e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(9); 01-06

Original Research Article

A Study Assessing the Association between Antibody Titers and Nutritional Status in Paediatric Population Diagnosed with Measles

Swesh Chandra[1], Debasis Kr Samanta[2]

[1]Senior Resident, Department of Pediatrics, Dr. Baba Saheb Ambedkar Medical College and Hospital, Rohini, Delhi, India

[2]Senior Resident, Department of Pediatrics, RKM Seva Pratishthan, Kolkata, West Bengal, India

Received: 13-2-2023 Revised: 25-03-2023 / Accepted: 20-04-2023
Corresponding author: Dr. Swesh Chandra
Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to find out any association of measles antibody titres with nutritional status in children 1 to 12 years.

Methods: This hospital based cross-sectional study was conducted in the duration of 12 months on 1–12-year-old children attending the Pediatric O.P.D. of Department of Pediatrics, Department of Pediatrics, Dr.Baba Saheb Ambedkar Medical College and Hospital, Rohini, Delhi, India with the objective of finding out the seroprevalence and anti-measles antibody levels, and studying their association with age, gender, as well as nutritional status of these children.

Results: Majority (70%) of the total subjects had been vaccinated against measles. However, the relationship between age and vaccination status was not found to be statistically significant (p=0.155). No statistically significant difference was observed in the baseline characteristics of vaccinated and unvaccinated group except for mean weight for age Z score which was significantly lower in the unvaccinated group. 41% of the total subjects ≤5 years old had severe wasting (severe acute malnutrition), while 32% had moderate wasting. In children > 5 years, 22% had severe thinness, 11.60% had thinness and only 2 (0.2%) case was overweight. 42.85% of the vaccinated subjects ≤5 years old had severe wasting (severe acute malnutrition), while 34.28% had moderate wasting. A highly statistically significant relationship was observed between BMI Z scores (in subjects aged ≥5yrs) and seropositivity, with higher seropositivity being noted in children with higher BMI z scores. Similarly, a statistically significant relationship was observed between height for age Z scores and seropositivity, with higher seropositivity being noted in children with higher height for age z scores.

Conclusion: Nutritional status of children has an association with measles antibody titres as well GMT of measles specific IgG antibody, with those with better nutritional status having higher measles antibody titres.

Keywords: Measles, Vaccine, Antibody, Vaccination, Malnourished, Anthropometry

Introduction

In India, Measles contributes to 2.3 percent of all deaths and one tenth of all deaths in the pre-school children. [1] A median case fatality ratio of 3.7%, range 0 to 23.9%, primarily affecting the remote tribal populations have been reported and case fatality rates of 5-30 percent have been observed. Despite the declining trends in measles cases from a reported 162560 in 1989 to 29339 in 2011 [2], measles remains a major cause of morbidity & mortality in the children in India. Currently, DRC gives one routine dose of measles vaccine to children nine months of age, and in outbreak settings, to children as young as six months. Although the WHO states that all countries should include a second routine dose of MV, regardless of national routine coverage level of the first dose. [3]

Because coverage achieved through healthcare is low in the DRC, attempts are made to reach missed children through Supplementary Immunization Activities (SIA), which Doshi et al. found to be associated with decreased measles incidence. [4] The ability of an infant to seroconvert is age dependent due to level and decay of maternal antibodies and immunological development; regional differences in seroprevalence have been observed. Measles contribute to the development of malnutrition because of protein-losing enteropathy, increased metabolic demands, and decreased food intake. Children who have measles early in life

have significantly lower mean weights for age than children of the same age who do not develop measles. [5]

The ability of an infant to seroconvert is age dependent due to level and decay of maternal antibodies and immunological development; regional differences in seroprevalence have been observed. Expectant mothers in endemic areas may be more likely to have had natural measles infection, resulting in higher measles antibody levels, and so pass on higher levels of measles antibody transplacentally to their infants, resulting in longer lasting protection than would occur in expectant mothers with vaccine-induced antibody. [6,7] Measles contributes to the development of malnutrition because of protein-losing enteropathy, increased metabolic demands, and decreased food intake. Children who have measles early in life have significantly lower mean weights for age than children of the same age who do not develop measles.

