MASTER OF PUBLIC HEALTH

Johns Hopkins Bloomberg School of Public Health & IIHMR University

PRACTICUM REPORT

By

Rachit Sharma

Cohort-5

2017-19

Under the Guidance of

Dr. Goutam Sadhu (Practicum Preceptor)

Dean & Professor- School of Developmental Studies

IIHMR University, Jaipur

&

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Associate Professor

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Rachit Sharma**, student of Master of Public Health Program offered by IIHMR University, Jaipur in cooperation with Johns Hopkins Bloomberg School of Public Health, Baltimore has undergone Practicum Training at **IIHMR University, Jaipur** from **October 15, 2018 to December 15, 2018.**

The Candidate has successfully carried out the study designated to him during practicum training and her approach to the study has been sincere, scientific and analytical.

The Practicum Training is in fulfillment of the course requirements.
I wish him success in all his future endeavors.

Dr. Monika Chaudhary
Associate Professor
IIHMR University, Jaipur

CERTIFICATE BY SCHOLAR

This is to certify that the Practicum Project titled submitted by me, **Rachit Sharma** (Enrollment No. IIHMR-U/07/2017-2019/0032) under the supervision of **Dr. Gautam Sadhu** for award of **Master of Public Health** carried out during the period **October 15, 2018 to December 15, 2018,** embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Rachit Sharma

MPH Cohort 5 (2017-19)

JHSPH & IIHMR University

INSTITUTE OF HEALTH
MANAGEMENT RESEARCH
(WHO Collaborating Centre for District Health System Based on Primary Health Care)

IIHMR UNIVERSITY

Date: April 17, 2019

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Dr. Rachit Sharma** IIHMR-U/07/2017-2019/0032 is a student of Master of Public Health Program offered by IIHMR University, Jaipur in cooperation with the Johns Hopkins Bloomberg School of Public Health, USA. He has undergone practicum training under "A study on assessment of nutritional status and formulation of evidence-based and actionable dietary advice for the children (6-23 Months) in Baran, Bhilwara and Udaipur district of Rajasthan" conducted by IIHMR University sponsored by IPE Global. His assignment in the project was from **15/10/2018 to 15/12/2018**.

Dr. Rachit has successfully carried out the statistical analysis of the above study designated to him during practicum training under the guidance of Dr. Goutam Sadhu, Professor, SDS, IIHMR University.

Lastly, through his integrity and resilience during the project, he has proven himself as a valuable researcher and public health leader. A person like Dr. Rachit Sharma would be a great asset for any institution he will join in future.

I wish him a prosperous academic and professional journey.

Dr. Goutam Sadhu
Professor- School of Developmental Studies

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Table of Contents

Introduction

India continues to grapple with its ever existent and ever challenging public health problem of malnutrition amongst children, especially those aged under-five years. In 2018, out of the 119 nations ranked on the basis of Global Hunger Index,[1] which takes into consideration four indicators- proportion of undernourished population, child wasting, child stunting, and child mortality, India stood at the rank 103. As per India's latest, fourth round of National Family Health Survey (2015-2016),[2] 21 percent of children under the age of five were wasted (that is, too thin for their height, reflecting acute undernutrition); 38 percent were stunted (that is, too short for their age, reflecting chronic malnutrition); while 36 percent were underweight.

Complementary feeding is recommended from mid-infancy (6 months onwards) to two years of age, along with breast milk. Such dietary practices provide for optimal early child nutrition and development, and any deviation from the same might lead to malnutrition.[3] Indeed, the data from NFHS 4 shows that, in India, only about 40 percent of children below three years were breastfed within an hour of birth, 55 percent of under-five children were exclusively breastfed, and a meagre 8.7 percent of breastfeeding children aged 6 to 23 months received adequate complementary diets.[2]

Rajasthan state level NFHS-4 report,[4] comparing under-five children's nutritional status with that of the findings of NFHS-3 (2005-06), describes that despite improvements in stunting (from 44% in 2005-06 to 39% in 2015-16) and underweight (from 40% in 2005-06 to 37% in 2015-16), child malnutrition continues to remain a major public health problem in the state. Moreover, the prevalence of wasting in under-five children rather increased from 20% to 23% over the same ten-year period. Furthermore, in Rajasthan, around 72 percent of children under the age of 3 years were not breastfed within one hour of birth due to different reasons leaving them under the threat of malnutrition.

Age-appropriate diets that provide a right mix of essential macro- and micro-nutrients can lay the early foundation of optimal physical and cognitive development among children, and together with required levels of physical activity, can reduce the risk of several diseases in later stages of life.[5] Given the importance of adequate nutrition for the first two years after birth,

the effects of poor feeding practices and intake deficiencies are long-lasting, and it is often hard to recover from undernourishment, even at the later stages of life.

While nationally representative National Family Health Survey shows high rates of childhood undernourishment and micronutrient deficiencies, very little is known about the nature, type and composition of *region-specific diets* of Indian children, especially those aged 6 to 23 months. Moreover, region- specific socio- demographic, cultural, economic and developmental factors that may directly or indirectly influence nutrition intake in children remain unexplored in many geographical regions. Such region- specific findings can prove instrumental in contextualizing public health interventions, aiming to improve nutritional status amongst children, potentially leading to greater impact at low cost.

Practicum Project Brief

IIHMR University, Jaipur, with the support from IPE Global Limited, conducted a study in Rajasthan, from August to December 2018, entitled, 'Assessment of Nutritional Status and Formulation of Evidence-Based and Actionable Dietary Advice for the Children (6-23 Months) in Baran, Bhilwara and Udaipur Districts of Rajasthan'.

