Summary and Conclusion

Recently, the number of women affected by reproductive health issues increased. Polycystic Ovarian Syndrome is one of the most common reproductive issues. Unlike other reproductive health issues, it is more related to pregnancy challenges and outcomes and also affects all aspects of health. These days, the medical field is more focused on the eradication of the symptoms and consequences connected to polycystic ovarian syndrome (PCOS) in young women and teenagers of reproductive age. The main purposes and principles of medical nutritional treatment include lowering insulin resistance, enhancing fertility, curing hirsutism or acne, restoring normal menstruation, and preventing endometrial hyperplasia and endometrial cancer. Scientific evidences in the therapy of polycystic ovarian syndrome (PCOS) support the use of nutritional intervention programmes in terms of nutrition education and dietary supplementation, including macronutrients and micronutrients in their routine dietaries.

Nutritional intervention programmes are expected to enhance their nutritional and health state as well as reduce the metabolic, hormonal, and physiological symptoms linked with polycystic ovarian syndrome (PCOS) in reproductive-age women. Generally, women of reproductive age do not have adequate micronutrients including vitamins and minerals, when compared to the ICMR RDA (2023) in their routine daily diet. This study was intended to solve inadequacies in the consumption of micronutrients among women of reproductive age as well as the nutritional importance and health benefits of supplements with a micronutrient-rich health mix to ameliorate symptoms of polycystic ovarian syndrome (PCOS) and to improve the quantity of life of an individual with PCOS.

5.1 Objectives

The researcher has conducted the present study with the following objectives.

- To formulate and evaluate the nutrition education modules on PCOS and dietary supplements for PCOS for dietary supplementation.

- To evaluate the effect of nutritional interventions on symptoms of PCOS, Nutritional Status and nutritional knowledge of the selected PCOS subjects

Secondary Objectives

- To elicit the data related to socio-economic profile, dietary, water intake and lifestyle pattern of the study subjects (18 – 21 years).
- To screen the young adult women (18-21 years) using Rotterdam Criteria tool to identify PCOS subjects
- To assess the nutritional status using ABCD techniques for the selected subjects
- To evaluate the nutritional knowledge and attitude related to PCOS among subjects.
- To assess menstrual regularity, exposure to sunlight, stress level, menstrual hygiene practices and physical activity level of the selected PCOS study subjects

This chapter focused especially on the breadth and depth of information as well as the abstracting of study outcomes. It included the objectives of this study as well as the examined hypothesis. Using a reflective discussion, the summary and conclusion were made at the conclusion that the expected results of the researcher had been achieved. Its concision, which incorporated all findings of the research study, as well as helped to reach a suitable conclusion, provided a concrete and all-encompassing grasp of the research study.

The present study consisted of six phases. The first phase, screening of young adult women (18-21 years) to identify PCOS, was conducted in different five colleges of Thrissur District, Kerala. Based on the inclusion and exclusion criteria a total of 1250 subjects were selected for the study. Among them, 25 per cent of the study subjects were identified with PCOS with the severity of symptoms using the validated tool of Rotterdam Criteria (2018). To make sure the quality of the study tool the questionnaire was validated by the experts for the collection of data related to the present study.

In second phase PCOS mapping was done among the selected subjects (N=1250) for nutrition interventions. In this phase we analysed hirsutism and menstrual

abnormalities with the study subjects of 120. Assessment of anthropometric, biochemical, clinical, dietary intake, and examination of physical activity was carried out in this phase. For the selected subjects of the study, haemoglobin levels, random blood sugar (RBS), and cholesterol levels were estimated. Examining PCOS clinically, the medical history was thorough and concentrated on hirsutism and acne. Dietary consumption was evaluated and also perceived stress, activity routines, stress levels, menstrual practices, nutritional knowledge and attitude among the selected subjects related to PCOS were assessed. Rotterdam diagnostic criteria guided the screening for PCOS using the validated Self-Administered Polycystic Ovarian Syndrome Questionnaire (SAPOCQ).

The third phase aimed to develop and evaluate nutrient-dense health mix powder and nutrition education modules for the selected PCOS young adult women. The Nutrient Dense Health Mix Powder is rich in micronutrients like calcium, phosphorus, selenium, zinc, magnesium, Vitamin B complex, and fibre, made from sesame seeds, ragi, oats, flax seeds, peanuts, sunflower seeds, and pumpkin seeds, in three variations. Variation III scored the highest score when the powder was analysed for sensory attributes and nutrient content. Additionally, physicochemical characteristics, microbiological safety, and heavy metal content of the health mix powder were also analysed. The economic feasibility of the developed health mix powder was evaluated by the cost-effective analysis. Combining offline and online sessions, instructional nutrition and health modules, a YouTube channel and WhatsApp groups were developed and implemented in the nutrition education intervention program, which helped the selected PCOS study subjects modify their lifestyle pattern for reproductive wellness and prevention of reproductive illness.

Nutrition intervention programs for the period of 90 days were assigned to the selected PCOS study subjects and diagnosed with polycystic ovarian syndrome (PCOS) in the fourth phase. The study involved four groups of 30 study subjects: a control group, which did not participate in nutrition intervention programs and study group II, III and IV termed as Experimental Groups. PCOS study subjects of Experimental group I, received nutrition and health education, focused on reproductive health and lifestyle modifications. Selected subjects of Experimental group II were involved in a structured exercise program, in terms of aerobic exercises, resistance training, and flexibility

exercises to improve their biochemical profile and weight management; selected study subjects of Experimental Group III were involved in a dietary intervention, which included nutrient dense health mix powder supplementation, nutrition education, and exercise programs.

The nutrition education intervention programs consisted of two offline and three online sessions for PCOS nutritional education per week. PowerPoint presentations and videos were used in offline sessions to educate the PCOS study subjects about pathophysiology, diagnostic criteria, nutritional care and support, lifestyle modifications, and stress management. Google Meet enabled online sessions that offered chances for conversation and clarification related to the offline and online nutrition education interventions. Using a questionnaire to evaluate the PCOS Study subjects' PCOS knowledge and knowledge gaps were found and the educational material was customized. The mix of in-person and online meetings guaranteed the accessibility and flexibility of the present research study.

