SUMMARY AND CONCLUSION 5

Malnutrition is a global health concern that has an impact on people's lives by raising health care expenditure and lowering productivity, forcing future generations into a cycle of poverty. All disorders such as wasting, anaemia, stunting, and deficiencies in micronutrients are included in the malnutrition category. In the past, malnutrition was categorised as double burden of malnutrition, focusing mainly on calorie intake and included both underweight and overweight conditions. There is need to include a new dimension because the dual burden of malnutrition does not adequately account for the total amount of malnutrition that is now widespread. The Dual or Double Burden of Malnutrition (i.e., Underweight and Overweight) and Micronutrient Deficiencies make up the Triple Burden of Malnutrition. According to WHO predictions, the Triple Burden of Malnutrition will affect over 2 billion people worldwide. Micronutrient deficiency, also referred to as hidden hunger, is a type of under nutrition in which people are deficient in vital vitamins and minerals, which are critical for normal growth, disease prevention, and general well-being. Since there are no outward signs of this illness, diagnosis is challenging without close observation and investigation. The phrase "hidden hunger" was created because, even in situations when there is enough food to meet needs for energy, these shortages frequently go unreported within communities. The Triple Burden of Malnutrition among young adult females (18–21 years old) is the subject of the current study. The present study is an effort to analyse the occurrence of Triple burden of Malnutrition in young adult women and to put forward nutrition intervention to prevent the occurrence of Triple burden of Malnutrition.

5.1.Objectives

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

The conceptualization of study findings and the depth and breadth of knowledge were highlighted in this chapter. The summary and conclusion section of a research study concisely encapsulates the objectives and hypothesis, declares the outcomes via reflective discussion to determine if the expected results were achieved, formats all aspects of the research, and helps reach an appropriate conclusion that provides a concrete and comprehensive understanding of the entire study. It restates the purpose and main points, highlights key findings, evaluates whether original objectives were met, and enables the reader to quickly grasp the significance and implications by summarizing the research question, methodology, results and discussion in a clear, concise manner that serves as a reflective capstone tying together all components of the research.

The study consisted of 5 phases. In the first phase of the study was conducted at Mercy College in Palakkad, Kerala, on the basis of, its accessibility and availability of young adult women aged 18-21 years, which aligned with the research study's requirements. The selection was further influenced by the cooperative attitude of the college authorities, who showcased strong coordination with the researchers. Importantly, the subjects from the institution were willing to participate in the study, having obtained permission from both their parents and the institution itself. This combination of factors - suitable demographics, institutional support, and participant willingness made Mercy College an ideal location for the research study.

In the second phase, the study assessed the nutritional status of selected subjects using a comprehensive approach. This included four key methods: anthropometric measurements to evaluate physical characteristics, biochemical estimation to analyze nutrient levels in biological samples, clinical examination to identify visible signs of nutritional deficiencies, and quantitative dietary intake assessment to understand food consumption patterns. This multi-faceted approach allowed for a thorough evaluation of the subjects' nutritional health, combining physical, biological, clinical, and dietary pattern.

In third phase, this study outlined a comprehensive nutrition intervention program addressing the triple burden of malnutrition. It involved two main components: first, the development and evaluation of dietary supplements, including their development, sensory evaluation, cost effectiveness, nutrient analysis, and shelf-life analysis. Second, the creation and implementation of an educational initiative, which encompasses developing and validating nutrition education modules, providing health education and personalized diet counselling to the selected subjects, creating a website for lifestyle modification awareness,

and using WhatsApp groups for ongoing monitoring and evaluation. This multi-faceted approach combined direct nutritional support with extensive education and digital outreach, aiming to effectively address malnutrition issues and promote healthier lifestyles among the study subjects.

In fourth phase, the study evaluates the effectiveness of a nutrition intervention program through two key aspects. Firstly, it assessed the effect of dietary intervention on the nutritional status of the selected subjects, likely comparing physical and biochemical indicators before and after the dietary intervention for the period of 90 days. Secondly, it examined how nutrition education influenced the subjects' nutritional knowledge, using KAP (Knowledge, Attitude, and Practice) study to measure changes in understanding of dietary principles. By combining these two elements, the research aimed to provide a comprehensive view of the intervention's success, addressing both the practical improvements in nutritional health and the enhancement of nutrition-related knowledge among the selected subjects.

In fifth phase, the data was consolidated and analysed with appropriate tools using SPSS. Descriptive measures were analyzed using percentage, Mean and Standard Deviation and Categorical variables were compared using the Karl Pearson $\chi 2$ test. Continues variable was analyzed by Karl Pearson Correlation. Comparison of means performed using independent sample T- test. Paired t-test was performed to determine the significance of the effect of interventions using pre and post intervention. One way ANOVA (analysis of variance) was used to find out the statistical significance among the three variations of the developed dietary supplements.

