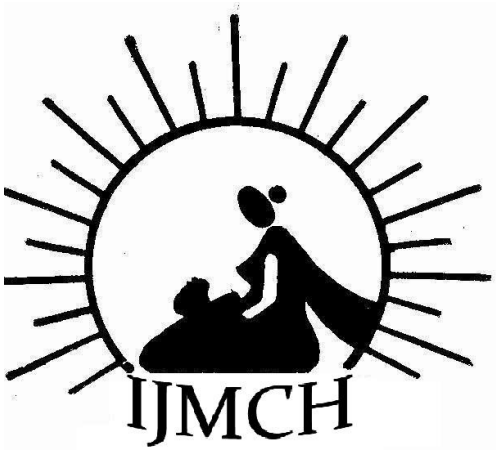
Volume 15 (1), 2013

Reciprocity between partial immunization and malnutrition significantly impairs health of preschool children

Ankita Ray
Nirmalya K. Sinha
Smarajit Maiti
Samir K. Roy
Kartik Maiti

www.ijmch.org



INDIAN JOURNAL OF MATERNAL AND CHILD HEALTH

What is the health status of partially immunized preschool children?

Reciprocity between partial immunization and malnutrition significantly impairs health of preschool children

Ankita Ray[1], Nirmalya K. Sinha[2], Smarajit Maiti[3,4*], Samir K. Roy[5], Kartik Maiti[6]

[1]Bandwan NRC, BPHC, Purulia, Pin 723129.
[2]Dept. of Nutrition, Raja N.L. Khan Women's College, Midnapore, 721102.
[3]Dept. of Biochemistry, Oriental Institute of Science & Technology, Midnapore, 721102, West Bengal, India.
[4]Founder and Secretary, Agricure Biotech Research Society, Mahatabpur, Midnapore, 721101, WB, India
[5]Residential Medical Officer & Clinical Tutor, Dept. of Pediatrics, Bankura Sammilani Medical College.
[6]Dept. of Zoology, Raja N.L. Khan Women's College, Midnapore, 721102.

***Correspondence Author:**

Dr. Smarajit Maiti, Reader and Head, Post Graduate Dept. of Biochemistry, Cell & Molecular Therapeutics Lab, Faculty, Dept of Biotechnology, OIST, Vidyasagar University, Midnapore
Email: maitism@rediffmail.com

Abstract

Research question
What is the health status of partially immunized preschool children?
Setting
This study was done in rural part of Midnapore District and associated Jungle-Mahal area, West Bengal.
Design
Six month community based cross-sectional study
Participants
Sixty (60) preschool rural children were selected randomly
Methodology
Evaluation of immunization status and nutritional assessment by standard questioner method and Kuppuswami's socioeconomic status scale. Anthropometric measurement was done to evaluate thinness, stunting and wasting. Statistic was done with Version 10.0, SPSS.
Results
The partial immunization (PI) rates are higher in girl than boys (55.17% vs. 45.16%) and body mass index is better in fully-immunized children of either sex (girls 14.04 vs. 13.18 and boys 14.54 vs. 13.31, $p<0.05$). The grade II/ III thinness, stunting, wasting and underweight are common in PI group but mild thinness as observed in fully immunized group indicates other factorial influences also. Partial immunization and malnourishment exhibits significant adverse and synergistic effects on children's health.
Keywords: *Partial immunization; undernutrition; stunting; wasting; preschool children; India*

Introduction

Immunization practice is associated with health status of children. It protects children from infectious and other diseases globally.[1] In last several decades, immunization has resulted in a significant reduction in children's morbidity and mortality in India.[2] In developed countries, immunization practice have been implicated to almost hundred percent of the children. Though efforts have been made from several directions i.e. international organizations (WHO, Red Cross society, UNICEF), respective countries and several non government organizations (NGOs) still, basic immunization coverage is unsatisfactory in developing countries. Approximately, 30/130 million children are not covered by full immunization every year. In 1985, the Government of India (GOI) laid earlier Expanded Programme on immunization (EPI) was modified to Universal Immunization Programme (UIP) aiming for application of six vaccines i.e. diphtheria, pertussis, tetanus, polio, measles and childhood tuberculosis [3] and increasing the target of immunization coverage from 80 to 100%.[4] But the current scenario suggests that only 44% of infants in India are fully immunized.[5]