The Nutrition Intervention Programme included nutrition education and a structured aerobic exercise for Experimental Group II study subjects. The program was conducted five days a week, with sessions in the college's indoor stadium. The program was designed by trained experts to handle the sessions systematically and effectively. The study subjects engaged in warm-ups and aerobic exercises, gradually increasing the intensity and duration of the aerobic exercise.

For the benefit of Experimental Group III PCOS study subjects, a nutritional intervention program was executed. Following aerobic activity sessions, the PCOS study subjects were instructed to have two packets of a health mix powder (35g per packet) daily in the evening and morning with water. Based on individual dietary intake, dietary guidance and advice were given. The approach also emphasized stress management, stress-lowering eating patterns, anti-inflammatory foods, mindfulness strategies, and enough sleep. Self-reported logs and regular check-ins tracked compliance while PCOS study subjects were informed about the nutritional importance and health benefits of health mix powder used in dietary supplementation.

Phase V assessed the effect of nutrition intervention programs on the nutrition knowledge, nutrition status, and PCOS symptoms of the PCOS study subjects. In phase

VI researcher has done a statistical analysis of the findings to ensure the effect of nutrition intervention programs on nutritional status and nutrition knowledge of the selected PCOS Study subjects.

5.2 Salient findings of the research study

The study involved 1250 young adult women (18-21 years), as the study subjects, from the Thrissur District and revealed significant insights into their demographic characteristics. Majority were aged 19 years (46 per cent), followed by 18 years (32 per cent), 20 years (17 per cent) and only a megre percent (5 per cent) were 21 years old. This indicated a concentration of younger subjects, particularly in their potential age and early higher education. The religious profile showed that 59 per cent were Hindu, whereas Christians and Muslims comprised 22 per cent and 19 per cent respectively. Family structure analysis highlighted a predominant preference for nuclear families (87 per cent), with 59 per cent of the study subjects coming from smaller family structures with 1-4 members. Educationally, an overwhelming 99 per cent were pursuing graduate studies, reflecting a strong aspiration for professional advancement.

Socioeconomic Status (SES) was assessed in terms of income, education, and occupation. The findings indicated that a substantial portion of the study subjects were in the lower middle class (40 per cent) and upper lower class (28 per cent), and 23 per cent were classified as upper middle class. This distribution underscored the economic challenges the study subjects faced and adversely affected health outcomes. The analysis also revealed that most of the heads of families had completed high school education (49 per cent), indicating a correlation between lower educational attainment and socioeconomic challenges.

Data related to lifestyle patterns of the selected 1250 subjects were gathered and focused on dietary pattern, sleep length, activity frequency, and possible interrelationships. Majority (64 per cent) of the study subjects had sleep of six and eight hours, which is regarded as ideal for preserving excellent health and cognitive ability. Still, 77 per cent of the study subjects did not participate in consistent physical activity, which could have contributed to problems including obesity and related health issues. The most often used form of exercise among the majority (69 per cent) of the study

subjects worked out for about thirty minutes which was brisk walking. The individuals' routines also heavily relied on the timing of exercise. Sixty four per cent were worked out in the morning hours, which helped to control circadian cycles and enhanced their sleep habits.

Data related to nutritional status revealed that 30 per cent were underweight and had BMI < 18.5. Normal BMI (18.5–24.9) for 59 per cent of the study subjects and considered as the healthy target group. Nine per cent were overweight (BMI 25.0–29.9), one per cent were obese in the grade I (30.0–34.9), and one was in grade II (35.0–39.9) and grade III (≥ 40.0). Increased percent of underweight study subjects calls for more nutritional and lifestyle study and dealt with social, psychological, and physical health issues. BMI is closely correlated with exercise, sleep, and WHR.

This study analysed the dietary patterns of the study subjects and revealed that 88 per cent followed a non-vegetarian diet, with only eight per cent adhering to vegetarian, two per cent ovo-vegetarian, and two per cent lacto-vegetarian diets. This suggested that a higher intake of animal proteins and fats influenced metabolic health, including reproductive health issues. Over half of the study subjects skipped meals, particularly breakfast, due to a dislike of certain breakfast items, lack of appetite, time to rush the college and lack of time. Skipping meals leads to erratic eating habits, potentially worsening common health issues in women with Polycystic Ovary Syndrome (PCOS). A high percentage of the selected subjects (77 per cent) rely on external food sources, leading to a dietary pattern characterised by higher levels of unhealthy fats, sugar, and preservatives, potentially worsening PCOS symptoms. The preference for sweet (31 per cent) and spicy foods (48 per cent) might not be aligned with dietary recommendations for managing PCOS, which emphasized whole foods, low glycemic index carbohydrates, and balanced macronutrients consumption.

The study revealed that significant dietary patterns among the study subjects, particularly concerning fried snacks, non-vegetarian snacks, carbonated drinks, sweet items, and bakery products. High daily sugar consumption (60 per cent) among the study subjects is alarming and suggests the need for dietary modifications. The Food Frequency Table revealed the significant dietary habits among the study subjects, particularly those with Polycystic Ovary Syndrome (PCOS). The study found that 76

per cent of the selected subjects consumed cereals, suggesting whole grains as the staple foods. Pulses were also consumed daily by 38 per cent and alternatively by 44 per cent of the study subjects. Green leafy vegetables were essential for reducing inflammation and improving metabolic health and included daily in their diet of 16 per cent of the study subjects. Dairy products were consumed by 44 per cent of the selected subjects, with 44 per cent consumed milk and milk products daily. The high sugar consumption (61 per cent) suggested the need for dietary modifications. The study also found three distinct dietary patterns - High-Fat and Sugar-Rich, Vegetable-Centric, and Cereal and Pulse-Based. The high-fat and sugar-rich pattern might be contributed to PCOS progression, while the vegetable-centric pattern might be had the protective effect.

