



## MAPPING THE FUNCTIONING OF MID DAY MEAL PROGRAMME IN SCHOOLS OF RURAL VADODARA AND ITS IMPACT ON THE NUTRITIONAL STATUS OF THE CHILDREN

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### ABSTRACT

Effective School Feeding Programmes (SFP) such as the Mid Day Meal (MDM) have been initiated by the Government of India for improvement in enrollment, health and academic performance among children. The following study aimed to monitor and evaluate the MDM programme in 10 schools of rural Vadodara in comparison with the NP-NSPE, 2006 guidelines; and to assess its impact on the nutritional status of 207 children (n=123 girls and n=84 boys) using qualitative and quantitative methods. Nutritional Status Assessment (NSA) involved: Socio-Economic Status (SES), Anthropometry, Clinical signs and symptoms (IDA, VAD, vitamin B-complex and vitamin C), Dietary behavior (FFQ), and Biochemical estimations (n=100) (hematological indices and red cell morphology). Results revealed that the MDMP in  $\leq 50\%$  of the schools adhered to the norms of NP-NSPE 2006 guidelines with reference to the infrastructure, facilities and nutritional quantity and quality. As per the findings of BMI for age (Z-scores) 44.9% children were normal, 28% had severe thinness ( $<-3SD$ ) and 26.6% were thin ( $<-2SD$  to  $-3SD$ ). An alarming number of 74% were anemic (62% mild anemia and 12% moderate anemia). Immediate step for programme management are required to be initiated in order to improve its overall functioning and nutritional status of the school children.

**Key words:** Mid Day Meal; Nutritional Status; Adolescents; Body Mass Index; Iron Deficiency Anemia.

### INTRODUCTION

After over 64 years of independence, India has the dubious distinction of having one of the highest prevalence (over 50%) of under nutrition (stunting, wasting, and micronutrient deficiencies like anemia, vitamin A deficiency and others), in the world. The prevalence of under nutrition in rural India reported by NNMB (2001) tended to increase from about 63% among children in 6-9 year age group to 78% in 10-13 years and then declined to 66% in 14-17 year age group. Among the school age children, the common deficiency signs found were conjunctival xerosis (5%), Bitot's spot (2.9%), angular stomatitis (2.8%) and dental fluorosis (3%). Such high prevalence of under nutrition among school going children, not only undermines educational attainments and productivity, but has adverse implications for income and economic growth as well [1,2, 3]. It is therefore must to have a holistic and effective intervention to combat childhood malnutrition.

The National Programme of Nutritional Support to Primary Education (NP-NSPE) was launched as a centrally sponsored scheme on 15th August 1995 with a view to enhance enrollment, retention, attendance and nutritional status of children [4]. The programme has innumerable advantages if implemented in line with the NP-NSPE norms however, poor logistics, inadequate political support, unawareness and lack of training to grass root level functionaries have resulted in several drawbacks of the programme. Therefore the present study aims to monitor and evaluate the MDM programme in rural Vadodara in comparison with the NP-NSPE, 2006 guidelines and assess its impact on the nutritional status of selected children attending rural schools.

### MATERIALS AND METHODS

**Area of research and sampling:** From different zones of rural Vadodara, 10/161 schools were purposively selected so as to get a representative sampling.

**Qualitative methods for Baseline data:** Knowledge, Attitude and Practice (KAP) questionnaire was used to collect data from all school Principals (n=10), 5 teachers/school and all MDM staff (n=60 teachers, n=30 MDM staff). Spot and direct observations were made to obtain information on infrastructure of MDM and school; hygiene practices of MDM staff and meal preparation procedures by staff. Secondary data was used for obtaining the details of the children's enrolment, gender and category rate.

**Quantitative method for Baseline data:** For assessing the nutritional status, data on various parameters as mentioned below was assimilated.

Socio-Economic Status (SES), Anthropometric measurements (n=207) (Wt, Ht, BMI, WHO 2007), Clinical signs and symptoms (n=207), Food frequency (Vitamin A, Iron and Vitamin C rich foods) (n=197) and Biochemical estimations: Hematological indices using MEK-6410J/MEK-6410K and red cell morphology (n=100) were collected using standard procedures. Ethical clearance and consent from the school authorities and parents were taken for collecting blood from the students.