As a Research Intern at IIHMR University, Jaipur, I was engaged in the project, for the duration of two months (15th October to 15th December 2018) and my practicum activity was be directly supervised by Dr. Goutam Sadhu, Professor and Dean (School of Developmental Studies, IIHMR, Jaipur), who was the Principal Investigator of this study.

The broad objectives of the study were:

1. To assess the anthropometry based nutritional status of the children (aged 6-23 months) in selected blocks of three districts of Rajasthan.

2. To identify nutrient gaps based on the dietary practices of children (6-23-monts) in selected three districts.

3. To study the locally available food items used for complementary feeding for children in the selected districts.

4. To select food-based recommendations (FBRs), ensuring adequacy for the maximum number of nutrients (m-FBRs) for the children; and identify realistic and specific dietary advice/ recommendations to address the identified nutrient gaps.

Practicum Learning Objectives and Responsibilities

By engaging in this study, I intended to enhance the following five of the core public health competencies:

1. **Analytical skills-** by critically analysing the nutritional status and identifying the key socio-demographic and developmental determinants of undernutrition and nutrient intake in the study population, by performing review of literature and analysing primary data generated through research activities under the project.

2. **Public Health Science skills-** by using an array of statistical tools and methods applying to analyse information and produce results on nutritional status, dietary practices, and nutrient intakes and gaps in the study population.

3. **Program Planning skills-** by developing evidence-based policy recommendations to address the identified nutrient gaps in the study population.

4. **Communication Skills-** by participating in key stakeholder consultations and preparing scientific for wider dissemination of the research findings.

5. **Public Health Advocacy and Leadership Skills-** by preparing and presenting preliminary research findings to key stakeholders to influence new initiatives to improve nutritional status of the study population.

My specific tasks and responsibilities under the project were:

1. To assess and determine the anthropometry- based nutritional status of children enrolled in the study, using WHO Anthro and SPSS statistical software.

2. To determine the dietary practices and patterns of intake of children, using WHO Opti food software.

3. To identify the nutrient gaps based on the collected 24 hour-recall dietary data.
4. To identify the socio-demographic, cultural, economic and developmental factors that might be significantly associated with the findings of undernutrition status and nutrient gaps of the children, using SPSS software.

5. To assist in selection of most suitable food-based recommendations (FBRs) to address the identified nutrient gaps.

6. To assist in preparation of the Project Report and dissemination of the same to respective key stakeholders at IPE Global, State Government of Rajasthan, communities from the studied districts, and IIHMR University.

Practicum Project Details

A. Study Material and Methods

Study Setting

Rajasthan, in all has 33 districts.[6] After stratifying the districts according to different agro-climatic zones, district Udaipur and Bhilwara from sub-humid southern plains and district Baran from humid south-eastern plain were selected to understand the spatial variability in food consumption and availability in these zones. A random sampling procedure was adopted for selection of zones and districts.

Study Design

Three stage sampling method was adopted. Three districts were randomly selected form total districts of Rajasthan and from each selected district, four rural blocks/urban slums based on

systematic random sampling was enrolled for the study. In later stage, for each selected block, ten villages/urban slums (PSUs) were selected. From each PSU, 6 children in the age group of 6-11 months and 12 children from the age group of 12-23 months based on systematic random sampling were enrolled for the study. It was done using the socio-demographic information available with ASHA and Anganwadi workers in the respective PSUs. Thus, from every district, a sample of 720 respondents comprising two groups of children's mothers, using 24 hours recall method were interviewed. And the total sample size for the study was 2160, for all three selected districts considered together.

Sampling Procedure

To determine the sample size, the single population proportion formula was used. The sample size of the study was determined taking into the consideration- 95% confidence interval, 5% margin of error, and 23.3 % prevalence of child undernutrition in Rajasthan from NFHS-4. Based on the prevalence, sample size calculation was done and estimate 716 ≅ 720 sample size was considered for the study in each district.

Study Tools

Three research tools were developed, keeping in focus the following aspects. The tools were pretested before final data collection:

1. **Socio-demographic and economic indicators of the respondents' households:** Information on the family composition of households including age, religion, caste, occupation, and income was elicited through this tool. Information on assets, financial security etc. was also covered.

2. **Child feeding practices:** Information on infant and young child feeding practices were elicited from the mothers of children included in the study, using food frequency method and 24-hour dietary recall method.

3. **Knowledge, attitude, and practices (KAP) pertaining to nutrition, feeding and dietary practices:** KAP about nutrition and dietary practices of children had been

covered in this section. Questions about cultural dietary practices and beliefs months were also asked.

Anthropometric Measurements

Anthropometric data was collected by measuring length and weight of all children included in the study. Weight was measured with minimum clothing and using a standard weighing scale. Kilogram had been the unit of measurement and values were considered to the nearest value of 0.1 kg. Firstly, the weight of the mother and the child was collectively measured on the weighing scale and then for the mother alone. The value of the weight of the child was finally obtained by subtracting the mother's weight from the cumulative weight of the mother and child combined. Length was measured with the child in a recumbent position, from head to toe and using a standard measuring tape. The unit of measurement for height was centimetres and height values were recorded to the nearest 0.1cms.

Dietary Assessment Methods

Dietary data was collected using an interviewer-administered food frequency questionnaire (FFQ) and a multiplier (i.e. two) pass 24-hour recall. The list of foods in the FFQ included all foods reported in the 24-hour recalls. For the FFQ, interviewers asked mothers about the number of times per week and the number of times per day each food was consumed by their child during the previous day. The type of food consumed, quantity of ingredients, total volume cooked and served, leftovers were also measured using the 24-hour recall form. The 24 hrs recall was done twice from the same households within the next 10 days of first 24 hrs recall survey.

