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**“An Assessment of the Knowledge, Attitudes, and Practices Pre-
and Post- ‘SODOTO’ Model of Intervention in the Mobile
Teaching Kitchen”**

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ID 372 Independent Study

Readers: Amon Emeka and Jennifer McDonald

Abstract.

Background. Despite improvements in the overall status of malnutrition in India, the numbers remain alarmingly high. In order to address this problem in rural India, the Need for Nutrition Education/Innovation Program (NNEdPro) Global Center for Health and Nutrition, the Remedy Clinic Study Group in Kolkata, and the Inner Wheel Club for Greater Calcutta launched the *Bhavishya Shakti* Mobile Teaching Kitchen (MTK) project in two slums in Kolkata, India. The *Bhavishya Shakti* MTK project seeks to ameliorate the level of malnutrition in rural India by improving diet diversity and awareness through cooking demonstrations of sustainable, nutritious, and affordable meals. Locally trained volunteers follow a 'See One, Do One, Teach One' (SODOTO) model to transfer nutrition knowledge to their peers.

Objective. To evaluate the effectiveness of the SODOTO model of intervention in the *Bhavishya Shakti* MTK project.

Methods. Participants ($n=12$; mean age = 29.9 ± 8.6 years) were selected by virtue of their location. Final analyses include survey data. Used a simple rating scale to score the 'Teach One' assessment and KAP survey responses. Measures of central tendency and variability were used to assess the impact of the SODOTO model, as well as identify patterns between income, education, and occupation of the participants and their overall 'Teach One' responses.

Results. For the 'Teach One' responses, participants with no formal education ($n = 4$) on average performed less than their educated counterparts ($n = 8$). Participants with the highest level of education, higher than level IV primary, had the overall highest score (2.60 ± 0.40 ; 95% CI: 1.61 – 3.59). Further, housewives ($n = 5$) had a higher mean score of 2.36 ± 0.17 (95% CI: 2.15 – 2.57) than domestic workers (mean score = 2.28 ± 0.50 ; 95% CI: 1.82 – 2.75). Additionally, participants who earn the least amount of money, less than 2000 /- annually, scored highest during this step of the intervention relative to those who made over 2000 /-. Lastly, overall mean scores for KAP survey response increased post-intervention from 1.43 ± 0.52 to 1.83 ± 0.58 .

Conclusion. Analysis of the KAP survey responses showed overall improvements in nutrition-related knowledge, attitudes, and practices of the participants. However, findings must be interpreted with caution given the small sample size.

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Background

Malnutrition persists as a global health emergency and is among the leading risk factors to the global burden of disease and disability. According to the World Health Organization (WHO), every country in the world is affected by one or more forms of malnutrition (World Health Organization, 2020). This condition poses a serious burden globally, particularly for developing countries in Sub-Saharan Africa and South-East Asia, where undernutrition and overnutrition exist concurrently, otherwise known as the double burden of malnutrition. India has the highest prevalence of undernutrition globally, and as of 2016, the nation was ranked 102 out of 117 countries by the Global Hunger Index (Global Hunger Index, 2019). The prevalence of the different forms of malnutrition in India varies greatly across the different states and regions (Sengupta and Syamala, 2012), and therefore different areas present different challenges.

For this reason, the government of India collaborates with local non-governmental organizations (NGOs) as well as international agencies in the design and implementation of policy interventions and program to address this issue, both directly and indirectly. Some of the current major nutrition policy interventions include the *Public Distribution System* (PDS), the *Integrated Child Development Services* (ICDS) and the *Mid-day Meal Program* (MDM) (Radhakrishna, 2005; Ramakrishnan et al., 2012). PDS is a consumer subsidy program that emphasizes price stabilization restricted to urban areas and food deficit areas. The ICDS, launched in 1975, “is a centrally-sponsored, state-administered, nation-wide direct nutrition intervention program which integrates supplementary nutrition with primary healthcare and informal education”, [and MDM is a] national program [that provides] nutritional support to primary education” (Radhakrishna, 2005,

p. 1818-1821). These food-based interventions have had significant impacts in decreasing prevalence rates of undernutrition in India since the 1990s, however, “large procurement prices, ... burgeoning and injudicious food grain stocks, ... meagre allocation of budgetary resources, and faulty budget design”, impact their efficacy (Radhakrishna, 2005, p.1821). These programs also fail to adequately target and cater to the most vulnerable populations, women, particularly pregnant women and mothers of low socioeconomic status in the rural parts of the country (Ramakrishnan et al., 2012).

