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SUSTAINABILITY OF HEALTHY NUTRITIONAL POLICY INTERVENTIONS FOR SCHOOL CHILDREN: A CASE STUDY OF MID-DAY MEAL SCHEME IN ODISHA, INDIA

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ABSTRACT

School feeding programme has remained a prime tool amongst food interventions in addressing hunger and malnutrition of children. The present study examines the nutritional value contributions of the school feeding programme of India namely Mid-Day Meal scheme in Odisha vis-à-vis provides a cost-benefit analysis for restructuring the programme. The nutritional values in terms of total energy, protein, fat, carbohydrate, iron, zinc, calcium and magnesium content were calculated using weekly menu and quantity of food items provided to the school going children. The calculated nutritional values were then compared with the recommended dietary allowances (RDA) provided by Indian Council of Medical Research for children and adolescents. The study finds that with the present menu, Calcium (Ca) and Zinc (Zn) content of the food meets less than 30% of the RDA. Comparatively, the Ca and Zn content is found to be lower on Monday and Thursday when *dalma* (a local recipe prepared adding vegetables with the pulses) is provided. This is due to the non-availability of guidelines for the preparation of *dalma* for which schools use pulses and vegetables of their choice and convenience without considering their nutritional potency. The study concludes with the recommendation of restructuring the current menu of using horse gram in place of red gram, and additionally suggests preparing a vegetable curry with the vegetables previously used for making *dalma.* Moreover, it advocates that the selection of vegetables should be based on their nutrient content.

Contribution/Originality: This study contributes to the existing literature by examining the nutritional value contributions of the school feeding programme of India namely Mid-Day Meal scheme in Odisha (a backward state) considering varied nutrients.

1. INTRODUCTION

Malnutrition has remained a major public health challenge affecting one in five children and contributing around half of all childhood deaths globally (Black et al., 2013; Brown et al., 2020). Food insecurity is found to be the predominant factor of malnutrition (Drammeh, Hamid, & Rohana, 2019). Thus, the rate of malnutrition is found to be high in lower-middle income countries including India due to the prevalence of food insecurity (Black et al., 2013; Gassner et al., 2019; Oostindjer et al., 2017; Siamwalla & Valdés, 1980; Swaminathan et al., 2019). The problem of malnutrition can be addressed developing a healthy dietary habit among children, which in turn will not only help them in their overall growth and cognitive development, but also will also prevent them from chronic diseases in later life (Amine, 2012; Jomaa, McDonnell, & Probart, 2011; Lytle & Kubik, 2003; Sabinsky, Toft, Sommer, & Tetens, 2019).

Recent World Health Organisation report reveals that there are a total of 178 million undernourished children; of which, approximately 11% (20 millions) suffer from severe malnutrition (Humbwavali, Giugliani, Nunes, Dalcastagnê, & Duncan, 2019). Eighty per cent of the total undernourished resides in 20 countries and one third of the total undernourished (around 60 millions) is found in India (Yadav et al., 2016). The scenario of malnutrition become troublesome in India due to its high population growth rate, insufficient food intake and poor dietary quality, which hinder the path of making the nation hunger free, for which India ranks 102 (out of 119 countries) in global hunger index (Murarkar et al., 2020; Patidar, 2019). Further, in India, more than 50% of all childhood deaths are relating to malnutrition (Yadav et al., 2016). Therefore, food security intervention focusing children will be a quintessential footstep towards eliminating hunger and malnutrition (Lentz, Barrett, Gomez, & Maxwell, 2013). School feeding programme is one amongst food intervention in addressing hunger and malnutrition.