The study split the study subjects' beverage intake into frequency ranges. With 83 per cent of the study subjects' drinking water more than twice daily, it was the most often drank liquid. Fruit juice was consumed by 48 per cent, never or less than once a week. Consumption ranged from 59 per cent never drinking whole milk to 16 per cent daily. Likewise rare per cent had soft drinks; 63 per cent of the study subjects never drank soft drinks. Coffee and tea consumption varied significantly, 14 per cent and 24 per cent drank one daily.

The study analysed the risk of polycystic ovary syndrome (PCOS) among study subjects based on their Risk Assessment Scores and Hirsutism Scores. The results showed that 61 per cent of the study subjects were classified as 'low-risk category', while 22 per cent had 'no risk category'. Seventeen per cent, were in the 'moderate-risk category', and less than one per cent were in the 'high-risk category'. In terms of hirsutism, 61 per cent of the study subjects had low hirsutism scores, suggesting a minimal risk for hyperandrogenism. Only 11 per cent were categorised as moderate risk, and less than one per cent were in the high-risk category. The study also revealed that 49 per cent of the study subjects had high-Risk Assessment and Hirsutism scores, indicating a small proportion at significant risk for PCOS. Thirteen per cent had high RA scores alone. Overall, 25 per cent were identified across these categories, underscoring the substantial prevalence of risk factors associated with PCOS.

This study looked at how menstruation health, hirsutism, and Body Mass Index (BMI) were related to each other in the study individuals to see how likely they were

to have symptoms of polycystic ovarian syndrome (PCOS). Results showed that there was a strong positive link between missed periods in a regular menstrual cycle and hirsutism scores. There was a negative link between hair loss and symptoms like nausea and vomiting during menstruation, which suggests that hirsutism levels were lower. There was also a substantial positive link between hirsutism scores and difficulties losing weight, which suggests that people who had trouble managing their weight were more likely to have greater levels of hirsutism. Higher levels of hyperandrogenism were linked to skin folds around the neck and armpits become darker and thicker. These results showed how menstrual health, hirsutism, and weight management are all connected in the case of PCOS. This shows how important it is to have thorough assessment and management plans for the study subjects.

The statistical analysis of the present study found that there was a significant relationships between hirsutism in specific areas and risk assessment scores for polycystic ovary syndrome (PCOS) and Body Mass Index (BMI). The strongest positive correlation was observed in the lower abdomen, followed by the upper lip and upper abdomen. Other areas, such as the chin and thighs, also showed a significant positive correlation. The strongest positive correlation was found in the upper lip and chin, suggesting that study subjects with higher BMI might also experience increased hair growth in these areas. However, other locations, such as the chest and arms, showed no significant correlations with BMI. These results emphasized the importance of specific hair growth patterns as indicators of PCOS risk and potential metabolic implications in the study subjects. The study underscored the need for a multifaceted approach to diagnosis and management that considered various clinical features, including menstrual health, hirsutism, and metabolic factors.

The present study also looked into the physical symptoms linked to many medical conditions including anemia, obesity, underweight, osteoporosis, and pre-diabetes. With 47 per cent of the study subjects having this experience of headache. Headache is the most often occurring physical symptom of anaemia. Additional noteworthy symptoms included angular stomatitis (95 per cent), shortness of breath (16 per cent), and dizziness and tiredness following physical exertion (24 per cent). Often feeling weary (30 per cent), hip and back discomfort (30 per cent), and more perspiration (21 per cent), were the most common physical indicators of obesity. Only

three per cent of the study subjects reported snoring, which is usually connected with body fat content.

The most often mentioned physical symptoms of underweight were muscle issues (16 per cent) and chilly fingers and toes (15 per cent). Eleven percent of the study subjects experienced tiredness and lethargy; the most of the study subjects (88 per cent) did not show any of these symptoms. The most often occurring physical symptom of osteoporosis was lower back pain (18 per cent). A meager fraction of the study subjects additionally reported alteration in posture (6 per cent) and dyspnea (8 per cent).

For many different health issues, including anaemia (4 per cent), obesity (6 per cent), underweight (2 per cent), osteoporosis (1.5 per cent), and prediabetes (4 per cent), the study revealed that a sizable portion of the study subjects reported more than three symptoms. The most common symptoms linked to obesity were those related to the quality of life, hence it affects it. Furthermore, overlapping symptoms from anaemia and hyperglycemia hinder the nutritional and health care and support plans. Lower per cent of symptoms for underweight and osteoporosis indicated that these disorders would not cause as many overlapping symptoms as obesity or anaemia. Study subjects with PCOS sometimes reported weight gain, tiredness, and metabolic problems—which could be all coincided with the problems experienced in obesity and prediabetes. More than three symptoms in these disorders could point to a greater risk for women with PCOS since they could have similar difficulties with insulin resistance and hormonal imbalance. With obesity, underweight, osteoporosis, and prediabetes, anemia showed a moderatly positive correlation indicating that the likelihood of the other also increased as one condition increases. With osteoporosis and prediabetes, obesity also showed modest positive correlations that highlighted the need for combined approaches in treatment and preventative plans.

The statistical analysis of the medical history of the study subjects exposed several health issues like heart disease, seizures, migraines, alcoholism, depression, osteoporosis, and gynaecological disorders that could be disproportionately impacted this demographic profile. Though they are rare, seizures can seriously affect young women's health, especially pregnancy and reproductive health. Forty per cent of women in their reproductive years suffered from common migraines.

