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SUMMARY AND CONCLUSION

Fertility is the natural human capability of producing offspring. A woman's fertility peaks in the early and mid twenties, after which it starts to decline, being accelerated after the age of 35 years with advanced maternal age causing an increased risk of female infertility. This popularity refers to as a woman's biological clock. According to WHO (2013), the reproductive age generally ranges from 15-45 years. This period is also popularly known as the age and stage of fertility problems like PMS (Kumari, et al., 2015).

Premenstrual Syndrome (PMS) refers to a group of menstrually related disorders, characterised by physical and mental symptoms that occur in the luteal phase of menstrual cycle. These symptoms result in the deterioration of interpersonal relationships, personal health and functional efficacy of the body. Symptoms start shortly after ovulation with increased in severity and reach a maximum during the last five premenstrual days. After the onset of menstrual bleeding, the symptoms rapidly disappear and are usually gone within three to four days. PMS is related to ovulatory cycles and resolves at menopause. PMS have an onset at any time during the reproductive years and once symptoms are established and tend to remain fairly constant until menopause. These symptoms are known to have a great impact on daily life activities and social functions and result in significantlyreduced Quality of Life (QOL). Women with PMS had a worst QOL due to physical pain, vitality, limitations in daily activities, perception and changes in overall health status.

With these backdrops, it is customary to know the prevalence of PMS and assess the nutritional and health status of the participants with PMS. The present study entitled "**Effect of Nutrition Intervention on Symptoms of Premenstrual Syndrome (PMS) among Women of Reproductive Age (20-45 Years)"** has been undertaken by the investigator with the following specific objectives:

- Find out the prevalence of PMSamong the women of reproductive age (20-45 years).

- Study the influence of demographic, dietary, menstrual, nutritional and psychological variables on premenstrual symptoms
- Formulation and evaluation of health mix rich in micro nutrients for dietary intervention
- Development and evaluation of educational modules for nutrition education and
- Evaluate the effect of nutritional intervention strategies on symptoms of PMS

The present study consisted of four phases. In the first phase, household survey was conducted to find out the prevalence of PMS among reproductive age women in Sulur area of Coimbatore. Total of 600participants were selected to screen for PMS. From the 600 participants, 541 with PMS symptoms were screened and included for the study. To gather the correct information in an effective manner three subsequent menstrual cycles were carefully monitored and each and every aspect of menstrual cycles recorded. An interview schedule was adopted to collect relevant information regarding demographic status, dietary pattern, nutritional and health status and menstrual cycle. Details related to premenstrual cycle and syndrome were recorded using a standard tool Premenstrual Daily Symptom Diary (PMDD). Level of Anxiety and self esteem was assessed through the State Anxiety Inventory and State Trait Inventory and Rosen Berg's Self Esteem scale. The basic knowledge of the selected participants on PMS was also assessed.

In the second phase, acceptability trials were carried out for the selected five variations of health mix and evaluated for the selection of the best combination for dietary intervention through sensory evaluation.

In the third phase of the study, the sub sample of 100 participants were selected and assigned to experimental (N=50) and control (N=50) groups. All the participants in the experimental group were supplemented with 150 g of health mix in the form of cookies and nutrition education was given to the selected participants in the experimental and control groups during the study period of 120 days.

In the fourth phase, impact of nutrition intervention was assessed through the nutrition and health status, severity of symptoms of PMS and their knowledge on PMS.

Phase: I Prevalence of Symptoms of PMS

In the first step of the research, prevalence of the symptoms of PMS was recorded using a quick screening tool (ACOG Diagnostic criteria, 2000) among 600 reproductive age women in the age group of 20-45 years. Among the selected 600 participants, 59 participants were healthy and free from PMS and rest of them (N=541) had one or other symptoms of PMS.

Salient findings of the research are discussed in the following pages.