Despite improvements in the overall status of malnutrition in the region, the numbers remain alarmingly high. In order to address this public health crisis in rural India, the Need for Nutrition Education/Innovation Program (NNEdPro) Global Center for Health and Nutrition, the Remedy Clinic Study Group in Kolkata, and the Inner Wheel Club for Greater Calcutta launched the *Bhavishya Shakti* Mobile Teaching Kitchen (MTK) project in two slums in Kolkata, India. NNEdPro is an international think tank based in Cambridge, United Kingdom. This company was founded in 2008 and consists of “regional networks across six continents as part of the International Knowledge Application Nutrition Hub in Nutrition-2025” (NNEdPro.org.uk, 2019). The *Bhavishya Shakti* MTK project seeks to ameliorate the level of malnutrition in rural India by improving diet diversity and awareness through cooking demonstrations of sustainable, nutritious, and affordable meals. Locally trained volunteers follow a ‘*See One, Do One, Teach One*’ (SODOTO) model to transfer nutrition knowledge to their peers. This study seeks to evaluate the effectiveness of the *Bhavishya Shakti* MTK program. Can the SODOTO model of intervention improve nutrition knowledge and practice among women in rural India?

The MTK program was envisioned in line with the United Nations (UN) Sustainable Development Goals and the UN Decade of Action on Nutrition. NNedPro aims to create a sustainable solution that will enable the rural-urban slum-dwellers and various marginalized communities across regions of the world to challenge food insecurity and malnutrition. The current model constitutes a Mobile Teaching Kitchen Project which involves a fully adapted van, with fully functioning kitchen, travelling to two slums in Kolkata, India and providing nutrition education to slum-dwelling mothers. Trained volunteers were used to deliver nutrition teaching to mothers in these communities, with the aim of empowering them with skills and knowledge on cooking a healthy nourishing meal, whilst being able to pass this knowledge on to others. The nutrition program follows a template menu, comprised of locally available ingredients which are nutritionally complete, affordable, and can be made into a tasty meal.

This is taught through a SODOTO model providing education in a more traditional, story-telling or practical method. This model was proposed in 1890 by William Halstead, Chief of Surgery at John Hopkins Hospital as “a formal training program ... to ensure that surgical advancement [and training] would be passed on efficiently and effectively” (Kotsis & Chung, 2013). Since then, researchers like Qayumi (2010), Rohrich (2006), and Vozenilek et al. (2004) have criticized this model as outdated, especially in surgical training. The SODOTO model is disputed mainly with regards to its nonuniform application and patient safety as “students are unable to safely perform a medical procedure after only seeing it once” (Lenchus, 2010; Kotsis & Chung, 2013, p.1195). Despite contentions within surgical training, application of the SODOTO model remains relevant and applicable in other fields such as law and law enforcement (Coughlin, 2012).

Similarly, public health interventions, such as the MTK project, adopt this model of training as participants are more likely to learn and retain the steps involved in the cooking demonstrations if they learn it 'hands-on' and explain it to their peers.

Defining and Measuring Malnutrition

Malnutrition “refers to the deficiencies, excesses, or imbalances to a person’s intake of energy and/or nutrients, ... resulting in a measurable adverse effect on body composition, function, and clinical outcome” (World Health Organization, 2020; Saunders & Smith 2010; p. 625). The term covers two comprehensive conditions: undernutrition, which includes wasting, stunting, underweight, micronutrient deficiencies, and overnutrition, including overweight, obesity, and diet-related noncommunicable diseases (World Health Organization, 2020). Malnourishment is categorized differently for adults and children. For adults (>18 years), undernutrition is defined as a body mass index (BMI) below 18.5 kg/m² whereas BMI above 25 kg/m² and 30 kg/m² is defined as being affected by overweight and obesity respectively (World Health Organization, 2020; Center for Disease Control, 2020). For children, undernourishment is characterized by stunting (low height-for-age) and wasting (low weight-for-age), which can be either moderate or severe. A child is considered moderately or severely stunted or wasted when their height or weight is less than minus two standard deviations from the median height or weight for the reference population (UNICEF, n.d.). Further, micronutrient-related malnutrition is the inadequate intake of vitamins and minerals and the most common forms include iron, vitamin A, iodine, folate and zinc deficiencies. This condition affects individuals of all

genders and ages, however pregnant women and children under 5 years old are most at risk (Bailey et al. 2015).

One of the ways to characterize malnutrition, in all its forms, is to determine the nutritional status of an individual. A person's nutritional status depends on multiple factors such as complex interactions between the food they eat, the environment they occupy and their overall health state, hence its determination is often complex and problematic. It is usually determined using the ABCDE method which includes anthropometric, biochemical, clinical, demographics, and environmental and social factors (Upadhyay & Tripathi, 2017). According to the Global Nutrition Report 2018, the different forms of malnutrition continue to compound one another. Three of the most common forms of malnutrition are stunting of growth, anemia in women of reproductive age and overweight among women. Globally, 124 out of 141 (~ 88%) countries experience high levels of at least two of these indicators, with 41 reporting high rates of all three (Global Nutrition Report, 2018).

