

INTRODUCTION

Micronutrients are essential vitamins and minerals required by the body in miniscule amounts throughout the life cycle (UNICEF, 2012). Micronutrients are responsible for maintaining sound health and also important for normal functioning of human body systems.

Micronutrients play leading roles in the production of enzymes, hormones and other substances and also help to regulate growth, activity, development and functioning of the immune and reproductive systems (Ekweagwu *et al.*, 2008).

Inadequate intake of micronutrients are now recognized as an important contributor to the global burden of disease through increased rates of illness and death from infectious diseases and of disability such as mental impairment (Black, 2003).

Micronutrient deficiency has global health impact because its manifestations become less visible and usually begins to show when the condition is severe and has already led to serious health burdens, justifying the name “hidden hunger.” Deficiencies occur when people do not have access to micronutrient-rich foods such as fruits, vegetables, animal products and fortified foods, usually because they are too expensive to buy or are locally unavailable (Bhandari and Banjara, 2015).

Micronutrients affect low-income countries but are also a significant factor in health problems in industrialized societies with impact among wide vulnerable groups in the population, including women, children, the middle-aged and the elderly people. Micronutrient deficiencies are not always clinically apparent or dependent on food supply and consumption patterns. They are associated with physiologic effects that can be life-threatening or more commonly damaging to optimal health and functioning. Iron deficiency is the most prevalent nutrition

problem in the world. Folic acid deficiency remains responsible for excess birth defects, and many other micronutrient deficiencies are affecting populations at risk of growing obesity and with poor habits of physical exercise (Tulchinsky, 2010).

Micronutrient deficiencies can have major adverse health consequences, contributing to impairments in growth, immune competence, mental and physical development, and poor reproductive outcomes (Viteri and Gonzalez, 2002, Ramakrishnan, 2002). Micronutrient deficiencies have huge impact on health of vulnerable population like women and children and have jeopardized the national economy and prosperity of developing countries. The major causes of micronutrient deficiencies are poor diet, diseases and infestations and poor health caring practices (Bhandari and Banjara, 2015).

Deficiencies of fat soluble vitamins, iron, and zinc are particularly common, but deficiencies of other water-soluble vitamins, minerals and trace elements are also found and have great impact in physical, mental and cognitive development of an individual. Iron deficiency is the most common and widespread nutritional disorder in the world. It affects a large number of children and women in developing countries (<http://www.who.int/nutrition/topics/ida/en/>). Folic acid deficiency remains responsible for the excess birth defects (Blencowe *et al.*, 2010). Vitamin D deficiency can lead to osteoporosis and bone fractures and may become life-threatening or leave an elderly person permanently handicapped, thus reducing length and quality of life (Holick and Chen, 2008). Vitamin A deficiency is a public health problem in more than half of all countries, especially in Africa and Southeast Asia, which causes preventable blindness and increases the risk of disease and mortality (Sommer, 2008).

World Health Organization (WHO) considers that more than 2 billion people worldwide suffer from vitamin and mineral deficiencies, primarily iodine, iron, vitamin A and Zinc, with important health consequences (WHO, 2000).

Globally, night blindness affects 5.2 million preschool age children and 9.8 million pregnant women, which corresponds to 0.9 per cent and 7.8 per cent of the population at risk of Vitamil A Deficiency (VAD), respectively. The prevalence of

night blindness is moderate to severe public health significance in 45 countries for preschool-age children and 66 countries for pregnant women. According to current estimates, 122 countries are classified as having a moderate to severe public health problem based on biochemical VAD in preschool-age children; while 88 countries are classified as having a problem of moderate to severe public health significance with respect to biochemical VAD in pregnant women (WHO, 2009).

According to the NNMB (2006) report, of the 14,039 men and 18,603 women examined, 0.4 per cent of men and 0.3 per cent women had Bitot's spots, with a relatively higher prevalence in the State of Tamil Nadu. About 2.3 per cent women had goiter, while its prevalence was negligible among men.

