SPECIMEN FORMAT FOR THESIS OF MONTH

Faculty	:	Dr. S Kowsalya
Department	:	Food Science and Nutrition
Branch/ Area:	:	Clinical Nutrition, Community Health
Sub Subject Heading:	:	Public Nutrition
Candidate's Name	:	Nita Ann Johnson
Candidate's Address with email	:	Department of Food Science and Nutrition Avinashilingam Institute for Home Science and Higher Education for Women Coimbatore, Tamil Nadu - 641043
Title of the thesis	:	Impact of Lifestyle Interventions on Nutritional Status, Physical Activity and Sleep Pattern of Overweight and Obese 18 to 25 year old Women during Covid-19
(i) In Roman Script		-
(ii) In roman script		-
Nomenclature of Degree:	:	
Month & Year of Enrolment:	:	January, 2019
Month & Year of Registration:	:	January, 2019
Month & Year of Submission:	:	February, 2024
Month & Year of Award	:	November, 2024
Name of Supervisor	:	Dr. S Kowsalya
Designation of Supervisor	:	Former Registrar and Professor, Department of Food Science and Nutrition Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu - 641043

Centre/department/school in which research was conducted	:	Department of Food Science and Nutrition, School of Home Science, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu - 641043
University's Name & Address	:	Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu - 641043

Abstract within 300 words:

The present study lays the foundation for a more comprehensive investigation into obesity, and the non-invasive, individualized, behaviour-change-based strategies intended to treat this prevalent problem of health. The four objectives of the study were to: study the socio-economic status, determine the nutritional status, lifestyle pattern including physical activity, sleep quality, and Knowledge, Attitudes and Practices (KAP) of 18 to 25 year old women; develop aerobic exercise routines and nutrition education modules as interventions; and assess their impact on the above parameters. A total of 632 women participants, who self-reported as aged between 18 and 25 years, had lived in Coimbatore for at least three years, and their initial Body Mass Index (BMI) suggested that they were overweight or obese were included as participants of the present study. Pre-tested and validated, structured survey forms were used towards clinical, biochemical and dietary assessment. The Global Physical Activity Questionnaire and the Pittsburgh Sleep Quality Index assessed the subjects' physical activity levels and sleep quality respectively. Subjects were randomly allocated to either the control group (Group 0), the exercise intervention group which underwent exercise for five days a week (Group 1), the nutrition education group which had 20-minute dietary counselling every week (Group 2) or the combination of exercise and nutrition education group (Group 3). The subjects were re-evaluated for their nutritional status, dietary habits, level of physical activity, sleep quality, and KAP after six months. Multiple regression analysis showed that educational awareness decreased body weight, BMI and Waist-to-Hip Ratio (WHR). Exercise improved Skeletal Muscle Mass (SMM) by 2.7 kg and Basal Metabolic Rate (BMR) by

0.5 kcals up to 60%. As a combined effect of 42%, weight, BMI, WHR, and percentage of body fat significantly decreased while SMM and BMR increased ($F=19.56$, $p<0.001$). Nutrition education intervention improved the haemoglobin content and lowered the serum thyroid levels. Combining both interventions, random blood glucose, and thyroid function parameters decreased while haemoglobin increased up to 48% ($F=11.60$, $p<0.001$). Both the interventions combined significantly reduced dietary intake as well as improved the sleep quality of the study subjects up to 44% ($F=247.37$, $p<0.001$). Thus, a combination of exercise and nutrition education results in an overall enhancement in women's lifestyles and the potential for long-term weight management by improving their nutritional status, physical activity, and sleep quality.

i) Major objectives :

1. To study the socio-economic status, dietary pattern, nutritional status and frequency of morbidities of 18 to 25 year old college-going women.
2. To determine the nutritional status, physical activity levels, sleep quality, and the knowledge, attitudes and practices of healthy lifestyles of these collegiate women.
3. To develop aerobic exercise routines and nutrition education modules for the women based on their nutrition knowledge and health status and assessing the impact of this intervention on the nutritional status & lifestyle pattern of selected women.

ii) Hypothesis:

1. $H_0$1: Research tools (questionnaires) and intervention methods (education modules and exercise routines) cannot be formulated and validated to be utilised for the selected population
2. $H_0$2: There is no association between being overweight / obese and being less physically active, having poor dietary intake, poor sleep quality and poor knowledge, attitudes and practices related to the management of obesity
3. $H_0$3: Following the aerobic exercise and nutrition education interventions, there is no significant improvement in the levels of physical activity, dietary

intake, sleep quality or knowledge, attitudes and practices related to the management of obesity

iii) Methodology :

The second wave of Covid-19, which ran from April 2021 to April 2022, was the period during which the longitudinal research study was carried out among college-going women in Coimbatore, TN, India (Institutional Human Ethics Committee acceptance number: AUW/IHEC/FSN-19-20/XPD-38). Participants who were women, who self-reported as being between the ages of 18 and 25, were going to college, had lived in Coimbatore for at least three years, and their initial body mass index (BMI) suggested that they were overweight or obese were included as participants of the present study. Sample size of the study was calculated utilising the formula as described by Daniel and Cross (2018), and Liu *et al*., (2021) and determined to require at least 670 subjects.