In the first recall, interviewers asked mothers to recall all food and beverages consumed by their child on the previous day of the interview visit, starting from the first item the child consumed when they woke up in the morning and ending with the last item, they consumed till they went to sleep in the evening. The time and place of consumption had also been recorded. In the second recall, interviewers probed for any additions to foods consumed by children and also asked mothers to estimate the amount of each food or beverage their child consumed by

showing the total volume, in water, of the item in the measuring utensil used to feed the child and the volume leftover. The volume consumed by the child was recorded.

B. Data Analysis

Anthropometric Data Analysis

For anthropometric analysis, six different age categories were created. Category C1 included children belonging to the age group of 6-8 months, Category C2 comprised children of aged 9-11 months, C3 comprised children aged 12-14 months, C4 contained those aged 15-17 months, C5 comprised children of 18-20 months age and C6 involved of children 21-23 months. Age regarding completed months was considered, and it was calculated considering the birth date of the child and the survey date.

WHO Anthro version 3.2.2 software was used for the anthropometric analysis; inputs were made in the software for the parameters of Survey Date, Cluster, ID, Household, Gender, Date of Birth, and anthropometric measures- weight (in Kg), height/length (in cm) and age (in months).

Using the WHO Anthro, the Z-scores of the anthropometric indices of Wasting, Stunting, and Underweight, were respectively obtained as Weight-for-Height (WHZ), Height-for-Age (HAZ) and Weight-for-Age (WAZ). The WHO Child Growth Standards (2006) were considered as a reference. The anthropometric index of wasting was defined as per the tool as a low weight-for-height Z-score (WHZ), with WHZ values below -2SD of the reference population indicating wasting, while below −3SD meaning severe wasting. Stunting was defined as a low height-for-age Z-score (HAZ), with values below -2SD, indicating stunting while those falling below -3SD indicating severe stunting. Similarly, underweight was defined as having weight-for-age Z-score (WAZ) value below -2SD as underweight and the values below or -3SD as severely underweight.

The analysis using the software was performed for the entire population of 2160 children firstly, and then district-wise analysis of the children belonging to each of the three districts (720 sample size per district) was also performed, and results were obtained and interpreted.

Socio- demographic and 24- Hour Recall Data Analysis

Based on the research tools, a data entry structure was developed using the CsPro 6.1 software. All socio- demographic and food frequency data was entered in CsPro and later transferred to SPSS and MS Access. The data for 24-hour recall was standardized to get raw food items used in preparing the dishes consumed by the child, which was entered into WHO Optifood software. The information on intake quantity and their nutritive values were also saved according to UIDs of the child in MS Access and later converted and merged in data of WHO Opti food software for further analysis.

Statistical Analysis

To determine the determinants that might be significantly associated with insufficient nutrient intake and anthropometric outcomes of wasting, stunting and underweight in the three study districts, distinct statistical tests were performed.

After an extensive literature review, a total of 25 independent variables were considered for the statistical analysis; the information of which were collected using the questionnaire during household visits was selected for measuring the association with the nutrient and anthropometric outcomes (dependent variables).

Different variables considered for the analysis were:

1. type of area (rural or urban)
2. family size,
3. type of family (joint, nuclear, extended nuclear)
4. religion
5. caste
6. possession of agriculture land
7. main sources of income
8. average monthly expenditure
9. number of children in household
10. birth weight of the child
11. immunization of the child

12. pre-lacteal feed given or not
13. colostrum given or not
14. exclusive breast-feeding practice
15. frequency of breast feeding
16. age of initiation of complementary feeding
17. main source of drinking water
18. type of toilet facility in household
19. mother's/ primary care giver's handwashing behaviour (before cooking /handling food, after passing urine/stool, before eating food, before feeding the child, after cleaning child's faeces after touching pets or handling animals and their waste, after blowing nose or coughing) method adopted for child's stool disposal, mother's education
20. working status of mother
21. mother's knowledge of nutrition
22. mother's knowledge of take-home ration
23. mother's knowledge of breast feeding
24. decision making power of the mother for her own health care
25. decision making power of the mother for treatment seeking for her children

For each of the independent variables, using descriptive statistics, frequencies and proportions were determined and presented in tables. After that, multivariable binary logistic regression analysis was performed, a backward stepwise elimination method was used to identify the determinants of insufficient nutrient intake. The results were presented by Odds Ratios (ORs) with 95% Confidence Interval (CI). The statistical association was declared significant if the p-value was less than 0.05.

Further, as part of the nutrient intake analysis, firstly (using SPSS statistical software version 21.1) average intakes of thirteen nutrients, namely food energy, protein, fat, calcium, iron, zinc, vitamin C, thiamine, riboflavin, vitamin B6, folate, vitamin B12, and vitamin A RAE were computed, and compared with corresponding RDAs recommended by ICMR (2011 guidelines). The descriptive analysis incorporated proportions (age, gender, and district wise), mean values, and standard deviations for each of the nutrients. Further, one- way analysis of variance (ANOVA) test was performed to assess age group wise variation in the average intake of each of the nutrients separately. Fisher's least significant difference post- hoc test was

considered for the multi-group comparison in the ANOVA test, and the significance level was set at 0.05.

C. Results and Discussion

I. Anthropometry- based Nutritional Status of the Children

The results as per the WHO Anthro software were obtained in the form of age-group wise and gender-wise for the entire children population included in the study and also separately for each of the three districts for the three anthropometric indices of wasting, stunting, and underweight.

The overall prevalence of wasting, with all the three districts considered together (n=2160), was 16.9%, with severe wasting at 6.4%. The overall prevalence of stunting was 58.1%, of which 36.7% were severely stunted. And the overall prevalence of underweight was 34.2%, with severe wasting at 12.9%.