Malnutrition disproportionately affects women in India. According to the National Family Health Survey, as of 2016, 22.9% of women have a body mass index (BMI) below normal (BMI <18.5 kg/m²) compared to 20.2% of their male counterparts. Furthermore, 20.6% of women are affected by overweight or obesity compared to 18.9% of men (Saunders & Smith, 2010). In addition to gender, there are also disparities between urban and rural areas - 26.7% of women in rural areas are underweight (BMI < 18.5 kg/m²) compared to 15.5% of their urban counterparts (Saunders & Smith, 2010). Women living in urban areas are more likely to be affected by overweight or obesity and this condition is more acute in women of higher income and socioeconomic status than their poorer

counterparts. Further, more than 33% of India's child deaths are due to undernutrition, mostly from its most severe manifestations (National Family Health Survey, 2015-2016).

Malnutrition, in all its forms, is complex and multifactorial. According to Saunders and Smith (2010), "disease-related malnutrition arises due to reduced dietary intake, malabsorption [of food], increased nutrient loss or altered metabolic demands" (p.624). Additional factors associated with malnutrition include food insecurity, mental health disorders, income level, physical disability or impairment, level of education attained, inadequate healthcare infrastructure, and government policies (Meinhardt et al., 2011). Consequently, the populations most at risk include individuals with greater nutrient needs such as women and children, individuals residing in resource-deprived contexts, older individuals who are most at risk of physical impairment, and individuals with low health literacy, especially low nutrition knowledge.

Malnutrition presents serious health consequences for individuals and communities that are affected by it. Most common immediate health risks include weight loss, loss of muscle function, and decrease in cardiac-respiratory function, gastrointestinal and immune function. Long term health consequences include high blood pressure, increased risk of developing chronic diseases such as cardiovascular diseases and type 2 diabetes, growth retardation and stunting in children, and death (Meinhardt et al., 2011).

Individuals affected by malnutrition are also at risk of psychosocial health problems such as anxiety and depression as they are more likely to be stigmatized and/or bullied, particularly among children and young adults (NHS, 2018; Kvamme et al., 2011). Lastly, this condition also presents an economic burden to the communities and nation states that are affected by it directly through healthcare costs and indirectly through lost

productivity. Annually, India loses 12 billion USD in GDP to vitamin A and mineral deficiencies and childhood anemia alone is associated with a 2.5% decrease in adult wages (National Family Health Survey, 2015-2016).

Literature Review

Malnutrition remains the leading cause of death and disability worldwide. Since the 1990s, the overall prevalence rate of undernutrition in India has decreased for both adults and children (Aijaz, 2017), however, the numbers remain unacceptably high. In 2015, Davey et al. reported that over 33% of the world's malnourished children live in India whilst the 2017 ORF issue brief on preventing malnutrition and hunger in India, reported that 1194.6 million individuals in the country were undernourished during 2014 to 2016 (Aijaz, 2017). As such the government of India has declared malnutrition a public health emergency, and together with local NGOs and international agencies, has launched a multitude of food-based interventions and policy initiatives to address the issue of malnourishment in the region, although, challenges remain (Aijaz, 2017; Radhakrishna, 2005). As a way of addressing the issue of malnutrition among vulnerable populations, the *Bhavishya Shakti* MTK project included mothers from two slums in Kolkata, India as part of their pilot intervention study. An important aspect of this pilot intervention program is the application of medical education's "See One, Do One, Teach One" pedagogy established in 1890 by William Halstead (Kotsis & Chung, 2013). The goal of this literature review is to illustrate the overall state of malnutrition, including undernutrition, overnutrition, and micronutrient deficiencies, as well as outline the role of nutrition knowledge and education in food-based interventions.

State of Malnutrition in India

Malnutrition in India has been named the 'silent emergency' and according to the International Food Policy Research Institute (IFPRI), the nation was placed 66 out of 88 in the IFPRI Hunger Index (Ramakrishnan et al., 2012). According to a report released by researchers, Narayan, John, and Ramadas, in collaboration with the Ministry of Health and Family Welfare (2018), nearly 50% of India's children are malnourished and over 1 million children die annually before one month of age. Additionally, about 56% of women and adolescent girls aged 15 to 19 years are affected by iron deficiency anemia (Narayan et al., 2018) whereas for women aged 15 to 49 years, 35.8% and 14.4% are affected by underweight and overweight respectively (Sengupta & Syamala, 2012). Furthermore, a study by Ramakrishnan et al (2018) finds that India accounts for 40% of low birth weight (LBW) births in the developing world (p. 78-81).

In India, malnutrition disproportionately affects individuals of different ages and sexes. A study by Dutta et al. (2019) found that men and women aged 15-19 years had the highest prevalence of underweight whereas those aged 35-49 years were more likely to be overweight. For individuals aged 15-19 years in India, 46.3% of females and 49.7% of males were affected by malnourishment (Dutta et al., 2019). The opposite is observed for young adults aged 20-34 years where 40.7% of women were affected by malnourishment compared to 34.3% of young adult men. For adult men and women aged 35-49 years, 39.9% of the former were affected by malnourishment compared to 46.2% of the latter (Dutta et al., 2019).

