

Original Research Article

Prevalence of sub-clinical vitamin-D deficiency and hypothyroidism in children aged 18- 36 months with open anterior fontanelle: a cross-sectional study

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ABSTRACT

Background: The range of normal closure time of the anterior fontanelle (AF) is generally regarded to be 4 to 26 months. The objectives of this study was to find out the prevalence of subclinical vitamin D deficiency and hypothyroidism in children aged 18-36 months with open AF.

Methods: This is a hospital based, cross-sectional study done over a period of 24 months, in which thyroid function tests and 25-hydroxy-vitamin D levels were done for healthy children aged 18-36 months with open AF; the latter was also done for equal numbers (n=30) of age and sex matched children with closed AF for control values. The mean vitamin D levels and proportion of children of various categories based on vitamin D levels among both the groups were compared.

Results: Open AF was seen in 37 children. Seven of them had obvious causes of delayed AF closure and were excluded. In the remaining 30 children, none of the children had abnormal thyroid function tests. 23.3% of the study group had low vitamin D levels; but, the levels were low even in 37% of control group. The mean vitamin D level of the study group (39.05 ± 17.11 ng/ml) was similar to the control group (37.3 ± 14.74 ng/ml).

Conclusions: Neither subclinical vitamin D deficiency nor subclinical hypothyroidism accounted for delayed AF closure in this study.

Keywords: Anterior fontanelle, Children, Hypothyroidism, Vitamin D deficiency

INTRODUCTION

The range of normal closure time of the anterior fontanelle (AF) is generally regarded to be 4 to 26 months.¹ In one large study looking at time period for closure of anterior fontanelle, the closure was found to be 52.4% by 13 months of age, 78.6% by 16 months, and 95.6% by 19 months.² The median time for closure is generally regarded as around 14 months.³ Many earlier researchers believed that AF closure is said to be delayed when it remains open beyond 18 months of age.⁴ The age

of closure however varies depending upon race, sex and disease conditions. Some of the common causes for delayed AF closure include hypothyroidism, increased intracranial pressure, Down syndrome, achondroplasia, rickets, megalencephaly and normal variation.^{4,5} Before considering normal variation, it is important to rule out other common conditions mentioned above. In clinical practice, we do find a lot of normal children who have open AF well beyond 18 months without any tell-tale signs of any particular etiology. Therefore, one needs to use his or her judgement to decide whether a particular

child needs any investigation for identifying the reason for delayed closure of AF before being labelled as normal variant. Of the six abnormal conditions mentioned above, hypothyroidism and vitamin D deficiency are the two common diseases which can have a sub-clinical presentation and therefore identifying them in children with delayed closure of AF would be beneficial. In this study, we want to answer the research question whether all well looking infants with delayed closure of AF need to be routinely investigated for hypothyroidism and vitamin D deficiency or not.

METHODS

This cross sectional study was conducted in a tertiary care hospital over a period of two years from May 2012 to June 2014 after the approval of the Institute Human Ethics Committee (IHEC). All children aged 18- 36 months attending the Pediatric department were screened for open AF. Those identified to have open AF were then subjected to measurement of size of AF; the four corners of AF were marked using skin marking pen at each angles of sagittal and coronal planes as A, B, C and D. The anterior fontanelle size was calculated using the Popich and Smith method (6) i.e. taking the average of length (AB) and width (CD) ($AB+CD/2 = AF$ size). All the measurements were done by the same investigator in all study children using a non-stretchable tape graded in millimetres. Those children with macrocephaly, dysmorphism, clinical features of raised intracranial pressure, hypothyroidism and rickets and those on calcium and/or vitamin D supplementation were excluded from the study. The remaining children without any identifiable causes were recruited in the study. After informed consent, 4 ml blood sample was taken and sent for estimation of serum calcium, phosphate, 25-hydroxy vitamin D level and thyroid function tests (free T4 and TSH). An equal number of age and sex matched healthy children with closed AF were randomly selected and their blood sample is also subjected for the same lab tests as above. Children were classified in to three groups based on vitamin D status: Deficient (<20ng/ml), Insufficient (21-29ng/ml) and Sufficient (≥ 30 ng/ml). Those identified to have vitamin-D deficiency were treated accordingly.

Statistical analysis

The statistical analysis was done using SPSS version 13.0. Proportions were expressed as percentages. To compare the mean vitamin D levels among both the groups 't' test was used. To compare the proportions of children in each category of vitamin D status in both the study and the control groups, Chi-square test was used.

RESULTS

A total of 5228 children aged 18- 36 months were examined during the study period. Open AF was noted in 37 of these children; among them seven children had an

obvious diagnosis (three with a phenotype suggestive of Down syndrome, two with clinical features of hypothyroidism, one each with hydrocephalus and mucopolysaccharidosis) and were excluded from the study. The remaining 30 children had open AF with no clinically identifiable etiology and were included for analysis (Figure 1). None of them were on routine calcium or vitamin D supplements. The prevalence of open AF in otherwise well appearing infants aged 18-36 months was 0.57%.

