INTRODUCTION

At each stage of life, nutrition has its potential for the biggest positive impact on the health and wellness of an individual. Among the population, it is in charge of promoting optimum health and also preventing the causes of ill health and mortality. A common misconception is that undernutrition is always referred to as malnutrition. Basically, malnutrition is defined as a state where improper nutrition (i.e.) either more or less amount of nutrition, the real reflection of a person's nutritional status. The dual or double burden of malnutrition is that type of nutrition where the person is either with undernutrition or overnutrition. A new term coined to define malnutrition, which is the current topic for research, is the Triple Burden of Malnutrition. The Triple Burden of Malnutrition is described as the coexistence of undernutrition, overweight/obesity and micronutrient deficiencies within populations, households, and even individuals. In many parts of the world, people from all walks of life are affected by more than one form of malnutrition, which puts them at high risk of poor health outcomes and long-term chronic diseases. Any kind of malnutrition is always accompanied by a decline in the health status of an individual. Therefore, it is better to prevent the onset of malnutrition than to cure it.

Food stands Second in the Sustainable Development Goals (SDG) among the seventeen Sustainable Development Goals. This marks the importance of food for sustainable health promotion. This initiative, which was taken up by the United Nations, aims to achieve 'Zero Hunger' by 2023. According to the UN, the world is currently not on track to achieving 'Zero Hunger' by 2023. Therefore, it should be a collective effort of each individual of us to achieve this goal of achieving 'Zero Hunger' for optimum health (Henderson and Loreau, 2023).

Despite rising levels of food production, hunger, and malnutrition (which encompasses both overnutrition and undernutrition) still impact billions of people worldwide. It is now understood that these can also develop as a result of poor diets. High-quality diets in terms of nutrient-rich diets can fulfil the body's nutritional requirements. It is now more important than ever to concentrate on food quality and bioavailability rather than quantity of food consumed. According to data from the Global Burden of Disease Study (2017), one in five fatalities globally was attributed to dietary factors in 2017. Millions of people worldwide continue to suffer from hunger and malnutrition which

includes both overnutrition and undernutrition. It is now known that these might mainly arise from unhealthful diets. The body's key dietary requirements can be fulfilled by adequate quantity and quality diets composed of all nutrients in the diet. Concentrating on food quality and bioavailability rather than food quantity is now more crucial than ever. Globally, the prevalence of severe food insecurity among the general population grew from eight percent in 2014 to ten percent in 2018. Malnutrition among young adult women is mostly caused by a lack of access to affordable food. Every country in the world is affected by malnutrition in some way, and it is a significant barrier to achieving adequate nutrition, global food security, and sustainable development. Malnutrition is having a triple-whammy effect on the human population. From childhood through maturity and gender imbalance in nutrition exists in India. Due to inadequate nourishment, women never develop to their full potential. Women's malnutrition is linked to illiteracy, lack of awareness, lack of progress, and poverty. According to the current survey, there are more malnourished females (25.2 per cent) than males (20.2 per cent). To increase women's nutrition and food security, a wide range of development initiatives are required and are initiated effectively (Song *et al.,* 2020).

Research was conducted by Little *et al.,* (2020) in India on the double burden of malnutrition and revealed that co-morbid anaemia and overweight or obesity were present in 23.1 per cent of women and 13.1 per cent of men. Co-morbid anaemia and pre-diabetes prevalence was six percent in women and less than three percent in men, whereas co-morbid anaemia and diabetes prevalence was six per cent in women and nearly seven per cent in men. Indicators of over nutrition or under nutrition, such as diabetes, overweight, obesity, abdominal obesity, hypertension, stunting, anaemia, or underweight, did not exist in only thirteen per cent of participants (8.7 per cent of women and 17.9 per cent of men), indicating that only a small portion of the population were properly nourished and metabolically healthy. In an age- and sex-adjusted logistic regression model, several variables were linked to co-morbid anaemia and overweight. High caste was linked to higher probabilities of being overweight and having anaemia and being overweight concurrently. Wealth index values were linked to higher odds of obesity and co-morbid anaemia and obesity, suggesting that wealthier people were more likely to experience these consequences. Overweight and co-morbid anaemia and overweight were inversely correlated with rurality index values, indicating that people from less rural households were more likely to have these diseases.