In addition to age and gender differences in the prevalence rates of malnutrition in developing countries, the different forms of malnutrition disproportionately affect individuals across the socioeconomic gradient. A study by Ellen Van de Poel et al. (2008) investigated the extent to which child malnutrition differs between more and less socially and economically advantaged individuals – *socioeconomic inequality* in developing countries. Using data from the Demographic Health Survey (DHS), this study finds that stunting and wasting disproportionately affect the socially and economically disadvantaged (Van de Poel et al., 2008). Stunting and wasting were more concentrated among the poor, however, socioeconomic inequality across regions was less than that for stunting and was insignificant for about one-third of the countries (Van de Poel et al., 2008). Although, there was no apparent association between socioeconomic inequality and average level of stunting and wasting respectively. Recent works of Sengupta and Syamala (2012) and Dutta et al., (2019) reported similar trends in adult malnutrition in India where the prevalence rates for undernutrition is higher among adults of low socioeconomic status than their counterparts with higher social standing. Navaneetham (2008) also illustrated this phenomenon in his ‘Factsheet on Women’s Malnutrition in India’ where the prevalence rate of malnutrition is highest among socially and economically disadvantaged groups in the region.

Furthermore, there are also variations in state-level prevalence rates of both under- and overnutrition as well as variations between urban and rural areas. Less affluent states like Jharkhand, Orissa, and West Bengal, experience higher prevalence rates of underweight, whereas, in more affluent states like Delhi and Kerala, there is evidence of the simultaneous existence of underweight and overweight across populations (Sengupta &

Syamala, 2012). In these affluent regions, overweight and obesity is reported to affect women across the socioeconomic gradient whilst being more prevalent among the wealthier groups. Similar observations were made for place of residence (rural or urban), although, the gap between prevalence rates of chronic energy deficiency and overnourishment is decreasing (Sengupta & Syamala, 2012).

The double burden of malnutrition

A phenomenon with malnutrition in developing countries is the simultaneous existence of undernutrition and overnutrition, otherwise known as the double burden of malnutrition. Using data from the National Family Health Survey (NFHS), Sengupta and Syamala (2012) and Dutta et al., (2019) investigate the double burden of malnutrition in India, including patterns of distribution of its different forms between the sexes, across different age groups, as well as different states in the country. Overall, the analyses show a steady increase in the proportion of women and men affected by overweight and a stagnation in the proportion of those affected by underweight (Sengupta & Syamala, 2012; Dutta et al., 2019). For undernutrition, this condition is more prevalent among the poorest, and least educated men and women living in rural areas whereas overnourishment presents a problem for women of high socioeconomic status living in urban areas. Contrary to what is observed in high income countries, chronic energy deficiency is more prevalent among individuals of low socioeconomic status (SES), whereas those with a higher SES are more likely to be affected by overweight or obesity (Sengupta & Syamala, 2012; Dutta et al., 2019).

Overall, the different forms of malnutrition disproportionately affect different groups of the population. Sociocultural and economic factors such as caste discrimination, poverty, level of education attained, and employment status affect the distribution of this condition. Whilst the works of Sengupta and Syamala and Dutta et al., remain relevant, in-depth analyses of the effects of caste discrimination, diversification of food sources among the impoverished, social norms, and beliefs is lacking. Additionally, the literature overwhelmingly uses the body mass index (BMI) as a measure of chronic energy deficiency and overnutrition, thereby obscuring other forms of malnutrition such as abdominal obesity, protein energy malnutrition, and iron deficiency which present serious health effects for affected populations. In the Aijaz (2017) report, it remains unclear what BMI classification tool was used to determine whether a person or child was normal weight or affected by under- or overnutrition. Furthermore, Van de Poel et al.'s (2008) analysis of socioeconomic inequality, used a generalized index that was appropriate for comparisons of inequality and malnutrition across different regions with significant differences in levels of malnutrition. However, this paper focused solely on the relationship between socioeconomic inequality and childhood malnutrition, failing to account for the determinants of socioeconomic inequality in malnutrition. Additionally, the asset index used to deduce the socioeconomic status was constructed separately for each country, hence, it is likely for correlation between assets to differ between countries. Lastly, for 6 of the 47 countries in the study, data was only available for ages between 0 and 3 years. Since the level of observed malnutrition aggregates over time, the average rates of malnutrition for these regions were underestimated compared to the others. Lastly, earlier studies like Sengupta & Symala (2012) and Navaneetham (2008) used NFHS-2 and NFHS-3 as a

primary data source. The NFHS-2 survey included nutritional information for women aged 15-49 years that were ever married and therefore analysis is lacking for women that were never married at the time.

