Brief Research Article

Prevalence and Risk Factors of Anemia and Zinc Deficiency among 4–6-Year-Old Children of Allahabad District, Uttar Pradesh

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Summary

Anemia and zinc deficiency are two of the most daunting nutritional problems afflicting the young children among developing countries like India. Thus, in view of this the following study was designed to investigate the status of undernutrition and micronutrient status (iron and zinc) of children aged between 4 and 6 years of Allahabad district. The anthropometric measurements (height and weight); biochemical parameters (hemoglobin and serum zinc), and general information of the children were recorded. Out of the total 365 children studied, 92.9% were anemic out of which 90.6% (n = 307) were moderately anemic having and 2.3% belonged to mild anemic group. Serum zinc deficiency was 65.3%. Anemia was more commonly observed among undernourished children. In case of zinc deficiency poor nutritional status, the age of 60–71 months and rural settlement projected out to be the potent risk factors.

Key words: Anemia, preschoolers, serum zinc deficiency

An alarming national prevalence of anemia has been consistently increasing with 63.2% children (age 6–59 months) being anemic in Uttar Pradesh itself.[1] Uttar Pradesh has the second largest prevalence of anemia (90%); where Allahabad district has 89.7%, 93.9% and 88.9% among the age brackets of 6–59 months, 5–9 years and 10–17 years, respectively.[1] With 55 districts, Uttar Pradesh has highest rates of stunting of 62% among 9 EAG states; in which Allahabad has a grim status of 57.6% moderate less than two standard deviation (<2SD) and 29.7% severe (<3SD) stunted children below 5 years.[2] On the other hand, globally 2 billion people are at risk of zinc deficiency and account for 2.9% of global disease burden and affect about one-third of the world's population.[3] Since the iron and zinc deficiencies have been found to coexist in high-risk population here is an acute need to scrutinize the predictors of these morbidities and evaluate the status of iron and zinc among the preschoolers of Allahabad district.

The present study was performed between October 2015 and March 2016. Assuming the prevalence of anemia as 90% among the children (48–71 months)[1], the formula $n = (Z^2\,pq)/l^2$ was used where z = 1.96, l = absolute precision of 5% and q was the complement of p. Multiplying by the design effect of 2 and allowing a nonresponse rate of 20% sample size calculated was 345 who were evaluated for iron and zinc status. Proportionate multistage stratified random sampling was employed to select the respondents from rural (one-third, i.e., n = 140) and urban (two-third, i.e., n = 285) areas. Six wards and eight villages were selected randomly (using the table of random numbers) to obtain respondents from the urban and rural areas, respectively. In order to attain a representative sample Anganwadi centers (rural areas) and playschools (urban areas) were listed and randomly selected as the sites of the study. From each selected Anganwadi and playschool, the list of the children belonging to the target age group was procured and after screening them for the exclusion criteria 35 children and 24 children from each village Anganwadi and playschool were selected respectively, finally yielded the total sample of 365 children.

Access this article online

Quick Response Code:

Website: www.ijph.in

DOI: 10.4103/ijph.IJPH_342_17

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How to cite this article: Sharma U, Yadav N. Prevalence and risk factors of anemia and zinc deficiency among 4–6-year-old children of Allahabad District, Uttar Pradesh. Indian J Public Health 2019;63:79-82.

A prior informed written consent was taken from the parents, and they were the respondents for collecting the information regarding their ward. A pre-tested survey schedule was used to record relevant information including sociodemographic characteristics, dietary habits, and medical history. Anthropometric measurements (Height and Weight) were measured using the standard procedure. Children were classified as per the World Health Organization Reference where ±2 SD was used as the cut off for weight-for-age, height-for-age, and weight-for-height. The cutoff used for anemia prevalence was hemoglobin (Hb) level <11 g/dL in 6–59 months and <11.5 g/dL in 5–11 years. It was further classified into mild (if Hb-10–10.9 g/dL in 6–59 months, 11–11.4 g/dL in 5–11 years), moderate (if Hb-7–9.9 g/dL in 6–59 months, 8–10.9 g/dL in 5–14 years), and severe (if Hb <7 g/dL in 6–59 months and <8 g/dL in 5–14 years).[4] Hb estimation was done by cyanmethemoglobin method and serum zinc was estimated by Atomic Absorption Spectrophotometer method. Since the estimation of serum zinc was costly (due to its expensive laboratory requisites) as per the constraints of the study a uniform subsample of one-third of the total sample size, i.e., 130 children were assessed for the serum zinc. The children with serum zinc level ≤65 μg/dl were considered as deficient.[3] Venous blood was collected by a trained laboratory technician. Biochemical tests of blood and serum were done by the investigator at the National Accreditation Board for Testing and Calibration Laboratories accredited Food Analysis and Research laboratory under the supervision of trained personnel.