Hence the aim of study was to find out any association of measles antibody titres with nutritional status in children 1 to 12 years.

Material & Methods

This hospital based cross-sectional study was conducted in the duration of 12 months (Jan 2016 to December 2016) on 1-12 year old children attending the Pediatric O.P.D. of Department of Pediatrics, Department of Pediatrics, Dr.Baba Saheb Ambedkar Medical College and Hospital,Rohini, Delhi , India with the objective of finding out the seroprevalence and anti-measles antibody levels, and studying their association with age, gender, as well as nutritional status of these children. A total of 600 patients were evaluated initially. Out of these, 500 patients whose parents consented for the study were enrolled in the study. The procedure of systematic random sampling was used for selection of subjects. Blood samples were tested for presence of measles specific IgG antibodies.

Inclusion criteria

- Children in the age group of 1 to 12 years.

Exclusion criteria

- Refuses to give parental consent,
- Received blood or
- Blood components within last 3 months, received corticosteroid therapy or other immunosuppressive therapy, are HIV positive, are transplant recipients (bone marrow/ solid organ), received of gamma globulins within last 2 months, are on dialysis and are having malignancies.

The techniques of measurement described in Cogill's (2003). [8] Anthropometric Indicators Measurement Guide were followed to make the following measurements.

Weight was measured using a portable electronic weighing scale with a weighing capacity from 1 kg to 150 kg in 100 g divisions, accuracy +/- 100g.

Height: was measured in centimetres to a precision of 0.1cm by a wall mounted tape measuring up to 2 meters. An infantometer was used to measure the length for children less than 2 years of age.

The following indices & their z scores were calculated:

Body Mass Index (BMI) = $Weight\ (Kg)/\ Height\ (m)^2$.

Weight for age: for children less than 10 years of age by W.H.O standard growth chart and z score was calculated.

Height for age: for all children based on W.H.O standard growth chart and z score was calculated.

Weight for height: for children less than 5 years based on W.H.O standard growth chart and zscore was calculated.

Nutritional status of children was classified on the basis of the WHO Growth Standards, 2006 for 0-60 months; and the WHO Reference, 2007 for 5-19 years.

Children 5-19 Years:

Overweight: >+1SD (equivalent to BMI 25 kg/m2 at 19 years) Obesity: >+2SD (equivalent to BMI 30 kg/m2 at 19 years). Thinness: <- 2SD. Severe thinness: <-3SD.

Children 0-60 months:

Moderate wasting: weight-for length/ height Z -score -2 to -3 Severe wasting (severe acute malnutrition): weight-for length/ height Z –score <-3.

Overweight: BMI-for-age or weight-for-length/ height Z -score > 2. Obesity: BMI-for-age or weight for- length/ height Z -score>3. Moderate stunting: length/ height for age Z -score -2 to -3. Severe stunting: length/ height for age Z -score < -3.

Blood samples were collected, and serums were separated by centrifugation and stored at -20 degree Celsius till the time of assay. Measles specific IgG antibodies were detected by using a commercial IgG ELISA kit (Measles Virus IgG ELISA, IBL International GMBH) in accordance with the manufacturer's instructions.

Results

Table 1: Vaccination status of children against measles

Age group (years)	Vaccinated N (%)	Unvaccinated N (%)	Total	P value
1-12	350 (70)	150 (30)	500	0.155

Majority (70%) of the total subjects had been vaccinated against measles. However, the relationship between age and vaccination status was not found to be statistically significant (p=0.155).

