CONTENTS

Certificate
Acknowledgement
List of Tables
List of Figures
List of Flow Chart
Abstract

<table>
<thead>
<tr>
<th>CHAPTERS</th>
<th>DESCRIPTION</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I INTRODUCTION</td>
<td></td>
<td>1-5</td>
</tr>
<tr>
<td>II REVIEW OF LITERATURE</td>
<td></td>
<td>6-41</td>
</tr>
<tr>
<td></td>
<td>2.1 Calcium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2 Bone Cycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2.1 Bone as an Organ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2.2 Bone and Aging</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2.3 Time of Peak Bone Mass Attainment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 Calcium Homeostasis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4 Calcium Absorption</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5 Calcium Deficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6 Osteopenia/Osteoporosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6.1 Prevalence of Osteopenia/Osteoporosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6.2 Diagnostic Criteria for Osteopenia/Osteoporosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6.2.1 Bone Mineral Density</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6.2.2 Bone Mineral Density Measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.7 Calcium Rich Sources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.8 Calcium Fortification in Food Products</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.9 Dietary Calcium Intake in Indian Women</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.10 Nutritional Calcium Supplements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.11 Clinical Trials of Nutritional Calcium Supplements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.12 Clinical Trials on Effect of Nutritional Education on Calcium Intake</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.13 Terminology</td>
<td></td>
</tr>
</tbody>
</table>
III MATERIALS AND METHODS

3.1 Determination of Calcium Content of Commonly Edible Foods
   3.1.1 Collection of Samples for Analysis
   3.1.2 Preparation of Samples for Analysis
   3.1.3 Calcium Content

3.2 Preparation of Calcium Rich Recipes
   3.2.1 Organoleptic Evaluation

3.3 Study Design

3.4 Locale of Study

3.5 Sample Selection

3.6 Experimental Plan
   3.6.1 Criteria for the Selection of Experimental Subjects for Trials
   3.6.2 Sub Grouping of the Volunteered Calcium Deficient Subjects for Interventional Trials

3.7 Data Collection of the Subjects
   3.7.1 Development of Questionnaire
      3.7.1.1 General Information
      3.7.1.2 Menstrual History
      3.7.1.3 Reproductive History
      3.7.1.4 Lactational History
      3.7.1.5 Dietary Habits
      3.7.1.6 Physical Activity Pattern
      3.7.1.7 General Knowledge about Calcium Deficiency

3.8 Nutritional Status
   3.8.1 Anthropometric Measurements
      3.8.1.1 Measurement of Weight
      3.8.1.2 Measurement of Height
      3.8.1.3 Derived Anthropometric Indices i.e. Body Mass Index (BMI)

3.8.2 Clinical Assessment

3.8.3 Bone Mineral Density Test

3.8.4 Biochemical Parameters
3.8.4.1 Collection of Blood Samples
3.8.4.2 Determination of Serum Calcium
3.8.4.3 Determination of Serum Alkaline Phosphatase

3.8.5 Dietary Assessment
3.9 Interventional Trials
3.10 Data Processing & Statistical Analysis

IV RESULTS AND DISCUSSIONS

4.1 Calcium Content in Locally Available Food Stuffs
4.1.1 Sensory Evaluation of Calcium Rich Recipes

4.2 Profile of the Subjects
4.2.1 General Profile
4.2.1.1 Physiological State with Age of the Subjects
4.2.1.2 Educational Status
4.2.1.3 Marital Status
4.2.1.4 Type of Family
4.2.1.5 Occupation
4.2.1.6 Monthly Income

4.2.2 Menstrual History
4.2.2.1 Menstrual Cycle
4.2.2.2 Menstrual Type
4.2.2.3 Pain During Menstruation
4.2.2.4 Period of Pain
4.2.2.5 Medicine Taken During Pain