Obesity in adults has been characterized of having a body mass index (BMI) equivalent to or greater than 30 kg/m^2. Globally, prevalence of obesity in adults was 13.2 per cent in 2016, which has consistently increased from 8.3 per cent in 2000. Obesity is often linked with excessive food consumption, but it is also usually related to micronutrient deficiencies and starvation. Prevalence of obesity among the adult population is usually attributed to micronutrient deficiencies such as zinc, iron and vitamin A, C, D and E. The increase in cases of obesity is a reminder to change our lifestyle pattern and food consumption pattern to improve our health status. Overweight and obesity are closely related to cardiovascular disease and diabetes. Gestational diabetes which is one of the pregnancy complications and found to mostly affect the people who are over-weight or obese. Therefore, it is need of the hour to maintain a healthy lifestyle pattern for quality living (Dietz and Santos-Burgoa, 2020).

According to present estimates, the prevalence of health issues as many as thirty-five percent of India's districts (221 out of 636) have an increased risk of underweight in women. Bihar has the highest rate—32 out of 38 districts—followed by Jharkhand (eighteen out of 24 districts), Madhya Pradesh (36 out of 50 districts), and Chhattisgarh (ten out of 18 districts). In the southern, northern, and western regions, there are several clusters where there is a significant vulnerability to becoming overweight in both men and women. Districts from the states of Kerala, Goa, Delhi, Tamil Nadu, Punjab, and Gujarat have significantly greater overweight burdens among adult population including males and women, whereas districts from Bihar and West Bengal have significantly lower burdens (Bhandari *et al.,* 2021).

In developing countries, malnutrition is a serious problem. According to NFHS 5 survey, one in three women had anaemia. Nearly half of anaemia cases are thought to be caused by iron deficiency, while folate, vitamin A, vitamin B12, and chronic inflammatory deficiencies are all known to contribute to anaemia. Preterm births and low birth weight rates are frequently associated with maternal anaemia. These are frequently among the main causes of greater infant death rates, higher perinatal mortality rates, and worse levels of productivity and mental focus. The public distribution system needs to be strengthened to improve in this area of malnutrition. (Jumrani and Rai, 2020).

Micronutrients are vitamins and minerals required by our body in small amounts essential to maintain good health and prevent diseases. These micronutrients even though required by our body in smaller quantity, need to be consumed on a daily basis, and are

equally important as macro nutrients. Common micronutrient deficiencies include iron, vitamin A, zinc, iodine, and folate. These deficiencies are often caused by poor dietary intake, low absorption of nutrients due to infections and even genetic factors and other unfavourable causative factors. Most of the micronutrient deficiencies does not give any kind of signs or symptoms. Therefore, micro-nutrient deficiencies are also called as 'hidden hunger'. These deficiencies can be cured to a greater extent with the help of a healthy lifestyle pattern with proper dietary and nutrient intake. Micronutrient deficiencies lead to serious health consequences, including anaemia, blindness, impaired cognitive development, and weakened immune systems, among the people in all walks of their life. Populations in developing countries tend to be the most vulnerable to these deficiencies, however, it is important to note that even affluent populations in developed countries are not immune to this issue. Current state of the country is such that the affluent people are becoming malnourished by choice. The lifestyle adopted by many young people and even adult is making them prone to this kind of malnutrition. In this state it is not the unavailability or access to proper food and nutrition; it is the choice of the food they take leading to malnutrition and downfall in their health. It is not food insecurity which is the major cause of the majority of malnutrition rather they are malnourished by choice (Godswill, *et al.,* 2020).

The concept of micronutrients as "magic bullets" is common. Global issues with vitamins and minerals alone and in combination include micronutrient deficiency illnesses and micronutrient malnutrition. Supplementing with food products help to combat the Triple Burden of Malnutrition. There is always a chance of underdosing or overdosing while taking supplements. The magic bullets could therefore become harmful if ingested in excess (Berger and Manzanares, 2021).