Table 1 below describes in detail the age- wise and gender- wise prevalence of wasting, stunting, and underweight for the entire sample size of 2160 children.

Table 1: Age- wise and Gender- wise Prevalence of Wasting, Stunting, and Underweight in children of study districts (N=2160).

Age groups- Genders combined	**Wasting**			**Stunting**			**Underweight**		
	N	**% < -3SD**	**% < -2SD**	**N**	**% < -3SD**	**% < -2SD**	**N**	**% < -3SD**	**% < -2SD**
Total:	2160	6.4	16.9	2160	36.7	58.1	2160	12.9	34.2
(6-8)	404	9.4	21.8	404	30.7	50.2	404	15.3	37.4
(9-11)	368	7.1	18.8	368	33.4	56.3	368	11.1	31.5
(12-14)	414	6.5	15	414	25.6	48.3	414	9.9	28
(15-17)	324	3.4	13.6	324	39.5	60.8	324	9	24.7
(18-20)	328	5.2	12.8	328	47	66.8	328	14.6	42.4

(21-23)	322	6.2	18.6	322	48.8	71.1	322	17.7	42.2
Males									
	N	% < -3SD	% < -2SD	N	% < -3SD	% < -2SD	N	% < -3SD	% < -2SD
Total:	1116	7.1	18.7	1116	40.8	62.4	1116	15	38.5
(6-8)	202	9.4	22.8	202	35.1	53.5	202	17.8	41.1
(9-11)	178	7.3	19.7	178	34.3	60.7	178	11.8	36
(12-14)	219	7.3	17.8	219	30.1	54.8	219	11.4	30.1
(15-17)	157	4.5	16.6	157	46.5	67.5	157	11.5	30.6
(18-20)	177	6.2	15.3	177	52	68.4	177	18.6	46.3
(21-23)	183	7.1	19.7	183	50.3	72.7	183	18.6	47.5
Females									
	N	% < -3SD	% < -2SD	N	% < -3SD	% < -2SD	N	% < -3SD	% < -2SD
Total:	1044	5.7	14.9	1044	32.3	53.5	1044	10.6	29.5
(6-8)	202	9.4	20.8	202	26.2	47	202	12.9	33.7
(9-11)	190	6.8	17.9	190	32.6	52.1	190	10.5	27.4
(12-14)	195	5.6	11.8	195	20.5	41	195	8.2	25.6
(15-17)	167	2.4	10.8	167	32.9	54.5	167	6.6	19.2
(18-20)	151	4	9.9	151	41.1	64.9	151	9.9	37.7
(21-23)	139	5	17.3	139	46.8	69.1	139	16.5	35.3

The indicator-wise and district-wise anthropometric results are discussed in the subsequent sections:

Wasting

- The overall prevalence of wasting in Bhilwara district was 15.4%, with severe wasting at 6.4%. Amongst males, 17.6% were wasted, of which 8.3% were severely wasted. The prevalence of wasting in females was found to be 12.9%, with sever wasting at 4.2%.

- The overall prevalence of wasting in Udaipur district was 16.7%, with severe wasting at 6.7%. Amongst males, 18.9% were wasted, of which 6.5% were severely wasted.

The prevalence of wasting in females was found to be 14.5%, with sever wasting at 6.8%.

- The overall prevalence of wasting in Baran district was 18.6%, with severe wasting at 6.3%. Amongst males, 19.7% were wasted, of which 6.4% were severely wasted. The prevalence of wasting in females was found to be 17.4%, with sever wasting at 6.1%.

- In all the three districts prevalence of wasting was higher in males compared to females. Of all the three districts, Baran district had highest prevalence of wasting at 16.7%

Stunting

- The overall prevalence of stunting in Bhilwara district was 53.2%, with severe stunting at 33.6%. The prevalence of stunting amongst males was 56.2%, with severe stunting at 36.5%. Amongst females, 49.7% were stunted, of which 30.2% were severely stunted.

- The overall prevalence of stunting in Udaipur district was 62.4%, with severe stunting at 42.4%. The prevalence of stunting amongst males was 67.5%, with severe stunting at 46.9%. Amongst females, 57.4% were stunted, of which 38.0% were severely stunted.

- The overall prevalence of stunting in Baran district was 58.8%, with severe stunting at 34.0%. The prevalence of stunting amongst males was 63.8%, with severe stunting at 39.4%. Amongst females, 53.2% were stunted, of which 28.2% were severely stunted.

- The prevalence of stunting was higher in males compared to females in all the three districts. Similar to wasting, Udaipur had highest prevalence of stunting at 62.4% compared to Bhilwara and Baran.

Underweight

- The overall prevalence of underweight in Bhilwara district was 26% with sever underweight prevalence at 9.6%. The prevalence of underweight amongst males was

28.2%, with severe underweight prevalence being 12.4%. Amongst females, 23.4% were underweight, of which 6.3% were severely underweight.

- The overall prevalence of underweight in Udaipur district was 39.3% with sever underweight prevalence at 16.8%. The prevalence of underweight amongst males was 44.4%, with severe underweight prevalence being 18.6%. Amongst females, 34.4% were underweight, of which 15.0% were severely underweight.

- The overall prevalence of underweight in Baran district was 37.2% with sever underweight prevalence at 12.2%. The prevalence of underweight amongst males was 43.6%, with severe underweight prevalence being 14.1%. Amongst females, 30.2% were underweight, of which 10.2% were severely underweight.

- The prevalence of underweight was higher in males compared to females. The Udaipur district had highest prevalence of underweight at 39.3% compared to Bhilwara and Baran.