4.2.3 Reproductive and Lactational History of the Selected Subject
4.2.3.1 Reproductive History
4.2.3.1.1 Number of Children
4.2.3.1.2 Gap between Each Child
4.2.3.2 Lactational History
4.2.3.2.1 Number of Breastfed Children
4.2.3.2.2 Duration of Feeding

4.2.4 Clinical Symptoms
4.2.5 Physical activity pattern
  4.2.5.1 Exercise Pattern
  4.2.5.2 Household Work Pattern
4.2.6 Eating Pattern
  4.2.6.1 Dietary Habits
  4.2.6.2 Skipping of Meals
  4.2.6.3 Eating Out Pattern
4.2.7 General Knowledge of the Selected Subjects about Calcium Deficiency
4.2.8 Anthropometric Measurements of the Subjects

4.3 Responses of Different Interventions on BMD- T Scores of the Subjects
  4.3.1 Responses of Different Interventions on Bone Mineral Density- T scores of Normal (non pregnant non lactating) Subjects Suffering from Osteopenia
  4.3.2 Responses of Different Interventions on Bone Mineral Density-T scores of Premenopausal Subjects Suffering from Osteopenia
  4.3.3 Responses of Different Interventions on BMD- T scores of Postmenopausal Subjects Suffering from Osteopenia
  4.3.4 Responses of Different Interventions on BMD- T scores of Normal (npi) Subjects Suffering from Osteoporosis
  4.3.5 Responses of Different Interventions on BMD- T scores of Premenopausal Subjects Suffering from Osteoporosis
  4.3.6 Responses of Different Interventions on BMD- T scores of Postmenopausal Subjects Suffering from Osteoporosis

4.4 Responses of Different Interventions on Blood Profile of the Subjects
  4.4.1 Responses of Different Interventions on Serum Calcium Level of the Osteopenic Subjects
  4.4.2 Responses of Different Interventions on Serum Calcium Level of the Osteoporotic Subjects
4.4.3 Responses of Different Interventions on Serum Alkaline Phosphatase Level of the Osteopenic Subjects

4.4.4 Responses of Different Interventions on Serum Alkaline Phosphatase Level of the Osteoporotic Subjects

4.5 Impact of Different Interventions on Different Physiological States

4.5.1 Comparison of Mean BMD- T scores of Osteopenic Subjects Before and After Giving Different Interventions in Different Physiological States

4.5.2 Comparison of Mean BMD- T scores of Osteoporotic Subjects Before and After Giving Different Interventions in Different Physiological States

4.5.3 Comparison of Mean Serum Calcium Level of Osteopenic Subjects in Different Physiological States

4.5.4 Comparison of Mean Serum Calcium Level of Osteoporotic Subjects in Different Physiological States

4.5.5 Comparison of Mean Serum Alkaline Phosphatase Level of Osteopenic Subjects in Different Physiological States

4.5.6 Comparison of Mean Serum Alkaline Phosphatase Level of the Osteoporotic Subjects in Different Physiological States

4.6 Impact of Different Interventions on Osteopenic vs Osteoporotic Groups

4.6.1 Comparison of Mean BMD- T scores of Osteopenia vs. Osteoporosis Subjects Before and After Giving Different Interventions

4.6.2 Comparison of Mean Serum Calcium Level of Osteopenic vs Osteoporotic Subjects Before and After Giving Different Interventions

4.6.3 Comparison of Mean Serum Alkaline Phosphatase Level of Osteopenic Vs Osteoporotic Subjects

4.7 Nutrient Intake of the Subjects Before and After Intervention Trials
4.7.1 Nutrient Intake of the Normal (nnpnl) Subjects Before and After Intervention Trials

4.7.2 Nutrient Intake of the Premenopausal Subjects Before and After Intervention Trials

4.7.3 Nutrient Intake of the Postmenopausal Subjects Before and After Intervention Trials

SUMMARY 194-212

BIBLIOGRAPHY 213-242

APPENDICES 243-259

APPENDIX - I

APPENDIX - II

APPENDIX - III