As part of Phase I of the study, pre-tested and validated, structured survey forms and globally accepted questionnaires were developed by the researcher to gather information on the socio-economic status, anthropometric assessment, physical examinations, dietary habits, food consumption, and Knowledge Attitudes and Practices (KAP) of the subjects regarding the management of obesity. The questionnaires were tested for construct validity with feedback from 50 subject and 50 non-subject experts and for reliability using the test-retest method, which was spaced one month apart. The Pittsburgh Sleep Quality Index (PSQI) questionnaire (Buysse *et al.*, 1989) was implemented to get information on the sleep quality of the study subjects, while the Global Physical Activity Questionnaire (GPAQ) (WHO, 2012) was utilized to gather data about physical activity.

In Phase II, the age, educational attainment, living locations, family structure, income, and, if relevant, the age at which the participants were married were among the background details that were examined. Using the modified Kuppuswamy scales (Sood & Bindra, 2022), socio-economic profiling was carried out by assigning the research respondents to one of five categories: higher, upper middle, lower middle, upper lower, and lower based on the family head's employment, education, and income.

Phase III consisted of the data collection evaluating the nutritional status of the study subjects using the "ABCD" approach. The anthropometric parameters of the subjects' including their height (in m), weight (in kg), resultant BMI (in kg/m^2), waist circumference (in cm), hip circumference (in cm), resultant waist-to-hip (WHR) ratio were recorded using the standard methods of measurements as per ICMR-NIMS (2021) guidelines and body composition parameters analysed through body impedance analysis pertaining to the subjects' skeletal muscle mass, percent body fat, basal metabolic rate and overall fitness score. Assessment of biochemical parameters of study subjects included conducting tests of random blood glucose, haemoglobin and thyroid function including serum triiodothyronine (T_3), thyroxine (T_4) and thyroid stimulating hormone (TSH) following the good clinical laboratory practice guidelines (GCLPG by ICMR, 2021). Clinical examination of the study subjects consisted of the researcher conducting the physical examination of the study subjects with the assistance of a qualified medical practitioner for physically observable signs and symptoms of diseases related to the hair, skin, eye, mouth, teeth, and musculature including nutritional oedema, problems with vision, texture of skin, anaemia, muscle wasting, oral health and dental hygiene etc. through a pre-tested checklist. Self-reported responses from subjects were used to detect the morbidity pattern up until 3 months prior to the study utilising a pre-tested questionnaire that included queries on covid, episodes of cold/fever, bouts of diarrhoea, nausea/vomiting and their frequency, whether subjects consumed medication for the above morbidities and the presence or absence of food allergies. Dietary pattern / preferences and food consumption were assessed by food frequency questionnaires, and 24-hour-recall (24HR) questionnaire. As for the indicators of their lifestyle, the data collected included their physical activity through the GPAQ, sleep patterns through the PSQI, and their knowledge, attitudes, and practices on managing obesity through a pre-tested and validated questionnaire.

In Phase IV, the intervention methods to be used in the present study were identified and validated based on the data of the pre-study responses of the initial KAP survey. Firstly, nutrition education modules through PowerPoint presentations, posters focusing on general health, a calendar for the following year (2023) with positive messages were developed to be used along with nutrition counselling and secondly, online exercise routines that could be followed by prospective study subjects were identified and subjected to pre-testing, approval and validation by a representative sub-sample population.

Phase V included implementing the interventions aimed at lifestyle modifications of the study subjects. A computerized approach was used to randomly allocate participants into one of the four intervention groups, with a total of 158 subjects divided among the four groups. Group zero consisted of the control group, and no intervention was given to them. The subjects of experimental Group 1 were imparted a physical activity intervention for five days a week, subjects in experimental Group 2 received weekly dietary instruction and counselling and the subjects of Group 3 received a combination of nutrition education and counselling interventions in addition to physical activity.