**Statistical Analysis:** Data were calculated using SPSS 13.0 software. Chi-square was used for testing statistical significance and the level of significance was  $p < 0.05$ .

**Ethical Clearance:** Approval for the study was obtained from the ethical committee of the home institution ethical board (Approval no. F.C.Sc./FND/ME/29). Necessary permissions were obtained from the District education board and the MDM section, rural Vadodara. Consent to conduct the survey on the student was obtained from the parents through the school authorities. Verbal assent was also taken from the children after demonstrating and explaining the procedure.

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## RESULTS AND DISCUSSION

**Enrollment, Caste and Gender:** Overall a decline of 16.5% in enrollment was recorded as compared with the records of the previous year. Out of the 3429 enrolled students in 10 schools, 66.9% belonged to either SC, ST or OBC with prominent castes being Mali, Vaghela, Prajapati, Makwana, Gohil, Naik, Rathore, Parmar, Solanki, Vasava, Chauhan etc. highlighting the fact that various tribes have migrated and settled around the city of Vadodara. Out of these, 55.1% were girls suggesting that girl child is encouraged for education in the Rural Vadodara.

On the contrary 15% increase in enrollment was observed [5] with 43% increase of SC and ST children and 38% increase for the girls. In the tribal region of the Dangs also [6] enrollment of the SC and ST children was found to be encouraging (81%). Thus, MDMP has been partially successful in encouraging enrollment for the disadvantaged section of the society.

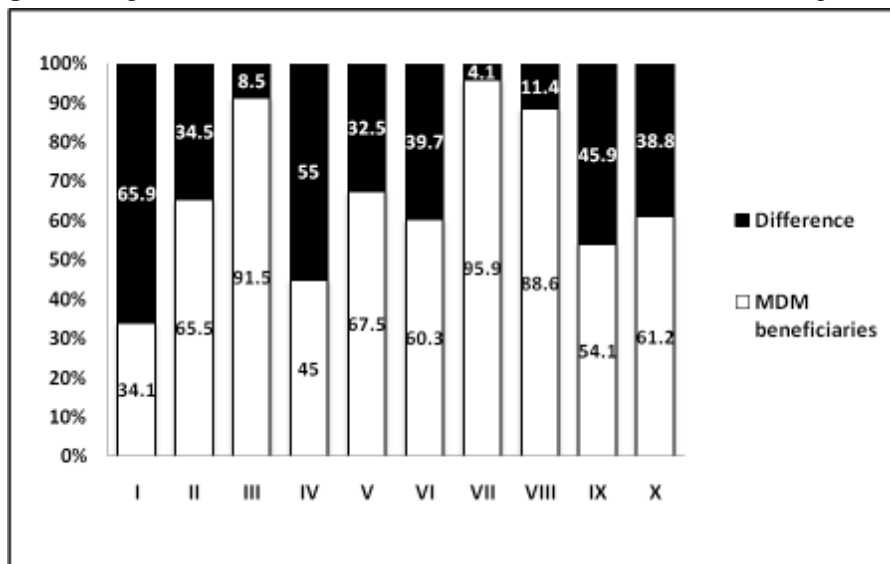
**Enrolled vs MDM beneficiaries:** School records revealed that only 66.4% of the registered students consumed MDM (Minimum 34.1% in School I and maximum 95.9% in school VII, Undera) (Figure 1). In the schools of urban Vadodara also the actual number of beneficiaries was recorded up to 63% [7]. Many reasons are concomitant with poor participation in MDM. Some of the reasons as given by the beneficiaries are: "We don't like the food", "Our parents do not allow us to eat", "If we forget to bring serving plates, then we do not eat the MDM". Thus it is necessary to address these issues on urgent basis for increasing the partaking by the children.

spoilage by the insects. Vegetables (potatoes, onion, brinjal, tomato, bottle gourd) were generally bought on daily basis by the staff. The stock records were maintained only by the MDM in charge in all the schools.