Consequences of Malnutrition

Malnutrition, in all its forms, is associated with adverse health outcomes. In addition to marasmus and kwashiorkor in children, malnutrition can also lead to growth retardation, cognitive impairment, and increased susceptibility to infectious diseases (Narayan et al., 2018). Due to reduced cognitive ability in childhood owing to undernutrition, labor productivity in adulthood is decreased, thereby impeding economic growth and development. Previous research such as the works of Aijaz (2017) and Radhakrishna (2005) describe the effects of malnutrition among different age groups - newborns, adolescents, and adults. Malnutrition among newborns and infants results in low birth weight and growth retardation, and its most severe manifestations are fatal. In adults, malnourishment increases susceptibility to infectious diseases like tuberculosis, and increases risk of chronic diseases like ischemic stroke and cardiovascular diseases (Aijaz, 2017). In addition to health consequences, malnutrition presents an economic burden for individuals, communities, and countries that are affected by it such as healthcare costs. According to a report by the United Nations Development Program (2012), India loses \$12 billion annually to micronutrient-related malnutrition.

Risk factors and affected population

Narayan et al., (2018) proposed that the risk factors for child malnutrition in India include mother's nutritional status, lactation behavior, poor sanitation, and the lack of nutritional knowledge among mothers. Additionally, the prevalence of adult malnutrition in the region is associated with unemployment and income poverty, lack of nutrition knowledge, inadequate investment in healthcare infrastructure and services, lifestyle, and weak implementation of nutrition schemes (Aijaz, 2017). However, the association of income poverty and economic growth with malnutrition in India remain an area of contention. Studies such as Radhakrishna (2005) and Navaneetham (2008) revealed that although "economic growth resulted in a decline of poverty [in the region], it has not translated in a commensurable increase in food energy intake" (Radhakrishna, 2005, p.1821), particularly for women. Despite India's recent economic growth and development followed by reasonable reductions in poverty levels in the region, women's nutrition has not been significantly improved. Instead, there has been an increase in malnutrition levels among this group, particularly iron deficiency anemia (Navaneetham, 2008).

Current government initiatives and policies

The government of India has initiated a multitude of food-based intervention and policies that target malnutrition in India. These initiatives vary in size, target population and function such as growth monitoring, micronutrient supplementation, financial incentives, education, and counseling. The works of Aijaz (2017), Radhakrishna (2005), and

Ramakrishnan et al. (2012) examine past and current policies and food-based program interventions in India. Reports describe the key nutrition policies and initiatives in the region, such as the *ICDS*, *MDM*, *PDS*, and National Rural Health Mission as well as highlight improvements that have been made so far and the challenges that remain. Findings show that current government initiatives, like the micronutrient supplementation, food distribution, and food fortification strategies, have been effective in reducing the prevalence rates of undernutrition, as well as micronutrient-related diseases among pregnant women and children (Ramakrishnan et al., 2012). Overall, since the 1990s, there has been a decrease in the proportion of undernourished adults (from 24% in 1990-92 to 15% in 2014-16), as well as a decrease in the proportion of children who are underweight, stunted, or anemic (Aijaz, 2017), however, mismanagement of resources and funds or lack thereof, loss of food grains, inadequate training for workers, and social and cultural barriers threaten the implementation and effectiveness of existing nutrition policies and initiatives (Aijaz, 2017). Furthermore, Radhakrishna (2005) noted the need for a more targeted approach toward women and children in rural areas.

The studies cited above remain relevant to inform public policy interventions and government initiatives in the region. However, Ramakrishnan et al. (2012) focused on impoverished rural populations and provides no data on the urban poor. Additionally, key informants suggest that individuals are more likely to seek treatment at private facilities, although, the private healthcare sector was excluded in this study. Further, analyses is lacking for the social and cultural barriers that hinder the implementation of these food-based strategies, including the extent to which they impact implementation.

Nutrition Knowledge and Changes in Food Behavior

In 1990s, Wardle et al. (1999) investigated the associations between nutrition-related knowledge and food behavior, namely, intake of fat, fruits, and vegetables. This study was based in England and included 500 patients randomly selected from general practitioners' lists in Essex, Lancashire, and Oxfordshire. Participants were asked to fill out questionnaires in order to assess the nutrition-related knowledge and food intake. Results indicated that "nutrition-knowledge was significantly correlated with intake of all three food types" (Wardle et al., 1999, p.272). Generally, women consumed more fruits and vegetables and less fat compared to their male counterparts. They also scored higher for their nutrition knowledge assessments than the men (F=64.1%, M=59.7%). Furthermore, knowledge scores increased with age and level of education. Respondents between 45 and 64 years scored an average of 64% whereas those aged 13-34 years scored 58.9%. Similarly, patients with degree/higher degree scored highest at 72.3% than their counterparts with no qualifications (56.2%). In addition, non-manual workers had higher knowledge scores than manual workers. Therefore, older, more educated individuals who are non-manual workers consumed more fruits and vegetables and less fat than their counterparts.