I. Demographic characteristics:

- Forty two per cent of the participants were from rural areas and rest of the participants were (29 per cent) from urban and semi urban locality. Sixty five per centbelonged to nuclear families. Majority (59 per cent) of the families of the participants were comprised of 5-6 members and 50 per cent of the participants belonged to low income group with monthly income of Rs. 2500-4500.
- As far as the educational status of the parents was concerned, 83 per cent of father and 73 per cent of mother of the participants had middle school education.
- Fifty five per cent of the participants were in the age group 20-30 years, 24 per cent were between 31 and 40 years and 21 per cent were in the age group of 41-45 years. The mean age of the participants was found to be 30.04±4.06 years.Fifty five per cent of the participants were unmarried, 43 per cent of them were married and only two per cent were separated and meagre per centof theparticipants were widows.
- Thirty seven per cent of the participants had under graduate education and twenty three participants had only middle school education and rest of them had different levels of school or college education. When considering the occupational status of the participants, 45 percent were students followed by 20 per centwere government or non government employees and 15 per cent were at home or seeking jobs to enhance the economic status of the family.

II. Food and dietary pattern

- Among 541 participants, 64 per cent were non vegetarians, 18 per cent were vegetarians and 15 per cent were ovo-vegetarians and three per cent were

vegans.Thirty seven per cent of the families spent between Rs. 1000-2000 towards their food expenses.

- Eighteen per cent of the participants took less than one litre of water, 53 per cent of the participants took 1-1.5 litre of water, 22 per cent took 1.5-2 litre of water and seven per cent of the participants took more than two litres of water daily. Majority (35 per cent) of the participants took 350 ml. of milk each day. Forty eight per cent of the participants took coffee or tea (3-4 times) daily, followed by 22 per cent had coffee/tea more than five times a day. Seventy eight per cent of the participants had carbonated beverages occasionally.
- Consumption of junk foods by the participants included bakery items, hot spicy, chat and fried foods items. It was noted that irrespective of age, majority (16-46 per cent) of the participants preferred junk foods, once or twice in a week.
- Among the dietary intake of Iron rich foods, roasted bengal gram was mostly included by 37 per cent of the participants. Other Iron rich foods included by the participants were whole cereals, green leafy vegetables, lean meat, jaggery and dried fruits (9-37 per cent). Eight to 19 per cent of participants consumed Vitamin –C rich foods like sprouted grains, amla, guava, citrus fruits, fresh raw vegetables and green leafy vegetables daily.
- Eighteen to 66 per cent of the participantsconsumed Calcium rich food items like ragi, milk, milk products, green leafy vegetables, gingelly seeds, meat and tender bones weekly twice or thrice in their daily dietary.
- Percapita oil consumption per day among 44 per cent of the participants was noted to be five grams, less than five grams among 26 per cent of the participants, more than seven gramswas noted among 22 per cent of the participants. It was noted that the participants consumed fats and oils less than the ICMR suggested RDA of 25 grams (ICMR, 2011).
- Majority (82 per cent) of the participants used groundnut oil for their cooking followed by gingelly oil (68 per cent) coconut oil (58 per cent) and sunflower oil by 58 per cent of the participants. Thirty four per cent also used palm oil for their cooking purposes and only 10-15 per cent took butter, ghee or vanspathi for daily preparations.

III. Details related to menarche and menstrual cycle

- Mean age at menarche was 13.04±1.285among the participants. Majority of the participants reported that the age at menarche was found to be 12 years (31 per cent) and 13 years (29 per cent).
- Eighty seven per cent of the participants had regular menstrual cycle whereas 13 per cent had menstrual irregularity.
- Forty per cent of the participants had regular menstrual cycle at 30 days or above and 28 days cycle was reported by 35 per cent of the participants. The mean of regular menstrual cycle was 28.45±3.34 days.
- It was reported that menstrual bleeding days lasted up to four days among 46 per cent of the participants and more than seven days among nine per cent of the participants and rest of them had scanty or excess bleeding for 3-5 days .The mean menstrual bleeding days were 4.21±1.1 days.
- Menstrual flow was moderate among 48 per cent of the participants. Severe flow was noticed among 31 per cent and mild among 21 per cent of the participants.
- Special food items were included to improve their reproductive and health status of the participants and were gingelly oil and raw egg (45 per cent), black gram dhal with jaggery (53 per cent), rice flakes with jaggery (19 per cent), fenugreek preparations (23 per cent) and fruit juice and adequate milk were consumed by only18 per cent of the participants. Some food items like mango, papaya, pineapple and brinjal were considered as hot foods and were avoided during menarche and menstrual cycle by 59 per cent of the participants.