The infrastructure facilities of MDM in other states were found to be average than that found in the present study. In Rajasthan only 5% schools had a kitchen shed, 36% schools had separate store rooms, 76% schools used firewood, 14% used gas and 10% used kerosene as a cooking fuel [8]. Facilities such as separate kitchen shade, store rooms, electricity, water facility and waste disposal was up to the mark in 68% of schools in urban Vadodara, however the schools demanded for new cooking utensils [9]. It is therefore necessary to take immediate action for improving the infrastructure and facilities as per the NPNSPE guidelines for upgrading the quality of MDM served.

**Serving details:** In 70% (n=7) schools service area was unclean; food was served in open ground. In most of the schools food was being served by elder students to all the children and not by the helper or cook. Practice of serving food by elder students was commonly found in tribal, rural and urban Vadodara. Just 3 schools in urban Vadodara had taken efforts to create a separate, well-constructed and clean serving area. On an average 40% of the schools in tribal, rural and urban area of Vadodara provided with serving plates for children with financial support of some organization or other donations [6-9]. Since MDM provides Rs. 9440 crores of budget for the schools which includes money for purchase of utensils, serving plates have to be procured in order to ensure that the children are consuming the stipulated

**Figure 1:** Registered students v/s Actual MDM beneficiaries in all schools as per records



**Infrastructure of MDM:** A comparison with the NPNSPE guidelines revealed that all the schools had decentralized kitchens, 70% (n=7) had separate kitchen sheds within the school premises, 40% (n=4) of the school kitchens had raised cemented platforms and firewood was used as a cooking fuel in all schools, 80% (n=8) schools had adequate serving utensils but the cooking utensils were very old and inadequate. None of the schools had shelves in their store rooms for safe food storage. Only 3 schools stored grains in drums covered with lids while others (n=7) stored in gunny bags which had a chance of

ration provided by the Government. It is also suggested that standardized serving spoons should be used and the staff should be trained in serving equal amount of the meal to the children.

**School Infrastructure:** Village tank water was available in 90% (n=9) schools and in the remaining ones, either "well" and/or "hand pump" was used as the source of water for cooking and drinking purposes. Separate toilet facilities were available for boys and girls in schools but none of them were functional.

Schools in the urban area had well maintained waste disposal (60%), however the functionality of toilets was a major problem recorded in all surveyed areas of Vadodara district [9, 10]. The school infrastructure is managed by District Education department under the SSA grants, which is double than that allocated for the MDM, still however repeated surveys have revealed under and improper utilization of these grants. Hence intersectoral and integrated approach by the government officials would provide an impetus towards betterment of both MDMP and SSA.

**MDM Menu:** Our results revealed that the cyclic menu with ration allocation provided by the MDM office of Rural Vadodara was not followed by all the schools, and the ration allotted was 129 gm instead of 180 gm as per the guidelines. As per their records 421 Kcal and 12 gm protein was obtained from the meals however, when the same recipes were replicated in laboratory only 390 Kcal and 10 gm proteins on average was obtained from the meal. Observations revealed that quantification of the menu was not uniform as it was influenced by the size of their plates, tiffin boxes etc. However, on an average, one serving (200 ml) was served to each child.

The menu suggested by the MDM section of rural Vadodara after the introduction of fortified wheat flour (FWF) on 25th Sept 2009 in Gujarat, was not followed by the schools due to various reasons. The original recipe Kansar + vegetable was substituted with only boiled and spiced FWF recipes such as "Spiced wheat flour (Thiko lot)" and "Sweet wheat flour (Meethi lapsi)" as none of the cooks were trained for preparing FWF based recipes. Moreover basic utensils for preparation of recipes from FWF such as chappatis were not available.

Due to dark appearance and unacceptable texture and taste, the FWF recipes were not liked by the children. Similar situation was observed in the tribal region of the Dangs [6]. The menu provided in schools was deficit of 60 Kcal and 2 gm proteins when compared with the NP-NSPE guidelines 2006. It was also monotonous as only one item i.e. Khichdi was mostly prepared which led the children to skip the lunch at school; however in West Bengal [11], variety of foods were given to the children. Moreover augmenting the MDM with seasonal, easily available and cost effective vegetables also adds to the nutritional quality as well as variety to the MDM [12].