Recent studies revealed the significant gaps in knowledge about Polycystic Ovary Syndrome (PCOS), particularly its long-term health implications. While 49 per cent of study subjects had knowledge about PCOS, 69 per cent were aware of problems of PCOS, primarily menstrual problems and pregnancy delays. Only 16 per cent aware of the treatment options, with weight reduction being the most recognized method. Symptoms associated with PCOS were notably lower, with 52 per cent recognized irregular menstrual cycles as a symptom. The study also found that individuals from higher socioeconomic backgrounds had better access to health information and resources. Family class is significant predictor of knowledge about PCOS. Targeted nutrition educational interventions targeting younger women were significantly improved their understanding of PCOS and its complications.

For Polycystic Ovary Syndrome (PCOS), the pre-assessment phase (second phase) consisted in a thorough review of dietary intake, anthropometric measurements, biochemical profile, and clinical characteristics. While menstrual hygiene practices, exercise routines, lifestyle factors, stress levels, and selected subjects' understanding about PCOS are very vital for optimal self-management techniques, ovarian shape and cysts were evaluated using ultrasonic scanning by the gynaecologist.

The study was executed to evaluate the nutritional status using anthropometric measurements including height, weight, waist and hip circumference, Body Mass Index (BMI), and waist-hip ratio (WHR), the possible effects of PCOS on the selected study subjects. The study analysed height measurements and weight measurements of the selected study subjects with PCOS before interventions. The control group had a mean height of 156 cm, while the experimental group had a mean weight of 52.633 kg. The experimental groups had higher mean BMIs. Measuring waist circumference, hip circumference, and WHR as well, the experimental groups showed means ranging from 66.900 cm to 71.250 cm while the control group had a mean waist circumference of 64.871 cm.

The study analyzed the biochemical profile of the selected study subjects before implementing the intervention, focused on parameters such as random blood sugar (RBS), cholesterol level, and haemoglobin (Hb). The control group had a stable glucose level of 101.6 mg/dl, while the experimental groups showed lower RBS values,

suggesting better glycaemic control. Cholesterol levels varied among the study groups, with the control group having a mean cholesterol level of 142.9 mg/dl, while the experimental group had the highest value at 151.9 mg/dl. Haemoglobin levels were relatively stable, but menstrual irregularities could affect them over time. The study highlighted the importance of monitoring these parameters to identify individuals at higher risk for metabolic syndrome and cardiovascular complications

Examining pre-assessment phase acne scores, the study produced significant new information on the frequency and degree of acne among the selected PCOS study subjects. With a median of 3.00 and a standard deviation of 3.69, the control group had a mean acne score of 4.29, therefore indicating a broad range of values from 0 to 12.

The study examined the profile of Polycystic Ovary Syndrome (PCOS) symptoms among selected study subjects using the Cronin Questionnaire. The results showed that the control group experienced moderate symptoms, while Experiment Group 1 had slightly more severe symptoms. Experiment Group 2 showed a significant decrease in mean score, suggesting more significant complications or symptoms. Experiment Group 3 had considerable variability in symptom severity.

The Cronin Questionnaire (Cronin et al., 1998) gave a whole picture of the degree of symptoms the selected study subjects in various study groups. Two main conclusions from the one-way ANOVA (Welch's analysis) were a highly significant difference in pre-PCOS scores ($F = 7.67$, $p = 0.001$) and a non-significant difference in acne scores across the four study groups ($F = 0.839$, $p = 0.477$).

The study intended to pre-evaluate the selected study subjects with Polycystic Ovary Syndrome (PCOS) by means of food patterns and deficits, therefore determining their nutritional situation. Selected study subjects' eating patterns were compiled using the three days 24-hour dietary recall technique. The findings revealed that there was a notable energy intake deficiencies, especially in Experiment Group III, which would help to explain metabolic dysregulation of weight management. For women with PCOS, this could cause weight gain or impede efforts at weight loss—two important considerations.

Though all were below the Estimated Average Requirement (EAR), protein intake was rather constant throughout the study groups. With 34.13 g of protein, Experiment Group 3 had the lowest intake—which could not be sufficient for metabolic health and muscle maintenance. The study groups' fat intake varied greatly; Experiment Group 3 consumed the most—24.08 g—above the EAR of 20 grams.

Particularly in calcium and magnesium, the assessment of mineral and vitamin intake exposed alarming deficits among the four study groups. All readings much below the EAR of 800 mg, calcium consumption ranged from 234.07 mg in Experiment Group 3 to 252.02 mg in Experiment Group 1. All the experimental groups had low magnesium levels; Experiment Group 3 had an EAR of 270 mg while its mean intake was just 98.32 mg. With iron intakes ranging from 6.37 mg in Experiment Group 3 to 7.79 mg in the Control group—well below the EAR of 15 mg—iron and zinc levels were likewise considerably lower than the EAR across all the research groups. The subjects' vitamin C levels varied greatly, suggesting a notable deficit that might affect the immune system and antioxidant capacity.

In this study, 40 per cent of the selected study subjects underwent ultrasound scanning to assess ovarian morphology and identify cysts, a hallmark feature of PCOS with the help of a gynaecologist. Aligning with diagnostic criteria for PCOS, 39 per cent of the selected subjects had polycystic ovaries.

To better grasp their consequences for reproductive health, the study examined menstrual hygiene routines among the selected study subjects. With rates ranging from 60 per cent in Experiment Group III to 78 per cent in Experiment Group I, most participants used throw-away sanitary pads. Experiment Group III (40 per cent) had more usage of cloth or towel as a menstruation material than other study groups, implying either cultural or financial influence on material choice.

Among the selected study subjects, 66 per cent washed two or more times daily, so the frequency of genital washing differed. On the other hand, too frequent washing could upset the natural vaginal flora and cause infections. Regarding the disposal of menstrual products, most of the selected study subjects used latrines or toilets, which raises environmental problems and possible sanitation problems if improperly handled.

Twenty-one per cent of the selected study subjects also reported burning items, therefore emphasizing cultural customs related to menstrual waste disposal.