5.2.Salient Features of the research study

The socio-economic profiling of 570 selected subjects revealed diverse demographic characteristics. Among them, 19 per cent were 18 years old, 16 per cent were 19, 38 per cent were 20, and 27 per cent were 21. The subjects were predominantly Christian (41 per cent), followed by Hindu (29 per cent) and Muslim (30 per cent). In terms of education, 36 per cent were first-year undergraduates and 64 per cent were in their second year. Marital status showed that 15 per cent were married while 85 per cent were unmarried. Geographically, 71 per cent resided in urban areas, benefiting from better access to health and educational facilities, while 29 per cent were from rural areas. Family structures indicated that 28per cent belonged to joint families and 72 per cent to nuclear families. The

educational qualifications of fathers showed that 37 per cent were postgraduates, while 58 per cent of mothers were graduates. Employment data indicated that 53 per cent of fathers worked in government jobs, and 21 per cent of mothers held government positions. Monthly family income was categorized according to the revised Kuppuswamy scale, with 19 per cent classified as upper-middle class, 71 per cent as lower-middle class, and 10per cent as upper-lower class. The findings highlighted the significant impact of family income on nutrition and health outcomes, emphasizing the need for targeted interventions to address malnutrition and improve living conditions.

The medical history assessment of the 570 selected subjects revealed that 8 per cent had a history of health issues, 28per cent experienced food allergies, 22 per cent faced menstrual irregularities, and 18per cent reported problems related to bowel movements. The past medical history provides valuable insights into the subjects' overall health status and immunity. Dietary suggestions were tailored based on the identified food allergies to ensure appropriate nutritional intake. Additionally, the study explored alternative food sources that could potentially replace supplements and address nutritional deficiencies. The high prevalence of bowel movement issues among the subjects may be attributed to inadequate dietary fiber consumption. Promoting adequate intake of dietary fiber is crucial for maintaining gut health and preventing related disease conditions.

The lifestyle patterns of the selected subjects were assessed to understand their impact on health, revealing a significant connection to the triple burden of malnutrition. While 20 per cent engaged in listening to music and 16 per cent in board games and dance for leisure, physical activity levels varied, with 64 per cent participating in one hour of exercise daily, and 7 per cent not engaging in any physical activity at all. Sleep patterns indicated that 55 per cent slept for 2-4 hours, while 39 per cent managed 8-10 hours. Social interactions were also noted, with 53 per cent interacting with family and friends, which is essential for mental health. Transportation choices showed that 57 per cent used private vehicles, which may limit physical activity, while 23 per cent did not receive daily sun exposure. Social media usage was prevalent, with 54 per cent spending 1-3 hours online, potentially detracting from physical activity and social engagement. Overall, these findings suggested that lifestyle choices, including physical activity, sleep, and social interactions, play a crucial role in health outcomes, highlighting the need for interventions to promote healthier habits and address the triple burden of malnutrition.

The ABCD (Anthropometric measurements, Biochemical estimation, Clinical examination and Dietary intake) nutritional status assessment was used to conduct the screening procedure. The mean height of the subjects selected for this study, as determined by anthropometry, was 154.83±5.45 cm, which was less than the standard height of women recommended by ICMR NIN (2020). Similarly, the mean weight of the subjects (n=570) selected for this study was found to be 57.35±11.09 kg, which was more than the standard weight of 55 kg recommended by ICMR NIN (2020). According to the data related to BMI results, 69 percent of the selected subjects were underweight, with the BMI of less than 18.5; 12 percent were in the range of 18.5-24.9, which was normal; 14 percent were in the over-weight category, with a BMI of 25-29.9; four percent were in the range of 30-34.9, which was the category of Obesity Grade I; one percent were in the range of 35-39.9, which was the category of Grade II Obesity; and none of the subjects were in the range of Grade III Obesity, which is defined as being higher than 40 BMI. WHR revealed that 14 percent of the selected subjects were in the range of 0.7-0.75, 37 percent were in the range of 0.76-0.8, 17 percent were in the range of 0.81-0.85, and 32 percent were in the range of 0.85-0.9 of WHR. The WHR mean was 0.768±0.027, which was within the normal range of less than 0.85 for women's WHR.

The biochemical estimation of 570 selected subjects, conducted with the assistance of a physician and laboratory technician, revealed that, out of the total subjects, 37 per cent (214) had low haemoglobin levels below the normal range of 12 g/dl, indicating a high prevalence of anaemia. Furthermore, 16 per cent of the subjects had serum calcium levels below the normal range of 8.7-11 mg/dl. The 214 subjects with low haemoglobin levels were further assessed for serum folic acid and serum iron levels to determine the underlying causes of their anaemic condition. These findings highlighted the need for dietary interventions to address the high rates of folic acid deficiencies (53 per cent), Iron deficiencies anaemia (47 per cent) and low serum calcium levels among the study subjects, which might have significant implications for their overall health and well-being.

The clinical profiling of 570 selected subjects revealed various signs and symptoms indicative of nutritional deficiencies. Among the subjects, 4per cent exhibited pallor, while 14 per cent reported experiencing fatigue. Additionally, 12 per cent had visual problems, and 30 per cent faced issues related to hair loss. A significant 54 per cent of the subjects experienced regular headaches, suggesting potential nutritional concerns, and 6per cent had brittle nails. Furthermore, 14 per cent presented with dry and scaly skin. These findings

underscore the prevalence of nutritional deficiencies within the population, highlighting the need for further investigation and potential interventions to address these health issues. There were no cases of palpitations, bitot spots, or bleeding gums among the selected subjects. The most significant indicators of iron deficiency anaemia were found in those selected subjects who experienced fatigue and irregular menstruation. The subjects who were selected and experienced constipation might have had improper eating habits, such as consuming insufficient amounts of dietary fibre on a daily dietary. Sufficient consumption of dietary fibres is beneficial for promoting gut health and preventing illnesses.