**Food Safety, Sanitation and Hygiene Practices in MDMS:** A study of food safety and sanitation parameters such as waste disposal, washing of utensils prior use, washing of vegetables prior cutting, hand washing, washing of grains prior cooking, removal of footwear while eating food etc revealed the good practices were followed by a range of 20-90% indicating that training in safe food handling needs to be initiated for MDM staff. On job quality training on frequent basis helps to improve the awareness, belongingness and accountability among the staff members thereby improving their working efficiency and quality [6, 7, 13].

**Quality of Food Grains:** Presence of dirt/pebbles and excess bran in grains was found in 90% (n=9) schools and insects in 50% (n=5) of the schools. The spices used in cooking had AGMARK on the label except for one school. Iodized salt (Brands: "Sheetal salt", "Jay salt" etc) was used in all the schools however, open packets and improper storage conditions in 70% (n=7) schools may

lead to loss of iodine present in it. The cotton seed oil fortified with vitamin A and D was provided by the state Government (Brands: "Gokul" and "Tirupati") but were kept in open tins which could lead to loss of the fortified vitamins. Similar findings were recorded in the tribal and rural setting of the MDM in Vadodara district [6, 14].

**Perceptions of MDM Staff:** About 60% (n=18) of the staff members were unaware about the objectives of the MDMS, 30% (n=9) reported that the program protects children from class room hunger and increases school enrollment 23.3% (n=7). About 76.7% (n=23) of the staff members found infrastructure to be inadequate in terms of, firewood used for cooking, inadequate number of cooking utensils and improper storage facilities as a major drawback in successful implementation of the program. The advantages of MDM according to 60% (n=18) staff members was that children get at least one good meal in a day.

None of the staff members were happy with their low wages, the in charge was paid Rs. 500/-, cook was paid Rs. 250/- and Rs. 175/- to the helper per month. These figures are much lower than the wages decided for agriculture Rs. 100/day and Rs. 136.3/day for semi-skilled workers in gram panchayat by the minimum wages act. Due to this reason motivation of the staff members gets reduced which is one of the drawbacks of MDM. Moreover, due to inappropriate facilities, the labour involved in operating the MDM increases tremendously which is inappropriate to the wages given [14].

**Perceptions of Teachers:** Though the involvement of teachers in monitoring of MDM was poor, they suggested that MDM should continue as it provides one meal to the child; however variation in the menu needs to be made.

Only in 40% schools the teachers used to monitor the serving of the meal. A Study conducted in Delhi [15] reported in most cases teachers supervised the distribution of the meal which greatly enhanced the efficiency of the system and also the fair treatment of each child. Thus teachers should be given training regarding active participation in the program, and their role in improving the nutritional status of their children.

**Perceptions of Students:** Majority of the students 48.8% (n= 101) ate MDM because they felt hungry and all the students liked rice based recipes compared to the broken wheat or FWF recipes. About 46.9% students suggested including seasonal fruits along with the meal and 29% suggested providing variety in the menu. However only 15% (n= 31) students reported MDM was of poor quality and only 10.1% (n= 21) students reported that the quantity of food provided was less indicating that children were ignorant about the amount of ration provided for them by NP-NSPE guidelines (100 g cereals for children I-V Std and 150 gm for VI-VIII Std).

Monotonous menu and poor palatability along with presence of dirt and other extraneous matter in the cooked food drove off the willingness of children from consuming MDM. Still however extreme poverty and hunger, made most of the students satisfied by whatever quality and quantity of food was provided by the MDM kitchen. [6, 8, 9].

**Socio-Economic Status:** Though in standard 7 the age range of students varied from 11-16 years (with 68.2% <13 yr). About 90.3% students were Hindu. About 31.4% of the students' fathers had studied till 10-12th standard and 35.3% mothers had studied till primary school (< 7th

Standard). Around 28.5% students' fathers did service and 64.7% students' mothers were housewife. About majority of the students lived in nuclear families and 71% had family size of 5-10 members.

A significant correlation was observed ( $p < 0.05$ ) between the number of family members with the prevalence of anemia among children. The students having less than 5 family members were found to be less anemic (14.5%) compared to those with 5-10 family members (59.0%). Similar results were [16] reported and the prevalence of anemia among children having five or less family members was 25.6% while it was 32.8% in those with more than five family members.