Across Study Groups—Control, Experiment Group I, Experiment Group III, Experiment Group III—the Godin Leisure-Time Exercise Questionnaire (GLTEQ) evaluated physical activity levels. Three activity levels—Active, Moderately Active, and Sedentary—were used to separate selected study subjects. Regarding physical activity involvement among the selected study subjects, the data revealed a notable trend. Many people, meanwhile, stayed inactive, which is connected to health issues like obesity and metabolic disorders like Polycystic Ovary Syndrome (PCOS). Selected study subjects' pre-assessment of their perceived stress gave information about the psychological and emotional terrain, especially for individuals with disorders like PCOS.

The study analyzed the stress levels of the selected study subjects before nutrition intervention. The majority of participants reported moderate stress. However, in Experiment Group II, there was an increase in high stress, while in Experiment Group II, only 16 per cent experienced low stress. This highlights the need for effective stress management strategies.

The study also revealed varying correlations between perceived stress and physical activity of the selected PCOS study subjects. For the Control group, there was a weak relationship between stress levels and physical activity. In contrast, Experiment Group 2 showed a significant strong negative correlation, suggesting that higher levels of perceived stress were associated with lower levels of physical activity. This suggests that high stress impairs motivation to engage in physical activity, leading to a cycle of inactivity that exacerbates stress levels.

The study analyzed pre-assessed nutritional knowledge on Polycystic Ovary Syndrome (PCOS) among the four study groups. The results showed that the control group had a basic understanding of PCOS, with 50 per cent of participants scoring below this level. Experimental Group I had a higher mean score of 14.4, reflecting a more robust grasp of PCOS concepts. The presence of multiple modes indicated diverse levels of understanding within this group. Experimental Group II had a slightly higher mean score of 12.7, suggesting similar levels of understanding. Experimental Group III

had a mean score of 13.7, indicating consistent knowledge levels among the selected study subjects. The differences in scores among the study groups suggested that tailored nutrition intervention approaches could be effective in improving understanding and management strategies for PCOS prevention.

In phase three we developed a nutrient-dense health mix powder and nutrition education module. Considered for dietary supplements, the sensory evaluation study examined three variations of the developed Nutrient Dense Health Mix powder. Variation III outperformed the other two in most attributes, particularly in Appearance (5.6), Aroma (4.4), and Taste (4.6). It achieved the highest ratings for Overall Acceptability (3.6) and Texture (3.3). Variation II displayed moderate performance across all attributes, with its best score in Aroma (3.7) and its lowest in Overall Acceptability (2.8). Variation I generally scored lower than the other variations, except in Taste where it matched Variation II at 2.4. It notably struggled with Overall Acceptability, scoring just 1.5. The sensory evaluation indicated that Variation III was the most well-rounded and highly rated option across all sensory attributes.

The Nutrient Dense Health mix powder, a nutrient-dense supplement, is a valuable tool for young adult women who required additional nutrition care due to dietary deficiencies or specific health issues. The powder contained macro and micro nutrients, including energy, fat, carbohydrates, and protein, as well as vitamins and minerals. The energy content was 27.2 per cent of the ICMR RDA, making it beneficial for higher caloric content. The powder also contained 14.8 g of fat, which meets 74 per cent of the ICMR RDA. The carbohydrate content was 48.5 per cent of the ICMR RDA, while protein level was 36 per cent. Fiber content was substantial, contributed to digestive health and satiety. The powder also offered a range of vitamins and minerals, included 230 mg of calcium, 74 mg of magnesium, 19.1 mg of iron, zinc (4.8 mg), selenium (20 mcg), phosphorus (210 mg), potassium (628 mg), thiamine (1.2 mg), riboflavin (1.8 mg), and niacin (2.7 mg). Nutrient-dense foods are essential for weight management and improving insulin PCOS health status, particularly for the selected study subjects. This nutrient composition analysis highlights the potential benefits of incorporating a nutrient-dense health mix powder into daily routine dietaries.

A study on the physicochemical and microbiological properties of formulated nutrient-dense health mix powder at two times—the 5th and 40th day of storage—was carried out. The physicochemical characteristics of the health mix powder—including appearance, colour, odour, and pH—were evaluated and indicated good stability. The pH dropped from 6.8 on the fifth day to 6.6 on the forty-first day, but it stayed within the reasonable range of 6.5 to 8.0.

Crucially important for assessing the safety of developed health mix powder, the microbiological tests concentrated on total bacterial and fungal counts. By the 40th day, the overall bacterial count dropped from $200x10^{1}$cfu/g to 12×10^{1} cfu/g, suggesting good over-time microbial control. Product safety was shown by the overall fungus count always staying well below detectable levels (<10cfu/g).

The components of the nutritious powder have low moisture content which reduces the possibility of bacterial development and extends the shelf life of the product. Natural antioxidants found in oil seeds and nuts also help to fight against oxidative stress and rancidity and also extend product quality over time. The nutritional powder proved free of dangerous heavy metals in terms of lead, mercury, arsenic, cadmium and nickel, according to the toxicity study, so suggesting its safety and legitimacy as a health aid for subjects with PCOS.

The cost-effectiveness of the developed nutrient-dense health mix powder was calculated and the cost was Rs 27.63/100g, considering the economic possibility of developing nutrient-dense health mix powder while including PCOS diet options at an affordable level. Comparing Nutrient Dense Health Mix Powder to other commercial formulae for PCOS treatment showed a considerable price benefit. Nutrient Dense Health Mix Powder's cost may inspire more people to use nutritional interventions in their PCOS management plan. In conclusion, Nutrient Dense Health Mix Powder was the cost effective formula for PCOS management and the product makes dietary supplements accessible to the persons with PCOS.

In phase four the effect of nutrition interventions among selected study subjects have evaluated. Generally, Nutrition education interventions are increasingly important for promoting better eating patterns and health outcomes. These programs helped to inform food choices and navigate the complexity of food choices in a world full of

processed options and deceptive marketing. This study evaluated the effect of nutrition education interventions on the selected study subjects' nutrition knowledge levels before and after the nutrition intervention for the period of 90 days.