II. Determinants of Undernutrition Status

The statistical analysis revealed that gender of the child was significantly associated with wasting, stunting and underweight. The male children were significantly more wasted (OR=1.30, CI:1.03-1.64), stunted (OR=1.41, CI:1.19 -1.689), and underweight (OR= 1.48, CI: 1.23-1.78), as compared to the female children.

Regarding wasting, the main source of water, at the household level, was significantly associated. For those drinking water from hand pump (0R=2.092, CI =1.301-3.361) and tanker (OR=2.665, CI= 1.607- 4.) were at higher risk of wasting, as compared to other sources of drinking water.

In agreement to some of the studies done in India, assessing the association of household sanitation and personal hygiene practices with child stunting, the present study revealed a significant association between the method of disposal of stool and stunting. For those adopting methods of stool disposal as putting stool in drain or ditch(OR=8.870,CI:1.034-76.063),

throwing into the garbage (OR=9.673, CI:1.130-82.817), burying the stool (OR=10.007,CI:1.176- 85.190) and leaving stool in the open (OR=12.461, CI:1.264-122.846) were at a significantly high risk of stunting, as compared to those adapting using toilet/ latrine.

It was also observed that the likelihood of being stunted was significantly higher for children who had comparatively delayed initiation of complementary feeding between the age of 9-12 months (OR=2.741, CI=1.205-6.233). Mother's education was also found to be an important associated factor for stunting. Children of uneducated mothers (OR=1.533, CI=1.090- 2,156) were at higher risk of stunting compared to children of educated mothers.

Regarding underweight, only male gender emerged as a significant factor of association.

III. Infant and Young Child Feeding Practices

Mothers of children below 2 years were interviewed to elicited information on their feeding practices including early initiation of breast milk, colostrum feeding, exclusive breast feeding and complementary feeding to their children.

Colostrum feeding practices and its determinants revealed that around 97 per cent mother who initiated breast feeding early, gave colostrum to their new-born child. District wise data described that practice was highest (99 per cent) in Baran followed by Bhilwara and Udaipur which were 96 and 95 per cent respectively.

Further in-depth analysis suggested that the mother feels that it is good for the health of the baby (79 per cent) and 20 per cent says it protect the baby from infections. Practice of exclusive breastfeeding was found highest (73 per cent) in Baran district followed by Bhilwara (62 per cent) and Udaipur (57 per cent).

Regarding IYCF practices, little less than two-third (64 per cent) of the mothers-initiated breastfeeding and the others were not able to initiate due to separation from the mother or due to advice from the mother-in-law. A total of 64 per cent of the mothers-initiated breastfeeding within 30 minutes after delivery. There was a delay of 2 to 3 hours in feeding.

A total of 36 per cent of the mothers in our study didn't breastfeed even after 24 hours after the delivery. They gave pre-lacteal feeds and discarded the colostrum. A total of 6% of the babies were fed with jaggery water alone for more than 48 hours. *Janam Ghuti* (5%) Honey (3%) and plain water (2%) were also commonly used pre-lacteal feeds. (Table 2.4 annex)

Only 64% of the mothers did the exclusive breastfeeding until 6 months and started weaning after 6 months. A total of 36% of the mothers in our study prematurely started weaning the child. A majority of the mothers started weaning at the age of 6 to 9 months. The most common reason given for the start of supplementary feeding was insufficient milk (92%).

Only 6 per cent mothers continued to breastfeed the baby even at 9 months. A total of 84% of the mothers followed on-demand feeding practices and rooming in. Cow's milk (26%) was the most common food used for the infants who were breastfed less than 6 months followed by 'ragi sari'. Ragi sari is crushed millet and is given mixed with milk and water. Only 10 mothers (19%) used commercial formula. Cow's milk was diluted by the mothers before administration.

IV. Food Sources

Lowest proportions of consumption were observed for Nuts and Oil seeds (1.2%), Green Leafy vegetables (2.1%), Meat, Fish and Poultry (0.3%), and for Spices and Condiments (4.3%). Pulses, Roots and Tubers, Vegetables other than green leafy vegetables, and Fruits were reported to be consumed in comparatively higher proportions at 34.6%, 30.1%, 25.4%, and 16.7% respectively. Highest consumption was for Cereals at 92.6%, Mother's Milk at 94.5%, Milk (other than mother's milk) and milk products at 86.3%, followed by Oils and Fats at 86.9% and Sugars at 86.2%.

Protective food groups like Fruits and vegetables was found to be lowest and not as per recommended allowances by ICMR. Among the three study districts the proportion of consumption of all the food groups, was reported to be the lowest for Udaipur.

Amongst Cereals and Millets, wheat flour was consumed highest in children at 90.1%, followed by refined flower and rice at 16.9% and 15.4% respectively (Table 3 annexed). Likewise, Mung Beans were the maximally consumed Pulses (16.1%), amongst Roots and

Tubers maximum were Onions (22%), Tomatoes amongst non-leafy vegetables (16.8%), followed by Banana being maximally consumed fruit (13.6%).

Amongst Milk and Milk products, Mother's milk (94.6%) and Cow Milk (83.9%) were consumed maximum by children. Cooking Oil was observed to be the main source of oil for children, with its consumption in 84.5% of the children, followed by Ghee at 12.3%.

Lowest proportions of consumption were observed for Nuts and Oil seeds (1.2%), Green Leafy vegetables (2.1%), Meat, Fish and Poultry (0.3%), and for Spices and Condiments (4.3%). Pulses, Roots and Tubers, Vegetables other than green leafy vegetables, and Fruits were reported to be consumed in comparatively higher proportions at 34.6%, 30.1%, 25.4%, and 16.7% respectively. Highest consumption was for Cereals at 92.6%, Mother's Milk at 94.5%, Milk (other than mother's milk) and milk products at 86.3%, followed by Oils and Fats at 86.9% and Sugars at 86.2%.