In 2002, a similar study carried out by Anthony Worsley, professor at the School of Health Sciences, Deakin University, investigated the role of nutrition knowledge in changes in food behaviors through a review of the literature. Worsley interrogated the domains of nutrition knowledge, how we measure nutrition knowledge, and its effect on food behaviors. His findings revealed that although nutrition knowledge is a contributing factor

to an individual's food behaviors, it is not sufficient to explain food behaviors (Worsley, 2002). According to Worsley, other factors that influence food-related choices and behaviors include motivators, the psychological capability of an individual, and the physical and social opportunity when making food choices. This paper emphasizes the social, economic, and cultural factors as important predictors of food behaviors, almost as important as nutrition knowledge. Worsley advocated for more research into the ways people acquire and use nutrition knowledge, considering individual's personal food goals and being attentive to the development of knowledge frameworks in adults and children.

Further research by Sharman et al (2019) assessed the determinants of knowledge, attitudes, and self-efficacy, and the relationships between nutrition-related knowledge, attitude, and self-efficacy among adolescents in India. This observational study included 2,210 participants from three rural and urban areas in Uttar Pradesh and West Delhi respectively. Overall, “adolescents living in rural areas and belonging to other backward classes and general caste performed better than their counterparts living in slums” (Sharman et al., 2019, p.3), and performance increased with participants' age and level of education. Further, adolescents from scheduled castes or tribes had lower self-efficacy scores and poor-nutrition knowledge than their counterparts from non-backward classes. However, results show that improving the level of education increases self-efficacy.

In the Wardle et al. (1999) paper, the study instrument was a postal survey, hence there may be bias towards individuals interested in dietary issues. Further, the sample is not representative, almost 100% respondents were white and therefore the findings may not be generalizable to ethnic minorities. Similarly, in Sharman et al. (2019), the sample

was not truly random as participants were chosen from project districts. Further, the sample was not representative of the population in these areas with regards to caste groups and social class, thereby limiting the external validity of the findings. Lastly, there is a potential for self-reporting and non-response bias with self-administered surveys.

Malnutrition in India persists despite recent economic growth and current government nutrition-related interventions and initiatives. The reviewed literature suggests that although current food-based interventions have been effective, there is a need for more targeted approach, particularly for women and children that are socially and economically disadvantaged (Radhakrishna, 2005; Sengupta & Syamala, 2012; Dutta et al., 2019). Furthermore, improving maternal education and overall nutrition-related knowledge were associated with improving the nutritional status of mothers as well as their children (Kalosona et al., 2016; Radhakrishna et al., 2005). However, further research is needed to solidify the association of nutrition knowledge with improving malnutrition in India.

The positive association between maternal education and nutritional status of mothers and children in India (Kalosona et al., 2016; Radhakrishna et al., 2005), and the reported applicability to the SODOTO method of training in other fields (Coughlin, 2012) leads me to believe that this method of intervention in public health nutrition, especially in the MTK project in Kolkata, India will be effective in conveying nutrition-related knowledge, attitude and practices, hence improve overall nutritional status of mothers in the long haul.

Methodology

Data

This study includes 12 participants that were selected by virtue of their location. Final analysis include survey data collected for the pilot phase of the *Bhavishya Shakti Mobile Teaching Kitchen* program in February 2018 by the NNedPro team.

Key Independent Variables

Demographics data collected include level of education, occupation and annual income. For the level of education, respondents were categorized as having either primary education or none. In addition, participants were categorized as either 'housewife' or 'domestic worker' for their occupation, and for income, they were categorized according to their annual earnings .

Key Dependent Variables

The knowledge, attitude and practices of the participants with regards to nutrition were surveyed pre- and post-intervention using the survey questionnaire shown in Appendix A. At the end of the 'Teach One' step, participants were assessed on 5 key components using the questionnaire shown in Appendix B. These key components include food handling and overall hygiene, cooking skills, understanding the importance of a balanced diet, their retention of knowledge and skills gained, and most importantly, their ability to explain and teach others.

Analysis

Using Excel-based tools, measures of central tendency and variability were used to assess the impact of the SODOTO model of intervention in both slums as well as identify patterns between income, level of education, and occupation of the participants and their 'Teach One' assessment. The 'Teach One' self-assessment and KAP survey responses were scored using a simple rating scale. For the 'Teach One' responses, scoring was as follows: 'not confident' (0), 'average' (1), 'good' (2), and 'excellent' (3). In the case of the KAP survey responses, each of the three components of the survey were coded separately, as seen in Appendix D. Appendix E shows the simple rating scale for the demographics data. The explanatory variables include level of education, occupation and income, and the response variable is the 'Teach One' responses. Furthermore, the knowledge, attitudes, and practices were assessed for statistically significant improvements, if any, pre- and post-intervention. Differences in variables pre- and post-intervention were analyzed using a dependent sample t-test.