The results showed that especially in focused techniques, nutrition education significantly improved knowledge acquisition. The control group showed minimal change, while the experimental groups showed significant improvements. The control group's mean pre-test mean score was 12.2 and the post-test mean score was 12.1, a mean difference of 0.0968 ($F = 0.251$, $p = 0.620$). There was no statistically meaningful improvement. The pre-test mean score for Experiment 1 was 14.4, while the post-test mean score was 20.0, a mean difference of -5.53 ($F = 46.3$, $p < 0.001$). The p-value showed a substantial nutrition knowledge increase. Significant gains were observed in Experimental Group 2, with a mean difference of -11.4 ($F = 293$, $p < 0.001$) between pre-test and post-test mean scores of 12.7 and 24.0, respectively. In Experimental Group 3, the mean difference between pre-test (13.7) and post-test (25.3) was -11.6 ($F = 760$, $p < 0.001$). Results showed that there was a significant effect on the nutritional knowledge of the study participants due to the nutrition education programme.

The study analyzed the effect of nutrition interventions on anthropometric measurements, particularly height, weight, and Body Mass Index (BMI), in managing conditions including Polycystic Ovary Syndrome (PCOS). The results showed that height remained consistent across all study groups, while significant changes were observed in weight and BMI among the selected study subjects of experimental groups I, II, and III compared to the control group. The control group experienced a slight increase in weight, mean difference was 0.48, while the experimental groups showed varying degrees of weight changes. Experimental Group I showed a non-significant reduction in weight from 53.87 to 53.22 kg (Mean difference = 0.66, F-8.68, $p = 0.006$). Experimental Group II showed a significant reduction in weight from 54.63 kg to 53.44 kg (mean difference = 1.19, $F = 22.2$, $p < 0.001$), while Experimental Group III also exhibited a notable decrease from 52.63 kg to 51.67 kg (mean difference = 0.967, $F = 18.1$, $p < 0.001$). The results also showed similar trends in BMI measurements, with the control group showing a meagre increase of 0.19.

The study examined the effects of nutrition interventions on body composition of the selected PCOS study subjects. In terms of waist circumference, the control group experienced a slight increase from an average of 64.871 cm to 65.097 cm, resulting in a mean difference of -0.226 cm ($F = 5.03$, $p = 0.032$), which indicates a statistically significant change. In contrast, Experimental Group I achieved a non-significant reduction in waist circumference, with a mean difference of 0.34 cm ($F = 5.05$, $p =$ 0,032). Experimental Group II achieved a significant reduction in waist circumference, with a mean difference of 0.204 cm ($F = 14.6$, $p < 0.001$), demonstrating the effectiveness of the nutritional intervention in reducing abdominal fat. Likewise, Experimental Group III also exhibited a decrease in waist size, with a mean difference of 0.367 cm ($F = 9.02$, $p = 0.005$). The results suggested that targeted dietary strategies effectively influenced body measurements associated with metabolic health.

The study examined the effects of nutrition interventions on metabolic health in the selected PCOS subjects. The control group showed minimal changes in these biochemical parameters, while the experimental groups demonstrated significant improvements. Random blood sugar (RBS) levels showed a significant decrease in all experimental groups. The control group had a slight increase with a mean difference of 7.55 mg/dl ($F = 5.85$, $p = 0.022$). Experimental Group III experienced the most substantial reduction, with a mean difference of 15.8 mg/dl ($F = 52.8$, $p < 0.001$). Experimental Groups I and II also demonstrated significant reductions in RBS, with mean differences of 10.0 mg/dl and 11.9 mg/dl, respectively (both $p < 0.001$). Regarding cholesterol levels, all groups showed minimal changes, with p-values indicating no significant differences ($p > 0.05$). The control group had a mean difference of 0.516 mg/dL ($F = 0.0399$, $p = 0.843$), suggesting the nutrition intervention did not significantly affect cholesterol levels, possibly due to the study's short duration. Haemoglobin levels varied among groups: the control group reported a decrease of 0.429 g/dL ($F = 30.5$, $p < 0.001$), while Experimental Groups I and II reported decreases of 0.144 g/dL and 0.368 g/dL (both $p < 0.01$). In contrast, Experimental Group III had an increase of -0.167 g/dL ($F = 13.1$, $p = 0.001$).

Emphasizing pre- and post-nutrition intervention evaluation, the study looked at the different dietary interventions that affected grades of acne. In the Control group, the pre-nutrition intervention mean score was 4.29 (SD: 3.69), which remained

unchanged post-intervention at 4.29 (SD: 3.69), resulting in a mean difference of 0.00. This indicates no fluctuation in acne severity, serving as a baseline for the experimental groups. Experiment Group I had a pre-intervention mean of 3.22 (SD: 4.05) and a post-intervention mean of 3.19 (SD: 3.84), with a mean difference of 0.0313. The F value was 0.139 and the p-value was 0.712, suggesting minimal to no effect of the nutrition intervention on acne severity. In Experiment Group II, participants had a pre-intervention mean score of 3.09 (SD: 2.18) and a post-intervention mean of 3.00 (SD: 2.05), yielding a mean difference of 0.0937. The F value was 3.21, with a p-value of 0.083, indicating a slight improvement that was not statistically significant at conventional levels ($p < 0.05$). Experiment Group III showed more promising results, with a pre-intervention mean score of 3.53 (SD: 2.83) and a post-intervention mean of 3.30 (SD: 2.48). The mean difference was greater at 0.233, with an F value of 6.43 and a p-value of 0.017, indicating statistical significance in the reduction of acne severity following the nutrition intervention and suggesting effective treatment in this group.

This study analyzed the nutrient intake of the selected PCOS study subjects using a 24-hour dietary recall method. The effect of the nutrition intervention was evaluated by calculating the mean differences before and after the nutrition intervention.