School feeding programmes have been introduced in different countries in reducing malnutrition and improving child survival (Neervoort et al., 2013). A majority (more than 70%) of the low and middle income countries have initiated this programme (Jomaa et al., 2011). In India, the school feeding programme was introduced in the year 1995 as a social safety net programme in the name of National programme for Nutritional Support to Primary Education (NP-NSPE) to augment the nutritional levels amongst school going children vis-à-vis improving their enrolment, retention, and attendance (Agnihotri, 2010). Later, the programme was popularly known as Mid-Day Meal (MDM) scheme. In India, for the first time MDM was started in Madras city in 1925, and subsequently it was implemented by different states (Si & Sharma, 2008). It is the largest national programme in the world enrolling 11.59 crore children under the programme.

The impact of the school feeding programme on nutritional attainment in developed and developing countries has been examined in Powell, Walker, Chang, and Grantham-McGregor (1998); Murphy et al. (2003); Van Stuijvenberg (2005) and were found to be effective. Studies have also been carried out in assessing the impact of MDM (school feeding programme of India) on nutritional status considering body-mass index, total calorie consumption and protein content in India (Anitha et al., 2019; Laxmaiah et al., 1999; Patel, Patel, Chiplonkar, Khadilkar, & Patel, 2016). It is apparent from the above literature that the studies related to impact assessment of school feeding programmes on nutritional status are skewed towards developed states; and the nutritional benefits received by the children under MDM scheme considering varied nutrient contents in a backward state in general and Odisha in specific is scantly investigated. Thus, to breeze the above conspicuous gap, this study tries to assess the nutritional benefits received under MDM programme in Odisha. Moreover, prevalence of high level of hunger and food insecurity makes Odisha a backward region (Mishra, Mishra, Baitharu, & Das, 2020), which proves the selection of Odisha as ideal one for a case study and can be an endeavour to the existing literature.

2. METHODOLOGY

2.1. Data

The study uses the weekly schedule of MDM (published in the website http://www.mdmodisha.nic.in/) as the secondary data to assess the nutritional value received from the food provided under MDM in Odisha. The weekly schedule reveals that the Government of Odisha in a week provides rice and *dalma*[1] (Monday and Thursday), rice and soya bean curry (Tuesday and Friday), and rice and egg curry (Wednesday and Saturday) to the students. On the contrary, no strict guidelines were found on types of pulses and vegetables to be used for the preparation of *dalma* in the website. For this reason, the study also gathers primary data by visiting different schools and observes the use of vegetables such as brinjal, drumstick, pumpkin, and papaya in the preparation of *dalma*. Moreover, the use

[1] a local recipe prepared adding vegetables with the pulses.

of red gram was predominant. Therefore, while calculating the nutritional value for Monday and Thursday, only these vegetables and red gram (as pulses) were considered.

2.2. Consideration of Nutrients and Calculation of Nutritional Value

Consistent with Anitha et al. (2019), this study considers energy, protein, fat, iron (Fe), calcium (Ca), and zinc (Zn) content of the food to assess the nutritional value. Alike other minerals like Calcium, magnesium (Mg) acts as a cofactor in various enzyme systems and required for energy production (Schwalfenberg & Genuis, 2017). Thus, along with the nutrients considered in Anitha et al. (2019), the present study considers 'Mg' as an additional nutrient while assessing the nutritional value.

Once the nutrients were identified, the nutrient contents of different meals were calculated considering the food items used. The Government has circulated a norm (vide order no. 725/spmu/02.07.219)[2] and based on that provides 100gm and 150gm of rice, 25gm and 30gm of pulses, 60gm and 100gm of vegetables, 12gm and 25gm of soya bean to primary and upper primary students respectively. On Wednesday and Saturday, primary and upper primary students are provided with one and two eggs respectively. Then, the study calculates the equivalent nutrient content (as per weight) of food provided under the programme following (Gopalan, Sastri, & Balasubramanian, 2018). Further, the study compares the nutritional value received under MDM with the recommended dietary allowances (RDA) provided by Indian Council of Medical Research (ICMR) to know whether the nutritional value received under MDM is sufficient for children or not. In India, primary school students belong to the age group of 6-9 years. Similarly, the upper primary students belong to the age group of 10-12 years. Therefore, the nutritional value of primary students is compared with the RDA for children (6-9 years) and value of upper primary students is compared with the RDA for adolescent (10-14 years).