Globally, anaemia affects 1.62 billion people, which corresponds to 24.8 per cent of the population. The highest prevalence is among preschool-age children (47.4%) and the lowest prevalence is among men (12.7%). However, the population group with the greatest number of individuals affected is non-pregnant women (468 million) (WHO, 2008). The overall prevalence of anaemia among women was about 75 per cent, with about 31 per cent having moderate and 3 per cent severe anaemia (NNMB, 2006).

Iodine deficiency is estimated to have lowered the intellectual capacity of almost all of the nations reviewed by as much as 10 to 15 per cent points. Vitamin A deficiency is compromising the immune systems of approximately 40 per cent of the developing world's under-fives and leading to the early deaths of an estimated one million young children each year. Folate deficiency is causing approximately 2,00,000 severe birth defects every year and is associated with approximately 1 in every 10 adult deaths from heart disease. Severe iron deficiency anaemia is causing the death of an estimated 50,000 young women a year in pregnancy and childbirth. Iron deficiency in adults is so widespread that it is lowering the energies of nations and the productivity of workforces – with estimated losses of up to 2 per cent of GDP in the worst affected countries. "Vitamin and mineral deficiencies," says the World Bank "impose high economic costs on virtually every developing nation" (UNICEF, 2004).

Osteoporosis is a significant problem in rapidly ageing populations in Asian regions. It causes a significant personal and societal impact and increases the burden on health care services (Ediriweera de Silva *et al.*, 2014). In 2013, 50 million people in India are either osteoporotic (T-score lower than -2.5) or have low bone mass (T-score between -1.0 and -2.5) (Mithal and Kaur, 2012).

In a study among Indian women aged 30-60 years from low-income groups, Bone Mineral Density (BMD) at all skeletal sites was much lower than values reported from developed countries, with a high prevalence of osteopenia (52%) and osteoporosis (29%), thought to be due to inadequate nutrition (Shatrugna *et al.*, 2005). One out of three women in India suffers from osteoporosis (Cummings *et al.*, 2002). Dietary calcium and phosphorous were significantly lower in rural adults than in urban adults (Harinarayan *et al.*, 2007).

In most parts of India, for a girl child, life is a constant fight for survival, growth and development from the time she is conceived till she attains 18 years (Park, 2015). Women bear the brunt of under nutrition, facing inequities from birth in terms of access to resources like care, food, access to health care services, household burden etc. In 2005 -2006 according to NFHS 3 about three fourths (72%) of women of 14-49 years of age had some form of anemia. In adolescent/pregnant or lactating women only 60-75 per cent of the protein requirement was met (Gulati *et al.*, 2012).

Women are the central figure providing the child care, hygiene, nutrition and even Primary Health Care (Balasubramaniam, 2006). Women are instrumental in the acquisition of food, its preparation, storage and distribution. However very often they are subjected to malnutrition and form a group highly vulnerable to morbidity and mortality due to undernutrition (Lakshmi and Babitha, 2014).

More than one-third (36%) of women aged 15-49 years in India have a BMI below 18.5 indicating chronic nutritional deficiency, including 16 per cent who are moderately to severely thin. Fifteen per cent of women are overweight or obese (NFHS 3, 2005- 2006). One out of three women in rural India above the age of 35 have been found to be overweight (The Times of India, April 6, 2009).

Poor health has repercussions not only for women but also their families. Women in poor health are more likely to give birth to low birth weight infants. They also are less likely to be able to provide food and adequate care for their children. Finally, a woman's health affects the household economic well-being, as a woman in poor health will be less productive in the labour force (Kamalapur and Reddy, 2013).

In India, Micro finance and Self Help Group (SHG) intervention have brought tremendous change in the life of women at the grass root level by empowering them (Lopamudra and Suresh, 2012).

Health is obviously an integral component of women's well being and empowerment and it is also organically linked to their living within the household and the society. The health and nutritional status of women are at large very critical and various strategies are being adopted to improve the condition. One of the best agency through which women's status can be improved is Self Help Groups (SHGs).

