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The effect of iodine-deficiency disorders on academic achievement of schoolchildren in Southern Ethiopia

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Abstract

Objective: The present study aimed to assess the effect of iodine deficiency on academic achievement of schoolchildren in Wolaita Sodo town, Southern Ethiopia.
Design: School-based comparative cross-sectional study.
Settings: Primary school in Sodo town, Southern Ethiopia.
Subjects: A sample population of 270 children with goitre and 264 without goitre. All students in each class were examined for the presence of goitre and classified based on WHO recommendations.
Results: Among children with goitre, a higher proportion (54·8 %) was female and the proportion increased with age. The odds of scoring low on school performance was higher among children whose fathers were illiterate (adjusted OR = 1·9; 95 % CI 1·1, 3·5) and those who were absent for more than 5 d in the last academic year (adjusted OR = 1·5; 95 % CI 1·1, 2·3). Goitre was significantly associated with low academic achievement (adjusted OR = 1·8; 95 % CI 1·2, 2·5).
Conclusions: The study showed that the presence of goitre has a negative effect on academic achievement even after accounting for parental education and absenteeism from school. Awareness of endemic goitre and its impact on school performance, and an emphasis on prevention and control by concerned bodies, are recommended to alleviate the problem.

Keywords
Iodine
Effect
School
Performance
Ethiopia

Globally, 2·2 billion people live in areas with iodine deficiency and are at risk of iodine-deficiency disorders (IDD). It is estimated that 740 million people worldwide have goitre, 50 million children suffer from varying degrees of IDD and 100 000 cretins are born every year[1,2]. Universal salt iodization is the agreed strategy for achieving iodine sufficiency[3]. The effects of IDD vary according to the person's status. Among children, some of the major effects are impaired mental and physical development, mental retardation, physical deformities and cretinism[4]. Iodine deficiency is estimated to account for 1·8 million disability-adjusted life years in children younger than 5 years of age in the thirty-six focus countries[5]. Furthermore, the adverse health consequences of iodine deficiency can lead to reductions in both productivity and intellectual potential in adulthood[6,7]. Reducing the prevalence of micronutrient deficiencies is a high priority for many health policy makers in developing countries[8].

In Ethiopia, one out of every 1000 people is affected with cretinism and about 50 000 prenatal deaths occur annually due to IDD[9]. According to one national survey, twenty-six out of every 100 Ethiopians have goitre and 62 % are at risk of IDD[10]. Some pocket areas of the country have goitre rates of between 50 and 95 %[9].

There is a paucity of evidence in Ethiopia and many low-income countries on the link between IDD and academic performance. The present study attempted to fill this important research gap by examining the effect of iodine deficiency on academic achievement among schoolchildren in Ethiopia. It is hoped that the findings of the study will help in promoting evidence-based advocacy and practice to address iodine deficiency.

Methods

Study setting and context

The study was conducted in Wolaita Sodo town, which is the capital of Wolaita zone and located 330 km south of Addis Ababa in the Southern Nations Nationalities and People's Region[11], from December 2010 to February 2011. Common staple foods in the area include cereals, roots, tuber crops and vegetables. The town has three high schools, ten primary schools and nineteen kindergarten schools[12,13].

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Study design and populations

A school-based comparative cross-sectional study was conducted in Sodo town of Wolita zone. As per recommendations of WHO/UNICEF/International Council for the Control of Iodine Deficiency Disorders, schoolchildren in the age group of 6–12 years from both sexes were selected because of their high vulnerability to goitre and easy accessibility. They are also considered to be representative of their age group in the community[14]. Children who were in the age range of 6–12 years and who had stayed in the town for at least 6 months were included in the study.

The sample size was calculated using the two-sample proportion formula:

$$n_1 = \left((Z\alpha/2)\sqrt{[1+(1/r)]P(1-P)} + Z\beta\sqrt{[p_1(1-p_1)]+\{[p_2(1-p_2)]/r\}}\right)^2/(p_1-p_2)^2$$

$$n_2 = n_1 r$$

where n_1 = sample size of children with goitre, n_2 = sample size of children without goitre, p_1 = proportion of below-average academic performance among schoolchildren with goitre, p_2 = proportion of below-average academic performance among those children without goitre, P = average proportion, α = level of significance = 0·05, $1-\beta$ = desired power = 80 %, r = ratio of with goitre to without goitre = n_1/n_2 = 1:1, Z = coefficient at level of power = 0·84 and $Z\alpha/2$ = coefficient at level of significance = 1·96. Taking proportions of respectively 0·19 and 0·30 for below-average score in the Primary School Leaving Examination Test among those without IDD and with IDD from a study in Tanzania[15], the sample size was calculated as 257 for each group. Accounting for a possible non-response rate of 5 % during the actual survey (based on similar studies), the sample size became 270 for n_1 and 270 for n_2.

Sampling procedure

One primary school was selected out of ten primary schools in the town by a convenience sampling technique. Number and list of students were obtained from school officials. All students in each class were examined for the presence of goitre. Children who had goitre were given an identification number and selected randomly (by a lottery method). For every child with goitre, the nearest child without goitre was selected from the same class.