V. Nutrient Intake and Gaps

The prevalence of insufficient dietary intake of all the thirteen nutrients assessed in this study was found to be greater than 60% in all the study districts. Out of the thirteen nutrients assessed for, seven nutrients Food energy, Calcium, Iron, Zinc, Thiamine, Riboflavin, and Vitamin B6) had insufficient intake prevalence greater than 70% and were identified as problem nutrients. Table 2 below describes the combined and gender-wise prevalence of insufficient dietary intake of the nutrients assessed.

Table 2: Prevalence of Insufficient Nutrient Intake in children (N=2160)

Nutrient	Category	District			Rajasthan
		Bhilwara	Udaipur	Baran	
Food Energy	Total	71.9%	72.2%	74.0%	72.7%
	Females	65.3%	72.8%	70.3%	69.5%
	Males	77.7%	71.7%	77.5%	75.7%
Protein	Total	48.6%	60.8%	59.4%	56.3%
	Females	41.6%	62.1%	57.4%	54.0%

	Males	54.7%	59.5%	61.3%	58.4%
Fat	Total	36.5%	41.3%	34.3%	37.4%
	Females	33.2%	43.3%	32.1%	36.4%
	Males	39.4%	39.1%	36.3%	38.3%
Calcium	Total	89.9%	94.7%	95.6%	93.4%
	Females	89.8%	94.3%	94.5%	92.9%
	Males	89.9%	95.2%	96.6%	93.8%
Iron	Total	100.0%	99.7%	99.9%	99.9%
	Females	100.0%	99.7%	100%	99.9%
	Males	100.0%	99.7%	99.7%	99.8%
Zinc	Total	100.0%	99.8%	99.4%	99.7%
	Females	100.0%	100.0%	99.1%	99.7%
	Males	100.0%	99.5%	99.6%	99.7%
Ascorbic Acid	Total	66.8%	65.3%	66.3%	66.1%
	Females	61.7%	66.5%	65%	64.5%
	Males	71.2%	64.0%	67.4%	67.7%
Thiamin	Total	97.4%	98.9%	98.6%	98.3%
	Females	97.6%	98.9%	98.3%	98.3%
	Males	97.2%	98.9%	98.9%	98.3%
Riboflavin	Total	76.3%	80.1%	82.9%	79.8%
	Females	73.4%	83.1%	82.8%	79.9%
	Males	78.8%	77.1%	83.0%	79.7%
Vitamin B6	Total	94.2%	98.9%	97.1%	96.7%
	Females	93.7%	98.9%	96.8%	96.6%
	Males	94.6%	98.9%	97.3%	96.9%
Folate	Total	63.5%	63.8%	63.3%	63.5%
	Females	58.7%	65.9%	61.8%	62.3%
	Males	67.6%	61.5%	64.7%	64.7%
Vitamin A RAE	Total	71.9%	67.2%	70.1%	69.8%
	Females	67.1%	68.7%	67.3%	67.7%
	Males	76.2%	65.7%	72.7%	71.7%
	Total	64.9%	66.4%	66.5%	65.9%

Vitamin B12	Females	59.3%	67.3%	65.9%	64.3%
	Males	69.7%	65.4%	67.1%	67.5%

In **Bhilwara district**, 71.9% of the children presented with insufficient food energy intake and increasing prevalence was observed in children aged 12 months and above. The prevalence of energy insufficiency was higher in males (77.7%) compared to females (65.3%). Prevalence of Calcium insufficiency was 89.9%, with the highest prevalence (98.1%) in children aged between 18-20 months. Regarding Iron, the noticeable prevalence of 100% insufficiency was presented, indicating that all the children (n=720) consumed iron well below the RDA. Similarly, all the children aged 12 months and above, presented with insufficient Zinc intake with 100% prevalence. The overall prevalence of Thiamin insufficiency was presented at 97.4%, with similar approximate prevalence in all the age categories. Prevalence of Riboflavin insufficiency was observed at 76.3% with the highest prevalence (96.2%) in the age group of 18-20 months. In the case of Vitamin B6, the overall prevalence was 94.2%, with the same approximate prevalence in all the age groups as well as both the genders.

In **Udaipur district**, the prevalence of food energy insufficiency was presented at 72.2%, with similar gender wise prevalence, and the highest prevalence (99.1%) was observed in children aged 18-20 months. Prevalence of Calcium insufficiency in Udaipur district was 94.7% with similar approximate prevalence in all age groups as well as gender. In case of Iron and Zinc insufficiency, approximate to the high prevalence in Bhilwara district, the prevalence in Udaipur district was 99.7% and 99.8 % respectively for the two micronutrients. The overall prevalence of Thiamin insufficiency was reported at 98.9%, with the same approximate prevalence age group wise and gender-wise. Regarding Riboflavin insufficiency, Udaipur district presented a prevalence of 80.1%, with higher prevalence in all children aged above 12 months, whereas gender wise, the prevalence in females was higher (83.1%) as compared to males (77.1%). The overall prevalence of Vitamin B6 was observed at 98.9%, with the same approximate prevalence in all the age groups and across both the genders.

In **Baran district**, the overall prevalence of insufficient food energy intake was presented at 74%, with higher prevalence in males (77.5%) as compared to females (70.1%). Prevalence of Calcium insufficiency was presented at 95.6%, with similar approximate prevalence in all the

age groups and across both genders. Similar to Bhilwara and Udaipur districts, the prevalence of Iron and Zinc insufficiency in Baran was again highly observed at 99.9% and 99.4% respectively. The overall prevalence of Thiamin was reported at 98.6%, with similar approximate prevalence across all age groups and genders. The Riboflavin insufficiency was 82.9%, with prevalence higher in children aged above 12 months. The overall prevalence of Vitamin B6 was reported at 97.1%, with approximate prevalence across all age groups and genders.