Self Help Group is a group of village based financial intermediary usually composed of 10-15 local women. The group may be either a registered or unregistered group having homogenous socio economic backgrounds, willfully joining together with an attitude to save their money, make use of such funds to contribute to a common fund with an intention to meet their emergency needs on the basis of mutual help (Mandal, 2013).

Self Help in the context of women's health is not new. For centuries, women had knowledge and control of their own bodies. It was only with the "modernization" of our medical system that our bodies became the "property" of doctors. However, even today women in rural areas rely mostly on information gathered and share from other women or elderly women in family or society in the matters of their health, and other related problems and remedies. Although we cannot say that these interactions take place in formal SHG structure, it is a century old practice to help others. Whereas formal self help groups consist of women of diverse orientation, race, class and age, who come together to explore various issues,

mostly their economic needs and business where they also discuss and share health related information and issues with other members of the group (Kumar,2006).

Self Help Groups enable the members to learn, to cooperate and to work in a group environment by providing savings and an effective credit delivery mechanism in order to cater to the economic needs of the members (Bassi, 2015). Credit is the need for women as it improves women access to resource and also controls their spending thereby helping them to cope with poverty, and state of backwardness (Justus and Mahiba, 2000).

SHGs play a vital role in creating awareness of health issues through necessary group meetings with women (Chakravarthy and Jha, 2012).SHGs emerge as an important strategy for empowering women and in alleviating poverty. SHG is a “people’s scheme” and its organization is a significant step towards empowering women. Women SHGs represent a form of intervention that is a radical departure from most current programmes. They are an effective strategy for poverty alleviation, women development and social empowerment (Das and Bhowal, 2013).

It is assumed that SHGs will play a larger role in its contribution towards improving women’s health and empowerment as well as for achieving “Millennium Development Goals” in developing countries.

There are 5, 56, 311 SHGs with 85,69,676 members in Tamil Nadu as on 30.09.2012. In Coimbatore district 19,236 SHG groups were formed as on 31.03.2012 with 295754 members (TCDW, 2013). Out of which 1044 groups are in Karamadai Block among the 17 Panchayat villages and 595 groups are in Periyanaickenpalyam block among the 9 Panchayat villages (Saravanakumar and Mamta, 2012).

A woman’s nutritional status has important implications for her health as well as the health of her children. A woman with poor nutritional status, as indicated by a low Body Mass Index (BMI), short stature, anaemia, or other micronutrient

deficiencies, has a greater risk of obstructed labour, having a baby with a low birth weight, having adverse pregnancy outcomes, producing lower quality breast milk, death due to postpartum haemorrhage, and illness for herself and her baby (NFHS-3, 2005-06).

Major challenge is how to identify individuals and/or populations who have nutritional problems. Appropriate nutritional assessment can provide the answer. Anthropometric indices such as weight for age, height for age, weight for height, and measurements such as mid-upper arm circumference and triceps skinfold, are especially useful in detecting a possible chronic imbalance of protein and energy, and can be used in certain cases, to identify moderate and severe malnutrition. No single index of nutritional status provides a definite diagnosis of all levels of nutritional deficiency. To assess the nutritional status of individuals or populations, a combination of dietary, biochemical, anthropometric and clinical methods is considered the gold standard (Wasantwisut *et al.*, 2011).

Addressing nutritional deficiencies brings considerable economic and social benefits like reducing morbidity and mortality, leads to resource savings in health, improves education outcomes, enhances productivity and increases incomes (SCN, 2004). The methods available to control malnutrition are diet diversification, food fortification, medicinal supplements and disease control (<http://www.fao.org/docrep/x0051t/x0051t09.htm>)

The most popular approaches to addressing malnutrition are supplementation and food-based strategies including nutrition education and food fortification (Ruel and Levin, 2000). Food based interventions play an important role for overcoming and preventing micronutrient deficiencies (Chaudhary *et al.*, 2011).