The result of dietary intake of the selected subjects revealed that 24 per cent followed a vegetarian diet, 47 per cent a non-vegetarian diet, 9 per cent adhered to a vegan diet, and 20 per cent consumed an ovo-vegetarian diet. These findings highlight the diversity in eating patterns among the population. However, the quality of food emerged as a critical factor in preventing malnutrition, rather than just the quantity of food consumed. The lack of quality food can contribute to malnutrition, even if the quantity of food intake is adequate. This underscores the importance of promoting a balanced and nutrient-rich diet to ensure optimal health and prevent malnutrition among the selected subjects.

The analysis of dietary frequency and variation among the selected subjects indicated that 48 per cent enjoyed a varied diet every day, while 30 per cent experienced dietary variety only occasionally during the week, and 22 per cent had variety solely on weekends. This prevalence of monotonous eating patterns can lead to food aversion, ultimately contributing to malnutrition. Promoting dietary variation is crucial to combat this monotony; a more diverse food pattern encourages increased consumption of food in appropriate quantities. Therefore, enhancing the variety in diets is essential for improving overall nutrition and preventing malnutrition among the subjects.

Increasing food variety can significantly reduce food aversion and help prevent eating disorders. The study revealed that meal frequency varied among the selected subjects, with 2 per cent consuming only one meal a day, 43 per cent eating two meals, 30 per cent having three meals, 20 per cent consuming four meals, and 5 per cent eating five meals daily. This variation in meal frequency is linked to malnutrition, emphasizing the importance of food availability and accessibility in combating nutritional deficiencies. Interestingly, the current trend of malnutrition among young adult women is not primarily due to limited access to food but is largely influenced by dietary choices, particularly the

consumption of junk foods. This highlighted the need for education and interventions aimed at promoting healthier eating habits.

The analysis of beverage consumption among the selected subjects revealed diverse drinking habits. Specifically, 34 per cent of the subjects consumed tea daily, while 19 per cent drank milk, 16 per cent consumed coffee, 15 per cent opted for health drinks, and 16 per cent included fruit juice in their daily intake. These findings highlighted the variety of beverages consumed by the subjects, which may play a role in their overall nutritional status and dietary patterns.

Factors influencing food consumption among the selected subjects revealed that 32 per cent consumed food based on food availability, while 11 per cent engaged in binge eating, 17 per cent consumed food due to weight consciousness, 28 per cent were influenced by premenstrual syndrome (PMS), and 12 per cent consumed as a response to stress. The consumption patterns linked to PMS are particularly concerning, as they may lead to unintentional weight gain and subsequent health issues. These factors are crucial in shaping the food consumption behaviours of the subjects, with binge eating identified as a significant contributor to unhealthy eating patterns. Addressing these influences is essential for promoting healthier dietary habits and preventing malnutrition.

The 24-hour dietary recall analysis of the selected subjects revealed an average daily intake of 1846.71 ± 271.28 kcal for energy, 157.15 ± 33.84 g for carbohydrates, 53.28 ± 25.98 g for protein, 36.53 ± 10.67 g for fat, 613.06 ± 283.96 mg for calcium, 18.14 ± 5.92 mg for iron, 150.49 ± 35.23 µg for folic acid, 36.23 ± 15.83 mg for vitamin C, 480.74 ± 210.94 µg for vitamin A, and 10.07 ± 11.88 g for dietary fiber. Compared to the recommended dietary allowances, the subjects consumed excess amounts of energy (201.7 kcal), carbohydrates (27.15 g), protein (7.58 g), and fat (17 g). However, they were deficient in iron (10.86 mg), calcium (386.94 mg), folic acid (70 µg), vitamin A (359.26 µg), vitamin C (29 mg), and fiber (15 g). These findings suggested that the combination of surplus macronutrient intake and deficient micronutrient consumption contributes to the coexistence of over nutrition and micronutrient deficiencies among the selected subjects, emphasizing the need for a balanced and nutrient-dense diet to address these nutritional imbalances.

The food frequency questionnaire results indicated that rice is a staple in the diets of the selected subjects, with 86 per cent consuming it regularly as part of their daily meals.

Additionally, 93 per cent reported occasional consumption of rice flakes, while 85 per cent consumed puffed rice occasionally. Wheat was consumed daily by only 17 per cent of the subjects, and ragi, a calcium-rich grain, was consumed daily by just 1 per cent. Bajra, a nutritious millet, was consumed occasionally by 77 per cent of the subjects, while 41 per cent consumed vermicelli on a monthly basis. Semolina was consumed weekly by 37 per cent, and refined wheat flour, associated with various lifestyle diseases, was consumed daily by 12 per cent and monthly by 58 per cent of the subjects. These findings highlighted the predominant role of rice in the diet and the varied consumption patterns of other grains among the subjects, reflecting potential areas for dietary improvement.

