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Original research article

Study on prevalence of nutritional anemia and its risk factors in children aged 6 to 24 months at tertiary health care centre

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Abstract

Aim: To study the prevalence of nutritional anemia in children aged 6 to 24 months.

Methodology: The current study was a prospective cross sectional analytical study. The study was conducted on 225 children aged 6 to 24 months who were attended to the OPD at Mamata Academy of Medical Sciences. Study was approved by institutional human ethics committee. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study.

Results: In this study, the overall prevalence of anemia is about 71.1%. Out of 225 children,141 (62.7%) of children have IDA, 19 (8.4%) of children have megaloblastic anemia and the rest of the children are non-anemic. In our study, among the children with anemia, 44.3% of mothers were literates whereas 55.6% of mothers were illiterates. This is statistically significant. Among the children with anemia, 54.3% of mothers were working while 45.6% of mothers were housewives which is statistically significant. In our study, 57.5% of children were belonged to class 4 while 37.5% and 5% of children were belonged to class 3 and class 2 respectively. This is statistically significant. Prevalence of anemia in children belonging to nuclear family was 35% while it was 65% in the joint family which is statistically significant. 68.1% of anemic children have preterm birth, whereas 31.8% of children have term birth. This is statistically significant. Anemia prevalence in the children with early and delayed introduction of complementary feeds was significantly higher than the children with EBF for 6months which is statistically significant. In the present study, the factors like gender, religion and type of family diet have no significant role in the anemia prevalence.

Conclusion: There was a statistically significant association is present between the factors like the education of mother, occupation of mother, socio-economic class, location, type of family, gestational age at the time of birth, exclusive breast feeding, duration of exclusive breast feeding, time for introduction of complementary feed, history of pica and nutritional anemia among children. By taking the appropriate measures, we can prevent nutritional anemia as most of these associated factors are preventable.

Keywords: Anemia, nutritional status, socio-economic, prevalence, megaloblastic, MCV

Introduction

Anemia can be defined as the reduction in the red blood cell (RBC) count or hemoglobin (Hb) level below the normal range of the values occurring in healthy individuals [1]. Anemia is a severe global health problem impacting the children and women of reproductive age group [2].

Nutritional deficiency disorders constitute a serious health issue in India. Additionally, to direct implications for morbidity and mortality, under-nutrition predisposes children and adults to various infections [3]. In young children, the anemia prevalence continuous to remain over 75% in most parts of our country, despite a long running program that has been started earlier [4].

Nutritional anemia results when the ingestion of nutrients are insufficient for the synthesis of hemoglobin and RBCs. Deficiency of iron is the typical cause, which contributes to almost 42% of cases in children under-five years of age worldwide [5]. Deficiencies of vitamins A, riboflavin (B2), pyridoxine (B6), cobalamin (B12), C, D, E, folic acid, copper will also result in anemia. Iron is an essential nutrient necessary for hemoglobin, and then for RBC production. It is also an essential part of Hb molecule. Poor iron states may be transferred intergenerationally from the mother to the child [6].

Exclusively breastfed babies for six months receive enough iron through breast milk. Healthy newborn infants have a total body iron of 250mg (equivalent to 80ppm). The stored Iron is exhausted in about

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6months, so that additional iron is required [7].
The Iron content of conventional complimentary foods is insufficient to fulfil the demands of growing infants and children. Infants who do not obtain adequate iron will have impaired cognition, growth and development, language development and rising mortality and morbidity. It also leads to reduced Academic achievement [8].
Anemia accounts for significant mortality and morbidity, the current study was made to know the prevalence of anemia due to nutritional causes in children aged 6 to 24 months and to assess the associated risk factors.

Aims and Objectives
1. To study the prevalence of nutritional anemia in children aged 6 to 24 months.
2. To assess the risk factors of nutritional anemia.

Materials and Methods
Study site: This study was conducted in the Department of pediatrics, Mamata Academy of Medical Sciences.

Study population: Children aged 6months to 24months attending OPD of pediatrics department

Study design: The current study was a prospective cross sectional analytical study.