The age of the respondents was confirmed by the registration details provided by the Anganwadi officials and primary school records. With that children whose parents were not present or who did not give their written consent were not included in the study. Children suffering from morbid conditions such as fever, diarrhea, dysentery, pneumonia, or receiving any medications were excluded from the study. The study was registered and received clearance by human ethical committee (Registration No: 14/9.20) of the Population Resource and Research Center established under the Society on Integrated developed and Social Reconstruction, Kamla Nehru Memorial Hospital Allahabad. Statistical Package for Social Sciences version 19.0 for windows (SPSS Inc, Chicago, IL, USA) was used to perform statistical analysis. Multivariable logistic regression analysis was done to test the association of the factors by computing relative risk (RR) and with a confidence interval of 95% ($P < 0.05$).

Out of the total 365 respondents, an alarmingly prevalence of anemia was found to be 92.9% ($n = 339$). Out of this, 51.3% children were between 48–59 months and 41.6% belonged to the age of 60–71 months. Among the anemic children, most of them (90.6%) belonged to the moderate level, and only 9.6% had mild anemia.

On studying the risk factors of anemia [Table 1] most of the stunted children were mildly anemic (RR-36.629; 9.01–148.729 $P = 0.0001$) rather than moderately anemic (RR 13.87; 13.87 4.21–45.6 $P = 0.0001$). Underweight and wasted children had 2.5 times more chances of being moderately anemic ($P = 0.04$). Serum zinc deficiency (<65 μg/dL) had a prevalence of 65.3% ($n = 130$) among the respondents. Among the predictors of serum zinc deficiency [Table 2], it is seen that wasted children had around 3 folds more likeliness of having low serum zinc levels ($P = 0.001$). The severity of hypozincemia and its growth faltering outcomes increases with increasing age which accounts for the finding that children belonging to the age group of 60–

Table 1: Multivariable logistic regression analysis of risk factors of anaemia among 48–71 months old children of Allahabad district

Variables	Grades (*n*)	Nonanaemic, *n* (%)	Anaemic, *n* (%)	Mildly anaemic		Moderately anaemic	
				n	RR (CI) (*P*)	*n*	RR (CI) (*P*)
Under-nutrition	Under weight (188)	8 (4.3)	180 (95.7)	19	3.285 (1.104–9.795) (0.0324)	161	2.481 (1.047–5.877) (0.04)*
	Normal (177)	18 (10.7)	159 (89.3)	13	1	146	1
	Wasted (180)	7 (3.9)	173 (96.1)	19	3.782 (1.223–11.54) (0.02)*	154	2.588 (1.051–6.374) (0.039)*
	Normal (185)	19 (10.3)	166 (89.7)	13	1	153	1
	Stunted (177)	3 (1.7)	174 (98.3)	23	36.629 (9.01–148.739) (0.0001)*	151	13.87 (4.21–45.6) (0.0001)*
	Normal (188)	23 (12.1)	165 (87.8)	9	1	156	1
Age group	48–59month (185)	11 (6)	174 (94)	20	1	154	1.158 (0.818–1.339)
	60–71 month (180)	15 (8.4)	165 (91.6)	12	1.54 (0.401–1.142) (0.102)	153	(0.287)
Gender	Male (151)	9 (6)	142 (94)	11	1	131	1
	Female (214)	17 (3.9)	197 (92.1)	21	0.984 (0.333–0.99) (0.61)	176	1.406 (0.6875–3.2535) (0.426)
Type of settlement	Rural (177)	14 (3.9)	163 (92.1)	13	1.325 (0.765–2.296) (0.230)	150	1.102 (0.853–1.542) (0.39)
	Urban (188)	12 (6.4)	176 (93.6)	19	1	157	1
Food habit	Vegetarian (181)	13 (7.2)	168 (92.8)	12	1.158 (0.248–5.583) (0.183)	156	0.926 (0.43–2.02) (0.520)
	Nonvegetarian (64)	5 (7.7)	59 (92.3)	4	1	55	1
	Ovovegetarian (120)	8 (6.7)	112 (93.3)	6	0.9375 (0.973–5.070) (0.637)	96	0.889 (0.43–1.83) (0.485)
Total respondents		26 (7.1)	339 (92.9)		32 (9.4)		307 (90.6)

Total sample size of the study was *n*=425 but, only 365 respondents were assessed because 60 respondents did not give the consent for Haemoglobin estimation. *Numbers in parentheses denotes percentage. RR: Relative risk, CI: Confidence interval

Table 2: Multivariable logistic regression analysis of risk factors of zinc deficiency as per serum zinc values amongst 48–71 months old children of Allahabad district