Considering all the three districts together (n=2160), the highest levels of insufficient dietary intake were presented for Iron at 99.9% and Zinc at 99.7% followed by Thiamin at 98.3%, Vitamin B6 at 96.7% and Calcium at 93.4%.

The ***average intake per day*** of net food energy for all the children (n=2160) was 643.95 +/- 269.34 Kcal, which was 72.36% of the estimated RDA (Table 3)**.** However, significantly very low average daily intakes of **Iron (1.41+/- 0.91 mg), Vitamin B6 (0.25 +/- 0.13 mg), and Zinc (2.00 +/- 0.76 mg)** were presented, with their respective mean intake values being **as low as 18.63%, 34.72% and 40.0% of the estimated RDA** levels for each. Similarly, the average daily intakes of Calcium, Thiamine, and Vitamin B12 were well below 60% of their respective RDA estimated levels. On an average, only the daily intakes for Protein (15.35 +/- 7.57 g) and Fat (33.71 +/- 17.53 g) were able to meet their respective estimated RDA levels.

Table 3: Average Dietary Intake Per Day of Nutrients by Children (N=2160)

Nutrient	Average Nutrient Intake (Mean +/- Standard Deviation)		Estimated Mean RDA	Intake as Percentage of RDA
	Mean	SD		
Food Energy	643.95	269.34	889.88	72.36
Protein	15.35	7.57	15.14	101.39
Fat	33.71	17.53	24.14	139.64
Calcium	280.44	153.75	564.26	49.70
Iron	1.41	0.91	7.57	18.63
Zinc	2.00	0.76	5.00	40.00
Vitamin C	32.61	20.76	34.64	94.14

Thiamin	0.21	0.09	0.43	48.84
Riboflavin	0.34	0.16	0.53	64.15
VitaminB6	0.25	0.13	0.72	34.72
Folate	46.88	21.06	60.34	77.69
VitaminB12	0.3897	0.22	0.71	54.89
Vitamin A RAE	356.83	267.07	382.12	93.38

The ***age-wise multi-comparison*** ANOVA test results of nutrient intakes revealed that the **average food energy intake decreased significantly ($p<0.005$) as the age of the child progressed from 6-8 months to 9-11 months (Mean Difference C1-C2 = 80.63 Kcal/ day), followed by progression to age group of 12-14 months (MD C2-C3= 144.51 Kcal/day).** However, no significant difference ($p>0.05$) between the mean food energy intake was observed for those in the age categories above 14 months. **Similarly, fat intake** decreased significantly ($p<0.005$) as the age-progressed from 6-8 months to 9-11 months (MD C1-C2 = 6.40 g/ day), followed by progression to an age group of 12-14 months (MD C2-C3= 10.90 g/day), beyond which no significant decrease in fat intake was noted. Notably, the same pattern of variation in intakes was also observed for intakes of calcium, iron, zinc, their intake was observed as the age-progressed from 6- 8 months to 12- 14 months, beyond which there was no significant decrease in their respective intakes. However, there were no significant differences noted between the mean intakes of dietary protein, vitamin B 12, and thiamin across any of the age groups.

VI. Determinants of insufficient Nutrient Intake

In this study, in addition to the results presented above, we also assessed the influence of socio-demographic factors, economic factors, factors related to child's immunization and feeding practices, and factors related to WASH practices with insufficient intake of the thirteen nutrients in all the children of study districts.

The most notable finding was association of **child's immunization (partial, continuing and not done at all)** with nutrient insufficiency. The statistical analysis revealed that children who were partially (OR=3.017, CI=1.669-5.453), continuing (OR=5.280, CI=4-124-6.760) and not

all immunized (OR= 2.969, CI =1.125-7.832) were statistically significant with insufficient food energy intake compared to the children who were completely immunized. Similarly, children being partially (OR=8.954, CI=3.714-21.590), continuing (OR=6.005, CI=3.644-9.895) and not all immunized (OR= 8.265, CI= 2.078-32.875) had significant association with insufficient Calcium intake. It was also recognized that compared to children with complete immunization children with partial, continuing and immunization not done at all had higher risk of insufficient Vitamin C, Riboflavin, Folate and Vitamin A RAE whereas children with continuing immunization had higher risk of insufficient Protein, Fat and Vitamin B12.

We also observed that **mothers with no knowledge of nutrition** had significant association with insufficient nutrient intake. Children of mothers with no knowledge of nutrition were at 1.263 times higher risk of insufficient food energy intake compared to the children with mothers who had knowledge of nutrition. Similarly, children of mothers with no knowledge of nutrition were at 1.237 times higher risk of insufficient fat intake. Mother's knowledge of nutrition (OR=1.440, CI =1.419-1.805) was also statistically significant in children with insufficient Vitamin C intake. Furthermore, mother's no knowledge of nutrition was also significantly corelated to insufficient Folate and Vitamin A RAE intake compared to mothers who were knowledgeable about nutrition.

The study also showed significant association of working status of mothers with insufficient nutrient intake in children. **Children of non-working mothers** were at higher risk of insufficient Vitamin C, Riboflavin, Folate, Vitamin B12 and Vitamin A RAE compared to children of working mothers. Children of uneducated mothers (OR=2.409, CI=1.31-4.424) were at higher risk of Vitamin A RAE insufficiency compared to children of educated mothers.

