Chapter 5 Discussion

Undernutrition among children and adolescents is matter of concern and can cause life-long implications to individuals and society. Youth of the poor segments of society bear a large share of undernutition and its consequences.

Nutritional Status of MDM Beneficiaries

Anthropometric assessment was carried out in both the phases of this study to assess nutritional status of school going adolescents of rural industrial area of Vadodara. Schools selected in both the phases were different making the sample mutually exclusive. The data showed that there was no significant gender wise difference in the mean weight, height and BMI of the subjects. However, age wise data revealed that girls had higher mean weight and height than boys in the age groups between 12-14 years of age and 11-13 years of age respectively. This difference could be attributed to the fact that girls experience growth spurts earlier than boys. Tanner 1962 and Spear 2002, as referenced in a report on adolescent nutrition (WHO 2006), indicate that girls' growth spurt begins at the age of 10 and peaks at the age of 12. Boys get a growth spurt at the age of 12 and can outdo girls in 1 to 2 years' time.

Bhargava et al. (2020) carried out assessment of nutritional status of subjects covered in NFHS 3 and NFHS 4, using WHO 2007 growth reference standards. They reported the prevalence of thinness to be 14.3% and 10% in NFHS 3 and 4 respectively. They reported that thinness was higher among boys. This genderwise difference was also reflected in mean BAZ values among adolescents (boys: -1.17±1.14 and girls: -0.71±1.01) Stunting prevalence was 29.1% and 34.1% in NFHS 3 and NFHS 4 respectively. No significant difference in stunting as well as mean HAZ among boys and girls was reported by Bhargava et al. (2020) NHFS 3 reported 20.8% thinness (30.8%- boys, 17.2%- girls) in Gujarat. It was almost the same, 19.3% (25.3%-boys and 17.8%- girls) in NHFS 4. Gujarat showed 23.3% stunting (boys- 21.1% and girls 24.1%) in NFHS 3 and 29.6% stunting (27.8%- boys and 30%- girls) in NFHS 4 (Bhargava et al. 2020).

According to the Comprehensive National Nutrition Survey report, prevalence of thinness among adolescents (10-19 years of age) was reported to be 24% in India (MOHFW 2019). It was reported to be 30.2% in Gujarat with 10.5% severe thinness.

Comparison between rural and urban adolescents showed that thinness was higher among rural adolescents than urban adolescents (25.3% vs 20.4%) as reported by CNNS (MOHFW 2019). Bhargava et al (2020) reported that rural area had significantly ($p<0.001$) lower BAZ and HAZ than urban areas in both NFHS 3 and 4, indicating poor nutritional status among rural adolescents as compared to their urban counterparts. Thus, both the databases have shown that adolescents belonging to rural areas have higher prevalence of undernutrition than urban adolescence.

Present study was conducted in rural areas of Vadodara. First phase of the study reported 55.7% thinness in selected six schools of rural Vadodara with 25.9% subjects being severely thin. It was significantly ($p<0.001$) higher among boys (61.8%) than girls (49%). It was higher compared to the national databases cited above. Phase 2 of the study was conducted on six schools other than those selected in phase 1. Prevalence of thinness among study subjects in screening was 34%, which was comparable to CNNS data of thinness in adolescents of rural Gujarat.

The study showed higher prevalence of thinness among boys compared to girls as reported in phase I (61.8% vs 61.8%) as well as phase II (37.2% vs 31.1%). However, stunting prevalence was comparable in both the genders as reported in the study.

According to a study conducted in Aligarh, stunting and thinness affect 40.3% and 49.7% of rural primary school pupils, respectively (Sultan, 2014). According to Jayalakshmi and Jissa (2017), 13.4% of Mid-Day Meal programme participants in the Kottayam area of Kerala, were stunted, 38.8% were underweight, and 30.7 percent were wasted.

Dietary Intakes among MDM beneficiaries

Dietary assessment was also carried out on a sub-sample to understand the nutrient intake among children through their home diet as well as through MDM food supplement. Dietary intake and NAR of children in this study showed that they were able to meet 61%, 91%, 37% and 46% EAR of energy, protein, calcium and iron respectively. Patel et al. (2016) have reported similar findings in their study. Nutrient intake among MDM beneficiaries as reported by Patel et al (2016) met 60% energy, 78% protein, 50% calcium, and 53% of micronutrient requirements among boys while girls met 59% energy, 67% protein, 44% calcium, and 48% of micronutrient requirements.