3. RESULTS AND DISCUSSION

The menu wise nutritional values are calculated and provided in Table 1 & 2 for primary and upper primary students respectively. The comparative analysis of nutritional value received through MDM and RDA for Indians is depicted in Table 3. After assessing the nutritional values, the study finds that the average protein and iron content of food provided under MDM for primary students meets more than 50% of the RDA. On the contrary, the average Ca, Zn, fat and total energy content fulfils less than 30% of the RDA. The same nutrition pattern is found for upper primary students also. Moreover, it is evident from Table 3 that on Monday and Thursday, when *dalma* is provided to the children the nutrient content of the food is comparatively lower than other days with respect to all nutrients (except Mg). In India, micronutrient deficiencies among school going children is very high (Gonmei & Toteja, 2018). Among different minerals and trace elements, Zn and Ca play significant role in overall growth and development and their deficiencies is known to put negative effect on human body. For instance, long term exposure to Zn deficiency enhances the possibility of exposure to diarrhoea, low physical growth, and suppressed immune function (Hambidge, 2000). Alike Zn, Ca deficiency leads to osteoporosis (Sunyecz, 2008). In this connection, it is inferred from Table 3 that if the current menu (for Monday and Thursday) continues then the possibility of children remaining malnourished will be very high due to lack of minimum dietary requirement. Thus, there is a pressing need of restructuring the current menu of Monday and Thursday due to following reasons. First, the current menu fails to meet the minimum RDA to a great extent in terms of micronutrients like Ca and Zn. Second, in most of the cases children get more nutritious food in school than at their homes due to non-affordability of their parents for consumption of quality food because of their low income (Gupta & Mishra, 2014).

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[2] This circular was collected during physical visits to schools as it is not available in the website.

Table-1. Day-wise Nutritive value of Food provided under MDM for Primary Students.

Day	Menu	Items (in gm)	Carbohydrate(g)	Protein(g)	Fats(g)	Ca(mg)	Energy(Kcal)	Iron(mg)	Mg(mg)	Zn(mg)
Monday	Rice and *Dalma*	Rice (100gm)	78.2	6.8	0.5	10	345	0.7	90	1.4
		Red gram (25 gm)	14.4	5.575	0.425	18.25	83.75	0.675	22.5	0.225
		Tomato (10 gm)	0.36	0.19	0.01	2	2.3	0.18	1.5	0
		Potato(10 gm)	2.26	0.16	0.01	1	9.7	0.048	3	0.053
		Turmeric(3 gm)	2.082	0.189	0.153	4.5	10.47	2.034	8.34	0.0816
		Onion (5 gm)	0.555	0.06	0.005	0.5	2.5	0.024	0.8	0.0205
		Brinjal (10 gm)	0.4	0.14	0.03	1.8	2.4	0.038	1.5	0.022
		Drumstick (10 gm)	0.37	0.25	0.01	3	2.6	0.018	2.8	0.016
		Papaya (10 gm)	0.57	0.07	0.02	2.8	2.7	0.09	0	0
		Pumpkin (10 gm)	0.46	0.14	0.01	1	2.5	0.044	3.8	0.026
		Cumin (2 gm)	0.732	0.374	0.3	21.6	7.12	0.234	9.5	0.0532
		Garlic (1.5 gm)	0.447	0.0945	0.0015	0.45	2.175	0.018	1.065	0.02895
Total			100.836	14.0425	1.4745	66.9	473.215	4.103	144.805	1.92625
Tuesday	Rice and Soya bean curry	Rice (100gm)	78.2	6.8	0.5	10	345	0.7	90	1.4
		Soya bean (12 gm)	2.508	5.184	2.34	28.8	51.84	1.248	21	0.408
		Tomato (10 gm)	0.36	0.19	0.01	2	2.3	0.18	1.5	0
		Potato (20 gm)	2.26	0.16	0.01	1	9.7	0.048	3	0.053
		Onion(5 gm)	0.555	0.06	0.005	0.5	2.5	0.024	0.8	0.0205
		Turmeric 3 gm)	2.082	0.189	0.153	4.5	10.47	2.034	8.34	0.0816
		Garlic (1.5 gm)	0.447	0.0945	0.0015	0.45	2.175	0.018	1.065	0.02895
		Cumin (2 gm)	0.732	0.374	0.3	21.6	7.12	0.234	9.5	0.0532
Total			87.144	13.0515	3.3195	68.85	431.105	4.486	135.205	2.04525
Wednesday	Rice and Egg curry	Rice (100gm)	78.2	6.8	0.5	10	345	0.7	90	1.4
		Egg (75 gm)	0	13.3	13.3	60	173	21	0	0
		Tomato (10 gm)	0.36	0.19	0.01	2	2.3	0.18	1.5	0
		Turmeric 3 gm)	2.082	0.189	0.153	4.5	10.47	2.034	8.34	0.0816
		Onion (5 gm)	0.555	0.06	0.005	0.5	2.5	0.024	0.8	0.0205
		Garlic (1.5 gm)	0.447	0.0945	0.0015	0.45	2.175	0.018	1.065	0.02895
		Potato (20 gm)	4.52	0.32	0.02	2	19.4	0.096	6	0.106
		Cumin (2 gm)	0.732	0.374	0.3	21.6	7.12	0.234	9.5	0.0532
Total			86.896	21.3275	14.2895	101.05	561.965	24.286	117.205	1.69025