Results

'Teach One' Responses

Table 1. mean scores for 'Teach One' responses and the level of education.

Level of education	Mean Score \pm <i>sd</i>	95% CI
No formal education	2.05 \pm 0.19	1.75 - 2.35
Primary (up to IV)	2.36 \pm 0.41	1.85 - 2.87
Higher than IV	2.60 \pm 0.40	1.61 - 3.59

Table 2. mean scores for 'Teach One' responses and the level of annual income.

Annual Income (/ -)	Mean Score \pm <i>sd</i>	95% CI
< 2000	2.40 \pm 0.20	1.90 – 2.90
2000 - 4999	2.27 \pm 0.39	1.85 – 2.68
> 5000	2.33 \pm 0.61	0.82 – 3.85

For the 'Teach One' responses, participants who received no formal education ($n = 4$) on average performed less than their counterparts who were educated up to at least level IV primary ($n = 8$). Participants with the highest level of education, higher than level IV primary, had the overall highest score. In the case of the participants' occupation, housewives ($n = 5$) had a higher mean score of 2.36 ± 0.17 (95% CI: 2.15 – 2.57) than their counterparts who were domestic workers ($n = 7$, mean score = 2.28 ± 0.50 ; 95% CI: 1.82 – 2.75). Furthermore, participants who earn the least amount of money, less than 2000 /- annually, scored highest during this step of the intervention relative to their counterparts who made over 2000 /- annually, as shown in Table 2.

Knowledge, Attitudes, and Practices

Table 3. mean scores for KAP survey responses pre- and post-intervention.

	Mean Score \pm standard deviation
Pre-intervention	1.43 \pm 0.52
Post-intervention	1.83 \pm 0.58
P(T<=t) = 0.0033	

As shown in the table above, participants reported marginal improvements in their nutrition knowledge, attitudes, and practices post-intervention. The p-value is less than the threshold of 0.05 and therefore there is evidence that the *Bhavishya Shakti Mobile Teaching Kitchen* program improves the nutrition knowledge, attitudes, and practices of individuals who participate. However, this evidence is not 'strong', given the small sample size.

Discussion

This purpose of this study is to assess the effectiveness of the *Bhavishya Shakti* MTK program. In particular, to assess the SODOTO method of training in nutrition education among slum-dwelling mothers in rural India. Using survey data, this paper examines the relationship between demographic characteristics, namely the level of education of the participants from the two slums – R.G. Kar Canal and Chetla, their occupation and income status with their 'Teach One' responses. Additionally, changes in nutrition-related knowledge, attitude and practices pre- and post-intervention were assessed.

Findings show that participants with the highest level of education, in this case higher than level IV primary education (n=3), performed better during the final stage ('Teach One') of the SODOTO method of training than their counterparts who received no formal education. For occupation and annual income, the housewives scored higher than their counterparts who were domestic workers whereas, participants who earn the least amount of money, less than 2000 /- annually, scored highest during this step of the intervention relative to their counterparts who made over 2000 /-. Further, analyses of KAP survey responses revealed overall improvements in nutrition-related knowledge, attitudes and practices among participants post-intervention.

The findings in this study are congruent with earlier findings that showed that attaining higher levels of education improves nutrition-related knowledge, attitudes, and self-efficacy (Sharman et al, 2019). Furthermore, overall improvements in nutrition-related knowledge and practices is consistent with previous findings that suggest relevance and effectiveness of medical education's SODOTO pedagogy (Kotsis et al., 2013). Similarly, previous studies conducted have identified that malnutrition persists despite increase in income levels (Radhakrishna, 2005; Ramakrishnan et al., 2012), and manual workers, such as domestic workers, have poor-dietary habits relative to their counterparts with non-manual forms of employment (Wardle et al., 1999). However, it remains unclear whether the participant's income status or type of employment are strongly associated with poor nutrition knowledge due to confounders such as the level of education attained.

This study has several limitations. The generalizability of the findings are limited by the small sample size. Participants were selected by virtue of their location (non-random) which also limits the external validity of the findings. As such, it is beyond the scope of this study to conclusively claim a strong association between level of education attained, income status or occupation with nutrition-related knowledge, attitude, or practices. Although, this pilot work provides a good direction to the types of data that may be collected and analyzed in further work as this project is scaled in the future.