The consumption of pulses and legumes, which are categorized as the 2nd food group by ICMR, was analyzed among the selected subjects. Bengal gram (whole) is a good source of folic acid, and its sprouted form is rich in vitamin C and fiber, which helps prevent constipation. However, only 16per cent of the subjects consumed Bengal gram (whole) daily. Green gram (whole), another good source of folic acid, was never consumed by 1per cent of the subjects. Sprouted green gram is a commonly available and affordable pulse for most people. Horse gram is a rich source of iron, yet 21 per cent of the subjects never consumed it. Horse gram provides instant energy and a significant amount of dietary fiber. These findings suggested that while pulses and legumes are important sources of essential nutrients, their consumption varies among the selected subjects, with some missing out on the benefits of specific varieties like Bengal gram, green gram, and horse gram.

The consumption of green leafy vegetables among the selected subjects was notably low, despite their rich content of β-carotene and other essential nutrients. Specifically, 24 per cent of the subjects never consumed amaranth leaves, while only 17 per cent included drumstick leaves in their diet on a weekly basis. The bitter taste of fenugreek leaves deterred 41 per cent of the subjects from consuming them at all. Additionally, only 1 per cent reported eating mint leaves weekly. Cabbage was the most consumed green leafy vegetable, with 68 per cent of the subjects incorporating it occasionally into their dietary patterns. These findings highlighted a significant gap in the daily intake of green leafy vegetables, which are crucial for maintaining nutritional health.

The consumption of squash family vegetables among the selected subjects was generally low, primarily due to taste preferences. Only 3 per cent consumed ash gourd weekly, while 18 per cent never opted for bitter gourd. Drumstick was eaten occasionally by 52 per cent of the subjects, and cauliflower was consumed monthly by 38 per cent. In

contrast, 56 per cent included cluster beans in their weekly diet, and 15 per cent ate carrots daily. Potatoes, a significant source of carbohydrates, were consumed weekly by 38 per cent, but only 10 per cent consumed brinjal weekly, with aversion attributed to allergies. Additionally, 42 per cent had ladies' finger only on a monthly basis, and 34 per cent never consumed radish due to its odour. Sweet potatoes were consumed occasionally by 60 per cent, while yam and colocasia were largely rejected due to their texture. Plantains were eaten occasionally by 81 per cent of the subjects, but only 2 per cent consumed beetroot daily, despite its benefits as a source of non-haem iron. Similarly, just 6 per cent included cucumber in their daily diet, even though it serves as a cooling agent for the gastrointestinal tract. These findings indicated a significant underutilization of various nutritious vegetables within the selected population.

The results of the fruit consumption analysis indicated that a majority of the selected subjects consumed various fruits occasionally, with 83 per cent eating apples, 92 per cent consuming papaya, and 95 per cent opting for oranges on an occasional basis. Daily consumption was more limited, with only 29 per cent eating bananas daily and just 1per cent including pomegranate in their daily diets. Watermelon and guava were also consumed occasionally by 95 per cent and 82 per cent of the subjects, respectively. Notably, 56 per cent of the subjects consumed dates daily, which are known to improve haemoglobin levels and prevent iron deficiency anaemia, while 34 per cent consumed raisins daily. Other dried fruits and nuts had low daily consumption rates, with only 2 per cent consuming dry figs, 1 per cent groundnuts, 14 per cent cashew nuts, and 15 per cent almonds daily. Overall, the findings suggested that while some fruits are consumed regularly, many are only eaten occasionally, indicating a need for increased fruit intake among the subjects to enhance their nutritional status.

Among the selected subjects, 74 per cent occasionally consumed meat, while 36 per cent reported occasional fish consumption. Additionally, 26 per cent of the subjects included eggs in their diet once a week. Furthermore, 36 per cent indicated that they consumed meat only once a month as part of their routine diet. These findings highlighted a moderate level of protein intake from animal sources, with many subjects consuming these foods infrequently, suggesting potential areas for improvement in their dietary habits to enhance overall nutritional quality.

The consumption of dairy products among the selected subjects showed that 76 per cent drank milk daily, while 26 per cent never consumed paneer, a good source of calcium.

Curd, which provides protein and calcium, was consumed daily by 78 per cent of the subjects. Cheese, another protein source, was eaten occasionally by 53 per cent. Interestingly, only 1 per cent included jaggery, a healthier alternative to sugar, in their daily beverages. These findings indicate a reliance on milk and curd as primary calcium sources, but a lack of variety in terms of paneer and jaggery consumption, which could be improved to enhance the overall nutritional quality of the subjects' diets.

Three Dietary Supplements were formulated to address the Triple Burden of Malnutrition. The formulated Dietary Supplements were analysed for sensory, nutrient analysis, shelf-life study, and cost effectiveness. As the result of statistical analysis, there is a significant difference among the overall acceptance of the three variations of Sprouts Tikki was noted. The average score was 7.033 ± 1.12903 for ST1, 4.8667 ± 1.43198 for ST2, and 4.6000 ± 1.30252 for ST3. Based on these data, the most highly accepted variation was the Sprouts Tikki variation ST1. According to the data, RB1 had a mean score of 7.10±0.721, RB2 had a mean value of 6.75±1.136, and RB3 had a mean value of 6.11±0.916. The p-value for the overall acceptability of the three variations of Ragi brownie, which is less than 0.05, was 0.011. Of the three variants, RB1 was highly accepted. For NB1, it was 6.8±1.074; for NB2, it was 6.57±0.973; and for NB3, it was 7.4±1.125. Less than 0.05, or 0.019, is the p value for the overall acceptability of the three variations of Nutri Ball. The three Nutri Ball versions differ significantly from one another as a result. The average value showed that NB 3 was the Nutri Ball variety that was most highly accepted.