It is estimated that more than 10 million children in India do not receive Bacillus Calmette Guérin (BCG), 3 doses of Oral polio vaccine (OPV) and diphtheria, pertussis (whooping cough) tetanus (DPT), and measles vaccine during their first year of life and more than 3 million of these do not receive any immunizations at all.[6] It is reported that the neonatal, postnatal and child mortality rate is higher in partially immunized children than the fully immunized children.[1] Every year, globally 3 million premature deaths are attributable to inadequate vaccine coverage.[7] On the other hand, reports reveal that one of the most common causes of child malnutrition is their poor immunization status.[8] Lower socioeconomic status, inadequate health beneficiaries, illiteracy, lack of health awareness, gender inequities, environmental pollutions are the other common causes of childhood malnutrition. The under-nutrition impairs physical, mental and cognitive performance. Stunted and wasted women are likely to have obstetric complications, poor pregnancy and impaired post birth outcome.[9] Low socioeconomic condition and undernutrition also decrease resistance against environmental stress, pollution and toxicity.[10]

In the present investigation, interactive role of partial-immunization and malnutrition has been studied in children of one Indian town. To best of our knowledge, there have been very scanty reports on this influence in children of this area.

Method

Study location and participants

The study was undertaken in the district town Midnapore and nearby areas of Paschim Medinipur District (22.25°N 87.65°E), West Bengal, India. Midnapore is 23 meters above the sea-level and 127 km away from Kolkata. In the 2011 census, Midnapore municipality had a population of 169,127, out of which 85,362 were males. The 0–6 year's population was 14,365. Effective literacy rate for the 7+ population was 90.01%.[11] Midnapore is a drought prone coastal area with high humidity. The northwest part of the down town is locally named as 'Jungle-mahal' covered with a large belt of green forests and some natural wetland.

The research topic has been approved by a suitably constituted Institutional Ethics Committee. The procedures followed in this study were in accordance with the Helsinki

Declaration. The study population comprises of 60 preschool children (3-5 years, boys 29) from low socioeconomic status assessed by updated Kuppuswami's socioeconomic status scale.[12]

Study design

The present study is a community based cross-sectional type and conducted during the time period of February 2011 to July 2011. The standard questionnaire was based on demographic information, anthropometric data and personal hygiene. Each child was identified by name, age, sex. The date of birth was obtained from the birth certificates.

Anthropometric Measurement

The height and weight measurements were recorded to the nearest 0.1 cm and 0.1 kg respectively.[13] Body Mass Index (BMI) of children was calculated according to 'Quetelets' Index and computed using the following standard equation: BMI = Weight (kg) / height (m^2).

Nutritional status was evaluated using the age and sex specific cut-off points of BMI (Table 1).[14,15] Average thinness value for 3, 4, or 5 years children was calculated and denoted as BMI graded in III, II, I (severe, moderate and mild, respectively).[15]

Proof of immunization

Immunization status of children was assessed with the dates mentioned in their immunization cards. Few earlier investigation was conducted on 12-23 month aged immunized children.[5] In present study, we have chosen the children of age group 3-5 years. To best of our knowledge it is the first study with this age group. This apparently large time period (3-5 years) of children is sufficient for interacting with the surroundings and environment. This time period is also adequate for exposure to the socio economic/ demographic characteristics and other risk factors (natural foods instead of breast milk/ formula foods etc.) as well. So, the interactive role of immunization, natural nutrition and adaptability can be better evaluated from the present study design. Those who had missed any one or more dose of six primary vaccines [3] are considered as partially immunized in the present study.[16]

Statistical analyses

Data processing and statistical analyses were done using the SPSS for Windows statistical software package (Version 10.0, SPSS Inc., Chicago, IL, USA, 2001). Descriptive statistics were used for all the variables studied. The p value ≤0.05 was considered statistically significant.