IV. Nutritional status of the participants

- Nutritional status assessment of the selected participants revealed that the mean height was 152.32±8.1 cm (with a range of 120-170 cm). The mean weight of participants ranged between34-86 Kg. with a mean weight of 59.59±10.366 kg.
- Based on the BMI values, the participants were categorised as moderate malnutrition (13 per cent), mild malnutrition (38 per cent) and normal range (18 per cent) only. Twenty per cent were overweight and 11 per cent were in the grade-I obesity. The mean BMI value was 23.65±4.8. Based on waist-hip ratio, only eight

per cent of the participants were normal, 58 per cent were in mild and 34 per cent were in moderate obesity categories with a mean waist-hip ratio of 0.844±0.098.

- Based on the haemoglobin level, participants were graded as normal or non anaemic (32 per cent), mild anaemia (22 per cent), moderate anaemia (37 per cent) and severe anaemia (9 per cent). The mean haemoglobin level was found to be 10.52±2.24.

V. Prevalence of PMS

- Screening of PMS showed that the prevalence of PMS among 600 participants was 90 per cent (N=541) and the research was carried out for the 541 participants.
- From the collected data, it was noted that 48 per cent had mild symptoms, 45 per cent had moderate symptoms and seven per cent of the participants had severe symptoms of PMS.
- The major emotional symptom observed among the selected participants, was irritability (72 per cent), behavioural symptom was food craving (71 per cent) and physical symptom was abdominal pain (82 per cent). Back pain or breast swelling were experienced by 78 per cent of the selected participants.

VI. Anxiety level of the participants

Majority (65 per cent) of the participants had moderate level of state anxiety. The mean score of state anxiety was 2.88±0.64. The trait anxiety was also at moderate level among 71 per cent of the participants with mean 2.84±0.56. Self esteem level was moderate among 63 per cent of the participants with mean score of 3.1±0.64.

VII. Knowledge of the participants on PMS

- The knowledge of the participants on various aspects of PMS was noted to be poor among 78 per cent of the participants, 20 per centparticipants had average scores and only two per cent of participants had good score for their knowledge on PMS and the mean knowledge score was 2.07±1.48.
- Majority of the participants (98 per cent) were aware of the causes of PMS, 89 per centwere known about the meaning of PMS and least score (4 per cent)

was obtained for the question related to severe complications and consequences of PMS.

VIII. Statistical influence of the demographic, dietary, menstrual and nutritional variables on PMS

- Marital status showed significant association with PMS (p=0.001). Occupation of the participants had significant association with PMS (p<0.05), fathers' occupation (p=0.00) and mothers'occupation (p=0.00). Location of house (p<0.05) also showed significant association with PMS symptom score whereas educational level of father and mother, type, size and income of the family did not show any significant association with PMS symptom scores.
- Intake of water was significantly associated with PMS symptom score (p<0.05) milk and milk products showed mild degree of negative correlation (r = -0.063) with PMS symptom score.
- Intake of coffee was positively correlated with (r = +0.422) PMS symptom score (p=0.00), whereas skipping meal, intake of vegetables, green leafy vegetables, fruits, fats and oils and carbonated beverages did not show any statistical significance with PMS symptom score.
- Age at menarche was significantly associated (p=0.05) with PMS symptom score. Duration of menstrual cycle (p<0.01) and days of menstrual cycle (p<0.05) showed significant association with PMS symptom score. Menstrual blood flow does not show any significant association with PMS symptom score.
- Anthropometric measurements showed that PMS symptom score was significantly associated with weight (p=0.00) and height (p<0.05) whereas BMI values and waist hip ration did not show significant association with PMS symptom score.
- Under biochemical parameters, haemoglobin level of the participants was estimated and found that the anaemic status did not show any association with PMS symptom score.
- PMS symptoms score showed statistically significant association with State Anxiety, Trait Anxiety and Self Esteem at (p=0.00) level.
- Knowledge score of the participants was significantly associated (p<0.05) with PMS symptom score.