A study by Mehta et al. (2013) carried out in Ludhiana also reported that the daily nutrient intake of children studying in Government primary schools were inadequate to meet their RDA. They have further reported that 28.2%, 51.7% and 27.5% of daily intake of energy, protein and fat were contributed my MDM intake respectively. MDM contributed to 25.7% iron and 27.7% calcium intakes among children. It is found to be higher in present study for energy and fat but is comparable in case of the other nutrients. Another study carried out on a sample of 57 children studying in Government higher primary school of Sulia Taluk of Dakshin Kannada district (Karnataka) showed that diets of children were not adequate in meeting RDAs of nutrients. Mean nutrient intakes met only 71%, 49% and 27% RDAs of energy, protein and fat respectively. The diets were not adequate in terms of micronutrients, too. However, mid-day meal provided sufficient nutrients and about one-third of the energy requirements (Chethana and Prabhat, 2018).

Results of the present study show that, although MDM is improving quality of diet by contributing to the dietary intakes, variety of food groups and number of meals, the consumption is not sufficient to meet the nutrient norms. The tenth Joint Review Mission Report of Gujarat State has also reported that MDM consumption in Vadodara is not sufficient in meeting the MDM norms. (MHRD 2018). Lalita and Rekhi (2016) in their study standardized the recipes of MDM served in two schools of south zone of Delhi in college lab to study their

nutritional values. They found that menu of only one day was sufficient in energy and protein in terms of nutritional norms of the programme.

A study carried out in Vadodara by Kantawala and Iyer (2015) have reported the actual consumption of MDM by school children of urban Vadodara. The study found out that NGO intervention for providing MDM through centralized kitchen under public private partnership was effective in improving nutritional status of school children. The recipes provided by the centralized kitchen were also found to be nutritious. However, the average consumption of MDM by children remained to be insufficient in meeting MDM norms. Boys showed higher mean nutrient intake through MDM compared to girls. These results are in support of findings of the present study carried out in rural Vadodara.

Practices and perceptions regarding MDM, sanitation and hygiene

According to the present study, majority of the adolescents (81.3%) thought that MDMP was beneficial to them. A study conducted in rural areas of two districts, Dharwad (Karnataka) and Jhansi (Uttar Pradesh), also showed that children had a positive opinion of MDMP (Singh and Badiger 2016).

In the current study, the main perceived benefit of MDM was improved growth and health (36%). Nambiar and Desai (2013) also found that one of the favourable perceptions about MDM is improved health as reported by 21.4% students in urban Vadodara.

Data of present study on sanitation and hygiene behaviours and beliefs revealed that almost all of the students regarded handwashing, nail hygiene, and bathing as significant parts of personal hygiene. However, improving their understanding of the potential benefits of the hygiene behaviours and practices was felt necessary to bridge the gap in children's hygiene practises. Similar findings on sanitation and hygiene were reported in research studies conducted in different parts of India. As reported by Meher and Nimonkar (2018), 69% of youngsters washed their hands after eating and 84.1% washed their hands after using the toilet. Only 55.4% of the children in the study by Meher and Nimonkar (2018) said they always wash their hands with soap. Sarkar (2016) also found similar results related to hand-washing and nail hygiene. They reported in their study that while understanding of hygienic habits such as

handwashing before eating and after using the restroom, as well as nail trimming, was good among school children, there was a significant gap between knowledge and behaviour. Seenivasan (2016) reported that majority of the children (96.4%) cleansed their hands before eating in a study of school children in Chennai. All the students said that washed their hands after eating and after visiting toilet. However, 9.4% children were not washing their hands with soap. Majority of the children bathed once or twice a day, according to Seenivasan (2016). Only 11.2% of children said they cut their nails once a week, and the majority of the youngsters in the research said they trim their nails when they become long (69.2%). Results of present study showed that more than half of the children cut their nails once a week (52%) and only 22.5% children reported to be cutting nails when they grow long.

Thus, the results of the study emphasises a need of conducting activities focusing on reinforcement of hygiene related knowledge and encouraging adoption of good hygiene practices by children.

Microbial Analysis of MDM

Food safety has been a serious concern in the development era. More than 200 illnesses are associated with contaminated food consumption. After consuming unsafe food, an estimated 600 million individuals, or about one in ten, become unwell. This results in 420 000 deaths every year, resulting in the loss of 33 million years of healthy life (DALY) (WHO 2022). This is a serious threat to developing countries like India, affecting people's well-being and potentially impeding the country's progress. One of the biggest contributors to the vicious cycle of infectious diseases and malnutrition is poor food safety (WHO 2015).

Food safety is an important aspect of large scale programmes involving food supplementation such as MDM programme. It is crucial to ensure production and serving of foods that are safe for consumption to avoid any large scale food hazards. It is equally important in case of school level kitchens as well as large scale food establishments such as centralised kitchen, to maintain food hygiene.