Results and Discussion

There is an impending risk of outbreak of vaccine-preventable diseases due to increasing unplanned urbanization, migration, slum proliferation, continuous influx of a new pool of vector/ infective agents and poor coverage of primary immunization.[17] In the present study, overall 50.0% children are fully immunized (Table 2) which is lower than the report of UNICEF survey of 2009 in India (61%), NFHS-3 report for Urban Children in India (57.6%) and West Bengal (64.3%).[3,5]

The study also found that all of these children were born in hospital with 100% first scheduled immunization. But the adherence rate of next vaccination was found to be less due to lack of health consciousness and inadequate awareness programme and fear from

side effects.[18,19,20] An 100% coverage of pulse polio immunization is encouraging though.[17] In the present study, the percentage of fully immunized boys and girls were 55.17 and 45.16 respectively which is in line of the previous reports.[17,18] The mean weight, height and BMI of the participants are presented in Table 2. There was a significant difference among the fully and partially immunized boys and girls in terms of BMI and concerned parameters. Thus, the fully immunized boys and girls were heavier and taller and represent a better BMI than partially immunized group.

The overall prevalence of thinness is 65.0% which is higher than earlier reports.[21] On the other hand, some of the studies show that almost similar prevalence of under-nutrition.[22] Beside underprivileged status, few more causes for childhood undernutrition are the occurrence of malaria, filaria, chronic digestive disorders, diarrhea and other tropical diseases.[23] Pulmonary tuberculosis is also of great concern in this respect.[24] In addition, in developing countries, hookworm infestation is a major cause of iron deficiency anemia and malnutrition, growth delay.[25] One brief investigation suggests that low household income, parental illiteracy, early or late weaning and failure to BCG vaccination were significantly associated with severe protein energy malnutrition.[26]

The fact revealed in this study is that though the fully immunization were predominant among boys but the prevalence of thinness were similar in boys (65.52%) and girls (64.52%). This study also revealed that severe undernutrition i.e., grade III thinness were more common among girls (38.71%) than boys (17.24%) though grade II thinness were more in boys. The prevalence of thinness among the partially immunized boys and girls were 84.62% and 70.59% respectively and among fully immunized boys and girls it is 50.00% and 57.14%. One interesting experiment indicates that *Mycobacterium bovis* BCG vaccine fails to protect protein-deficient guinea pigs against respiratory challenge with virulent Mycobacterium tuberculosis suggesting the pre-requirement of nutrition.[27] It is regarded in some communities that child immunization and nutrition may compensate each other in a condition if one is skipped which has been proven wrong.[28] In this regard, it is suggested that expanded program is needed to identify and reach children who are missed by childhood immunizations.

To make decisive idea, more in-depth analysis is required to explain the interaction of infection/re-infection, immunization and undernutrition. Susceptibility to infection and re-infection has been evaluated by mathematical model in some vaccinated group of individuals.[29] From epidemiological perspective, the threshold level of pathogen burden has been shown to remain in a dynamic state in some sensitive community. This emphasizes that above the re-infection threshold, rates/ levels of infection are high, and vaccination fails to protect indicating the occurrence of recurrent infections in high-burden communities specially who are underprivileged.[29] This finding justifies our present results that, fully immunized individuals may also be susceptible to a specific pathogen burden due to the dynamic nature of infection threshold level. The interactive outcome of undernutrition and infection-threshold dynamism may also be important. Age-dependency of the individuals in acquired infection, and the implications of genetic variability in susceptibility to infection have also been taken into account.[30]

Conclusion

In a nut shell, the present result suggests that in either sex fully immunized children are significantly healthier in terms of their nutritional status. As because participants were randomly selected in low socioeconomic group, it can be concluded that immunization has an influence on nutrition and health outcome. Presently, a significant initiation has been taken from several levels to upgrade the nutrition /health status of the children and increase their immunization rates in the studied areas and other places as well. The understanding of how several factors attributing to health status in the studied group, vary by geography, socio-demographic and economic profiles will make it easier to design global interventions that are more integrative and effective.