Variables	Grades	*n*	Serum zinc deficient (<65 μg/dl), *n* (%)	Serum zinc sufficient (≥65 μg/dl)	RR (CI) (*P*)
Under-nutrition	Underweight	73	52 (71.2)	21 (28.8)	1.5 (1.001-2.347) (0.05)*
	Normal	57	33 (57.9)	24 (42.1)	1
	Wasted	81	69 (85.2)	12 (14.7)	3.150 (1.649-6.018) (0.001)*
	Normal	49	26 (53)	23 (47)	1
	Stunted	86	70 (81.4)	16 (18.6)	2.915 (1.399-6.073) (0.001)*
	Normal	44	26 (59.1)	18 (40.9)	1
Age group	48–59 month	71	52 (73.2)	19 (26.8)	1
	60–71 month	59	33 (55.9)	26 (44.1)	1.488 (1.032-2.145) (0.030)*
Gender	Male	75	44 (58.7)	31 (41.3)	1
	Female	55	41 (74.6)	14 (25.4)	1.331 (1.002-1.768) (0.055)*
Type of settlement	Rural	80	72 (90)	8 (10)	2.842 (1.0697-7.551) (0.05)*
	Urban	50	38 (76)	12 (24)	1
Food habit	Vegetarian	65	43 (66.2)	22 (33.8)	1.086 (0.514-2.293) (0.512)
	Nonvegetarian	22	14 (63.6)	8 (36.4)	1
	Ovo-vegetarian	43	28 (65.1)	15 (34.9	1.043 (0.516-2.293)
Total respondents		135	85 (65.3)	45 (34.7)	

*Numbers in parentheses denotes percentage. RR: Relative risk, CI: Confidence interval

71 months had 1.5 times more chances of having low serum zinc. Comparatively, undernourished boys were more anemic and had also 1.3 times more chance of being zinc deficient, but it was not statistically significant ($P = 0.055$). Rates of stunting is a reliable population-level indicator to assess the zinc status, and as anticipated it was found statistically significant ($P < 0.002$) risk factor in the present study also as stunted children had almost 3 times more risk of having serum zinc deficiency.

Among the children hailing from urban areas, 76% had low serum zinc levels which was much less as compared to the rural respondents (90%). Hypozincemia was significantly ($P < 0.001$) higher among the rural respondents (RR-2.842; 0697–7.551 $P = 0.05$).

In the present study, higher prevalence of anemia of 92.9% was found as compared to national survey data[2] where 89.7% and 93.9% of the children of the age group of 6–59 months and 5–9 years respectively. However, the National Family Health Survey-4 affirms that only 60.2% of the under-five children are anemic.[5] Stunting emerged out as the strongest predictor of anemia followed by wasting and underweight. Singh and Patra observed the similar association as anemia is a common clinical manifestation resulted from macronutrient and micronutrient deficiencies.[6] In our observation, female gender did not emerged as a risk factor of anemia ($P < 0.601$); however, instances are of more females being anemic have also been affirmed.[7] As food habits influences, the amount of iron in the diet is usually enough to cover body needs, consumption of poor bioaccessible nonheme iron from plant-based foods could have been a risk factor but we found no significant association signifying that exact contribution of dietary factors toward the risk of anemia is not well established and may vary with the level of infection and the diet quality.[8]

Serum zinc deficiency came out to be 65.3%. In other studies done on Indian preschoolers, 73%[9] were serum zinc deficient. Serum zinc deficiency was significantly associated with the (95% confidence interval 1.001–2.347) and wasting ($P < 0.002$). Stunting emerged out to be the most strong predictor of serum zinc deficiency ($P < 0.001$) among all the anthropometric indices[9] where stunted children had almost 3 times more risk of having serum zinc deficiency ($P = 0.001$). Collectively, stunting and serum zinc gives a better picture of the zinc status of a population and remarkable association between these two variables have been found.[9] Children belonging to the age group of 60–71 months had 1.5 times more chances of having low serum zinc which may be primarily because as the age increases and the child enters the growth spurt;[9,10] the requirements for zinc increases but the intestinal absorption of zinc is markedly inhibited since habitual Indian vegetarian (mixed cereal/pulse) diets are rich in phytate and thus the bioavailability of zinc is expected to be poor.

In conclusion, our study showed that approximately two out of three children have low serum zinc levels which depict a very upsetting micronutrient status of the children. Thus, suitable and sustainable intervention programs (nutrition education, health policies, and surveillance system) is required; to combat this escalating threat to child health.

Acknowledgment

Authors acknowledge the support and cooperation received from the NGO Pragati Sevasansthan Allahabad during the entire study.

Financial support and sponsorship

Authors are thankful to the University Grants commission JRF/SRF fellowship grant to the financial aid provided in the study.

Conflicts of interest

There are no conflicts of interest.

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