One of the most important steps in the formulation of Dietary Supplements is the cost calculation. The common people must be able to access and afford the substances utilised in the development of the dietary supplement and the results depicted that 100g of Sprouts Tikki (ST1) cost Rs 22.34, Ragi Brownie (RB1) cost Rs 22.25 and 100g of Nutri Balls (NB3) cost a total Rs 23.35.

The nutrient analysis of the Sprouts Tikki (ST1) revealed that the product contains 15.33 g of moisture, 7.13g of ash, and provides 485 Kcal of energy per 100g. It is a good source of carbohydrates (31.1 g), protein (17.6 g), and fat (5.3 g). The Sprouts Tikki is particularly rich in essential micronutrients, with 3.4 mg of iron, 186 mg of calcium, and 81.2 µg of folic acid. Additionally, it is high in dietary fiber (12 g) and crude fiber (7.5 g), which is beneficial for digestive health. The calculated vitamin C content is 2.524 mg. The high fiber content attributed to the use of sprouted Bengal gram and green gram in the preparation of the Sprouts Tikki. The product meets the one-third Recommended Dietary

Allowance (RDA) for dietary fiber (8.3 g) and contains a negligible amount of phytic acid (0.450 mg per 100 g). These findings suggested that Sprouts Tikki can be a nutritious snack option for overweight and folic acid deficiency subjects.

The nutrient analysis of the Ragi Brownie (RB1) indicated a moisture content of 12.16 g and an ash content of 7.22 g. The brownie provides 406 Kcal of energy, along with 64.2 g of carbohydrates, 10.6 g of protein, and 3.8 g of fat. It is rich in essential micronutrients, containing 5.1 mg of iron, 256.9 mg of calcium, and 38.1 µg of folic acid. Additionally, the brownie offers 6 g of dietary fiber and 4.6 g of crude fiber, making it suitable for individuals with calcium deficiency. The presence of phytic acid, an anti-nutrient commonly found in millets, was measured at 0.131 mg per 100 g. These findings suggested that Ragi Brownie is a nutritious option that can help address calcium deficiencies while providing other essential nutrients.

The nutrient analysis of Nutri Ball (NB3) indicated a moisture content of 12.1 g and an ash content of 7.26 g. The product provides 465 Kcal of energy, with 62.1 g of carbohydrates, 15.5 g of protein, and 17.2 g of fat. It is rich in essential micronutrients, containing 10.3 mg of iron, 186 mg of calcium, and 33.1 µg of folic acid. Additionally, Nutri Ball offers 8.4 g of dietary fiber and 6.2 g of crude fiber, making it a nutritious option. The presence of phytic acid, an anti-nutrient, was measured at 0.110 mg per 100 g. Nutri Ball is made from a variety of ingredients, including horse gram and bajra, which contribute to iron content. Traditional methods such as roasting, soaking, and fermenting can significantly reduce the phytic acid content, enhancing the bioavailability of nutrients. Overall, Nutri Ball is a food product that can support dietary needs, particularly in individuals requiring higher iron intake and underweight.

In a laboratory condition, the shelf life analysis of Sprouts Tikki was conducted. The pH was 6.5 on the fourth day and 7 on the seventh day. The pH range that was considered to be acceptable was 6.5-8. Less than 10 cfu/g was the total fungal count on day four, while 1x102 cfu*/g was recorded on day seven. For Total Fungal Count, the optimal range is ≤ 10 cfu/g. On day four, the total plate count was 200 cfu/g, and on day seven, it was 15x102 cfu/g. The desired upper limit was 1000 cfu/g. Consequently, Sprouts Tikki had a 7-day shelf life once it was produced. After conducting a shelf-life analysis, it was found that Ragi Brownie had a pH of 6.5 on day seven and 6.8 on day ten. The pH range that was most ideal is 6.5-8. On day seven, the total fungal count was less than 10 cfu/g, and on day ten, it was 1x102 cfu/g. On day seven, the total plate count was 230 cfu/g, and on day ten, it was

48X102 cfu/g. The shelf-life analysis indicated that Ragi Brownie can be consumed to the tenth day. According to the shelf-life analysis done on Nutri Ball, the pH of the product was 6.6 on day seven and 7 on day ten. On the seventh day, the total fungal count was less than 10 cfu/g, and on day ten, it was 2x102 cfu/g. On day seven, the total plate count was 100 cfu/g, and on day ten, it was 50x102 cfu*/g. As a result, the shelf-life analysis indicated that the product has a 10-day shelf life.