Acknowledgements

All authors sincerely acknowledge the cooperation from respondents and their guardians. Authors also wish a quality and long life to all children.

References

[1] Mondal Md. Nazrul Islam, Hossain Md. Kamal, Ali Md. Korban. Factors Influencing Infant and Child Mortality: A Case Study of Rajshahi District, Banglades. J Hum Eco, 2009; 26: 31–39.

[2] Giri D, Zachariah S, Thomas D. Five year screening on occurrence of vaccine-preventable diseases in rural Anantapur. Indian Journal of Pharmacy Practice, 2012; 5: 57–60.

[3] Lal S, Adarsh, Pankaj. 3rd ed. Textbook of Community Medicine Preventive and Social Medicine. CBS Publishers & Distributors Pvt. Ltd., New Delhi, India, 2011

[4] Sunil K, Nithya GJ, Nilima KA. Efficacy and Safety of Vaccines in Indian Children: a Review. Paediatr Perinat Drug Ther, 2002; 5: 124–134.

[5] International Institute for Population Sciences (IIPS) & Macro International. National Family Health Survey (NFHS-3), 2005–06: India. (Volume I). Mumbai, India: International Institute for Population Sciences 2007

[6] UNICEF Coverage Evaluation Survey. All India Report. New Delhi [DB/OL]: UNICEF 2009.

[7] Global Alliance for Vaccines and Immunization (GAVI). Immunize Every Child: GAVI Strategy for Sustainable Immunization Services: Global Alliance for Vaccines and Immunization [DB/OL]. Geneva, Switzerland 2003.

[8] Rao S, Joshi SB, Kelkar RS. Changes in nutritional status and morbidity over time among preschool children from slums in Pune, India. Indian Pediatr, 2000; 37: 1060–1071.

[9] Alderman H, Hoddinott J, Kinsey B Long-term consequences of early childhood malnutrition. Food Consumption and Nutrition Division Discussion Paper [M]. International Food Policy Research Institute, Washington DC, 2003

[10] Maiti S, Chattopadhyay S, Deb B, Samanta T, Maji G, Pan B, et. al. Antioxidant and metabolic impairment result in DNA damage in arsenic-exposed individuals with severe dermatological manifestations in Eastern India. Environ Toxicol, 2012; 27: 342-350.

[11] "Urban Agglomerations/Cities having population 1 lakh and above". Provisional Population Totals, Census of India 2011 [DB/OL]. http://www.censusindia.gov.in/2011-prov-results/paper2/data_files/India2/Table_3_PR_UA_Citiees_1Lakh_and_Above.pdf. Retrieved 2011-10-21.

[12] Kumar N, Shekhar C, Kumar P, Kundu AS. Kuppuswamy's Socioeconomic Status Scale-Updating for 2007. Indian J Pediatr, 2007; 74: 1131–1132.