- Intake of water had negative correlation with irritability (r=-0.119), head ache (r=-0.137), abdominal pain (r=-0.331) at p<0.001 and food craving (r=-0.088) at p<0.05. Water intake was positively correlated with muscle pain (r=0.178; p=0.00).
- Intake of fruits showed negative correlation with anxiety (r=-0.101) and tiredness (r=-0.109) at p<0.01 level, changes in sex desire (r=-0.168; p<0.01) and difficulty in concentration (r=-0.120) at p=0.00 level.
- Intake of vegetables also showed a negative correlation with individual PMS symptoms cry (r=-0.089; p<0.05), relationship problems (r=-0.142; p<0.05), food craving (r=- 0.093; p<0.05), weight gain (r= -0.115; p<0.011) and muscle pain (r= -0.115; p<0.011). Positively correlated with back pain (r=0.141; p<0.05).
- Intake of green leafy vegetables had positive correlation with tiredness (r=0.135; p<0.01) and back pain (r=0.119; p<0.05) and had negative correlation with difficulty in concentration (r=-0.113; p<0.05) and muscle pain (r=-0.119; p<0.01).
- Intake of coffee showed positive correlation with the symptoms of irritability (r=0.258), anger (r=0.175), anxiety (r=0.096), depression (r=0.127), food craving (r=0.185), difficulty in concentration (r=0.130), abdominal pain (r=0.152) and nausea (r=0.165) at p<0.01.
- Oil consumption was noted to have negative correlation with irritability (r=-0.271), breast tenderness (r=-0.125), muscle pain(r=-0.216) and over whelming(r= -0.259) at p<0.01 level and it was positively correlated with tiredness(r=0.174), weight gain (r=0.306) and nausea (r=0.121) at p<0.01.
- Intake of milk was negatively correlated with cry (r=-0.188), tiredness (r=-0.180), food craving (r=-0.187), insomnia(r=-0.264), abdominal pain (r=-0.331), muscle pain(r=-0.178) at weight gain (r=-0.117) a level of p<0.01 and difficulty in concentrating (r=-0.107) at p<0.05) and positively correlated with headache (r=0.137; p<0.01).
- Skipping of meal was negatively correlated with irritability (r=-0.0.116; p<0.05), breast tenderness (r=-0.214; p<0.01), and weight gain (r=-0.182).

Positively correlated with back pain (r=0.210), muscle pain (r=-0.212), at p=0.00 level.

- Age at menarche had positive correlation with the individual PMS symptoms of anger (r=0.093; p<0.05) and days of menstruation showed negative correlation with the individual PMS symptoms, irritability (r=-0.258; p=0.00) and depression (r=-0.018; p<0.05).
- In anthropometric measurements, Waist/Hip ratio alone had positive correlation with PMS symptoms like changes in sex desire (r=0.322; p=0.00); food craving (r=0.101; p<0.05) and abdominal pain (r=0.109; p<0.05). Though most of the symptoms had mild degree of positive correlation with Waist-Hip Ratio and other anthropometric parameters like BMI values, height and weight, and were statistically not significant.
- State anxiety was positively correlated with breast tenderness (r=0.134; p<0.01) and trait anxiety was positively correlated with back pain (r=0.134; p<0.01) and depression with (r=0.108; p<0.05). Self esteem was negatively correlated with anger (r=-0.094; p<0.05).
- Knowledge score on PMS was negatively correlated with head ache (r=-0.091; p< 0.05), back pain (r=- 0.095; p<0.05), muscle pain (r=-0.101; p<0.05), changes in sex desire (r=-0.129; p<0.01), irritability (r=-0.096; p<0.05) and anger (r= -0.094; p<0.034).