Table 2: Baseline characteristics of measles vaccinated and unvaccinated children

Characteristics	Vaccinated mean±SD	Unvaccinatedmean±SD	P value
Age (years)	6.4±3.0	5.6±3.4	0.512
Weight (kg)	16.4±7.3	16.2±6.1	0.244
Height (cm)	102.4±20.2	108.2±20.5	0.655
BMI (kg/m^2)	15.5±2.6	14.6±1.7	0.111
Weight for age Z score (1-10 years)	-1.4±1.2	-2.6±1.6	0.028
Height for age Z core	-1.6±0.4	-1.7±1.4	0.0756
Weight for height Z score(1-5 years)	-1.6±1.6	-1.6±1.8	0.420
BMI Z Score	-1.6±2.4	-1.6±1.8	0.640

No statistically significant difference was observed in the baseline characteristics of vaccinated and unvaccinated group except for mean weight for age Z score which was significantly lower in the unvaccinated group.

Table 3: Nutritional status of subjects

Parameter of Nutritional status		Total	(%)	Vaccinated	(%)	Unvaccinated N	(%)
Weight for ageZ Score (age ≤10yrs)	< -3	95	19	80	22.87	15	10
	-2 to-3	165	33	120	34.28	45	30
	>-2	167	33.4	77	42.85	90	60
	Total	250	100	350	100	150	100
Weight for Height Z Score (age≤5yrs)	<-3	135	27	105	30	30	20
	-2 to-3	160	32	120	34.28	40	26.66
	>-2	205	41	125	35.72	80	53.34
	Total	500	100	350	100	150	100
Height for Age Z Score	<-3	32	6.4	20	5.71	12	8
	-2 to-3	105	21	65	18.57	40	26.66
	>-2	363	72.6	265	75.72	98	65.34
	Total	500	100	350	100	150	100
BMI for age Z score (age > 5yrs;	<-3	110	22	65	18.57	45	30
	-2 to-3	58	11.60	35	10	23	15.34
	>-2 to 1	330	66	248	70.85	82	54.66
	>1	2	0.2	2	0.57	0	0
	Total	500	100	350	100	150	100

41% of the total subjects ≤5 years old had severe wasting (severe acute malnutrition), while 32% had moderate wasting. In children > 5 years, 22% had severe thinness, 11.60% had thinness and only 2 (0.2%) case was overweight. 42.85% of the vaccinated subjects ≤5 years old had severe wasting (severe acute malnutrition), while 34.28% had moderate wasting.

Table 4: Relationship of measles antibody status with nutritional status of total subjects

Parameter of nutritional status		Antibody status						Total	P value
		Positive	N (%)	Negative	N (%)	Equivocal	N (%)		
Weight for Age z score (age ≤10yrs)	<-3	60	63.15	26	27.36	9	9.47	95	0.050
	-2 to-3	120	72.72	30	18.18	15	9.09	165	
	>-2	115	68.86	25	14.97	27	16.16	167	
Height for Age Z Score	<-3	20	62.5	8	25	4	12.5	32	0.022
	-2 to-3	50	47.61	40	38.09	15	14.28	105	
	>-2	250	68.87	80	22.03	33	9.09	363	
Weight for Height z Score (age <5 years)	<-3	20	58.82	10	29.41	4	11.76	34	0.634
	-2 to-3	25	62.5	10	25	5	12.5	40	
	>-2	60	54.54	40	36.36	10	9.09	110	
BMI Z score(age≥5yrs)	<-3	60	54.54	40	36.36	10	9.09	110	0.001
	-2 to-3	34	58.62	16	27.58	8	13.79	58	
	>-2 to 1	250	75.75	70	21.21	10	3.03	330	
	>1	2	100	0	0	0	0	2	

A highly statistically significant relationship was observed between BMI Z scores (in subjects aged ≥5yrs) and seropositivity, with higher seropositivity being noted in children with higher BMI z scores. Similarly, a statistically significant relationship was observed between height for age Z scores and seropositivity, with higher seropositivity being noted in children with higher height for age z scores.