**Clinical Signs and Symptoms:** Vitamin A deficiency was largely prevalent among 207 students under the survey. Clinical signs and symptoms such as Night blindness (9.7%), Bitot's spot (6.3%), Conjunctival xerosis (1.0%) and Corneal xerosis (0.5%) were observed. Vitamin A deficiency as well as Iron Deficiency Anemia, both were found to be higher in boys as compared to girls. About 30.9% students had Pallor of nails, Pallor conjunctiva (35.3%), Pallor palm (19.3%), Pallor tongue (12.1%), Breathlessness (6.3%) and Koilonychia (0.5%). Prevalence of Vitamin B-complex deficiency was measured by observing symptom of Angular stomatitis (1.0%) and that of Vitamin C deficiency was bleeding gums (4.3%). About 10.6% students had monthly episodes of diarrhea which could be due to unhygienic surroundings.

As per NNMB (2001) [2] common deficiency signs among school age children in rural India were Conjunctival xerosis (5%), Bitot spot (2.9%), angular stomatitis (2.8%) and diarrhea (0.4%). The prevalence of Bitot's spot and diarrhea was higher among the children studied in present study than the NNMB (2001) data. The prevalence was found to be lower than reported in another study [16,17], about 95.1% of the children were clinically anemic, pale conjunctiva (77.6%), flat and pale nails (24.3%), atrophic lingual papillae (12.4%) and koilonychia (44.3%) were observed. Based on WHO growth standards for Height for age 24.6% of the students were stunted which was less than 39% [16] among adolescent children in rural India.

Students having Vitamin A deficiency had mean Hb levels of 10.5 g/dl while the mean Hb levels of non VAD students were 11.3 g/dl. Vitamin A and Beta-carotene inhibit the effect of polyphenol and phytate on iron absorption [17]. A significant correlation between consumption of MDM and prevalence of Vitamin A deficiency was observed. About majority of the students (55.4%) consuming the meal for more than three days a week had no clinical signs for VAD. Thus MDM had a positive effect on the Vitamin A status of the children [18, 19, 20].

**Food Consumption Pattern:** The boys consumed more of cereals and non-vegetarian foods on daily basis. And the girls consumed more of pulses, yellow/orange/red fruits and vegetables daily. In spite of such a consumption pattern, the prevalence of micronutrient deficiencies was higher, attributing to insufficient portion size, unhygienic cooking conditions and high rate of infections.

**Anthropometric Measurements:** The mean height of students of 7th standard was 142 cm and mean weight was 30 kg. The mean height and weight of girls was higher than that of the boys as a result of the higher growth spurt in girls as compared to the boys in this early phase of adolescence.

The height for age Z-scores based on WHO growth standards, showed that 65.7% of the students fall under normal category, 24.6% were stunted and 9.7% were severely stunted. Based on WHO growth standards (2007) for BMI for age Z-scores the percent children having normal BMI for age were 44.9%, severe thinness 28%, thinness 26.6% and only one girl 0.5% was overweight (Table 1).

**Hematological Indices and Red Cell Morphology:** About 74% of the students were found to be anemic of which 62% had mild anemia, 12% had moderate anemia (Table 2). The hematological indices showed that 42% of the students had low levels of MCV (Mean Cell Volume), 44% had low MCH (Mean Cell Hemoglobin), 9% had low MCHC (Mean Cell Hemoglobin Concentration), 34% had low PCV (Packed Cell Volume) and 36% of the students had low RBC (Red Blood Cell) count (Table 3).

**Table 1:** Degree of malnutrition among students based on WHO growth standards: Height for Age Z- scores (n= 207)

Variables	Boys		Girls		Total	
	N= 84	%	N= 123	%	N= 207	%
<b>Height for age</b>						
Severe stunting (<-3 SD)	12	14.3	8	6.5	20	9.7
Stunting (<-2 SD - -3 SD)	19	22.6	32	26.0	51	24.6
Normal (<+1 SD - -2 SD)	53	63.1	83	67.5	136	65.7
<b>BMI for age</b>						
Severe thinness (<-3SD)	35	41.7	23	18.7	58	28.0
Thinness (<-2SD - -3SD)	23	27.4	32	26.0	55	26.6
Normal (<+1SD - -2SD)	26	31.0	67	54.5	93	44.9
Overweight (<+2SD - +1SD)	0	0.0	1	0.8	1	0.5