The study subjects were divided into an experimental group and a control group, each comprising 250 subjects. After receiving nutritional education, the experimental group showed significant improvements in their level of understanding. The percentage of subjects with inadequate nutritional knowledge decreased from 95 per cent to 40 per cent in the experimental group following the intervention. The study also assessed the subjects' attitudes towards consumption, focusing on positive attributes to be developed and negative traits to be avoided. The experimental group exhibited a shift in attitude, with subjects avoiding negative attitudes and enhancing positive attitudes after receiving nutritional education. However, there was no major change in the practices of subjects in either the experimental or control group. The paired sample t-test was conducted to evaluate the effect of nutritional education on knowledge, attitude, and practice. The experimental group showed a significant improvement in knowledge ($p=0.004$) and attitude ($p=0.024$), while the control group did not exhibit any significant changes. The practice level remained unchanged in both groups, with p-values of 0.136 for the experimental group and 0.223 for the control group. These findings suggested that nutritional education can effectively improve knowledge and attitudes, but translating this into sustainable behavioral changes requires more comprehensive interventions.

In dietary intervention program, the data gathered were expressed in terms of nutritional status. There was a difference in mean value of BMI of selected subjects in Experimental group who were supplemented with Ragi Brownie (RB1) which was from 18.062±0.140to 25.068±0.140.The change in mean value of BMI in the selected subjects Control group was from 18.454±1.33to 18.37±1.33. The paired sample t-test which was conducted to assess the impact of nutrition intervention on BMI and the results showed that in the selected subjects in Experimental group had a p value 0.046 and t value was 1.421. The p value for the control group was $p =0.22$ and $t=2.322$. The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post dietary

intervention values. The p value and t value for independent sample t test between the post values of BMI of Experimental and Control group was 0.000 and 6.879 respectively.

The results on effect of dietary intervention on BMI of the selected subjects who were supplemented with Nutri Ball (NB3) showed that the paired sample t-test which was conducted to assess the effect of nutrition intervention on BMI and the results shows that in the selected subjects in Experimental group had a p value 0.047 and t value was 1.336. The p value for the control group was p =0.209 and t=2.338. The p-value in the Experimental group was $p<0.05$, therefore there is a significant difference between the pre and post dietary intervention values. The p value and t value for independent sample t test was 0.000 and 6.996 respectively.

The results for Ragi Brownie (RB1) showed that the paired sample t-test which was conducted to assess the impact of nutrition intervention on BMI and the results showed that in the selected subjects in Experimental group had a p value 0.046 and t value was 1.421. The p value for the control group was p =0.22 and t=2.322. The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post Nutrition Intervention values. The p value and t value for independent sample t test was 0.000 and 6.879 respectively. The results for Sprouts Tikki showed that the paired sample t-test which was conducted to assess the effect of nutrition intervention on BMI and the results showed that in the selected subjects in Experimental group had a p value 0.021 and t value was 2.692. The p value for the control group was p =0.110and t=3.788. The p-value in the Experimental group is $p<0.05$, therefore there is a significant difference between the pre and post Nutrition Intervention values. The p value and t value for independent sample t test was 0.00 and 6.873 respectively.

The results for WHR in Experimental Group and Control group before and after the Nutrition Intervention where the effect of nutrition education as well as dietary intervention was not evident. The change in WHR in both Experimental and Control group was not a prominent value as the p value is more than 0.05. Therefore the effect of nutrition intervention was not beneficial in bringing out an effect on WHR of Experimental and Control group. It may be due to the short duration of dietary intervention.

In case of improving the Iron status in blood, dietary intervention had a great impact as the presence of Iron in blood raised from 41.876±4.976 to 88.486±32.463 in Experimental group who were supplemented with Nutri Ball. There was no improvement

in Control group with respect to Iron status as the change was from 33.928±7.990 to 33.93600±7.993. The paired sample t-test which was conducted to assess the effect of dietary intervention on Serum Iron and the results showed that in the selected subjects in Experimental group had a p value 0.026and t value was 9.998. The p value for the control group was p =0.376 and t=2.296. The p value is less than 0.05, therefore there is a significant difference in Serum iron level in Experimental group. The p value and t value for independent sample t test was 0.000 and 11.459 respectively.

The mean value of Serum calcium in Experimental group who were supplemented with Ragi Brownie moved from 6.794±1.013 to 8.2796±1.010 and in Control group it was moved from 6.995±0.556 to 7.231±0.7185. There was a change in Serum Calcium in both Experimental and Control group, but it was prominent in Experimental Group. The paired sample t-test which was conducted to assess the effect of dietary intervention on Serum Calcium and the results shows that in the selected subjects in Experimental group had a p value 0.039 and t value was 8.82. The p value for the control group was p =0.126 and t=2.296. The p value was less than 0.05, therefore there was a significant difference in Serum Calcium level in Experimental group. The p value and t value for independent sample t test was 0.000 and 6.989 respectively.

The mean value of Serum Folic Acid had raised to 4.635±1.981 from 3.135±0.522 in Experimental Group who were supplemented with Sprout Tikki and in Control group it had raised to 2.907±0.6702 from 2.696±0.694. The paired sample t-test which was conducted to assess the effect of dietary intervention on Serum Folic Acid and the results showed that in the selected subjects in Experimental group had a p value 0.041 and t value was 5.575. The p value for the control group was p =0.133 and t=3.267. The p value was less than 0.05, therefore there was a significant difference in Serum Folic Acid level in Experimental group. The p value and t value for independent sample t test was 0.000 and 6.996 respectively.