Food based approaches, especially use of low cost locally available nutritious foods is the best strategy to improve the micronutrient status of the women. Women need to have sufficient knowledge to select, process and prepare the foods in right combinations. For that women need to have a sufficient

knowledge about food and their nutrients, deficiency diseases and the ways to correct the deficiencies especially micronutrient deficiencies. Hence, well designed food based interventions, with the use of supplements and supported by health and nutrition education can improve the diets of vulnerable populations in a relatively short period of time and that those improvements are sustainable (Fanzo *et al.*, 2012).

Supplementation strategies play an important role in combating acute micronutrient deficiencies, whereas food based strategies such as food fortification, nutrition education and home-gardening may potentially lead to longer-term elimination of micronutrient deficiencies (Chadha and Oluoch, 2003).

World Health Organization (2002) recommends to increase the consumption of fruits and vegetables and legumes, whole grains and nuts in the diet to overcome malnutrition.

A fundamental strategy to address micronutrient deficiencies in resource-poor communities is to increase the availability of, access to, and ultimately consumption of foods that are rich sources of micronutrients. Based on the micronutrient status of the SHG women, low cost locally available micronutrient rich foods were selected and used for the development of nutritious mixes for supplementation to SHG women.

Green Leafy Vegetables (GLV) are micronutrient dense nature's gift to mankind that provides more vitamins per mouthful than any other food. GLV are known to be rich sources of micronutrients such as vitamin A, iron, β -carotene, etc. and utilizing them in one way or other will ensure the micronutrient intake. GLV are inexpensive sources of micronutrients, however their utilization seems to be limited either due to ignorance or the inability to use them in many products (Gupta and Prakash, 2011).

Though India stands second in vegetables and fruits production, hardly two per cent of the produce is processed and 30-40 per cent is being wasted due to lack of processing and preservation infrastructure (Bukola *et al.*, 2011).

Green leafy vegetables are a storehouse of nutrients and looking at the Indian dietary patterns, it is well known that the amount of greens consumed is very low across the population despite the recommendation of a much higher quantity for desirable diets (Jamuna Prakash, 2013).

Processing by dehydration seems to be the simplest technology for preserving greens especially when they are abundantly available (Gupta and Prakash, 2011). Dehydration enhances the retention of nutritional value of the foods (Hussain *et al.*, 2008).

There are many varieties of green leafy vegetables which are though rich in micronutrients but usually discarded are not used for human consumption. One such leaf, a rich source of micronutrients but still under exploited is drumstick leaf (*Moringa oleifera*). Moringa leaves contain more vitamin A than carrots, more calcium than milk, more iron than spinach, more vitamin C than oranges, and more potassium than bananas, and that the protein quality of moringa leaves rivals that of milk and eggs. Dehydration of moringa leaves resulted in concentration of nutrients. Iron, calcium and phosphorus increased manifolds in the dehydrated samples (Joshi and Mehta, 2010).

A large number of researches on the nutritional quality of Moringa leaf report that it is rich in Beta carotene, calcium, iron, vitamin C and potassium (Fahey, 2005).

Araikeerai (*Amaranthus tristis*) has been noted to help boost the body's immune system. Solar drying of amaranth leaves showed the retention of beta carotene, iron and zinc in 77.5, 94.3 and 95.4 per cent respectively (Chege *et al.*, 2014).

Finger millet (*Eleusine Coracana*) is nutritionally significant in terms of its notably high calcium content, iron, zinc and dietary fiber. It also contains polyphenols which are phytochemicals with antioxidant activity (Rani and Antony, 2014). Of all the cereals and millets finger millet has the highest amount of calcium (344mg%) and potassium (408mg%) (Kathy *et al.*, 2013). Finger millet is nutritionally superior to other major cereals such as wheat, rice and maize and

being an excellent source of calcium, iron and zinc in addition to dietary fibre (Verma and Patel, 2013).