Sample size: N= Z 2 P (1-P) d2.

Where Z is the statistic corresponding to level of confidence (If the confidence levels are 95%, then the Z value would be 1.96; available from Z values table).
P is prevalence. In this study, P = 0.30 d is precision. In this study, d = 0.06 So, the sample size is 225.

Sampling method: Simple random sampling.

Study duration: The data collection for the study was done for a period of one year from March 2020 to February 2021.

Inclusion criteria
- Children between 6months to 24months of age attending pediatric OPD.

Exclusion criteria
- Not willing to participate in the study.
- Infants below 6months of age.
- Children above 24months.
- Children with hemolytic anemia.
- Children with anemia due to acute blood loss.
- Children with hemoglobinopathies.
- Children with chronic illness such as celiac disease, leukemias.
- Children with bone marrow suppression.

Ethical considerations
Study was approved by institutional human ethics committee. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and voluntary nature of participation were explained to the participants before obtaining consent. Confidentiality of the study participants was maintained.

Methodology
After getting approval from the ethical committee and after considering the inclusion and exclusion criteria 225 children aged 6months to 24months attending pediatric OPD at Mamata Academy of Medical Sciences were selected for the study.
After getting the written informed consent from parents, children were categorized according to age group criteria. Depending on the results of investigations they were classified under nutritional anemia. Later, assessment of risk factors associated with nutritional anemia was done using systemically designed proforma.
Statistical analysis
After completion of data collection, data was entered in Microsoft excel Spreadsheets and frequency of all variables were checked for completeness, data entry mistakes in data appropriate corrections was

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done. Data was then analyzed with the help statistical package for the social sciences software (SPSS) for windows version 21.0.

Results

A prospective cross sectional analytical study was done among 225 children aged 6months to 24months satisfying inclusion and exclusion criteria attending pediatric OPD of Mamata Academy of Medical Sciences during study period of 1years from Sep 2022 to Sep 2023 after taking the informed consent from parents.

Table 1: Prevalence of anemia

Anemia	n	%
Yes	160	71.1
No	65	28.9
Total	225	100.0

In current study, prevalence of anemia among the study population was 71.1%.

Table 2: Distribution of children according to peripheral smear

Peripheral smear	n	%
Normochromic normocytic	65	28.9
Hypochromic microcytic	141	62.7
Macrocytic	19	8.4
Total	225	100.0

In current study, peripheral smear was done for all the children. 62.7% of children had hypochromic microcytic anemia, 28.9% of children had normocytic normochromic smear and 8.4% of children had macrocytic anemia.

Table 3: Distribution of children according to type of anemia

Type	n	%
Non-anemic	65	28.9
Iron deficiency anemia	141	62.7
Megaloblastic anemia	19	8.4
Total	225	100.0

In current study, 62.7% of infants had iron deficiency anemia and 8.4% of infants had megaloblastic anemia. 28.9% of infants were non-anemic.

Table 4: Age distribution of children according to diagnosis

Parameter	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	Mean	SD	Mean	SD	Mean	SD
Age (months)	13.52	4.57	14.84	4.50	14.68	4.53
Minimum age	6 months		10 months		6 months	
Maximum age	24 months		24 months		24 months	
P value	0.163					

In current study, the mean age of the children with IDA was 13.52 ± 4.57months with a minimum age of 6months and maximum age of 24months.The mean age of the children with megaloblastic anemia was 14.84 ± 4.5months with a minimum age of 10months and maximum age of 24months. The mean age of the normal children was 14.68 ± 4.53months with a minimum age of 6months and maximum age of 24months. There was no statistical significance (P value 0.163).

Table 5: Gender distribution of children according to diagnosis

Gender	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	n	%	n	%	n	%
Male	80	56.7	8	42.1	36	55.4
Female	61	43.3	11	57.9	29	44.6
Total	141	100.0	19	100.0	65	100.0
Chi square	1.45					
P value	0.484					

In present study, among the children with IDA, 56.7% of children were males and 43.3% of children were females. In the children with megaloblastic anemia, 42.1% of children were males and 57.9% of children were females. Among normal children, 55.4% of children were males and 44.6% of children

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were females. There was no statistical significance (P value 0.484).