WHO growth standards (2007)

**Table 2:** Gender wise prevalence of Anemia among students (n=100)

Degrees of Anemia	Boys % (n=41)	Girls % (n=59)	Total % (n=100)	Hb (Mean±SD)
Normal ( $\geq 12$ g/dl)	31.7 (13)	22.0 (13)	26.0 (26)	12.6±0.8
<b>Anemic</b>			74.0 (74)	10.8±1.0
Mild (10-11.9 g/dl)	63.4 (26)	61.0 (36)	62.0 (62)	
Moderate (7-9.9 g/dl)	4.9 (2)	16.9 (10)	12.0 (12)	

Values in the parenthesis indicate number of subjects (UNICEF/UNU/WHO, 2001)

**Table 3:** Hematological indices in students of 7th standard screened for anemia (n= 100)

Hematological indices	Normal range*	Within normal range	Below normal range	Above normal range
Hemoglobin (g/dl)	$\geq 12$	26 (26)	74 (74)	-
Mean cell volume (fl/red cell)	79 – 101	56 (56)	42 (42)	2 (2)
Mean cell Haemoglobin (pg/red cell)	26 – 36	55 (55)	44 (44)	1 (1)
Mean cell Haemoglobin concentration (g/dl RBC)	31 – 37	90 (90)	9 (9)	1 (1)
Red cell count (cumm)	4.6 – 6.5	62 (62)	36 (36)	2 (2)
Packed cell volume (percent)	34 – 54	66 (66)	34 (34)	-

Values in the parenthesis indicate number of students

\* Nihon Kohden Japan (Fully automated hematology analyzer)

Abnormal red cell morphology was observed in students and only 37% had Normocytic Normochromic cells. Normocytic Hypochromic cells were present in 2.0%, Microcytic Hypochromic (51%), Normocytic Microcytic (1.0%), Macrocytic Hypochromic (1.0%), Microcytic Macrocytic Normochromic (1.0%) and Microcytic Hypochromic Macrocytic (3.0%), Microcytic Normochromic (3.0%) and Hypochromic (1.0%) (Table 4). These findings relate with prevalence of infection among the children.

**Relationship between Socio-Economic Status v/s Prevalence of Anemia:** The educational levels of mothers had no effect on the nutritional status of their children. About 15.7% of the children were anemic whose mothers were illiterate and 16.9% were anemic whose mothers had studied till 7-9th standards (Table 5). Thus there was no benefit of mother's education on their child's health. Therefore parents especially mothers of the school children should be given nutrition and health education which would help to improve the problem of micro-nutrient malnutrition.

**Table 4:** Red cell morphology of students from selected schools of Rural Vadodara (n=100)

Red cell morphology	Boys	Girls	Total
	N= 41 (%)	N= 59 (%)	(%)
<b>Normal</b>			
Normocytic Normochromic	18 (43.9)	19 (32.2)	37 (37)
<b>Abnormal</b>			
Normocytic Hypochromic	0 (0)	2 (3.4)	2
Microcytic Hypochromic	16 (39)	35 (59.3)	51
Normocytic Microcytic	1 (2.4)	0 (0)	1
Macrocytic Hypochromic	1 (2.4)	0(0)	1
Microcytic Macrocytic Normochromic	0 (0)	1 (1.7)	1
Microcytic Hypochromic Macrocytic	2 (4.9)	1 (1.7)	3
Microcytic Normochromic	3 (7.3)	0 (0)	3
Hypochromic	0 (0)	1 (1.7)	1

**Table 5:** Correlation of Iron Deficiency Anemia with the Mother's education and Family size of students (n=83)

Variables	Anemic	Non- anemic	Total	Chi-square
<b>Mothers educational status</b>				
Illiterate	15.7 (13)	9.6 (8)	25.3 (21)	6.82 <sup>NS</sup>
< 7 <sup>th</sup> Standard	30.1 (25)	3.6 (3)	33.7 (28)	
7-9 <sup>th</sup> Standard	16.9 (14)	8.4 (7)	25.3 (21)	
10-12 <sup>th</sup> Standard	9.6 (8)	2.4 (2)	12 (10)	
Dead	1.2 (1)	0 (0)	1.2 (1)	
Don't know	1.2 (1)	1.2 (1)	2.4 (2)	
<b>No. of Family members</b>				
<5 members	14.5 (12)	6 (5)	20.5 (17)	5.99*
5-10 members	59 (49)	15.7 (13)	74.7 (62)	
>10 members	1.2 (1)	3.6 (3)	4.8 (4)	

The family size had an influence on the nutritional status of children. Students having less than five members in their family were less anemic compared with the students who had five to ten family members. In poor families with more number of members the quantity of food distributed per family member reduces which would lead to inadequate availability of nutrients resulting in malnutrition (Table 5).