The study analyzed the dietary intake of Experiment Group I, which underwent a Nutrition Education Intervention to manage symptoms associated with Polycystic Ovary Syndrome (PCOS). The study used pre- and post-intervention measurements to evaluate changes in nutrient intake, highlighting the effectiveness of the dietary modifications implemented during the 90-day study. The results showed a significant decrease in energy intake from 1011.28 kcal to 1048.52 kcal, indicating that the nutrition intervention effectively reduced overall energy intake. Carbohydrate consumption decreased slightly to 164.391 g post-intervention, indicating a statistically significant reduction in carbohydrate intake. Protein intake remained relatively stable (34), with no significant change due to the intervention. Fat consumption showed a slight increase from 15.756 g to 16.299 g, indicating that there was no statistically significant effect. The analysis also revealed significant changes in the micronutrients, with calcium intake increasing from 252.018 mg to 274.632 mg, magnesium levels increasing from 137.127 mg to 147.029 mg, iron intake showing significant

improvement from 6.92 to 8.09, and zinc and selenium levels also increased. Both nutrients had statistically significant p-values at or below the conventional threshold.

The study analyzed the dietary intake of the selected study subjects in Experiment Group II, which received a nutrition intervention with the combined of Nutrition Education and Exercise to manage Polycystic Ovary Syndrome (PCOS). The results showed a significant decrease in energy intake, with a mean difference of -79.7 kcal. Carbohydrate consumption also decreased, with a mean difference of 9.05 g. Protein intake remained stable, with a megre mean difference of 0.278 g. Fat intake decreased slightly, with a mean difference of 1.06 g. Nutrient intake also showed significant changes, with calcium intake increasing from a pre-intervention mean of 234.077 mg to a post-intervention mean of 272.571 mg. Magnesium levels also showed significant improvement, with an average post-intervention level of 112.952 mg. Iron intake also showed significant improvement, with an average post-intervention level of 7.257 mg. Zinc and selenium levels also showed significant increase, with zinc raised from an average pre-intervention level of 2.522 mg to a post-intervention average of 3.839 mg and selenium increased from 15.589 µg to an average post-intervention level of 16.165 µg. These results suggested the potential for tailored dietary strategies to improve metabolic health and alleviate symptoms associated with PCOS.

The study analyzed the dietary assessment of Experiment Group III, which underwent nutrition interventions to manage symptoms of Polycystic Ovary Syndrome (PCOS). Energy intake significantly decreased from a pre-intervention mean of 969.850 kcal (SD: 239.472) to a post-intervention mean of 1054.85 kcal (SD: 180.003), with a mean difference of -85.0 kcal, an F value of 15.6, and a p-value of less than 0.001, indicating effective reduction. Carbohydrate (CHO) consumption also decreased from a pre-intervention mean of 156.926 g (SD: 38.853) to 145.530 g (SD: 26.401), yielding a mean difference of 11.4 g, F value of 12.1, and p-value of 0.002, showing statistical significance. Protein intake remained stable (pre: 34.128 g, SD: 11.970; post: 34.373 g, SD: 11.599), with a mean difference of -0.245 g and p-value of 0.102, indicating no significant change. Fat intake slightly increased from a pre-intervention mean of 17.981 g (SD: 10.290) to 18.143 g (SD: 10.164), resulting in a mean difference of -0.162 g, F value of 2.07, and p-value of 0.161, showing no significant effect. Significant improvements were observed in micronutrients are detailed below. Calcium

increased from 239.973 mg (SD: 114.994) to 284.584 mg (SD: 106.296) with $p < 0.001$; magnesium rose from 112.852 mg (SD: 74.983) to 128.955 mg (SD: 69.710), also with $p < 0.001$; iron increased from 6.369 mg (SD: 3.373) to 7.600 mg (SD: 2.965), $p < 0.001$; zinc rose from 3.006 mg (SD:1.512) to 4.606 mg (SD:2.144); and selenium increased from 25.982 µg (SD:22.923) to 27.611 µg (SD:21.503), all indicating significant changes due to the intervention.

The findings underscored the effectiveness of nutrition interventions in improving nutrient intake and managing symptoms associated with PCOS. The interventions led to notable increases in essential micronutrients such as calcium, magnesium, iron, zinc, and selenium, vital for overall health and metabolic functions. These nutrients play critical roles in hormonal balance and metabolic regulation, supporting the findings of recent studies that emphasized the importance of tailored dietary strategies for managing PCOS symptoms.

The results of the stress analysis shows that the control group did not have a significant change in stress levels, with a mean difference of -0.194 and a p-value of 0.206, which means that their sense of stress stayed the same. On the other hand, Experiment Group I's stress levels went down slightly (mean difference of 0.406, $p = 0.021$), which suggests that the dietary intervention had a good effect. Experiment Group II showed a big drop in stress levels, with a mean difference of 2.13 and a very significant p-value of <0.001. This proves that the intervention worked. Experiment Group III also had a big drop in stress levels (mean difference of 2.70, $p < 0.001$), which shows that the dietary intervention worked well for thisgroup. Overall, the data shows that the control group stayed the same, while both Experiment Groups 2 and 3 had a big drop in stress levels because to their nutrition interventions.

The study also investigated the effect of nutrition interventions on the symptoms of Polycystic Ovary Syndrome (PCOS). Data was collected using the Cronin Questionnaire, which included 26 questions covering five areas of PCOS problems: weight-related problems, menstrual problems, Hirsutism, Concern about Infertility-related Problems, and Emotion-related problems. In the study on weight-related problems, the control group maintained a mean score of 31.5, showing no change. Experiment Group I increased slightly from 27.9 to 28.2 (mean difference: -0.313, p =

0.048), while Experiment Group II rose from 25.3 to 25.8 (mean difference: -0.469, p = 0.009). Experiment Group III showed the most significant improvement, increasing from 23.1 to 25.3 (mean difference: -2.23, $p < 0.001$). For menstrual problems, the control group remained at 22.4, whereas Experiment Group I increased from 26.5 to 27.0 (mean difference: -0.500, p = 0.037). Experiment Group II decreased significantly from 20.8 to 21.8 (mean difference: -1.06, $p < 0.001$), and Experiment Group III showed a notable change from 21.2 to 24.4 (mean difference: -3.27, $p < 0.001$). In hirsutism, the control group had a constant score of 27.6, with minimal changes in Groups I and II, but Group III improved significantly from 25.4 to 27.1 (mean difference: -1.67, $p < 0.001$). All groups showed no change in infertility-related concerns, maintaining scores around 19.4. Lastly, the control group's emotional problems score remained at 45.2, with Experiment Group I slightly increasing from 49.2 to 49.3 (p = 0.211) and Group II decreasing from 43.3 to 43.6 (p = 0.077). However, Experiment Group III experienced significant improvement from an initial mean of 44.1 to a post-intervention mean of 45.8 (mean difference: -1.67, $p < 0.001$), indicating effective intervention for emotional distress related to PCOS.