Table 5: Gestational age at time of birth and diagnosis

Gestational age at birth	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	n	%	n	%	n	%
Term	45	31.9	6	31.6	38	58.5
Pre-term	96	68.1	13	68.4	27	41.5
Total	141	100.0	19	100.0	65	100.0
Chi square	13.67					
P value	0.001					

In present study, among the children with IDA, 31.9% of children were term babies and 68.1% of children were pre-term babies. In the children with megaloblastic anemia, 31.6% of children were term babies and 68.4% of children were pre-term babies. Among normal children, 58.5% of children were term babies and 41.5% of children were pre-term babies. There was significantly higher in incidence of anemia among children with pre-term birth when compared with children with term birth (P value 0.001).

Table 6: Exclusive breast feeding and diagnosis

Exclusive	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
Breast Feeding	n	%	n	%	n	%
Yes	75	53.2	6	31.6	45	69.2
No	66	46.8	13	68.4	20	30.8
Total	141	100.0	19	100.0	65	100.0
Chi square	9.67					
P value	0.008					

In present study, among the children with IDA, 53.2% of children had exclusive breast feeding and 46.8% of children had no exclusive breast feeding. In the children with megaloblastic anemia, 31.6% of children had exclusive breast feeding and 68.4% of children had no exclusive breast feeding. Among normal children, 69.2% of children had exclusive breast feeding and 30.8% of children had no exclusive breast feeding.

The incidence of anemia was significantly higher among the children with no exclusive breast feeding than the children with exclusive breast feeding (P value 0.008).

Table 7: Duration of exclusive breast feeding and diagnosis

Duration of EBF	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	n	%	n	%	n	%
1 month	9	6.4	4	21.1	23	35.4
4 month	57	40.4	9	47.4	22	33.8
6 month	35	24.8	2	10.5	16	24.6
12 month	40	28.4	4	21.0	4	6.2
Total	141	100.0	19	100.0	65	100.0
Chi square	36.36					
P value	<0.0001					

In present study, among the children with IDA, 40.4% of children had duration of 4months, 28.4% of children had duration of 12months, 24.8% of children had duration of 6months and 6.4% of children had duration of 1month of exclusive breast feeding. Among children with megaloblastic anemia, 47.4% of children had duration of 4month, 21.1% of children had duration of 1month, 21% of children had duration of 12 months and 10.5% of children had duration of 6months of exclusive breast feeding.

Among normal children, 35.4% of children had duration of 1month, 33.8% of children ahd duration of 4months, 24.6% of children had duration of 6months and 6.2% of children had duration of 12months of exclusive breast feeding. There was statistical significance (P value <0.0001).

Table 8: Time of introduction of complementary food and diagnosis

Time for introduction of complementary feed	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	n	%	n	%	n	%
<6months	66	46.8	14	73.7	20	30.8
≥ 6months	75	53.2	5	26.3	45	69.2
Total	141	100.0	19	100.0	65	100.0
Chi square	11.82					
P value	0.003					

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In present study, among the children with IDA, 46.8% of children age was less than 6months and 53.2% of children age was > 6months at the time of introduction of complementary feed. In the children with megaloblastic anemia, 73.7% of children age was less than 6months and 26.3% of children age was > 6months at the time of introduction of complementary feed. Among normal children, 30.8% of children were < 6months and 69.2% of children were more than 6months at the time of introduction of complementary feed. There was significant higher incidence of anemia among children with less than 6months time of complementary feed (P value 0.003).

Table 9: Family diet and diagnosis

Family diet	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	n	%	n	%	n	%
Veg	72	51.1	10	52.6	32	49.2
Non-veg	69	48.9	9	47.4	33	50.8
Total	141	100.0	19	100.0	65	100.0
Chi square	0.09					
P value	0.955					

In present study, among the children with IDA, 51.1% of children were vegetarians and 48.9% of children were non-vegetarians. In the children with megaloblastic anemia, 52.6% of children were vegetarians and 47.4% of children were non-vegetarians. Among normal children, 49.2% of children were vegetarians and 50.8% of children were non-vegetarians. There was no statistical significance (P value 0.955).