An attempt was made to study food safety of the meals provided by NGO run centralised kitchen in phase I C of this study. This included microbial yeast

testing of food items served in the meals for total plate count, coliforms, E. coli, and mould.

The Total Plate Count (TPC), also known as the Aerobic Place Count (APC)/ Aerobic Colony Count (ACC), is an indicator of food spoilage. TPC values of less than 10^5 cfu/gm are considered unsatisfactory by various food safety guidelines (Table 5.1). These foods are deemed unfit for human consumption. The same amount has been stated by Ali and Emmanuel (2017) as indicating a higher potential risk of presence of disease causing microorganisms (Ayçiçek H, Sarimehmeto Lu B, Çakiro Lu S, 2004). Table 5.1 summarises several guidelines related to microbial food safety and demonstrates that acceptable levels of TPC/ACC in ready-to-eat foods are between 10^3 and 10^4 cfu/gm. TPC levels were less than 10^5 cfu/gm in all of the food samples examined in this study, both at the time of manufacturing and serving.

Coliforms are a gram-negative, non-spore forming rod shaped bacteria group, which can ferment lactose with the formation of lactic acid and gas within 48 hours at 32° or 35°C (Davidson et al 2004). Some coliforms are considered to be disease causing microorganisms. Coliform levels of less than 20 cfu/gm food are deemed acceptable, from a food safety standpoint (Table 5.1).

E. coli belongs coliform bacteria group that lives in the lower intestine of warm-blooded animals. Presence of E. coli is a sign of faecal contamination of food. Some strains of E. coli can be responsible for severe foodborne illnesses (WHO 2018). E. coli counts of less than 20 cfu/gm are considered acceptable. (Table 5.1) Coliforms and E. coli were determined to be 10 cfu/gm and 0 cfu/gm, respectively, in all of the samples obtained at the time of manufacture and serving in this study.

Yeast and Mould are types of fungi. Certain moulds can create toxic compounds in food, resulting in foodborne illnesses. Yeast, on the other hand, can cause food spoilage but seldom causes food poisoning. Thus, yeast and

Table 5.1 Limits of Aerobic Plate Count/Standard Plate Count, Coliforms and E. Coli in Ready to Eat Foods as per Various Guidelines (cfu/gm)

Agency/ Author	Food Category	Parameter	Satisfactory/ Good	Borderline/ Acceptable	Unsatisfactory
International Commission for Microbiological Specification for Foods (1996)	Ready to eat foods	Plate Count	$\leq 10^3$	10^4-10^5	$\geq 10^6$
		Coliforms	<20	20-10^2	>10^2
		E. Coli	<20	20-10^2	>10^2
IFSA and AEA (2007)	Ready to eat foods	Plate Count	<10^6		$\geq 10^6$
		Coliforms	<10.000		>10.000
		E. Coli	<10		>10
Health Protection Agency (2009)	Ready to eat foods	ACC	<10^3	10^3-10^5	$\geq 10^5$
		E. Coli	20	20-10^2	>10^2
NSW Food Authority (2009)	Ready-to-eat foods in which all components are fully cooked for immediate sale or consumption	Standard plate count	<10^4	<10^5	$\geq 10^5$
		E. Coli	<3	3-10^2	$\geq 10^2$
Microbial Guidelines for Ready-to-Eat Foods- Canada (2010)	Ready to eat foods	ACC	<10^4	<10^5	$\geq 10^5$
		Coliforms	<10^2	<10^3	$\geq 10^3$
		E. Coli	<10	<100	≥100
Working Group of PHLS Advisory Committee for Food and Dairy Products- UK (2000)	Ready to eat foods- Category: Ready to eat meals	ACC	<10^4	10^4-10^5	$\geq 10^5$
		E. Coli	<20	20-10^2	$\geq 10^2$
Food Safety Authority of Ireland (2014)	Ready-to-eat food when placed on the market	ACC	<10^3	10^3-10^5	$\geq 10^5$
		E. Coli	20	20-10^2	>10^2
Centre for Food Safety, Hong Kong (2014)	Foods cooked immediately prior to sale or consumption	ACC	<10^3	10^3-<10^5	$\geq 10^5$
	Ready-to-eat foods	E. Coli	<20	20-10^2	$\geq 10^2$

ACC- Aerobic Plate Count, E. Coli- Escherichia Coli.

moulds, in addition to bacteria, are major spoilage causing microorganisms. Yeast count of 10^6-10^7 cfu/gm in foods with a high ACC can cause food spoilage (HPA 2009). Levels of yeast and mould were found to be <10 cfu/gm in all the food samples analysed in this study.