Table-2. Day-wise Nutritive value of Food provided under MDM for Upper Primary Students.

Day	Menu	Items (gm)	Carbohydrate(g)	Protein(g)	Fats(g)	Energy(Kcal)	Ca(mg)	Iron(mg)	Mg(mg)	Zn(mg)
Monday	Rice and *Dalma*	Rice (150 gm)	117.3	10.2	0.75	517.5	15	1.05	135	2.1
		Red gram (30 gm)	17.28	6.69	0.51	100.5	21.9	0.81	27	0.27
		Tomato (20 gm)	0.72	0.38	0.02	4.6	4	0.36	3	0
		Potato (20 gm)	4.52	0.32	0.02	19.4	2	0.096	6	0.106
		Turmeric (3 gm)	2.082	0.189	0.153	10.47	4.5	2.034	8.34	0.0816
		Onion (5 gm)	0.555	0.06	0.005	2.5	0.5	0.024	0.8	0.0205
		Brinjal (20 gm)	0.8	0.28	0.06	4.8	3.6	0.076	3	0.044
		Drumstick (20 gm)	0.74	0.5	0.02	5.2	6	0.036	5.6	0.032
		Papaya (10 gm)	0.57	0.07	0.02	2.7	2.8	0.09	0	0
		Pumpkin (10 gm)	0.46	0.14	0.01	2.5	1	0.044	3.8	0.026
		Cumin (4 gm)	1.464	0.374	0.3	7.12	21.6	0.234	9.5	0.0532
		Garlic (3 gm)	0.894	0.0945	0.0015	2.175	0.45	0.018	1.065	0.02895
Total			147.3	19.297	1.86	679.465	83.35	4.872	203.1	2.7622
Tuesday	Rice and Soya bean curry	Rice (150 gm)	117.3	10.2	0.75	517.5	15	1.05	135	2.1
		Soya bean (25 gm)	5.225	10.8	4.875	108	60	2.6	43.75	0.85
		Tomato (25 gm)	0.9	1.575	1.275	87.25	37.5	16.95	69.5	0.68
		Potato (40 gm)	9.04	0.64	0.04	38.8	4	0.192	12	0.212
		Onion (10 gm)	1.11	0.12	0.01	5	1	0.048	1.6	0.041
		Turmeric (5 gm)	3.47	0.315	0.255	17.45	7.5	3.39	13.9	0.136
		Garlic (3 gm)	0.894	0.189	0.003	4.35	0.9	0.036	2.13	0.0579
		Cumin (4 gm)	1.464	0.748	0.6	14.24	43.2	0.468	19	0.1064
Total			139.4	24.587	7.8	792.59	169.1	24.73	296.8	4.1833
Wednesday	Rice and Egg curry	Rice (150 gm)	117.3	10.2	0.75	517.5	15	1.05	135	2.1
		Egg (150 gm)	0	19.95	19.95	259.5	90	31.5	0	0
		Tomato (25 gm)	0.9	0.475	0.025	5.75	5	0.45	3.75	0
		Turmeric (5 gm)	3.47	0.315	0.255	17.45	7.5	3.39	13.9	0.136
		Onion (10 gm)	1.11	0.12	0.01	5	1	0.048	1.6	0.041
		Garlic (3 gm)	0.894	0.189	0.003	4.35	0.9	0.036	2.13	0.0579
		Potato (30 gm)	6.78	0.48	0.03	29.1	3	0.144	9	0.159
		Cumin (5 gm)	1.83	0.935	0.75	17.8	54	0.585	23.75	0.133
Total			132.2	32.664	21.7	856.45	176.4	37.2	189.1	2.6269

