the decayed teeth (5.60 ± 2.5) in the participants' children (anaemic and non-anaemic) was the highest relevant factor to calculate the dmft index rather than missing and filled teeth, which have no significant difference.

Table 1 shows the dmft index and characteristics of the study samples. Despite this fact, the decayed, missing and filled teeth factors (not index) show no significant difference between anaemic and non-anaemic groups. Table 2 shows that anaemic children had a significantly higher mean dmft index (11.20 ± 2.6) than did the non-anaemic children (9.66 ± 1.2, $p < 0.05$). In addition, the missing teeth values were significantly higher in anaemic children compared with non-anaemic children. Table 3 shows that, in the statistical study of the *r* correlation values between haemoglobin levels, and by gender, there was a very strong positive relation between haemoglobin levels and age with no significant difference between males and females ($r = 0.77$). Moreover, a weak positive relation was observed between decayed and filled teeth in relation to haemoglobin levels in both genders; in addition, missing teeth moderated the negative relation between males and females. A histogram is a graphical representation of the distribution of the haemoglobin levels and frequency among study participants. This histogram estimates that the mean haemoglobin level was (10.77 ± 0.4) (Figure 1).

Table 1: Characteristics of the study samples.

Variable			Count	%
Total			160	100.0
Group	Anaemic		70	43.8
	Non-Anaemic		90	56.3
Gender	Male		90	56.3
	Female		70	43.8
	Min	Max	Mean	SD
Age	3.0	6.0	5.00	0.8
Haemoglobin Level	9.7	11.4	10.77	0.4
Decayed(d)	0	12	5.60	2.5
Missing(m)	0	6	2.28	1.5
Filled(f)	0	9	2.47	2.0
dmft	3	18	10.43	0.2

Table 2: The mean and standard deviation in relation to the dmft index between study samples.

Variables	Group		*P*-value
	Anaemic	Non-Anaemic	
Total	Count N = 70	Count N = 90	N/A
Age Mean ± SD	5.01 ± 0.9	4.99 ± 0.8	0.85
Decayed(d)	6.00 ± 2.4	5.29 ± 2.6	0.075
Missing(m)	2.60 ± 1.6	2.02 ± 1.4	0.017[a]
Filled(f)	2.60 ± 2.0	2.37 ± 2.0	0.459
dmft Mean ± SD	11.20 ± 2.6	9.66 ± 1.2	0.005[a]
Gender N (%) Male	40 (57.1%)	50 (55.6%)	0.841
Female	30 (42.9%)	40 (44.4%)	

[a] Significant using independent t-test (<0.05 level).

Discussion

The sample size is moderately convenient; however, a larger sample would provide the results with validity, and these need a more longitudinal study. The decay-missing-filled teeth (DMFT) index is one of the most common tools used in the dental community to assess the distribution of dental caries and treatment plan demands for children.[12] Despite the fact that the relation between the haemoglobin level factor (Hb) and the prevalence of caries has already been investigated, there is actually evidence that minimal data is available regarding the relation between the dmft index and Hb levels.[13] Therefore, the assessment and investigations of haemoglobin levels in relation to the prevalence of dental caries require further study.[14,15] Recently, studies have investigated the association between serum iron levels and early child caries (ECC) in children and utilized different epidemiological methods to measure the prevalence of dental caries.[10,11] Furthermore, it has been shown that dental caries may be considered an indirect factor for low levels of haemoglobin. Based on our results, there was a significant inverse association between the dmft index and haemoglobin levels.

The statistical analysis of the results show that children with lower mean haemoglobin levels had a significantly higher mean dmft index ($11.2 \pm 2.6\%$) than did non-anaemic children ($9.66 \pm 1.2\%$, $p < 0.05$); this may be attributed to the fact that anaemic patient diets are not nutritionally sound due to disease or irregular eating as a result of painful teeth. However, children who eat unhealthy foods are most likely to have increased caries levels because of the demonstrated relation between unhealthy food that may lack other constituents of important minerals and dental health.

There was a statistically significant difference in dmft indices between the anaemic and non-anaemic groups. However, inappropriate diets in children may halt dental development and increase the risk of future caries. According to Ramos-Gomez et al. (2002), there is no significant relation between early child caries and anaemia.[16] Similarly, it has often been observed that dentists should assess the correlation between dental caries and the malnutrition status of the children such as iron deficiency anaemia.[17]

Table 3: Shows the correlation between haemoglobin levels and the dmft index.