In Phase VI, after 26 weeks of the intervention period culminated, using the pre-tested and validated questionnaires as before the intervention, the subjects were evaluated once more for their nutritional status, dietary habits, level of physical activity, sleep quality, and KAP. All 632 subjects' responses (or 164 sub-samples) were documented as post-intervention data by the end of the study period to be studied and interpreted by using the Statistical Package for the Social Sciences (SPSS) software's version 26 for Windows (SPSS Inc., Illinois, USA). To determine key or significant differences between the control and experimental groups for the implemented interventions, two significance thresholds of $p \leq 0.05$ and $p \leq 0.01$ were chosen.

iv) Findings:

The salient findings of the research as summarized below:

- Assessing the Cronbach's alpha (α) and the Pearson's coefficient (r) statistical correlations revealed that the pilot tested KAP questionnaire was found to have desirable levels of construct validity (0.87) and inter-reviewer reliability (0.90).
- A majority of the 632 women participants of the study belonged to the subjects who were 18 years of age (15%). Observing the education level of the subjects, most of them were either pursuing or had completed the graduation (41%). Examining the family type of the study subjects, there were mostly nuclear families (89%) with only 11% belonging to joint families. The maximum of 56% of the study sample belonged to the lower middle-income category while the minimum of 21% belonged to the upper middle-income category.

- Initial BMI positively correlated with age ($r=0.192$, $p<0.001$) and was positively associated with income level of the study subjects ($F=13.75$, $p<0.001$). The initial BMI and WHR were found to be slightly positively yet significantly correlated ($r=0.16$, $p<0.001$). The initial BMI of the study subjects was positively and significantly correlated with the PBF ($r=0.623$, $p<0.001$).
- Outcomes of the initial clinical examination conducted for the sub-sample showed that 10.3% did not have any observable symptoms at the time of the initial clinical examination.
- Assessing the initial morbidity pattern of all the women subjects revealed that the most common ailments were cold or cough (33%), fever (37%), vomiting or diarrhoea (5.2%) and food poisoning (3.3%). 21.4% of the study samples were not sick up to three months prior to the initiation of the study. Episodes of these morbidities occur as frequently as once in two months to 41% and once a month to 25.8% of the study population.
- Data on the frequency of eating out by subjects before study revealed that 54.9% ate out once a week, 37.1 ate out 2-3 times a week, 1.74% ate out once a month and 6.1% ate out rarely.
- Considering the overall calorie intake of subjects among intervention groups before the intervention for Group 0 was 2784.30±71.14 kcals, while it was 2787.13±73.36 kcals for Group 1. Group 2 had 2783.85±83.54 kcals while Group 3 had 2793.01±69.80 kcals. Initial BMI and initial overall calorie intake were positively correlated ($r=0.113$, $p<0.001$).
- Analysing the exercise habits of the subjects at the time of study initiation showed 41.3% of subjects as not having regular physical activity, 35.1% as having physical activity 2-3 times a week and 23.6% as having daily physical activity.
- The initial GPAQ scores of the study subjects across intervention groups revealed that the average for all the subjects was 316.34±8.28 while Group 0 it was 314.97±8.10 and for Group 1 it was 315.06±8.09. For Group 2, it was 319.11±8.04 and for Group 3 it was 316.23±8.30, all below the standard 600.
- The initial PSQI scores of the study subjects across intervention groups showed that the average for all the subjects was 19.11±1.50 while for Group 0 it was 19.16±1.41

and for Group 1 it was 19.05±1.25. For Group 2, it was 19.14±1.22 and for Group 3 it was 19.07±2.0, all below the standard of 21 to 25 points.