Table 10: History of pica and diagnosis

History of pica	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	n	%	n	%	n	%
Yes	65	46.1	3	15.8	2	3.1
No	76	53.9	16	84.2	63	96.9
Total	141	100.0	19	100.0	65	100.0
Chi square	40.7					
P value	<0.0001					

In this present study, among children with IDA, 46.2% of children had history of pica. In the children with megaloblastic anemia, 15.8% of children had history of pica. Among normal children, 3.4% of children had history of pica. The incidence of IDA was significantly higher among the children with history of pica (P value <0.0001).

Table 11: Anemia severity and diagnosis

Severity of Anemia	IDA (n=141)		MBA (n=19)	
	n	%	n	%
Mild	28	19.9	2	10.5
Moderate	53	37.6	10	52.6
Severe	60	42.6	7	36.8
Total	141	100.0	19	100.0
Chi square	1.87			
P value	0.393			

In present study, among the children with IDA, 42.6% of children had severe anemia, 37.6% of anemia had moderate anemia and 19.9% of children had mild anemia. Among children with megaloblastic anemia, 52.6% of children had moderate anemia, 36.8% of patients had severe anemia and 10.5% of children had mild anemia. There was no statistical significance (P value 0.393).

Table 12: Hemoglobin and Diagnosis

Parameter	IDA (n=141)		MBA (n=19)		Non-anemic (n=65)	
	Mean	SD	Mean	SD	Mean	SD
Hb g%	6.87	1.36	6.52	0.96	11.56	0.51
Minimum Hb	5.2		5.2		11.0	
Maximum Hb	10.6		8.6		13.1	
P value	<0.0001					

In current study the mean Hemoglobin in children with iron deficiency anemia was 6.87 ± 1.36g %. The mean hemoglobin in children with megaloblastic anemia was 6.52 ± 0.96g %. The mean hemoglobin in

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normal children was 11.56 ± 0.51g %. There was statistical significance (P value <0.0001).

Table 13: MCV and diagnosis

MCV (g/dl)	IDA		MBA		Non-anemic	
	n	%	n	%	n	%
<80	110	78.0	0	0.0	0	0.0
80-100	30	21.3	2	10.5	65	100.0
>100	1	0.7	17	89.5	0	0.0
Total	141	100.0	19	100.0	65	100.0
Mean ± SD	76.41 ± 7.89g/dl		105.16 ± 6.42g/dl		89.95 ± 5.33g/dl	
P value	<0.0001					

In current study, among children with iron deficiency anemia, 78% had MCV less than 80g/dl, 21.3% of children had MCV of 80 to 100g/dl and 0.7% of children had MCV of more than 100g/dl with mean 76.41 ± 7.89g/dl. In the children with megaloblastic anemia, 10.5% of children had MCV of 80 to 100g/dl and 89.5% of children had MCV of more than 100g/dl with mean 105.16 ± 6.42g/dl. Among normal children, all children had MCV of 80 to 100g/dl with mean 89.95 ± 5.33g/dl. There was significant reduced MCV in children with iron deficiency anemia and increased MCV in children with megaloblastic anemia (P value 0.000).

Discussion

One of the major causes of morbidity and death in the pediatric age range in India and one of the major health issues is anemia. A significant social health issue is childhood anemia. Hemoglobin levels below 11 g/dl in children are used to diagnose anemia among age group 6 months to 6 years and a hemoglobin level less than 12 g/dl between 6 and 14 years.

In terms of global public health, nutritional anemia is almost always caused by iron insufficiency; folic acid deficiency is less widespread but frequently occurs in conjunction with iron deficiency. A vitamin B12 deficiency is quite uncommon.