Table 5: Nutritional status wise geometric mean titer (GMT) of measles specific igg antibody of total children

Parameters of nutritional status		GMT (mIU/mL)	P value
W/A z score	> -2SD	924	0.001
	<-2SD to-3SD	665	
	<-3SD	545	
H/A z score	-2SD	1785	0.005
	-2SD to-3SD	678	
	<-3SD	380	
W/H z score	> -2SD	578	0.550
	-2SD to-3SD	568	
	<-3SD	555	

It was not found statistically significant with p value 0.05 for seropositivity but significant with p value for antibody levels. In weight for length/height both seropositivity and GMT were found insignificant in well-nourished, moderately malnourished as well as severely malnourished subject.

Discussion

Measles is a highly infectious disease common in children. It is caused by a virus belonging to the myxoviruses group. [9] Worldwide, measles is the most common vaccine preventable disease accounting for 38% of disease burden. [11] Though safe and cost effective vaccine is available, measles is one of the common causes of death among young children especially in developing countries. [10] According to WHO, 145700 measles death have been documented in the year 2014, 400 children die every day and 16 die every hour. [12,13] Vaccination for measles has led to a 75% drop in measles mortality from 2000 to 2013 globally5. Through routine immunization, globally 84% of children at 1 year had received at least a single dose of measles vaccine. Inspite of above measures, measles continues to be a leading cause of morbidity and mortality in developing countries due to underlying malnutrition and overcrowding. [14]

Majority (70%) of the total subjects had been vaccinated against measles. However, the relationship between age and vaccination status was not found to be statistically significant (p=0.155). No statistically significant difference was observed in the baseline characteristics of vaccinated and unvaccinated group except for mean weight for age Z score which was significantly lower in the unvaccinated group. 41% of the total

subjects ≤5 years old had severe wasting (severe acute malnutrition), while 32% had moderate wasting. In children > 5 years, 22% had severe thinness, 11.60% had thinness and only 2 (0.2%) case was overweight. 42.85% of the vaccinated subjects ≤5 years old had severe wasting (severe acute malnutrition), while 34.28% had moderate wasting. McMurray et al [15] found that the children's nutritional status had no effect after vaccination. All the children have equal immunological response with respect to nutritional status. Mean hemagglutination-inhibition titres are slightly reduced in all nutritional groups 14 months after vaccination. Smedman et al [16], Halsey et al [17], Ekunwe et al. [18] found good antibody response in children which were not severely malnourished. Similarly Lyamuya et al [19] found there were no significant differences in measles antibody levels with regard to variations in nutritional status. Some studies reported seroconversion rates at least as high in malnourished as in well-nourished children because it is cell mediated immunity that is suppressed not the humoral immunity. [20,21] Similar to our study, there was one study which demonstrated that stunting is associated with low antibody response. [22] In the same study, apart from severe stunting, severe wasting was also associated with lower antibody response, an observation which was not observed in our study. Idris et al [23] found decreased antibody titre in children with Kwashiorkar. Hafez et al [24] found decrease humoral response to measles vaccine. [25]

A highly statistically significant relationship was observed between BMI Z scores (in subjects aged ≥5yrs) and seropositivity, with higher seropositivity being noted in children with higher BMI z scores. Similarly, a statistically significant relationship was observed between height for age Z scores and seropositivity, with higher seropositivity being noted in children with higher height for age z scores. So, it was seen that malnourished children in the community can be safely and effectively vaccinated against measles. But some studies showing good antibody response and some showing poor antibody response. The mechanisms behind the immunological response are still inadequately understood. More researches are needed in this field to come to any conclusion.

Conclusion

Nutritional status of children has an association with measles antibody titres as well GMT of measles specific IgG antibody, with those with better nutritional status having higher measles antibody titres.