The dietary intervention study demonstrated slight improvements in various health indicators among subjects in the experimental group. Specifically, the prevalence of pallor decreased marginally from 2.4 per cent to 2.3 per cent, while fatigue symptoms reduced from 7.2 per cent to 6.7 per cent. Menstrual irregularities also saw a decrease from 7.2 per cent to 6.4 per cent. Additionally, the introduction of Ragi Brownie contributed to improvements in fatigue (from 2.0 per cent to 1.8 per cent), bowel movement (from 3.2 per cent to 3.0 per cent), and menstrual irregularities (from 4.0 per cent to 3.7 per cent). Other

minor improvements were noted in bowel movement (from 4.4 per cent to 3.9 per cent), menstrual irregularities (from 3.6 per cent to 3.2 per cent), and hair loss (from 11.6 per cent to 11.3 per cent). Overall, the results indicated a positive trend in the management of these symptoms through dietary interventions.

The analysis of clinical signs and symptoms revealed that the experimental group had a mean value of 1.004 ± 0.021, while the control group had a mean of 0.10 ± 0.011, resulting in a mean difference of 0.167 between the two groups. However, there were no significant changes observed, as the p-values for both the experimental (0.211) and control (0.349) groups exceeded the threshold of 0.05, indicating no significant difference. Additionally, the independent sample t-test yielded a p-value of 0.077 and a t-value of 0.988, further supporting the conclusion that the dietary intervention had no significant impact on the clinical signs and symptoms in either group.

The 24-hour recall results indicated notable shifts in nutrient consumption among the experimental and control groups following a nutrition intervention. In the experimental group, energy intake increased from 1871.05 ± 180 Kcal to 1893.05 ± 186 Kcal, while carbohydrates and fat decreased to 149.02 ± 42.9 g and 11.02 ± 13.6 g, respectively. Conversely, calcium, iron, folic acid, and dietary fibre saw increases, with calcium rising to 633.1 ± 204.4 mg, iron to 21.144 ± 3.14 mg, folic acid to 168.31 ± 30.3 µg, and dietary fibre to 31.8 ± 1.1 g. Despite minimal changes in vitamin C, A, and protein, the overall consumption pattern reflects the positive impact of the nutrition education provided to the experimental group. In contrast, the control group exhibited negligible changes, with energy intake slightly increasing and carbohydrates remaining stable, while protein intake rose modestly. However, there were declines in calcium, iron, vitamin C, and dietary fiber, attributed to the lack of nutrition education in this group. Overall, the findings suggested that the nutrition intervention significantly influenced the dietary habits and nutritional status of the experimental group, while the control group showed minimal improvement due to insufficient knowledge about proper nutrition.

The association study examining the relationship between family type and socio-economic status revealed a significant finding, with a p-value of 0.002, indicating a strong correlation ($p < 0.05$). The Pearson Chi-square coefficient ($\chi 2$) for this association was 7.515. Additionally, a positive correlation was observed between occupation and socio-economic status, with a p-value of 0.047, also below the 0.05 threshold, and a Pearson Chi-

square value of 2.770. These results suggested that both family type and occupation were significantly associated with socio-economic status.

The association study between BMI and nutrient intake among overweight subjects in the experimental group revealed notable correlations using the Pearson correlation method. Before the nutrition intervention, there was a positive correlation between energy intake and BMI ($p = 0.015$, $r = 0.106$), which improved post-intervention ($p = 0.010$, $r = 0.111$). Conversely, a strong negative correlation was observed between BMI and iron intake, with a consistent p-value of 0.001 and a correlation coefficient that slightly decreased from $r = -0.142$ to $r = -0.143$ after the intervention. Similarly, the negative correlation between folic acid and BMI remained stable, with $p = 0.015$ and r changing from -0.108 to -0.113. In underweight subjects, a positive association between BMI and energy was also identified, with p-values and r-values remaining consistent before ($p = 0.015$, $r = 0.109$) and after the intervention ($p = 0.015$, $r = 0.116$). Additionally, a strong positive correlation between BMI and iron intake was noted, with $p = 0.001$ and r increasing from 0.146 to 0.153 post-intervention, while the correlation between folic acid and BMI improved from $p = 0.015$, $r = 0.108$ to $p = 0.013$, $r = 0.121$. These findings highlight the significant associations between BMI and various nutrient intakes in both overweight and underweight subjects following the nutrition intervention.

The analysis of the correlation between Waist-to-Hip Ratio (WHR) and nutrient intake in the experimental group with over-weight subjects revealed a significant relationship, particularly with carbohydrate intake. Before the nutrition intervention, the correlation was characterized by a p-value of 0.001 and a correlation coefficient (r) of 0.355. Following the intervention, these values indicated an increased correlation, with a p-value remaining at 0.001 and the correlation coefficient rising to 0.410. The analysis revealed a strong positive correlation between Waist-to-Hip Ratio (WHR) and energy intake, with a p-value of 0.007 and an r-value of 0.384 prior to the nutrition intervention in under-weight subjects. After the intervention, the p-value remained unchanged at 0.007, while the r-value slightly increased to 0.385. Additionally, there was a significant correlation between fat intake and WHR, with an initial p-value of 0.016 and an r-value of 0.358 before the intervention; post-intervention, the p-value improved to 0.014, while the r-value remained constant at 0.358.