Deodhar et al. (2010) found high levels of uric acid (a rat infestation indicator) and aflatoxin (a fungus-produced toxin) in some food grains in MDM's centralised and school-level kitchens in Ahemdabad, indicating unsatisfactory food safety.

There are not many research findings on the microbiological food safety of MDM in India. Microbial analysis of foods served under MDM as a means of reviewing food safety issues is now part of state government initiatives (MHRD 2015).

The results of this study showed that although the time between production and serving was higher than the suggested guidelines, the microbial counts for studied parameters were within safe limits. However, there is a need to conduct such analysis on large number of samples.

Impact of Nutrition Health Education

Second phase of the study comprised of impact evaluation of NHE on nutritional status of children with low BMI for age. Comparison between experimental and control groups showed no significant impact on mean anthropometric measurements as well as indices. Stunting and underweight prevalence did not show any impact, too. However, a shift from thinness to normal category was observed in both the groups. The shift was higher in experimental group than control group. Dietary data showed a significant increase in mean energy and carbohydrates consumption after intervention in experimental group as opposed to a non-significant decrease in the control group. Mean haemoglobin levels showed slight increase in experimental group than control group. NHE did not bring about any significant changes to morbidity profile, cognition scores and physical work capacity among children

Many studies done on Nutrition Health Education have shown an improvement in knowledge among children after intervention. Some of these studies have indicated that it can contribute to improvement in nutritional status. Nutrition

Education given through flip-charts showed to have improved KAP scores among adolescent school girls as reported by Raikar et al. (2020). A study by Rathore and Upadhyay (2016) on effect of nutrition education given through two game to students of upper primary schools of Sitapur also reported improvement in nutrition knowledge among children. Anitha and Anusuya Devi (2018) reported that a 21 days nutrition education given through multimodal tools in 10-12 years old students brought about reduction in overnutrition among children. Nutrition related knowledge scores also increased post intervention among children. The study reported selection of healthier snacks over unhealthy and packaged snacks post intervention among children. However, the intervention did not contribute to cognition scores. This finding was similar to the results of present study. Sachithananthan et al (2012) reported that a 3 months nutrition health education given to 14-21 old school children in Benghazi (Libya) could not bring down BMI in selected group of students with high prevalence of over nutrition. However, a reduction in consumption frequency of unhealthy foods among children along with increased average intakes of carbohydrates and energy among boys. Indicating improvement in dietary practices among children which may influence their nutritional status positively in a long run. Thus, researches have shown mixed results pertaining to impact of NHE on improvement of anthropometric indicators of nutritional status. Though, the results strongly suggest that nutrition health education activities do improve knowledge and positive attitude towards healthy dietary choices among children reflected in improved dietary practices. This can bring about positive outcomes in their nutritional status on a long run.

Personal hygiene was an important component of NHE given in the second phase of present study. The results revealed that NHE brought about positive changes in hand-washing and nail-hygiene practices was after intervention. Significant increase in number of children washing their hands with soap was reported post intervention, which was maintained after washout period also. MHRD have given guidelines for implementing WASH to ensure that proper hand-washing practices are followed in schools. Many studies have shown similar results indicating that health education can be an effective tool to impart knowledge about personal hygiene which can be effectively translated into

practice. A study conducted on 10-12 years old schools children in Lucknow by showed that school health education significantly improved knowledge regarding personal hygiene practices such as general body hygiene, nail and hand hygiene as well as oral hygiene (Khatoon et al. 2017). Three months health education on hygiene given to school children in Sudan showed an improvement in awareness about personal hygiene and hygiene practices. Improvement in hand washing at before eating, after eating as well as after using toilet was reported in the study (Yahia and Mariod, 2021). Sembiah et al. (2019) reported improvement in hand-washing with soap before consuming MDM among children of Government and Government aided schools of Kolkata. These results were comparable to the results of present study.

MDM provided in the study area were safe for consumption and contributed to the dietary adequacy of children but the intakes showed insufficient intakes of MDM to meet nutrient norms of the programme. Prevalence of undernutrition among these children was high. Thin children of experimental group showed a higher shift to normal category post intervention as compared to control group. A slight decrease in children with normal BAZ was observed in both the groups but it was still higher in experimental group. Apart from this, increase in number of children having positive attitude towards MDM post intervention however some of these showed slight decline after washout period. Nutrition Health Education given for two months brought about positive changes in hand-washing practices among children which did not change much after a two months washout period. This emphasised that NHE activities can be effective if they are conducted frequently with reinforcement sessions to ensure retention of the messages. This may help improve dietary choices of the children resulting in a better nutritional status.