References

1. Narain JP, Banerjee KB. Measles in India: epidemiology and control. The Indian Journal of Pediatrics. 1989 Jul 1;56(4):463-72.
2. Measles [Internet]. World Health Organization. 2016 [cited 11 September 2014].
3. Department of Health (Taiwan, China). Proceedings of the national annual meeting for infectious diseases control. Taipei, 1996 (in Chinese).
4. Doshi R et al. The effect of immunization on measles incidence in the Democratic Republic of Congo: results from a model of surveillance data. Vaccine 2015;33(48):6786–92
5. Dewangan M, Zaka-Ur-Rab Z, Ahmad A, Shahab T. Association of measles antibody titres with nutritional status in paediatric population. International Journal of Medical Paediatrics and Oncology.:51.
6. Liu CC, Lei HY, Chiang YP. Seroepidemiology of measles in southern Taiwan: two years after implementation of the measles elimination program. Journal of the Formosan Medical Association= Taiwan yi zhi. 1996 Jan 1;95(1):37-40.
7. Chiu HH, Lee CY, Chih TW, Lee PI, Chang LY, Lin YJ, Hsu CM, Huang LM. Seroepidemiological study of measles after the 1992 nationwide MMR revaccination program in Taiwan. Journal of Medical Virology. 1997 Jan;51(1):32-5.
8. Cogill B. Anthropometric indicators measurement guide. Revised 2003.
9. Mason WJ. Measles. Kliegman RM, Stanton BF, Geme JW, Schor NF, Behrman RE. Nelson Textbook of Pediatrics. 19th ed. Philadelphia: Elsevier; 2011; 1069-1075.
10. Park K. Textbook of preventive and social medicine. 22nd ed. Jabalpur: Bhanot; 2013; 138-141.
11. WHO Fact Sheet No.286. 2006.
12. WHO (2012), Weekly Epidemiological Record, No.5, 2012
13. WHO. Global Measles and Rubella. Strategic Plan 2012-2015.
14. John TJ, Choudhury P. Acclerating Measles Control in India: Opportunity and Obligation to Act Now. Indian Pediatr2009; 46:939-943.
15. McMurray DN, Rey H, Casazza LJ, Watson RR. Effect of moderate malnutrition on concentrations of immunoglobulins and enzymes in tears and saliva of young Colombian children. The American journal of clinical nutrition. 1977 Dec 1;30(12):1944-8.
16. Smedman L, Silva MC, Gunnlaugsson G, Norrby E, Zetterstrom R. Augmented antibody response to live attenuated measles vaccine in children with Plasmodium falciparum parasitaemia. Annals of tropical paediatrics. 1986 Jun; 6(2):149-53.

17. Halsey NA, Boulos R, Mode F, Andre J, Bowman L, Yaeger RG, Toureau S, Rohde J, Boulos C. Response to measles vaccine in Haitian infants 6 to 12 months old: influence of maternal antibodies, malnutrition, and concurrent illnesses. New England journal of medicine. 1985 Aug 29;313(9):544-9.
18. Ekunwe EO. Malnutrition and seroconversion following measles immunization. Journal of tropical pediatrics. 1985 Dec 1;31(6):290-1.
19. Lyamuya EF, Matee MI, Aaby P, Scheutz F. Serum levels of measles IgG antibody activity in children under 5 years in Dar-es-Salaam, Tanzania. Annals of Tropical Paediatrics: International Child Health. 1999 Jun 1;19(2): 175-83.
20. Bhaskaram P, Madhusudhan J, Radhakrishna KV, Reddy V. Immune response in malnourished children with measles. Journal of tropical pediatrics. 1986 Jun 1;32(3):123-6. 15.
21. Powell GM. Response to live attenuated measles vaccine in children with severe kwashiorkor. Annals of tropical paediatrics. 1982 Sep;2(3):143-5.
22. Waibale P, Bowlin SJ, Mortimer EA, Whalen C. The effect of human immunodeficiency virus-1 infection
23. and stunting on measles immunoglobulin-G levels in children vaccinated against measles in Uganda. International journal of epidemiology. 1999 Apr 1;28(2):341-6.
24. Idris S, El Seed AM. Measles vaccination in severely malnourished Sudanese children. Annals of tropical paediatrics. 1983 Jun;3(2): 63-7.
25. Hafez M, Aref GH, Mehareb SW, Kassem AS, El-Tahhan H, Rizk Z, Mahfouz R, Saad K. Antibody production and complement system in protein energy malnutrition. The Journal of tropical medicine and hygiene. 1977 Feb;80 (2):36-9.