[13] Lee RD, Nieman DC. 3rd ed. Nutritional assessment [M]. McGraw Hill, New York, 2003
[14] Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity: international survey. Br Med J, 2000; 320: 1240–1243.
[15] Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut-offs to define thinness in children and adolescents: international survey. Br Med J, 2007; 335: 194.
[16] Punith K, Lalitha K, Suman G, Pradeep BS, Jayanth KK. Evaluation of Primary immunization coverage of infants under universal immunization programme in an urban area of Bangalore city using cluster sampling and Lot quality assurance sampling techniques. Indian J Comm Med, 2008; 33: 151–155.
[17] Kumar D, Aggarwal A, Gomber S. Immunization Status of Children Admitted to a Tertiary-care Hospital of North India: Reasons for Partial Immunization or Non-immunization. Journal of Health, Population and Nutrition, 2010; 28: 300–304.
[18] Chaudhary V, Kumar R, Agarwal VK, Joshi HS, Sharma M. Evaluation of Primary immunization coverage in an urban area of Bareilly city using Cluster Sampling Technique. National Journal of Integrated Research in Medicine, 2010; 1: 10–15.
[19] Yadav S, Mangal S, Padhiyar N, Mehta JP, Yadav BS. Evaluation of Immunization coverage in urban slums of Jamnagar city. Indian J Comm Med, 2006; 31: 300–302.
[20] Chaturvedi M, Nandan D, Gupta SC. Rapid assessment of immunization practices in Agra district. Indian J Public Health, 2007; 51: 132–134.
[21] Biswas S, Bose K, Bisai S, Chakraborty R. Prevalence of Thinness among Rural Bengalee Pre-school Children in Chapra, Nadia District, West Bengal, India. Malays. J Nutr, 2009; 15: 155–164.
[22] Das S, Bose K. Anthropometric Characteristics and Nutritional Status of Bauri Pre-School Children of Nituria Block, Purulia, West Bengal. The Internet Journal of Biological Anthropology 2009; 3(2).
[23] Sousa-Figueiredo JC, Gamboa D, Pedro JM, Fançony C, Langa AJ, Magalhães RJ, et. al. Epidemiology of malaria, schistosomiasis, geohelminths, anemia and malnutrition in the context of a demographic surveillance system in northern Angola. PLoS One, 2012; 7:e33189.
[24] Maiti S, Patra S, Nandi D, Bandyopadhyay B, Mondal KC, Pati BR. Tuberculosis: studies on role of gender, age and drug addiction in eastern part of India. SAARC J Tuber Lung Dis HIV/AIDS, 2010; 7: 1–9.
[25] Chu D, Bungiro RD, Ibanez M, Harrison LM, Campodonico E, Jones BF, Mieszczanek J, Kuzmic P, Cappello M. Molecular characterization of Ancylostoma ceylanicum Kunitz-type serine protease inhibitor: evidence for a role in hookworm-associated growth delay. Infect Immun, 2004; 72: 2214–2221.
[26] Iqbal Hossain M, Yasmin R, Kabr I. Nutritional and mmunization status, weaning practices and socio-economic conditions of under five children in three villages of Bangladesh. Indian J Public Health, 1999; 43: 37–41.
[27] McMurray DN, Carlomagno MA, Mintzer CL, Tetzlaff CL. Mycobacterium bovis BCG vaccine fails to protect protein-deficient guinea pigs against respiratory challenge with virulent Mycobacterium tuberculosis. Infect Immun, 1985; 50: 555-559.
[28] Semba RD, de Pee S, Berger SG, Martini E, Ricks MO, Bloem MW. Malnutrition and infectious disease morbidity among children missed by the childhood immunization program in Indonesia. Southeast Asian J Trop Med Public Health, 2007; 38: 120–129.

[29] Gomes MG, White LJ, Medley GF. Infection, reinfection, and vaccination under suboptimal immune protection: epidemiological perspectives. J Theor Biol, 2004; 228: 539–549.

[30] Anderson RM, May RM. Age-related changes in the rate of disease transmission: implications for the design of vaccination programmes. J Hyg (Lond), 1985; 94: 365–436.

Table 1. Age and sex specific international body mass index cutoff points for the assessment of nutritional status among children

Age (Years)	Boys					Girls				
	Thinness			Normal	Overweight	Thinness			Normal	Overweight
	III	II	I			III	II	I		
3	13.09	13.79	14.74	14.74-17.89	17.89	12.98	13.60	14.47	14.47-17.56	17.56
4	12.86	13.52	14.43	14.43-17.55	17.55	12.73	13.34	14.19	14.19-17.28	17.28
5	12.66	13.31	14.21	14.21-17.42	17.42	12.50	13.09	13.94	13.94-17.15	17.15

Table 2. Impact of immunization of the anthropometric indices.