The study investigated the relationship between nutrient intake and anthropometric measurements in the selected PCOS study subjects. It suggested that dietary advice should be tailored to better weight control management and metabolic issues in PCOS subjects by understanding the substances that might affect these metrics. The study emphasized the need for a comprehensive approach including Nutritional Education, Exercise, and Dietary Supplementation to minimize the consequences of PCOS and promote reproductive health status.

The analysis of collected data showed that there were weak links between food consumption, BMI, and WHR. There were almost no links between energy intake and carbohydrate intake. Before the intervention, protein intake was moderately negatively correlated with BMI, but it was still not significant. Calcium and magnesium both had negative relationships with BMI. After the intervention, fat intake was linked to both BMI and WHR in a positive way, although these results were not statistically significant. The study also identified a strong negative link between nutrient intake and waist-to-hip ratio (WHR) after the intervention. This suggests that eating more zinc might be linked to a lower WHR. Before the intervention, calcium consumption was

negatively correlated with WHR, which suggests that having enough calcium in the body might help control body weight and fat distribution.

The study also found variable correlations between biochemical profiles (Random Blood Sugar, cholesterol, and haemoglobin) and anthropometric measurements (BMI and WHR) across the four study groups. Elevated RBS levels were found to be linked to weight-related problems and infertility-related problems, suggesting that addressing these lipid abnormalities through lifestyle changes and nutrition interventions might be essential for effectively managing PCOS symptoms.

5.3 Recommendations for future research

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

- Future studies should use both longitudinal and cross-sectional approaches to keep track of people over lengthy periods of time. This kind of study will assist researchers find any delayed effects that might not be evident in smaller trials by helping to figure out how well dietary changes work in the long run for PCOS symptoms.
- Future study must include women from diverse cultural, ethnic, and socioeconomic backgrounds. This will help make it clearer how different lifestyle choices and cultural behaviors affect the frequency and management of PCOS, which will make the results more useful for many groups.
- Looking into the genetic predisposition to PCOS could reveal important risk factors and family ties. Future studies should include family history assessments and genetic testing to learn more about how genes may cause hormone imbalances, metabolic issues, and a higher risk of PCOS.
- Studies on the psychological effects of having PCOS should look at issues including anxiety, depression, and body image. Knowing these characteristics can result in more all-encompassing treatment strategies combining food and lifestyle adjustments coupled with mental health care.
- Mobile health technology, including applications that track how much food and exercise people are getting, can help people in the study stay involved and follow

through with the interventions. In the future, researchers should investigate into how successfully these tools help women with PCOS live healthier lives.

- Nutritionists, endocrinologists, psychologists, and fitness specialists can all work together to create comprehensive treatment plans that meet the needs of each person. Future research should focus on making initiatives that involve people from many different fields and look at all the different parts of PCOS.

5.4 Limitations of the study

- Even if there are 1,250 subjects it may not reflect appropriate demographic results, so we can't generalise the results.
- There is a chance for underreporting and overreporting by the participants because of social desirability. It will lead to possible biases depending on their dietary consumption and lifestyle choices.
- Longer-term trials for more complete results are necessary since the 90-day length of dietary interventions may not adequately reflect long-term benefits or changes in health state.
- The absence of a well-defined control group hinders the capacity to make strong conclusions regarding the efficacy of dietary therapies compared to routine care or no intervention.
- Variations in baseline nutritional knowledge among participants could affect their interaction with educational resources and consequent outcomes, therefore complicating the interpretation of results.
- An ultrasound scan was not done after the intervention because of economic constraints.

5.5 Scope of the study

- Emphasizing the need of micronutrients in controlling symptoms, the study focuses on assessing several dietary interventions meant to improve nutritional state among women diagnosed with PCOS.
- It evaluates the success of customized instructional courses meant to raise awareness of PCOS and support better lifestyle choices among participants.

- The study looks at how socioeconomic level affects eating patterns and PCOS-related health effects, therefore shedding light on the obstacles that different population groups experience.
- The study assesses how well lifestyle adjustments including stress management strategies and more physical exercise control PCOS symptoms.
- It looks at particular micronutrients' functions in reducing PCOS symptoms, thereby providing important data for creating dietary recommendations catered for affected women.

The rising prevalence of Polycystic Ovary Syndrome (PCOS) among young women underscores the urgent need for effective remedies, particularly through dietary changes and nutritional education. Lifestyle modifications, psychological support, and multidisciplinary cooperation should integrate to tackle the complexities of PCOS condition. Research has made substantial progress in understanding the underlying physiology of PCOS and developing effective nutritional care and support management strategies; however, there remains a critical need for further studies to explore diverse populations and assess the long-term effects of various treatments. Additionally, addressing the psychological aspects of PCOS is vital, as many women face mental health challenges alongside physical symptoms. By enhancing awareness and improving care for individuals with PCOS, we can foster better reproductive health, elevate their quality of life, and promote overall well-being. Continued efforts in research and education will be key to empowering women affected by this condition.

"Communities and countries and ultimately the world are only as strong as the health of their women" Michelle Obama