- The initial KAP scores of the study subjects across intervention groups revealed that the average for all the subjects was 12.51±1.71 while for Group 0 it was 12.46±1.67 and for Group 1 it was 12.41±1.67. For Group 2, it was 12.51±1. 97 and for Group 3 it was 12.70±1.70, all below the maximum score of 45.
- Analysing the validity and reliability of formulated exercise routines, it was found to have overall desirable levels of construct validity (0.88) and inter-reviewer reliability (0.90) among the physical education and non-physical education students. Analysing the validity and reliability of formulated nutrition education modules, it was found to have overall desirable levels of construct validity (0.90) and inter-reviewer reliability (0.90).
- Considering the anthropometric parameters of the study subjects after intervention, the average weight of the subjects was 59.54±5.13 kg, while the average BMI was 24.27±1.81 kg/m^2 and the average WHR was 0.83±0.28. All the differences were statistically significant across the intervention groups. The final BMI and WHR were found to be slightly positively and significantly correlated ($r=0.603$, $p<0.001$).
- Considering the anthropometric parameters of the study sub-subjects after intervention, the degree of overweight/obesity was negatively correlated with SMM ($r=-0.545$, $p<0.001$), BMR ($r=-0.723$, $p<0.001$) and fitness score ($r=-0.736$, $p<0.001$) while it was positively correlated with PBF ($r=0.964$, $p<0.001$).
- Biochemical assessment of sub-subjects after intervention revealed that the final BMI levels and post-intervention biochemical parameters such as RBG ($r=0.133$, $p<0.001$) and Hb ($r=0.946$, $p<0.001$) were positively correlated while the thyroid parameters such as T3 ($r=-0.169$, $p<0.001$), T4 ($r=-0.198$, $p<0.001$) and TSH ($r=-0.188$, $p<0.001$) were negatively correlated.
- Examining the clinical symptoms of study sub-sample after intervention revealed that 38% of the subjects did not have any of the symptoms by the end of the study period and 7.4% of the women reported a reduction or complete withdrawal in the tenderness of muscles. Assessing the post-intervention morbidity pattern for the entire study sample revealed that there was an improvement in the episodes of

morbidity (47.9%), especially food poisoning (0.8%) among the subjects after the study period. A marked improvement was also seen with respect to how the frequency of the above-mentioned morbidities occurred less (35.8%) in the months following the intervention.

- Considering the average final macro-nutrient intakes of the subjects, the energy consumption was 2314.16±31.91 kcals, the protein consumption was 43.12±27.1 g/kg body weight, the carbohydrate content was 238.24± 23.5 g, and fat intake was 43.27±19.2 g. In the average final micro-nutrient intakes of the subjects, iron intake was 16.21±2.14 mg, calcium intake was 763.0± 45.41 mg, vitamin A intake was 832.51± 92.19 mcg RAE, thiamine intake was 1.7±0.26 mg, riboflavin was 1.65±0.21 mg, and cobalamin was 1.8±0.13 mg. Vitamin D intake was 18.12±3.13 mcg while vitamin C intake was 68.87± 23.54 mg. The overall calorie intake and the final BMI of the subjects were positively correlated ($r=0.272$, $p<0.001$).
- The GPAQ scores of subjects across intervention groups post-intervention showed that all the groups had 810.27±392.31 as the average. Group 0 had 314.58±7.93, Group 1 had 974.67±20.01, Group 2 had 651.71±30.20, and Group 3 had 1300.13±31.08. The differences between the control and experimental groups were significant when analysed with analysis of variances ($F=31.63$, $p<0.001$), with the highest difference being observed in experimental group, Group 3. Final levels of physical activity and BMI were found to be negatively correlated ($r=-0.743$, $p<0.001$).
- There was an increase in subjects having the regular habit of exercise i.e., from 25.7 percent at study initiation to 86.6 percent by the end of the study period.
- As per the final PSQI scores of the study subjects, there was a significant improvement ($F=35.85$, $p<0.001$) across all the intervention groups and the average for all the subjects was 10.27±6.12. Group 0 had 19.14±1.38, Group 1 had 6.33±1.04, Group 2 had 12.11±1.55, and Group 3 had 3.52±1.06. Final sleep quality and BMI of the subjects were positively correlated ($r=0.771$, $p<0.001$).
- The average KAP scores of the subjects' post-intervention was 31.06±11.05 points. For Group 0, it was 12.58±2.08 points, while for Group 1 it was 21.70±1.91 points,

for Group 2 it was 35.11±2.35 points, and for Group 3 it was 44.84±6.24 points. Final KAP scores were negatively correlated with BMI levels ($r=-0.098$, $p<0.001$).

- Multiple regression analysis showed that as a combined effect of both the interventions, there was a 42% chance that weight, BMI, WHR, and PBF could significantly decrease while SMM and BMR could increase ($F=19.56$, $p<0.001$). Combining both the interventions, there is a 48% likelihood that serum parameters including RBG, and thyroid function parameters would decrease while Hb would increase ($F=11.60$, $p<0.001$). There was a 44% likelihood that both the interventions combined would significantly reduce dietary intake as well as improve the sleep quality of the study subjects ($F=247.37$, $p<0.001$).

Examiners

Internal Examiner : Dr. AJ Hemamalini,
Professor and Head,
Department of Clinical Nutrition,
Sri Ramachandra Institute of Higher Education and Research
Deemed University, Chennai

External Examiner : Dr. Srimathi Kannan,
University of Michigan
2248 Glencoe Hills Drive
Michigan, USA