Anthropometric Indices	Girls		Boys	
	Fully Immunized	Partially Immunized	Fully Immunized	Partially Immunized
	N=14 (45.16%)	N=17 (54.84%)	N=16 (55.17%)	N=13 (44.83%)
Weight (Kg)	13.58±0.41**	11.39±0.54	14.76±0.53***	11.26±0.47
Height (cm)	98.11±1.00*	92.72±1.63	100.54±1.53***	91.72±1.59
BMI (Kg/m^2)	14.04±0.40*	13.18±0.42	14.54±0.24*	13.31±0.41

Data are represented as mean±standard error.

*P<0.05, **P<0.01, ***P<0.001

Table 3. Prevalence of Thinness among urban slums

BMI classification	Boys			Girls		
	Fully immunized	Partially immunized	Total	Fully immunized	Partially immunized	Total
Normal	8(50.00)	2(15.38)	10 (34.48%)	6(42.86)	5 (29.41)	11 (35.48%)
Grade I Thinness	6(37.50)	2(15.38)	8 (27.59%)	4(28.57)	2(11.76)	6 (19.35%)
Grade II Thinness	1(6.25)	5(38.46)	6 (20.69%)	2(14.29)	0(0)	2 (6.45%)
Grade III Thinness	1(6.25)	4(30.77)	5 (17.24%)	2(14.29)	10(58.82)	12 (38.71%)
Total	16(100)	13(100)	29 (100)	14(100)	17(100)	31 (100%)

Data are represented as number (percentage)

Table 4. Distribution of children according to z-score

Sex	Z-score	Underweight		Stunting		Wasting	
		Fully Immunized	Partially Immunized	Fully Immunized	Partially immunized	Fully Immunized	Partially immunized
Girls	<-3	1 (7.14)	9 (52.94)	0 (0.00)	2 (11.76)	1 (7.14)	4 (23.53)
	-2 to -3	1 (7.14)	2 (11.76)	1 (7.14)	5 (29.41)	1 (7.14)	6 (35.29)
	Moderate to severe	2 (14.28)	11 (64.70)	1 (7.14)	7 (41.17)	2 (14.28)	10 (58.82)
	-2 to-1	6 (42.86)	5 (29.41)	4 (28.57)	7 (41.18)	6 (42.86)	3 (17.65)
	-1 to 0	4 (28.57)	1 (5.88)	4 (28.57)	3 (17.65)	3 (21.43)	2 (11.76)
	>0	2 (14.29)	0 (0.00)	5 (35.71)	0 (0.00)	3 (21.43)	2 (11.76)
	Total	14 (100)	17 (100)	14 (100)	17 (100)	14 (100)	17 (100)
Boys	<-3	0 (0.00)	7 (53.85)	0 (0.00)	5 (38.46)	0 (0.00)	2 (15.38)
	-2 to -3	1 (6.25)	5 (38.46)	0 (0.00)	3 (23.08)	1 (6.25)	6 (46.15)
	Moderate to severe	1 (6.25)	12 (92.31)	0 (0.00)	8 (61.54)	1 (6.25)	8 (61.53)
	-2 to-1	7 (43.75)	1 (7.69)	4 (25.00)	4 (30.77)	5 (31.25)	3 (23.08)
	-1 to 0	8 (50.00)	0 (0.00)	10 (62.50)	0 (0.00)	8 (50.00)	2 (15.38)
	>0	0 (0.00)	0 (0.00)	2 (12.50)	1 (7.69)	2 (12.50)	0 (0.00)
	Total	16 (100)	13 (100)	16 (100)	13 (100)	16 (100)	13 (100)

Data are represented as number (percentage)