Note: On Wednesday and Saturday, one egg to primary students and two eggs are provided to the upper primary students. Therefore, the nutritional values are calculated considering an average weight of 75 gm per egg.

Table-3. A comparative analysis of nutritional value of MDM as per the recommended dietary alliances (RDA) for Indians.

Nutrients	Amount of nutrient from MDM for Monday and Thursday		Amount of nutrient from MDM for Tuesday and Friday		Amount of nutrient from MDM for Wednesday and Saturday		RDA for Children (6-9 years)	RDA for Adolescent (10-14 years)	
	Primary	Upper primary	Primary	Upper primary	Primary	Upper primary		Boys	Girls
Energy(Kcal)	473.21	679.46	431.10	792.59	561.96	856.45	1690	2190-2750	2010-2330
Protein (g)	14.04	19.29	13.05	24.58	21.32	32.66	23- 32.6	36.3- 49.8	36.8- 49
Fat (g)	1.47	1.86	3.31	7.80	14.28	21.77	30	35-45	35-40
Iron (mg)	4.10	4.87	4.48	24.73	24.28	37.20	16	21-32	27
Calcium (mg)	66.9	83.35	68.85	169.1	101.05	176.4	600	800	800
Zinc (mg)	1.92	2.76	2.04	4.18	22.69	2.62	8	9-11	9-11
Magnesium (mg)	144.8	203.1	135.2	296.8	138.205	189.1	70-100	120-165	160-210

Note: RDA is based on the recommended dietary allowances for Indians ICMR (2010).

4. POLICY RECOMMENDATION

The present study recommends restructuring the menu for Monday and Thursday with the assumption of enhancing Ca and Zn content in order to fill the nutritional gap as well as for the overall development of the children. In that context, screening and selection of Ca and Zn rich food item is a pivotal step in the process of restructuring.

4.1. Screening and Selection of Food Item as the Replacement

It is evident that cereals, pulses & legumes, and vegetables are good sources of Zn and Ca (Gopalan et al., 2018). Thus, the restructuring should be based on considering one food item form the above three categories. It was found that pearl millet among cereal grains, cow pea among pulses &legumes, betel leaves among leafy vegetables have the highest Zn content. Likewise, the Ca content was found to be the highest in finger millet among cereals grain, horse gram among pulses & legumes and fetid cassia among leafy vegetables (Gopalan et al., 2018). The Ca and Zn content of the aforementioned food items are provided in Table 4. It is inferred from the table that horse gram is the best alternative amongst the above mentioned food items to meet the above micro nutrient deficiencies having a balanced Ca and Zn content. Therefore, the paper suggests adding horse gram in place of red gram on Monday and Thursday to meet the nutritional gap.