Considering the feeding practices, **deprivation from colostrum** was associated with insufficient protein and fat intake. Children who were not given colostrum (OR= 1.701, CI=1.014-2.856) were statistically significant with insufficient protein intake. In case of fat intake, children who were deprived of colostrum were at 2.058 times higher risk of insufficient fat intake compared to those who were given colostrum.

In case of frequency of breast feeding, children who were **breast-fed after a gap of more than 6 hours** were at 4.500 times higher risk of insufficient Calcium intake compared to those who were fed on demand. Likewise, children who were breast-fed after a gap of more than 6 hours

(OR=2.042, CI =1.282 -3.252) were statistically significant with insufficient Riboflavin intake. Factors such as exclusive breast feeding and age of initiation of complementary feeding did not show and significance with insufficient nutrient intake.

Our study also revealed another noteworthy factor associated with insufficient nutrient intake as WASH practices (Water, Sanitation and Hygiene). Hand washing practices had significant association with insufficient Food Energy, Protein, Calcium, Vitamin C, Thiamin, Riboflavin, Vitamin B6, Folate and Vitamin A RAE intake.

Children of **mothers who did not wash their hands before cooking and handling food** were at 1.464, 1.235and 1.648 times higher risk of insufficient Food Energy, Protein and Calcium intake respectively compared to the children of mothers who washed their hands before cooking and handling food. Not washing hands before cooking and handling food was also statistically significant with insufficient Vitamin C, Folate and Vitamin A RAE intake in children.

Also, **not washing hands before feeding the child** was significantly associated with insufficient Food energy, Vitamin C, Riboflavin, Folate and Vitamin A RAE intake in children.

It was observed that out of seven problem nutrients (prevalence >70%), two problem nutrients – Thiamin and Vitamin B6 had significant association with only hand washing practices. Children of mothers who do not wash their hands before feeding their child were at 2.611 times higher risk of insufficient thiamin intake whereas children of mothers who do not wash their hands after blowing nose were at 2.887 times higher risk of Vitamin B6 intake.

Assessing household sanitation practice with insufficient nutrient intake in child, present study revealed significant association between method of disposal of stool and insufficient Vitamin C, Riboflavin, Folate and Vitamin A RAE intake. For those adopting **methods of stool disposal as putting stool in ditch/drain and throwing it in garbage** were at higher risk of insufficient Vitamin C, Riboflavin, Folate and Vitamin A RAE intake as compared to those using toilet/latrine. Likewise, children using shared toilet facility were at higher risk of insufficient Vitamin C, Folate and Vitamin B 12 compared to those having their own toilet/latrine for use whereas no toilet facility was significantly associated with insufficient Vitamin A RAE intake.

At household level, main source of water was also significantly associated with insufficient nutrient in children. For those **drinking water from Hand pump, Tanker and Well** were at significantly higher risk of insufficient food energy and protein intake compared to other sources of drinking water.

In case of family type, **extended joint family** (OR=1.996, CI= 1.066- 3.739) was statistically significant with insufficient intake of food energy. It was also observed that type of area and gender had correlation with insufficient protein intake in children. **Children living in urban area** were at 1.514 times higher risk of inadequate protein intake compared to children living in rural area and in case of gender, **females** were at 1.206 higher risk of insufficiency in protein intake compared with males.

Overall, our study revealed significant association of immunization status of child, socioeconomic status of mothers, breast feeding practices and household sanitation and personal hygiene practices (WASH) with insufficient nutrient intake of child.

Practicum Experience and Learnings

I consider myself fortunate that from the very beginning of the project, I was able to engage in core research activities of the project. Through this practicum experience, I perceive to have developed my certain core public health competencies that I was aiming to enhance within the framework of pre-defined learning objectives.

In Table 4 below, I provide a brief summary of my achievements during my practicum in the light of learning objectives, informing the core public health competencies I perceive I have developed through my training and experience.

Table 4: Competencies acquired during the practicum as per learning objectives

S. No.	Practicum Training Achievements	Public Health Competencies Developed

1.	Using WHO Anthro and SPSS statistical software, assessed and determined the anthropometry- based nutritional status of children enrolled in the study.	Analytical Skills Public Health Science Skills
2.	Determined the dietary practices and patterns of intake of children, using WHO Opti food software and identified the nutrient gaps based on the collected 24 hour-recall dietary data, using SPSS.	Analytical Skills Public Health Science Skills
3.	Critically analysed and identified the socio-demographic, cultural, and developmental factors that were significantly associated with the findings of undernutrition status and nutrient gaps of the children.	Analytical Skills Public Health Science Skills
4.	Assisted in formulation of food-based recommendations in order to overcome the identified nutrient gaps	Analytical Skills Program Planning Skills
5.	Contributed towards preparation of final project report by conducting review of literature and incorporating findings of nutritional status assessment and evidence-based recommendations for improving nutritional status in the study districts.	Analytical Skills Program Planning Skills Communication Skills
6.	Participated in key stakeholder consultations and learned the art of conducting policy dialogue and preparing ground for new ideas for addressing old problems	Analytical Skills Communication Skills
7.	Communicated preliminary findings of the study with the key stakeholders at IPE Global	Communication Skills

		Public Health Advocacy and Leadership Skills

Conclusion

My contributions towards the study add to the evidence that will form the basis to formulate evidence-based strategies to mitigate the problem of undernutrition in the three districts of Rajasthan- Baran, Bhilwara, and Udaipur.

During my practicum period my ideas were encouraged and supported by my supervisor Dr. Gautam Sadhu and the rest of the research team at IIHMR University. My practicum training at IIHMR, Jaipur, provided me with the much-needed exposure and opportunities to experience and take my first steps towards developing the core public health competencies as a public health learner and servant.

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