Measurements

Data were collected using a pre-tested structured questionnaire prepared by reviewing prior studies and other relevant literature on the topic. The questionnaire was translated into the local language (Amharic) and back to English to ensure its consistency. The interview was conducted by five nurses who were trained for two days by the principal investigator. In addition, a comprehensive checklist was used to gather information on students' grade averages and days of absenteeism from reports available at the school.

Goitre survey method

All students of the recommended age group who were present on the days of the survey were clinically examined for enlargement of the thyroid (goitre) by three health officers trained to minimize inter-individual variability as per recommendations. Goitre was assessed using the palpation method and grading was done as per recommendations of the WHO/UNICEF/International Council for the Control of Iodine Deficiency Disorders (grade 0 = no goitre; grade 1 = thyroid palpable but not visible; grade 2 = thyroid visible with neck in normal position).

Data quality management

Data quality assurance was in place during questionnaire design, data collection and data entry. The data collectors and supervisors were provided with intensive training on the objectives of the study and on how to do thyroid examination to minimize inter-individual variability.

Statistical analysis

Data were entered using Epi-Info version 3·5·1 and exported to the statistical software package SPSS for Windows version 16 for analysis. Multiple logistic regression analysis was run to examine the effect of goitre as a proxy for iodine deficiency on academic achievement controlling for observed covariates. The dependent variable was academic achievement of the students. Independent variables factored in the model included age, sex, socio-economic status of parents, common staple foods, psychosocial variables and goitre presence. A P value of less than 0·05 was used to define statistical significance.

The following operational definitions are used in the present study. (i) Endemic goitre is defined as goitre prevalence of greater than 5 % among the population. (ii) Academic achievement is a school-level summary measure based on the average score of a student on the standard school achievement test; a high score and a low score are defined as a score above and below the mean of the students' grade, respectively. (iii) Absenteeism is defined as students' non-attendance at school during school hours for more than 5 d in the last academic year.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Boards of the School of Public Health at Addis Ababa University. Permission was also obtained from Sodo town health and education offices.

Results

Sociodemographic characteristics of study participants

A total of 534 participants (270 children with goitre and 264 without goitre) were included, making the response rate 98·9 % (534/540). Of them, 122 (45·2 %) children

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Table 1 Sociodemographic profile of children in Ligaba Beyene Elementary School, Sodo Town, Southern Ethiopia, March 2011

	With goitre		Without goitre		Total		
Variable	*n*	%	*n*	%	*n*	%	*P* value
Sex							0·74
Male	122	45·2	123	46·6	245	45·8	
Female	148	54·8	141	53·4	289	54·2	
Age (years)							
6–9	27	9·9	29	11·0	56	10·5	0·71
10–12	243	90·1	235	91·0	478	89·5	
Grade							
2	26	9·6	28	10·6	54	10·1	0·94
3	34	12·6	37	14·0	71	13·3	
4	47	17·4	45	17·0	92	17·2	
5	93	34·4	83	31·4	176	33·0	
6	70	25·9	71	26·9	141	26·4	
Pace of birth							
Wolaita	243	90·0	232	87·9	475	89·0	0·41
Gamo-Gofa	13	4·8	11	4·2	24	4·5	
Others	14	5·2	21	8·0	35	6·5	
Ethnicity							
Wolaita	220	81·5	223	84·5	443	83·0	0·36
Amhara	30	11·1	18	6·8	48	9·0	
Guraghe	15	5·6	17	6·4	32	6·0	
Others	5	1·9	6	2·3	11	2·0	
Religion							
Protestant	140	51·9	138	52·3	278	52·0	0·98
Apostolic	12	4·4	12	4·5	24	4·5	
Orthodox	99	36·7	94	35·6	193	36·1	
Muslim	14	5·2	16	6·1	30	5·6	
Catholic	5	1·9	4	1·5	9	1·7	
Total	270	50·6	264	49·4	534	100·0	

with goitre and 123 (46·6 %) children without goitre were male. The mean age of respondents with goitre and without goitre was not significantly different at 11·0 (SD 1·1) years and 10·9 (SD 1·2) years, respectively ($P = 0·71$). Relatively larger numbers, ninety-three (34·4 %) children with goitre and eighty-three (31·4 %) without goitre, were from 5th grade. A detailed description of the distribution of study children by selected socio-demographic characteristics is presented in Table 1.

Regarding educational status of their parents, thirty-two (11·9 %) children with goitre and twenty-five (9·5 %) children without goitre had illiterate fathers ($P = 0·23$). Fifty-three (19·6 %) children with goitre and thirty-nine (14·8 %) children without goitre had illiterate mothers ($P = 0·83$).