Phase-II Acceptability trial of the formulated health mix cookies

- Sensory evaluation showed that the Variation II was highly acceptable with an overall score of 32.58 out of 35.
- Nutritive value of the five variations of health mix were analysed and calculated Variation II with higher level of Calcium rich health mix cookies was used for dietary intervention. Variation II also showed higher amino acid profile and essential fatty acid profile.
- Sensory evaluation of health mix cookies showed that the score of formulated cookies was lesser than the standard cookies. The participants readily accepted the health mix cookies due to its Calcium and other nutrient content and also its health benefits.

- Formulated health mix cookies contributed 19.05 g of protein, 507 mg of Calcium and 604 mg of Magnesium, 18.9 mg of Iron and 233 micro grams of beta carotene per 100 g of the cookies used for dietary intervention for the period of 120 days.
- During the study period, each participant of the study group was supplied with eight health mix cookies. The study participants were instructed not to take coffee or tea or carbonated beverages before and after the intake of the health mix cookies. The study participants were encouraged to drink fresh fruit juices or fruits rich in Vitamin C. The investigator or her representative was directly involved in the distribution of the health mix cookies to all the participants who were gathered in same place each day in mid morning and mid afternoon.

PHASE-III

Impact of dietary intervention onnutritional statusand symptoms of PMS of the selected participants

Anthropometric measurements, showed that there was a significant difference in the experimental group for BMI and waist-hip ratio ($p<0.01$) before and after intervention.

- Biochemical estimations of serum Calcium, and blood haemoglobinshowed the significant difference between the experimental group ($p<0.01$) and serumMagnesium, TIBC and Ironrevealed that there was a significant difference between the experimental and control group after interventions ($p<0.05$) and also within the experimental group ($p<0.01$), before and after the intervention studies.
- Clinical examination showed that there was significant difference within the experimental group before and after intervention for general weakness, thin or lean stature, angular stomatitis, rough dry skin, bleeding and swollen gums, cheliosis ($p<0.01$) and head ache ($p<0.05$).
- Mean nutrient intake of the participants in the experimental and control groups showed that there was a significant difference within the experimental group before and after interventions and within the experimental for energy, protein, carbohydrate, Calcium, Magnesium, Iron, beta carotene, thiamine, riboflavin, niacin ($p<0.01$) and Vitamin-C ($p<0.05$) and between the final observations of experimental and control group after intervention for energy, protein, carbohydrate, fat, Calcium, Magnesium, Iron, beta carotene, thiamine, riboflavin

and niacin and Vitamin-C ($p<0.01$) and for protein, Magnesium and thiamine it was $p<0.05$.

PHASE- IV

IMPACT OF NUTRITION EDUCATION ON THE KNOWLEDGE AND SYMPTOMS OF PREMENSTRUAL SYNDROME OF THE SELECTED PARTICIPANTS

- PMS symptom score and number of PMS symptoms were statistically analysed and found that there was significant difference in the experimental group before and after intervention ($p<0.01$) and between the experimental and control group after intervention ($p<0.01$).
- The mean depression level of the selected participants showed that there was significant difference in the mean scores for depression within the experimental group ($p<0.05$) and between the experimental and control groups ($p<0.01$).
- There was a negative correlation of number of PMS symptoms with haemoglobin levels ($p<0.01$) and PMS symptom score was negatively correlated with serum Calcium levels. ($p=0.00$).
- Individual PMS symptoms like head ache, back pain, sensitivity, depression and loss of appetite were negatively correlated with serum Calcium level. Mood swing was negatively correlated with serum Magnesium level, palpitation was negatively correlated with serum ferritin level and palpitation, food craving and mood swing were negatively correlated with serum Iron. All showed statistical significance of $p<0.05$.
- Overall mean PMS knowledge score among experimental group before intervention was 31 per cent and after intervention it was 74 per cent. In the case of control group before intervention, it was found to be 38 per cent and that after intervention was 50 per cent.
- The frequency of individual symptoms like acne, abdominal bloating, breathlessness, dizziness, hot flashes, irritability, loss of appetite and wish to be alone ($p<0.01$) and fatigue, palpitation, breast swelling and mood swing ($p<0.05$) in the experimental group before and after intervention noted that there was statistical significant difference. There was no significant difference in the frequency of individual symptoms like headache, nausea, angry, anxiety,