There are two billion people worldwide who suffer from micronutrient deficiencies, both in industrialised and developing nations. Mineral and vitamin deficiencies are silent epidemics that afflict people of all ages, genders, and risk groups. They have a significant impact on morbidity, mortality, and quality of life not only by directly causing some diseases but also by aggravating infectious and chronic disorders or diseases. Supplementation is necessary for deficiencies in some groups of people who are particularly at risk, but population-based approaches that involve dietary interventions and food fortification are the most efficient sustainable way to safely satisfy community health needs. These alternative approaches are a problem for both clinical medicine and public health,

coupled with food security, education, and monitoring. Numerous chronic disorders, including osteoporosis, osteomalacia, hypothyroidism, colorectal cancer, and cardiovascular diseases are associated with micronutrient deficiency situations and needs to have an appropriate dietary intervention Fortification has been successfully used to prevent some diseases, including birth abnormalities, for almost a century now (Tulchinsky, 2020). The most critical micronutrient deficiency is nutritional anaemia. It impairs a person's ability to function physically, mentally, and emotionally and has a detrimental effect on the developing brains of infants and young children (Arcanjo *et al.,* 2021). It is brought on by iron insufficiency, followed by folate and vitamin B12 deficiencies, and in rare cases, copper or other micronutrient deficiencies. The study focuses on providing young adult women with an overall nutritional elevation for a healthy existence. A research study was conducted on folic acid supplementation where pregnant women participated. The result revealed that, 82 per cent were aware of folic acid (FA) supplementation and 89 per cent reported using it. 51 per cent followed government's recommendations. Knowledge of actual FA supplementation, knowledge of FA supplementation in compliance with national standards, and higher levels of education were statistically substantially correlated. Family, friends, general practitioners (GPs), and the internet were the main sources of information. Interventions should incorporate information sources that pregnant women currently often utilise, such as the internet, general practitioners, family, and friends. (Zheng *et al.,* 2020).

Promoting the consumption of specific foods (such as grains, greens, and pulses) and cooking in iron pots have had a limited impact, primarily due to their decreased bioavailability. In recent years, iron folic acid (IFA) supplementation programmes have started to focus the target adolescents, expectant and nursing women, newborns, and kids in nations like India. However, due to low compliance and motivation, the programme hasn't yet demonstrated any results in India. The most recent survey results revealed heavy burden of malnutrition and several deficiencies (Ahmed *et al.,* 2022).

Malnutrition rates are on the rise in the nation. To combat the rising incidence of malnutrition in the nation, the government has developed several policies and initiatives at both the state and central levels. Furthermore, it would be beneficial to stop the rise in overweight and obesity trends rather than focusing just on lowering the percentage of the population that is stunted in India (Acosta, 2017).

It is also worth highlighting that there are persistent gaps between geographic units within India. For example, states with relatively high income, such as Kerala, have

experienced a major overweight and obesity burden while states such as Odisha, Uttar Pradesh, and Bihar face a higher burden of stunting and micronutrient deficiencies. In addition to regional differences, there are noticeable discrepancies when comparing rural and urban indicators. We learned among other findings that although there is persistently high prevalence of communicable diseases during the first years of life, mostly associated with such infectious diseases as diarrhoea among children, a high proportion of lives lost during adulthood are due to non-communicable diseases, especially cardiovascular diseases. Given the loss of life and loss in life expectancy resulting directly from malnutrition and indirectly from the associated increased frequency and intensity of disease, India must enhance its public health, nutrition, and agriculture policies. Relying on economic performance to improve social outcomes is insufficient (Biswas *et al.,* 2022).

Before the lockdown was put into effect, there was a severe food insecurity situation in India. India has some of the worst hunger figures in the entire globe. The 2019 Global Hunger Index evaluated 117 countries, with India coming in at number 102. Around 190 million Indians, or 14.5 per cent of the population, were undernourished, and 51 per cent of women between the ages of 15 and 49 who were pregnant were anaemic. Increased prevalence and intensity of food insecurity in India, where social norms and a lack of economic opportunity perceive women as inferior class, can have serious effects on women's and girls' nutritional status. During this early adulthood, growth and development is generally slower than in the early stages of life but body changes are for replacement of worn-out cells in the body. Firstly, there is a need for special attention to be given to this group of population since they are an easy victim of malnutrition. Secondly, the nutrition of this segment of population is the foundation for future motherhood and health. Thirdly, malnutrition of adulthood can be a major hurdle to socio-economic development of the family and in turn the nation in the future (Mishra and Rampal, 2020).