Table-4. calcium and zinc content of selected food items.

Food item	Zinc (mg/100 gm)	Calcium (mg/100 gm)	Reference
Pearl millet	3.1	42	[Gopalan et al., 2018]
Finger millet	2.3	344	
Cow pea	4.6	77	
Horse gram	2.8	287	
Betel leaves	3.44	230	
Fetid cassia	-	3200	

4.2. Other Recommendations

Additionally, the paper suggests for making a curry with the vegetables (with the same quantity) which were being used to make *dalma*. Further, the paper suggests making a guideline for the inclusion of vegetables and that should be based on nutrients content. That implies schools should have the choice of vegetables to be used for the preparation of vegetable curry keeping their dietary values into account. In this connection, the vegetables should provide minimum 2 gm of carbohydrate, 1.2 gm of protein, 0.1 gm of fats, 12 gm of energy, 0.25 mg of iron, 8 mg of magnesium, 1 mg of zinc, and 15 mg of calcium for primary students to meet the required RDA. Similarly, the vegetables should provide minimum 3 gm of carbohydrate, 1.5 gm of protein, 0.15 gm of fats, 20 gm of energy, 0.5 mg of iron, 12 mg of magnesium, 0.15 mg of zinc, and 15 mg of calcium for upper primary students. In this context, to ease the work of the teachers in choosing vegetable based on nutrient content, the paper suggests providing a list of vegetables with their nutrient content to all the MDM operating schools.

After the suggestion for policy restructuring, the next prime questions are *how much additional cost shall be incurred for providing red gram and how much nutritional benefit the children will get?* For a better understanding a cost-benefit analysis (CBA) is provided in the paper as CBA provides information on the ratio of incremental cost of an intervention to the benefits provided considering all hidden costs and benefits (Sunstein, 2001).

4.3. Cost-Benefit Analysis for the Policy Restructuring

4.3.1. Cost

As mentioned earlier, there will be no change except for the pulses. Therefore, the additional cost of policy restructuring will be cost of pulse only. To ascertain the price differences between red gram and horse gram, inquiries were carried out in the five municipal corporations of Odisha which reveals that the price of horse gram is

20-30% higher than the red gram. Therefore, the government has to spend approximately additional INR 1.47 (30% of 4.93) and INR 2.19 (30% of 7.32) for primary and upper primary students respectively.

4.3.2. Benefits

With the additional cost of INR 1.47 and INR 2.19 what nutritional benefits the children will get is the prime question. In response to the above question, the paper advocates that if horse gram is introduced in MDM in place of red gram (with the same quantity) it can enhance the Ca content by 97%, Zn content by 70%, iron content by 31% and protein content by 40% for primary students. Likewise, the Ca, Zn, iron and protein content for upper primary students will be increased by 93.4%, 48.9%, 31.4%, and 35.6 % respectively if horse gram is introduced in place of red gram.

5. CONCLUSION

The present study was carried out with the objective of assessing nutritional benefits received by the children from the food provided under MDM programme in Odisha. The study found that the government provides food based on the weekly schedule. Nutrients like carbohydrate, protein, fat, total energy, Ca, Fe, Zn, and Mg were used to assess the nutritional values of the food. The nutrient contents of the food for Monday and Thursday (when rice and *dalma* are provided) were found to be lower than other days. This was due to non-availability of guidelines for the vegetables and pulses to be used for the preparation of *dalma*. Furthermore, the study suggests restructuring the menu for Monday and Thursday by replacing red gram with horse gram and also recommends preparing a vegetable curry with the vegetables previously used in the preparation of *dalma* considering their nutritional potency. Additionally, it was found that if horse gram is introduced in place of red gram, an overall increment of nutrients will happen with an approximate additional cost of INR 1.47 for primary and INR 2.19 for upper primary students.

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