A prospective cross sectional analytical study was done among 225 children aged 6months to 24months satisfying inclusion and exclusion criteria attending pediatric OPD of Viswabharathi Medical college during study period of 1years from March 2020 to February 2021 after taking the consent from parents.

Prevalence of anemia

In current study, prevalence of anemia among the study population was 71.1%. 62.7% of infants had iron deficiency anemia and 8.4% of infants had megaloblastic anemia. 28.9% of infants were non-anemic.

During a research work done by Kalhan *et al*. [71] demonstrated that 62.4% of children had anemia out of 170 children.

During a research work done by Zhao A *et al*. [73] demonstrated that 72.6% of children had anemia among 872 children.

Peripheral smear

In current study, peripheral smear was done all the children. 62.7% of children had hypochromic microcytic anemia, 28.9% of children had normocytic normochromic smear and 8.4% of children had macrocytic anemia.

Age

In current study, the mean age of the children with IDA was 13.52 ± 4.57months with a minimum age of 6months and maximum age of 24months. The mean age of the children with megaloblastic anemia was 14.84 ± 4.5months with a minimum age of 10months and maximum age of 24months. The mean age of the normal children was 14.68 ± 4.53months with a minimum age of 6months and maximum age of 24months. There was no statistical significance (P value 0.163).

During a research work done by Kalhan *et al*. [9] demonstrated that the Hb was 10.29 ± 1.03g/dl in the children aged 12 to 18months whereas the Hb was 10.58 ± 0.85g/dl in the children aged 19 to 24months.

During a research work done by Sunardi D *et al*. [10] showed that prevalence of anemia among age group of 6 to 11months children was 42.3% and among children of age group 12 to 23months was 25.7%.

Gender

In present study, among the children with IDA, 56.7% of children were males and 43.3% of children were females. In the children with megaloblastic anemia, 42.1% of children were males and 57.9% of children were females. Among normal children, 55.4% of children were males and 44.6% of children were females, which has no statistical significance (P value 0.484).

During a research work done by Sunardi D *et al*. [11] demonstrated that the anemia prevalence in the male children was 29.2% while it was 29.7% in the female children.

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Gestational age at the time of birth

In present study, among the children with IDA, 31.9% of children were term babies and 68.1% of children were pre-term babies. In the children with megaloblastic anemia, 31.6% of children were term babies and 68.4% of children were pre-term babies. Among normal children, 58.5% of children were term babies and 41.5% of children were pre-term babies. The incidence of anemia was significantly higher among children with pre-term birth than the children with term birth (P value 0.001).

During a research work done by Huang Z *et al*. [12] showed that among term children, 29.63% of children had anemia whereas among pre-term children, 27.49% of children had anemia which was statistically insignificant (P value 0.455).

During a research work done by Li Q *et al*. [13] showed that the anemia prevalence among pre-term children was 38.5% whereas it was 10.2% among term children which was statistical significance (P value 0.000).

Exclusive breast feeding

In present study, among the children with IDA, 53.2% of children had exclusive breast feeding and 46.8% of children had no exclusive breast feeding. In the children with megaloblastic anemia, 31.6% of children had exclusive breast feeding and 68.4% of children had no exclusive breast feeding. Among normal children, 69.2% of children had exclusive breast feeding and 30.8% of children had no exclusive breast feeding. The incidence of anemia was significantly higher among the children with no exclusive breast feeding than the children with exclusive breast feeding (P value 0.008).

During a research work done by Huang Z *et al*. [12] showed that among children with breast feeding, 42.89% of children had anemia whereas 24.59% of children without breast feeding had anemia which was significant statistically (P value <0.001).

Duration of exclusive breast feeding

In present study, among the children with IDA, 40.4% of children had duration of 4months, 28.4% of children had duration of 12months, 24.8% of children had duration of 6months and 6.4% of children had duration of 1month of exclusive breast feeding. Among children with megaloblastic anemia, 47.4% of children had duration of 4month, 21.1% of children had duration of 1month, 21% of children had duration of 12 months and 10.5% of children had duration of 6months of exclusive breast feeding. Among normal children, 35.4% of children had duration of 1month, 33.8% of children had duration of 4months, 24.6% of children had duration of 6months and 6.2% of children had duration of 12months of exclusive breast feeding, which has statistical significance (P value <0.0001).