To overcome the issue of dual burden of malnutrition and micronutrient deficiencies, among young adult population especially women population, several strategies are being used. One common approach is to promote diet based sustainable measures including food fortification, which involves adding specific vitamins and minerals to foods that are commonly consumed, such as flour, salt, and oil. This intervention has already proven to be highly effective in many countries in preventing deficiencies of vitamin A, iron, and other nutrients. The second approach is delivering specific supplementation to vulnerable population including young children, pregnant women, and lactating mothers

and elderly population. This approach is often used when food fortification is unlikely to reach the targeted group of population especially malnourished population. This well-known approach is to promote dietary diversification, which encourages individual to consume a wide variety of nutrient-dense foods from different food groups. Nutrition education campaigns and community-based interventions can also be effective in promoting dietary diversification and building awareness about micronutrient deficiencies and the consequences, health issues and so on (Rajwar *et al.,* 2020).

According to statistics from the National Health and Family Survey (NFHS 5) (2020), the United Nations International Children's Emergency Fund, and WHO (2020), the rates of malnutrition among adolescent girls, pregnant and breastfeeding mothers and children in India are alarmingly high. Among the variables contributing to malnutrition in the country are mothers' nutritional condition, lactation practises, women's education, and sanitation practises. These have a range of negative consequences on young generation especially young children in terms of stunting, childhood illnesses, and growth retardation. There is still a need for the effective application of research-based knowledge to address under nutrition, particularly because it impedes the socio-economic development of the country, even though several government programmes are in place and India has theoretically reduced malnutrition over the past ten years (Chakravorty, 2023).

Micronutrient deficiency is a critical component of the triple burden of malnutrition, which causes serious health consequences for an individual and the population. Addressing this issue requires a multi-faceted, multi-sectorial approach that includes food fortification, supplementation, dietary diversification, and nutrition education. With the right interventions, it is possible to prevent and overcome micronutrient deficiencies and improve the health and well-being of an individual thereby population around the world (Zielińska *et al.,* 2023).

The current study addresses the malnutrition among young adult women. Young adult Indian women are particularly affected by this phenomenon because they are at an age where their body needs to be able to grow and develop properly but also need to be able to maintain a healthy weight. A recent study conducted by UNICEF Nutrition Strategy (2020-2030) showed that there has been a spike in the amount of people suffering with malnutrition even after years of trying to tackle the double burden of malnutrition. Dietary approaches as the sustainable measure to overcome the health issues especially in terms of Triple Burden of Malnutrition among young adult women.

The most common form of malnutrition in India is under nutrition. This occurs when people do not have enough food to meet their nutritional needs. This might be due to be their poor dietary intake in terms of poor quality and quantity of nutrients of carbohydrate, fat, protein, vitamins and minerals. The other form of malnutrition is over nutrition often leads to obesity and invites many health issues like Type 2 diabetes mellitus (T2DM), cardiovascular disease, cancer etc. It is caused by consuming high-calorie foods that contain too much of sugar and fat but not adequate protein, vitamins and minerals (Barrea *et al.,* 2020). In India, Young women are more prone to triple burden of malnutrition than men for a variety of reasons. One reason is that they have less access to food due to their socio-economic status and standards of living. Another reason is due to pregnancy and lactation complications which leads to malnourishment during and after pregnancy in her life span (Seth and Jain, 2023).

Efforts to combat the plague of malnutrition continue to be thwarted by a wide variety of obstacles, including culture, eating habits, wealth and gender disparity, and social exclusion. The analysis of the living condition and environment of the subjects also plays a crucial role in the mental and physical health of the subjects. As per World Health Organisation (WHO), 'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. It is therefore important to maintain proper health. The analysis of the health and nutritional status can be carried out in different ways. It can be even a questionnaire or an interview method to a SWOT analysis which provides a clear scenario of the nutritional and health status of the subjects in the targeted group (Desyibelew and Dadi, 2019).

The best mode of assessing and monitoring health/ nutritional status of an individual is using ABCD (Anthropometry, Biochemical, Clinical and Dietary) technique. The subjects will be screened for height and weight for the calculation of BMI is anthropometric measurements. In biochemical estimation, any biological samples in terms of blood, serum, urine etc. are collected for qualitative and quantitative analysis. The physical characteristics of the subjects will be examined in clinical examination. The 24-hour dietary recall and food frequency table for dietary intake are very effective tools to assess the nutritional status of an individual (Melgar-Quiñonez, 2023).