Correlations		Haemoglobin[a,b,c,d]	Haemoglobin[c]	Haemoglobin[d]
Age	*r*	0.767[a]	0.369[b]	0.461[b]
	p-Value (2-tailed)	0.000	0.019	0.010
	N	70	40	30
Decayed(d)	*r*	0.277[b]	−0.016	0.404[b]
	p-Value (2-tailed)	0.020	0.922	0.027
	N	70	40	30
Missing(m)	*r*	−0.345[a]	−0.257	−0.147
	p-Value (2-tailed)	0.003	0.110	0.440
	N	70	40	30
Filled(f)	*r*	0.237[b]	0.093	0.351
	p-Value (2-tailed)	0.048	0.569	0.057
	N	70	40	30
dmft	*r*	0.157	−0.063	0.470[a]
	p-Value (2-tailed)	0.194	0.702	0.009
	N	70	40	30

If $r = +0.70$ or higher Very strong positive relation; +0.40 to +0.69 Strong positive relation; +0.30 to +0.39 Moderate positive relation; +0.20 to +0.29 weak positive relation; +0.01 to +0.19 No or negligible relation; −0.01 to −0.19 No or negligible relation; −0.20 to −0.29 weak negative relation; −0.30 to −0.39 Moderate negative relation; −0.40 to −0.69 Strong negative relation; −0.70 or higher Very strong negative relation.

[a] Correlation is significant at the 0.01 level (2-tailed).

[b] Correlation is significant at the 0.05 level (2-tailed).

[c] Haemoglobin level group by Gender = Male.

[d] Haemoglobin level group by Gender = Female.

There is significant evidence to suggest that the resolution of dental caries leads to a parallel resolution of iron deficiency anaemia.[18] Similarly, early research concluded that children who had early child caries had lower mean weights than did healthy children with no caries, and this could be explained by the fact that children with ECC had an inappropriate nutritional status.[19] However, there are other factors that were not part of this study such as diet analysis, medications and oral hygiene habits; all of these variables must be assessed in future studies. It is clear that assessing the oral health of children with anaemia and comparing it against non-anaemic children in relation to children who were caries-free could be one of the valid methods in future studies.[20] In addition, the haemoglobin level had relied on the medical records at the university's hospital. There can be no doubt that oral health can have a strong influence on individual quality of life.[21]

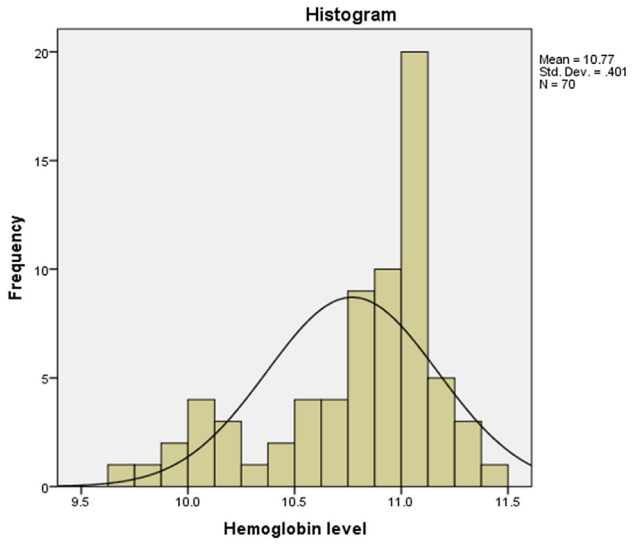

Figure 1: A histogram represents the distribution of haemoglobin levels among the study sample.

Conclusion

This cross sectional study revealed that anaemic children are more prone to dental caries in comparison to healthy children. This study highlights the need for incessant instructive intervention and further longitudinal studies to accomplish the prime objective of treating anaemic children in dentistry.

Recommendation

Frequent educational interventions of dentists are essential, particularly to pursue guidelines for preventive dentistry to diminish dental caries among children with anaemia; such campaigns and the development of excellent assertive events should be focused towards altering the outlook of dentists to rationalize and promote the vital facet of a regular check-up, pit and fissure sealant and fluoridation for the anaemic children. Preventive dentistry is highly imperative to restrain the dental caries, particularly in children with anaemia.

Conflict of interest

The authors declare that they have no competing interests.

Authors' contributions

HHA conceived and designed the study, conducted research, provided research materials, and collected and

organized data. GH analyzed and interpreted data. MAA wrote initial and final draft of article, and provided logistic support. ENA reviewed the academic writing style and analysed data. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Acknowledgement

The authors want to express their appreciation and gratitude to the participants and their children. We are also grateful for the medical records at King Abdulaziz University Dental Hospital and to Mr. Calvin Balucanag for statistical analysis.

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