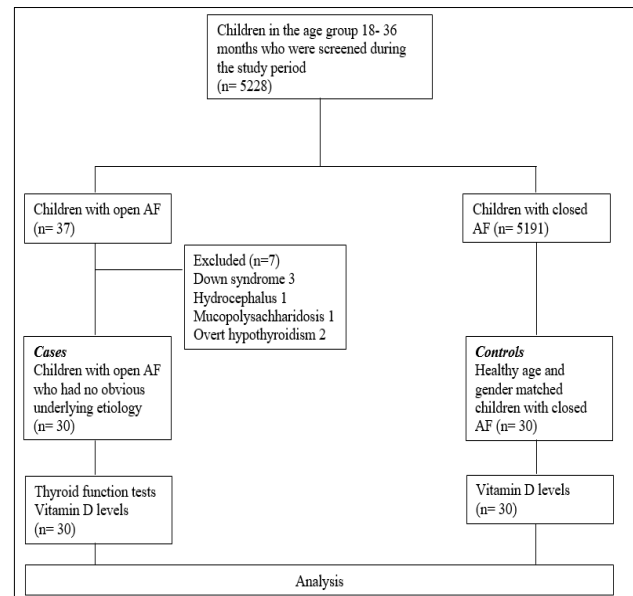


Figure 1: Methodology.

Among the 30 children with clinically no apparent cause, 12 (40%) children belonged to the age group of 18-19 months, 6 (20%) children were 20-21 months of age, 2 (6.6%) children were between 22-23 months of age, and 10 (33.3%) children were in the age group of 24-25months. There were no children with open AF beyond 25 months. The average AF size of the study group was 4.3 mm with SD of 1.47 (SE= 0.27, 95% CI= 3.75-4.85), with the range being 2 mm to 7.5 mm.

Table 1: Comparison of children based on vitamin D status among study and control groups.

Vitamin D levels	Number (Percentage)		Chi squared	P value
	Study group	Control group		
Deficient	05 (17%)	04 (13.3%)	0.157	0.6919
Insufficient	02 (6%)	05 (16.6%)	1.653	0.1985
Normal	23 (77%)	21 (63%)	1.377	0.2407

Thyroid function tests were normal in all the study participants. Between the groups, there was no statistically significant difference in the number of children with low vitamin D levels (23.3% in the study group vs 33% in the control group). Similarly, the mean Vitamin D levels of the study group were not

significantly different from those of the control group (39.05 ng/ml \pm SD of 17.11 vs 37.3 ng/ml \pm SD of 14.74). Also, there was no significant correlation between Vitamin D level and size of anterior fontanelle, in the study group (Table 1).

Table 2: Comparison of mean vitamin D levels of both the groups.

Group	Cases (n=30)	Control (n=30)
Mean	39.05667	37.53
SD	17.11164	14.73694
Difference		-1.530
Standard error		4.123
95% CI		-9.7835 to 6.7235
t-statistics		-0.371
DF		58
Significance level		P = 0.7119

DISCUSSION

In our study, we observed that 0.57% of the study population had open AF beyond 18 months but none of the children aged more than 25 months had open AF. This is in contrast to a study from India, in which 8.7% of children had open AF beyond 24 months and a study from Iran according to which all fontanelles had closed between 15 to 18 months in a cross sectional study involving 550 subjects from birth to 24 months.^{7,8} The mean anterior fontanelle size determined in our study was 4.3mm with SD of 1.47 mm. which is similar to 3.7mm and SD of 0.6mm reported by Mathur et al.⁷ In present study, none of the children had abnormal thyroid profile indicating that routine thyroid function tests are not indicated in otherwise well infants with delayed AF closure. Although sub-clinical Vitamin D deficiency existed in almost one fourth of the study population, the fact that nearly equal number of controls with closed AF also had low vitamin D levels, indicate that subclinical vitamin D deficiency cannot be considered as causal and it only reflects the high prevalence of subclinical vitamin D deficiency in the community as the sunlight exposure in this age group is generally low; this again strengthens the findings of other researchers on the magnitude of vitamin D deficiency in similar population.⁹

CONCLUSION

From this study, it may be concluded that neither subclinical vitamin D deficiency nor subclinical hypothyroidism could be attributed as causative factors for the delayed closure of anterior fontanalle in children

aged 18-36 months of this region. It may be related to racial and ethnic characteristics or some other unidentified factors affecting the osseous maturation.¹⁰ Large well designed longitudinal cohort studies might help in understanding the factors that influence the timing of closure of anterior fontanelle. Further studies on whether supplementing vitamin D results in hastening of closure of AF need to be done to establish a causal association.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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