Nutrition education plays a vital role in addressing malnutrition by empowering individuals with knowledge and skills to make informed dietary choices. Research emphasizes that nutrition education is a highly effective and sustainable intervention for

combating malnutrition, encompassing various forms of under nutrition, inadequate vitamin or mineral intake, overweight, obesity, and diet-related non-communicable diseases. By educating individuals, especially mothers and caregivers, on proper nutrition practices, such as food consumption, dietary habits, and nutrient intake, nutrition education can significantly impact the nutritional status of children, will lead to improved growth outcomes and reduced malnutrition rates. Additionally, nutritional education programs tailored to local contexts and available resources have shown promising results in enhancing dietary diversity, feeding practices, and overall nutritional well-being, highlighting the importance of education in preventing and managing malnutrition effectively (Hadiyati *et al.,* 2021).

In the present study, nutrient dense food products will be developed to address the issue of malnutrition while focusing on the micronutrient requirement of the target group of subjects. Millets were traditionally consumed in the developing and developed countries including India. Green revolution in India led to improved food security in India, but that also forced the population of this country to consume increased amounts of cereal grains. This increased consumption of cereal grains while addressed the calorie requirement failed to address the micro nutrient requirement of the population (Banerjee *et al.,* 2020). To address the malnutrition, it is required that products addressing the specific case of nutrition deficiency is developed. Recently the nutritional significance and health benefits of the millets are attracting the change in policies of the government. The policy changes with increase in production of the millets has resulted in acknowledging the nutritional benefits and the climatic resilience of millets. The millets being climatic resilience are also ecologically sustainable owing to the storage feasibility of millets. The millets can be stored for a longer duration without losing it to pests. It was India's suggestion to the UNGA to declare 2023 as the International Year of Millets. Millets are a viable solution to address the micronutrient deficiencies found in the population of this country. This achievement comes at a point of time when the calorie requirement mode of addressing nutrition has found to be flawed as it fails to focus on the micronutrient consumption of the population leading to malnutrition (Mathew and Joseph, 2022).

Understanding the importance of a healthy diet to promote health status and prevent chronic diseases like obesity, diabetes, heart diseases etc. is considered as the sustainable measure for optimum health and wellness. The knowledge about food, nutrition and health can guide an individual to make them healthier and support over all well-being. Nutrition

education maintains healthier lifestyle leading a better quality of life. KABP (Knowledge, Attitude, Belief and Practice) is an effective tool in gathering quantitative and qualitative information from the target population. This type of data collection revealed that the misconception or misunderstanding might be an obstacle to nourish their potential in their field of health and nutritional aspects (Gorain, 2023). KABP study is one of the effective tools in transitioning the subjects from misunderstanding to proper knowledge. It acts as a baseline to assess and help the subjects to enhance their health and related behaviours. It also acts as an intervention strategy that reflects on different factors that influence the subject's behaviour and practices. The present study was designed and carried out with comprehensive knowledge on various aspects of nutrition. The research was carried on the basis of following objectives.

- Study the socio-economic profile, dietary and lifestyle pattern of the selected young adult women in the age of 18–21 years.
- Assess the nutritional status of the selected young adult women.
- Develop and validate nutrition education modules for nutrition education.
- Standardize and evaluate nutrient content, shelf life and cost of the formulated Dietary Supplements.
- Study the effect of nutrition interventions on nutritional status and nutritional knowledge of the selected young adult women.

1.1.Novelty of the study

There is lack of nutrition interventions specifically designed to tackle triple burden of malnutrition. Most of the study on triple burden of malnutrition is on young children. Therefore the current study aims for nutrition interventions to tackle triple burden of malnutrition in young adult women who are the future of the nation.

1.2.Research hypothesis

Nutrition interventions has a great impact in bringing down Triple burden of malnutrition in young adult women (18-21 years)

1.3.Scope of the study

The study deals with triple burden of malnutrition and related health concerns. The study aims to recommend principles and policies to prevent the occurrence of Triple Burden of Malnutrition among the population with the focus of educating the selected subjects about

the need to have nutritional status and nutritional knowledge and the importance of consuming a balanced diet for improving their nutritional status to meet the Recommended Dietary Allowance (RDA) of nutrients to have a healthy life. Nutritional education programme was developed in such a way that it meets the need of the hour to educate the subjects about triple burden of malnutrition. The nutrition education tools used for nutrition education programme were handy and simple to be understood by the selected subjects. The dietary intervention study aimed to develop and analyse food products to supplement the selected subjects with triple burden of malnutrition and improve the nutritional status of the selected young dietary adult women. Development of dietary supplements are on the basis of low cost, locally available indigenous food items familiar to homemakers and easy for preparation to meet the nutritional requirement among the selected segment of population for their optimum health and wellness.