#### CONCLUSION

The MDMP has shown partial success in encouraging enrollment for the disadvantaged section, however the actual number of beneficiaries is still less from expectation due to various reasons such as monotonous recipes, poor quality of raw ingredients, lack of palatability and organoleptic qualities. Considering the infrastructure and facilities available,  $\leq$  50% schools adhered to the norms of NP-NSPE guidelines. Improving the logistics and facilities in the schools could help in improving the quality of MDM served as well as adhering to the cyclic menu thereby fulfilling the nutritional quality and quantity of the programme. Amended perceptions, developing positive attitude and improved capacity building of the school teachers as well as the MDM staff would be possible by repetitive training programmes. The nutritional status of the children have revealed high prevalence of micronutrient deficiencies, highlighting on the deficit of the micronutrient consumption, unhygienic cooking conditions and high prevalence of infections thus there is a need to augment seasonal vegetables, improve the sanitation and hygiene conditions during food handling and undergo some treatment of disinfection for the children [22-25].

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#### REFERENCE

1. INSA (Indian National Science Academy) (2009) Nutrition Security for India—Issues and way forward, A Position paper. Available at: [www.insaindia.org](http://www.insaindia.org)
2. NNMB (National Nutrition Monitoring Bureau) (2001) Diet and Nutritional Status of Rural Population. Available at: <http://www.nnmbindia.org/NNMBREPORT2001-web.pdf>
3. Gragnolati M., Shekar M., Gupta M.D., Bredenkamp C. and Lee Y.K. (2005) India's Undernourished Children: A Call for Reform and Action. Available at: [http://siteresources.worldbank.org/SOUTHASIAE/XT/Resources/223546\\_114727\\_2668\\_285/IndiaUndernourishedChildrenFinal.pdf](http://siteresources.worldbank.org/SOUTHASIAE/XT/Resources/223546_114727_2668_285/IndiaUndernourishedChildrenFinal.pdf)
4. NP-NSPE. National Programme of Nutritional Support to Primary Education, (2006). Available at: [www.education.nic.in/mdm/mdm.asp](http://www.education.nic.in/mdm/mdm.asp)
5. Jain J. and Shah M. (2005) Antyodaya Anna Yojana and Mid Day Meals in MP. *Eco Pol* 40 : 5076-5088
6. Nambiar V., Desai R., Kansara K., et al (2011) Final Report: Monitoring and Evaluation of the Mid Day Meal Programme in the Dangs, Gujarat, Department of Foods and Nutrition, Faculty of Family and Community Sciences, The M. S. University of Baroda, Vadodara, Gujarat
7. Nambiar V. and Desai R. (2009) An Action Research on Integration Of Various Sectors Influencing The Mid-Day Meal Program In Urban Vadodara For Its Holistic Upgradation, Unpublished Master's thesis, Department of Foods and Nutrition, Faculty of Family and Community Sciences, The M. S. University of Baroda, Vadodara, Gujarat
8. Vyas S., and Choudhry M. (2005) Prevalence of Anaemia in Tribal School Children, Department of Foods and Nutrition, College of Home Science, Maharana Pratap University of Agriculture and Technology, Udaipur 313 001, Rajasthan, India. *Kamla-Raj* 2005 *J. Hum. Ecol.*, 17(4): 289-291