Time for introduction of complementary feed

In present study, among the children with IDA, 46.8% of children less than 6months and 53.2% of children more than 6months of time for introduction of complementary feed. Among children with megaloblastic anemia, 73.7% of children less than 6months and 26.3% of children more than 6month time for introduction of complementary feed. Among normal children, 30.8% of children less than 6months and 69.2% of children more than 6month time for introduction of complementary feed. There was significant higher incidence of anemia among children with < 6months time of complementary feed (P value 0.003).

During a research work done by Zhao A *et al*. 10 showed that among anemic children, 34.6% children had complementary feeding during 0 to 5months of age, 51% of children had complementary feeding during 6 to 8months and 14.4% of children had complementary feeding at the age of > 8months whereas among normal children, 41.4% of children had complementary feeding during 0 to 5months of age, 51.5% of children had complementary feeding during 6 to 8months and 7.1% of children had complementary feeding at the age > 8months which has statistical significance (P value 0.005).

During a research work done by Huang Z *et al*. [12] showed that among children with optimum timing of complementary feeding was 31.83% of children had anemia whereas among children without optimum timing of complementary feeding was 29.49% which has statistical significance (P value 0.007).

History of pica

In present study, among the children with IDA, 46.2% of children had history of pica. In the children with megaloblastic anemia, 15.8% of children had history of pica. Among normal children, 3.4% of children had history of pica. There was significantly higher incidence of iron deficiency anemia among children with history of pica (P value<0.0001).

Severity of anemia

In present study, in the children with IDA, 42.6% of children had severe anemia, 37.6% of anemia had moderate anemia and 19.9% of children had mild anemia. In the children with megaloblastic anemia, 52.6% of children had moderate anemia, 36.8% of patients had severe anemia and 10.5% of children had

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mild anemia. There was no statistical significance (P value 0.393).
During a research work done by Kalhan *et al*. [9] showed that 41.8% of children had mild anemia followed by 17.7% of children had moderate anemia and 2.9% of children had severe anemia whereas 37.6% of children had no anemia.
During a research work done by Ayoya MA *et al*. [14] showed that 23.9% of children had mild anemia, 14.7% of children had moderate anemia and 0.2% of children had severe anemia.

Hemoglobin levels
In present study, the mean Hemoglobin in children with IDA was 6.87 ± 1.36g%. The mean hemoglobin in children with megaloblastic anemia was 6.52 ± 0.96g%. The mean hemoglobin in normal children was 11.56 ± 0.51g%, which has statistical significance (P value <0.0001).

Mean corpuscular volume
In present study, in the children with IDA, 78% had MCV less than 80g/dl, 21.3% of children had MCV of 80 to 100g/dl and 0.7% of children had MCV of >100g/dl with mean 76.41 ± 7.89g/dl. In the children with megaloblastic anemia, 10.5% of children had MCV of 80 to 100g/dl and 89.5% of children had MCV of >100g/dl with mean 105.16 ± 6.42g/dl. Among normal children, all children had MCV of 80 to 100g/dl with mean 89.95 ± 5.33g/dl. There was significant reduced MCV in children with iron deficiency anemia and increased MCV in children with megaloblastic anemia (P value 0.000).

Conclusion
In the present study, it was concluded that the anemia prevalence was significantly higher in the children of age group 6 to 24 months. IDA was more common in this age group when compared with megaloblastic anemia. Most of the children were presented with moderate to severe degree of anemia.
There was a statistically significant association is present between the factors like the education of mother, occupation of mother, socio-economic class, location, type of family, gestational age at the time of birth, exclusive breast feeding, duration of exclusive breast feeding, time for introduction of complementary feed, history of pica and nutritional anemia among children. By taking the appropriate measures, we can prevent nutritional anemia as most of these associated factors are preventable.

Conflict of Interest: None.

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