Conclusion

In India, malnutrition, in all its forms, is a public health emergency affecting nearly half of the nation's population. Due to the alarming prevalence rates of this condition in the region, the *Bhavishya Shakti* MTK program was implemented to ameliorate its effects

among socially and economically disadvantaged women living in slums. This program included locally trained volunteers that followed the SODOTO method to convey nutrition-related knowledge to their peers through cooking demonstrations of sustainable, nutritious, and affordable meals. Findings revealed a positive association between the level of education attained by participants and their overall performance during the final stage ('Teach One') of the pilot intervention. Furthermore, there were overall improvements in nutrition-related knowledge, attitude, and practices post-SODOTO method of intervention. However, further research is needed to establish the association between income level and form of employments with an individual's nutrition-related knowledge, hence dietary choices.

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Appendix A – KAP Survey Questionnaire

KNOWLEDGE

Please circle the box that most closely matches your level of knowledge

1. What do you understand about your child's healthy nutrition/healthy food practice?

No Knowledge	Some Knowledge	Moderate Knowledge	Good Knowledge	Very Good Knowledge
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2. Do you have any knowledge regarding the nutrition value of different types of oils such as mustard oil, soya oil, Banaspati/Dalda, ghee etc.?

No Knowledge	Some Knowledge	Moderate Knowledge	Good Knowledge	Very Good Knowledge
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3. Do you have any knowledge about protein rich foods?

No Knowledge	Some Knowledge	Moderate Knowledge	Good Knowledge	Very Good Knowledge
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4. Do you have any knowledge about the usefulness of green leafy vegetable for your child?

No Knowledge	Some Knowledge	Moderate Knowledge	Good Knowledge	Very Good Knowledge
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5. Do you have any knowledge about low cost nutritious food?

No Knowledge	Some Knowledge	Moderate Knowledge	Good Knowledge	Very Good Knowledge
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ATTITUDE

Share your opinion on the statements below: how strongly do you agree or disagree?

6. Fruits and vegetables are healthy/essential for your child.

Strongly disagree	Disagree	Neither agree nor disagree		Agree	Strongly agree
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7. Milk is highly recommended for strong bones and teeth.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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8. Pulses, nuts, seeds, egg, poultry, and flesh foods are essential for your child's growth and development.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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9. Mixed and variety of naturally colorful foods are an attractive and natural immune enhancer for your child.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
-------------------	----------	----------------------------	-------	----------------

10. Fruits and vegetables provide vitamins and minerals.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
-------------------	----------	----------------------------	-------	----------------

11. Small amount of frequent feeding is good for the health of your child.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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12. Breakfast plays an important role for your child's growth and development.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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13. If your child is ill, skipping meals is good.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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14. Whole fruit is better than fruit juice.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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15. It is better to wash vegetables before cutting.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
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PRACTICE

16. How often do you have milk & milk products?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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17. How often do you have roots and tuber?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
-------	------------	-------------	-------------	-----------------------

18. How often do you have pulses?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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19. How often do you have green leafy vegetables?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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20. How often do you have nuts & seeds?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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21. How often do you have fish/ meat/ egg?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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22. How often do you have fruits?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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23. How often do you offer your child homemade food during the day?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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24. How often does your child take outside food during the day?

Never	Once a day	2 x per day	3 x per day	More than 3 x per day
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25. Do you provide school *tiffin* to your child?

Never	1-6 days per month	7-12 days per month	13-18 days per month	Almost regularly
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Demographic Data				
NAME OF PARTICIPANT				
Address				
Age (Years)		Date of Birth (DD/MM/YYYY)		
Gender	Male		Female	
Please circle where this form was KAP questionnaire was completed				
See One	Do One	Teach One	Children Focus Group	Male Focus Group
Date:		Signature of investigator:		

Appendix B – ‘Teach One’ survey questionnaire



Knowledge, Attitude, Practices Self-Assessment: ‘Teach One’ Teaching Kitchen, Kolkata

Unique code		Date	
Participant Name			
Inner Wheel rep		Trained mother	

This should be completed by the participating mothers with the assistance of a team member.

Key



Not confident



Average



Good



Excellent

In the table below, circle how confident you feel in relation to your skills in the following areas:

Food handling and overall hygiene				
Cooking skills				
Understanding the importance of a balanced diet				
Retention of knowledge and skills gained				
Ability to explain and teach others				

Appendix C - Simple rating scale for KAP survey responses.

Knowledge

Multiple choice option	Score
No knowledge	0
Some knowledge	1
Moderate knowledge	2
Good knowledge	3
Very good knowledge	4

Attitudes

Multiple choice option	Score
Strongly disagree/Disagree	0
Neither agree nor disagree	1
Agree/Strongly agree	2

Practices

Multiple choice option	Score
Never	0
Once a day	1
2x a day	2
3x a day	3
More than 3x a day	4

Appendix D - Simple rating scale for demographic data.

Income

Annual Income (/ -)	Score
< 2000	0
2000-4999	1
>5000	2

Education

Level of education attained	Score
No formal education	0
Primary education (Up to IV)	1
Higher than IV	2

Occupation

Housewife	0
Domestic worker	1