A Pearson Correlation statistical analysis was conducted to examine the relationship between blood parameters and nutrient intake in the experimental group before dietary

intervention. The results indicated a significant negative association between dietary fiber and serum iron, with a p-value of 0.018 and a correlation coefficient (r) of -0.332. Conversely, a positive correlation was found between vitamin A and serum calcium, with a p-value of 0.019 and an r value of 0.431. Notably, there were changes in both the r and p values after the nutrition intervention, suggesting that the intervention may have influenced these associations in the experimental group. The Pearson correlation analysis revealed a significant negative association between dietary fiber intake and serum iron levels in the experimental group after the nutrition intervention, with a p-value of 0.018 and an r-value of -0.350. This suggests that as fiber intake increased, serum iron levels tended to decrease. Additionally, there was a positive correlation between vitamin A intake and serum calcium levels, with a p-value of 0.019 and an r-value of 0.431. This indicates that higher vitamin A intake was associated with higher serum calcium levels. The changes in the r-values and p-values after the nutrition intervention in the experimental group highlight the impact of the intervention on the relationships between nutrient intake and blood parameters.

5.3.Recommendations of the study

The following recommendations emerged from the present study to deepen understanding and guide effective nutrition interventions:

- More research works are suggested that integrates the study of Triple Burden of Malnutrition (under nutrition, over nutrition and micronutrient deficiencies) with the same age group of population especially young adolescent girls and adult women population and to identify and understand the different forms of malnutrition coexist and transition over time.
- Longitudinal studies must be undertaken to track the actual transition of different forms of malnutrition and long-term health outcomes associated with triple burden of malnutrition and epidemiological research to find out the prevalence and causative factors for the occurrence of Triple Burden of Malnutrition across the heterogeneous group of population and diverse settings.
- More research to assess the health issues and consequences of Triple Burden of Malnutrition and explore the factors to interact and influence nutritional status and identify the modifiable factors that must be targeted through nutrition interventions.
- Efforts must be taken to evaluate the effectiveness of nutrition interventions and policies to be developed for addressing Triple Burden of Malnutrition which

includes evaluating integrated approaches that target the various forms of malnutrition simultaneously and also focus on under nutrition, over nutrition and vitamin and mineral deficiencies.

- More research works are suggested to foster collaboration between researchers, policy makers, health care procedures and community stakeholders to develop research findings for implementing into practices. Capacity building efforts should focus on enhancing research skills, data collection capacities and policy implementation strategies.
- Research studies to develop standardized methodologies to measure and monitor the Triple burden of Malnutrition to ensure the consistency and comparability of data and to improve innovative technologies and approaches like digital health tools, geographic information system etc.

5.4.Limitations of the research study

1. Globally and nationally, there are many data gaps and inadequate quality and quantity of data on Triple Burden of Malnutrition. This makes it difficult to accurately assess the trends and prevalence of Triple Burden of Malnutrition in the community.
2. Triple Burden of Malnutrition involves various aspects in terms of nutrition, public health, lifestyle pattern etc. making it challenging to create integrated approaches and comprehensive studies.
3. Most of the research has focused on any one form of malnutrition at a time, rather than their interactions. This leads to have incomplete understanding and solutions which is not able to address all aspects of Triple Burden of Malnutrition.
4. These limitations require perfect coordinated efforts, increased data collection, inter and multi-disciplinary research and strong policy frame works, resulting in significant improvement in global nutrition and public health.

5.5.Scope of the study

The proper addressing of limitations and research gap related to Triple Burden of Malnutrition; several positive outcomes, comprehensive and effective solutions will be emerged for betterment of health and wellness.

Key aspects of scope include:

- Assessing the effectiveness and sustainability of nutrition interventions in terms of designing, implementing and evaluating.
- Developing evidence-based policy recommendations to address Triple Burden of Malnutrition.
- Examining the role of food systems in dietary pattern and nutritional outcomes and investigating the impact of food production, distribution and consumption on Triple Burden of Malnutrition.
- Comparing malnutrition trends and interventions across different regions and countries and understanding the global drives of Triple Burden of Malnutrition and their regional implications.
- Leveraging new technologies and methodologies like in health (mobile health) and mega data analytic to improve nutrition research and interventions.
- Investigating the impact of climate and environmental changes on food security and nutrition and to develop strategies to mitigate the effects of climate and environmental changes on nutritional outcomes.

Overall, the scopes of research related to Triple Burden of Malnutrition is exclusive and requires inter and multi-disciplinary collaboration to develop comprehensive and effective solutions for promoting better health and wellbeing worldwide.

By conclusion, Triple Burden of Malnutrition, characterized by co-existing under nutrition, micro nutrition deficiencies and overweight/obesity, pose a significant public health challenge globally. Our research highlights the need for a comprehensive approach to address this complex issue, focusing on sustainable food systems, nutrition education and health promotion. By prioritizing the nutritional wellbeing of young adult women, it is easy to break the intergenerational cycle of malnutrition and promote healthy growth and development and also ensure a healthy growth and development and also ensure a healthier future for all.

'Healthy dietary habits create a strong foundation for a vibrant life, nourish your body and flourish with wellness.'-Dr.Walter Willet