Psychosocial conditions of study participants

The majority of the respondents, 249 (92·2 %) with goitre and 246 (93·2 %) without goitre, reported to have good relationships with their peers ($P = 0·67$) and 263 (97·4 %) with goitre and 260 (98·5 %) without goitre had good relationships with their families ($P = 0·38$). One hundred and seventy (63·0 %) children with goitre and 159 (60·2 %) children without goitre had ever been bullied by a family member ($P = 0·51$) and 128 (47·4 %) with goitre and 140 (53·0 %) without goitre had ever been punished at school ($P = 0·19$).

Academic achievement of students

Average score of students for both groups was 70 %. Significantly more students with goitre had an academic score that was below the average, compared with those without goitre (57·0 % *v.* 41·3 %, $P < 0·01$). Absenteeism from class was also significantly higher among students with goitre than without goitre (34·1 % and 27·3 %, respectively; $P < 0·05$).

Factors associated with school achievement

Overall, the presence of goitre, low paternal educational status and absenteeism were found to be important predictors of educational achievement after controlling for mother's education, family size and studying comfortably at home (Table 2). Specifically, children whose fathers did not attend formal education were 1·9 times more likely to have lower academic achievement than those whose fathers attended formal school (adjusted OR = 1·9; 95 % CI 1·1, 3·5); students who had >5 d of absenteeism from school were 1·5 times more likely to be lower in their academic achievement than those with <5 d of absenteeism (adjusted OR = 1·5; 95 % CI 1·1, 2·3); and children who had goitre were 1·8 times more likely to have low academic achievement than those who did not have goitre (adjusted OR = 1·8; 95 % CI 1·2, 2·5).

Discussion

The present study revealed that the presence of goitre in schoolchildren is a significant predictor of lower academic achievement even after accounting for parental education and absenteeism. This is consistent with findings from many low-income countries in Africa and Asia[16–19]. Conversely, a study from Malaysia showed that mental performance of schoolchildren was significantly better following iodized oil supplementation[20].

Age and sex were not significantly associated with academic achievement in these Southern Ethiopian children, which is in agreement with findings from a South African study[16]. Educational status of the mother was associated with school performance in a study conducted among Chinese children[17], unlike in our study.

Father's educational status was independently associated with school performance in Southern Ethiopian children, which is consistent with results from the study in China[17]. In contrast to findings from the study in China, family size had no significant association with academic achievement of children in the present study[17]. This difference might be due to socio-cultural variations among the study subjects. For endemic cretinism, the impairing effects are observed on cognitive development, intellectual abilities and school performance of children[18]. There are studies suggesting that supplementation with iodized oil capsule improves schooling through its effect on cognition[15].

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Table 2 Results of binary logistic regression analysis on the predictors of academic achievement among children in Ligaba Beyene Elementary School, Sodo Town, Southern Ethiopia, March 2011

	Academic achievement							
	Below average		Above average					
Variable	*n*	%	*n*	%	Crude OR	95 % CI	Adjusted OR	95 % CI
Father's education								
Illiterate	46	17·5	21	7·7	2·5*	1·4, 4·3	1·9*	1·1, 3·5
Literate	217	82·5	250	92·3	1·0	Ref.	1·0	Ref.
Mother's education								
Illiterate	70	26·6	45	16·6	1·8*	1·1, 2·7	1·5	0·9, 2·4
Literate	193	73·4	226	83·4	1·0	Ref.	1·0	Ref.
Family size								
≤5	149	56·7	127	46·9	1·0		1·0	
>5	114	43·3	144	53·1	1·4*	1·1, 2·0	1·4	0·9, 2·0
Home comfortable to study								
Yes	240	91·3	260	95·9	1·0	Ref.	1·0	Ref.
No	23	8·7	11	4·1	2·4*	1·1, 5·3	2·0	0·9, 4·5
Goitre status								
No	109	41·4	155	57·2	1·0	Ref.	1·0	Ref.
Yes	154	58·6	116	42·8	1·8*	1·3, 2·6	1·8*	1·2, 2·5
Absenteeism								
<5 d	170	64·6	200	73·8	1·0	Ref.	1·0	Ref.
≥5 d	93	35·4	71	26·2	1·5*	1·1, 2·2	1·5*	1·1, 2·3
Total	263	100·0	271	100·0				

Ref., reference category.
*Significant at $P < 0·05$.

Children who had goitre had higher odds of getting a below-average score in school grade, compared with those who did not have goitre, in the present study. Other studies conducted in China[19], Mexico[21], Malaysia[20] and Tanzania[15] revealed a similar negative effect of IDD on the mental performance of schoolchildren.

The current study has both strength and limitations. It tried to assess a largely unexplored area of research in Ethiopia and many low-income countries using a well-designed comparative analysis of children's academic achievement using goitre status as a proxy for IDD. It is important to note that other potential confounders of academic achievement, specifically the role of genetic variations, were not measured in our study. In addition, the lack of a standardized intelligent quotient testing system that is adapted to the specific country context hindered its use as a measure of intellectual capacity.

Conclusions

Lower school performance was significantly higher among students with goitre regardless of the educational status of their fathers and status of absenteeism from class. It is recommended that IDD are prevented and controlled through a sustainable universal salt iodization programme and that awareness on IDD is raised among the community and school officials.

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