confusion, depression, food craving and forgetfulness in the experimental group before and after intervention.

- There was no significant difference in the frequency of individual symptoms in the control group before and after intervention except for the symptoms of hot flashes ($p<0.01$), confusion, mood swing and wish to be alone ($p<0.05$).
- The presence of individual PMS symptoms of final observations showed statistically significant difference between the experimental and control group for breathlessness, dizziness, fatigue, head ache, palpitation, anger, wish to be alone ($P<0.01$) and abdominal bloating, hot flashes, nausea, breast swelling, confusion and mood swing ($p<0.05$). The significance was noted at $p<0.05$ level.
- From the discussions, it was noted that there was significant improvement in mean nutrient intake of Iron, Calcium, carbohydrate, thiamine, riboflavin, niacin, Vitamin-C, serum Calcium, Magnesium and Protein levels, knowledge on various aspects of PMS, reduction in the number of PMS symptoms and PMS symptom scores. The individual PMS symptoms showed statistically significant difference in the experimental group before and after intervention as well as among the experimental and control group before and after intervention. It might be due to the micro nutrients present in the health mix cookies and also due to the impact of nutrition and health education.
- The results of the study concluded that the nutrition intervention (supplementation and nutrition and health education) proved to be effective in improving the health status and reducing the frequency and severity of PMS symptoms of the participants in the experimental group when compared to control group. There was a slight improvement in the blood parameters, nutrient intake, PMS symptoms, clinical symptoms and moderate increase in knowledge scores among the control group. This was attributed to the conduction of nutrition and health education to the control group also.

Thus, from the findings of the study, it is concluded that micro nutrients rich health mix is a welcoming appropriate and feasible attempt in alleviating the symptoms of PMS and in improving health status of the selected population.

Recommendations

The following recommendations are emerged from the present study.

1. More research works are suggested to improve the nutritional and health status of reproductive age women through nutrition education and dietary intervention since they are the pillar of family to support and uplift the overall development of the family.

2. Create awareness on the locally available, seasonal, inexpensive food items rich in protein, Iron, Calcium, Magnesium and Vitamins to optimise the nutrient intake of the women population.

3. Efforts have to be taken to improve the knowledge on various aspects of PMS among younger generation especially starting from school going and adolescent girls.

4. Elaborate studies must be undertaken on the prevalence of PMS in rural areas, different income groups and also girls or women engaged indifferent physical activities.

5. Popularise the non-pharmacological management techniques like dietary pattern, physical activities, regular exercises, yoga and meditation for reducing the severity of PMS.

6. Explore highly concentrated micronutrients like Iron, Calcium and Magnesium rich food items that can be regularly included in the routine daily dietaries to prevent PMS.

7. Simple recipes using locally readily available seasonal, low cost ingredients can be standardised and popularised so that it can be prepared and consumed regularly by the participants at their house hold level.

Nutritional and health well-being can be achieved only through a food based and not drug based approach. Pills and tablets can never be effective substitute for balanced diet. Our attempts must be to achieve appropriate dietary diversification to reduce the

health problems of PMS. A sound and sustained programme of nutrition education may be helpful in modifying the future of young generation.

"Any investment towards improving the health status of the women is the real investment for the health and wealth of the family".

(Rajammal P.Devadas, 1998)