9. Nambiar V. and Desai R. (2009), A Project Report on Evaluation of MDM in urban Vadodara, Department of Foods and Nutrition, Faculty of Family and Community Sciences, The M. S. University of Baroda, Vadodara, Gujarat
10. Nambiar V. and Desai R. (2009), A Project Report on Evaluation of MDM in rural Vadodara, Department of Foods and Nutrition, Faculty of Family and Community Sciences, The M. S. University of Baroda, Vadodara, Gujarat
11. CART (2007) An Assessment of the Mid-Day Meal Scheme, Pilot Study 5, Rajasthan India
12. Rana K., Santra S., Banerjee T., Mukherjee A., Kundu M. (2005) Cooked Mid-day meal programme in West Bengal – A study in Birbhum district Pratichi (India) Trust
13. Nambiar V, Gandhi N and Nitya S. A report on the “Action project of augmenting vegetables in the MDMS and evaluating the MDMS using HSR strategy and in-depth analysis of 2 MDM centers using case study methodology in urban Vadodara”. Department of Foods and Nutrition. The M.S. University of Baroda submitted to Shri Sanjay Nandan (IAS), Commissner MDM Scheme, Government of Gujarat, Gandhinagar. Pp1-13. 2008
14. Nambiar V., Gandhi N. and Nithya S. (2008) A training manual for the Mid-Day Meal functionaries of Gujarat. Pp 1-55, Department of Foods and Nutrition, The M. S. University of Baroda And Mid Day Meal Section, Department of Education. Government of Gujarat, Gujarat. India
15. Nambiar V., Roy K. and Patel N. (2010) A project report on Monitoring and evaluation of Mid day Meal in Rural Vadodara, Submitted to The Mid Day Meal Section, Department of Education. Government of Gujarat, Gujarat. India. pp 1-58
16. De A., Noronha C. and Samson M. (2005) “Mid Day Meal Scheme in Delhi- A Functioning programme”; CORD. <http://www.cordindia.com/images/Midday.pdf>
17. Gur E., Inci Y., Celkan T. Can G. Akkus S. Arvas S. Guzeoz S. Serdar C. Ili I (2005) Prevalence of Anemia and the Risk Factors Among School children of Istanbul. *J Trop Paed.* 51 : 346-350.
18. Venkaiah K., Damayanti K., Nayak M.U. and Vijayaraghavan K. (2002) Diet and nutritional status of rural adolescents in India, 1996-97. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad - 500 007, India *European Journal of Clinical Nutrition*, 56, 1119-1125. doi:10.1038/sj.ejcn.1601457
19. Layrisse M., García-Casal MN., Solano L. Baron MA. Arguello F. Llovera D. Ramirez J. Leets I. Tropper E (2000) New property of vitamin A and beta-carotene on human iron absorption: effect on ;hytate and polyphenols as inhibitors of iron absorption. *Arch Lationoam Nutr.*, 50(3):243-8 Available at : <http://www.nabi.nlm.nih.gov/pubmed/11347293>
20. Nambiar V., Sharma K. and Gandhi H. (2005) *Food Based Approach to Combat Vitamin A Deficiency*. UGC-DSA Monograph Series No. 3., Department of Foods and Nutrition, M.S.University of Baroda, Vadodara
21. Nambiar V. and Kosambia P. (2002) Assessing the community risk of vitamin A deficiency: Impact of nutrition education programs in improving vitamin A behavior. A report submitted to the Primary School Board, Urban Vadodara, Department of Foods and Nutrition, M. S University of Baroda
22. Nambiar VS. and Desai R (2013). Knowledge, attitude, practice of school teachers, students and mid day meal staff towards the mid day meal program. *Archives of Pharmacy and Biological Sciences (APBS)*, (1):1; 1-9
23. Nambiar VS. and Desai R. (2013). Behaviour change communication strategies for improvement of mid-day meal in urban Vadodara-western India. *Universal Journal of Pharmacy (UJP)*, (2):2; 111-117
24. Nambiar VS., Nithya S. and Pandit N (2012). Strengthening the Mid Day Meal Programme (MDMP) with Non-Pharmaceutical Measures: Role of Dietary Diversification and Nutrition Communication. *IJPI's Journal of Hospital and Clinical Pharmacy (JHCP)*, (3):11-15
25. Nambiar VS. and Desai R. (2012). Positive and negative deviant behaviors affecting the mid day meal programme (MDMP) in government aided primary schools of an urban Indian city: causes, consequences. *International Journal of Biomedical Research and Analysis. (IJBRA)*, (3):3; 1-10