Roasted Bengal Gram (*Cicer arietinum*) is one of the oldest and most widely consumed legumes in India. The proteins are more digestible and better assimilated than those in other pulses. On the whole, bengal gram protein is the best pulse protein owing to its high Net – Protein –Utilization value (Manay and Shadasharaswamy, 2001).

Groundnut (*Arachis hypogaea*) is the world's fourth most important source of edible vegetable oil and third most important source of vegetable proteins. Groundnuts are exceptionally rich in niacin. Combination of groundnut and Bengal gram with millet, sesame seed or milk powder should result in a mixture with a favourable amino acid composition (Srilakshmi, 2007).

Supplementation of drumstick leaves powder (7 g) and amaranth leaves powder (9 g) per day for 3 months significantly improved the antioxidant levels by increasing serum retinol, serum ascorbic acid, glutathione peroxidase, superoxide dismutase whereas decrease in marker of oxidative stress i.e. malondialdehyde in postmenopausal women (Kochhar, 2012).

Chandrasekhar *et al.* (2000) studied the beta carotene availability of ten commonly consumed green leafy vegetables and five other vegetables subjected to various cooking methods using HPLC. Drumstick leaves in raw form had maximum total carotene content of 41.98mg and beta carotene content of 28.16 mg per 100g. When subjected to different cooking methods, sautéing retained maximum carotene content (88%) and loss was more in solar cooking.

Jancirani and Sarojini (2012) developed value added recipes with the addition of dried powders of Brahmi, Moringa and Amla, results showed that the moringa leaves powder incorporated recipes had the maximum beta carotene (15590±223 mcg), calcium (1997 ±288mg), energy (203±11 kcal) and protein (27.5 ±6g) when compared to other fresh and dried powders.

Under the Integrated Child Development Services (ICDS) Scheme of MWCD supplementary nutrition is provided to pregnant and lactating women as

food supplement of 600 calories of energy and 18-20 gms of protein per day in the form of Micronutrient Fortified Food and/or energy dense food as Take Home Ration. Children in the age group of 6 months to 3 years receive food supplement of 500 calories of energy and 12-15 gms of Protein per child per day as Take Home Ration (THR) in the form of Micronutrient Fortified Food and/or energy-dense food marked as 'ICDS Food Supplement'. Children in the age group of 3-6 years receive food supplement of 500 calories of energy and 12-15 gms of Protein per child per day (Press Information Bureau, 2014).

According to Food and Agricultural organization, nutrition education provides people with correct information on the nutritional value of foods, food quality and safety, methods of preservation, processing and handling, food preparation and eating to help them make the best choice of foods for an adequate diet. The provision of correct information is not in itself a sufficient objective to improve nutrition. Successful nutrition education goes beyond the simple accumulation of knowledge, towards positive action.

Involvement of women Self Help Group activities enabled them to have control over material possession, knowledge, and decision making in home and community. However, how these economic benefits are being translated into change in women's health status has not been explored. Women's participation in income generating activities is believed to increase their status and decision making power. Health and nutritional status is very important in achieving the women empowerment. Educating the SHG women is the need of the hour. The impact of nutrition and health perspectives in SHGs would pave way for enhancing the nutritional profile of women in rural areas.

With this background the study on the **Prevalence of Micronutrient Deficiencies among Self Help Group Women and the Impact of Interventions** has been undertaken with the following objectives.

- ◆ To collect information on the general profile of selected SHG women
- ◆ To assess the health and nutritional status of the selected SHG women

- ◆ To determine the prevalence of micronutrient deficiencies among the SHG Women
- ◆ To formulate nutritious mixes using foods rich in micronutrients, conduct acceptability trials and analyse the nutrients and antinutritional factors and find out the shelf life and cost of the developed mixes
- ◆ To supplement the developed mixes to the selected SHG women for a period of four months
- ◆ To plan and implement nutrition education and evaluate the impact of supplementation of nutritious mixes and nutrition education among the selected SHG women.