

**Calcium intake and factors associated with the use of calcium supplements; a case study in Maharagama Divisional Secretarial Division, Colombo District**

**By**

**Athri Tharika Andrahennadi**

Thesis submitted to the University of Sri Jayewardenepura for the award of the Degree of Master of Science in Food Science and Technology in 2015.

The work describe in this thesis was carried out by me under the supervision of Dr. J. M.J.K. Jayasinghe, Department of Food Science and Technology, University of Sri Jayewardenepura and report on this has not been submitted in whole or in part to any university or any other institution for another Degree /Diploma.

*Athri*

.....  
Athri Tharika Andrahennadi  
Index Number – MFS/331,

Date: *10/12/2015*

I certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.



.....  
Dr. J.M.J.K. Jayasinghe  
Department of Food Science and Technology  
Faculty of Applied Sciences  
University of Sri Jayewardenepura,  
Nugegoda, Sri Lanka.

Date: ...16/12/2005.....

## Table of Contents

<b>List of Figures</b>	VI
<b>List of Tables</b>	VIII
<b>Acknowledgement</b>	IX
<b>Abstract</b>	X
<b>CHAPTER 1 – INTRODUCTION</b>	
	<i>Page No</i>
1.1 Introduction	1
1.1.2 Nutrition and human health	1
1.1.3 Minerals and human health	1
1.1.4 Calcium and human health	1
1.1.5 Calcium deficiency situation in Sri Lanka	2
1.1.6 Importance of Calcium supplements	2
1.1.7 Food Frequency Questionnaire	2
1.1.8 Theory of Planned Behaviour	3
1.2 General objective	4
1.3 Specific Objectives	4
<b>CHAPTER 2 – LITERATURE REVIEW</b>	
2.1 Human nutrition requirements	5-9
2.2 Minerals and human nutrition	10-16
2.3 Daily mineral requirements and daily mineral intakes	16-18
2.4 Calcium and human health	19-36
2.4.1 Recommended daily calcium intake	36-38
2.4.2 Calcium deficiency	39-41
2.5 Sources of dietary calcium	41
2.5.1 Foods rich in calcium	41
2.5.2 Other sources	42-49
2.6 Calcium and health issues in Sri Lanka	50-53
2.7 Health risks of excessive calcium	53-54
2.8 Development of a survey tool for calcium intake	54
2.9 Consumer behaviour and food choices	55-56
2.10 Theory of planned behaviour	56-58
<b>CHAPTER 3 - MATERIALS AND METHODS</b>	
3.1 Assessment of nutritional status and calcium intake	59
3.1.1 Study Area	59

3.1.2 Study Design	59
3.1.2.1 Survey	60
3.1.2.2 Survey Instrument	60
3.1.2.3 Food Frequency Model	60-61
3.1.3 Theory of Plan Behaviour exploratory survey	61
3.1.3.1 Intention	61
3.1.3.2 Attitude	62
3.1.3.3 Subjective Norms	62
3.1.3.4 Perceived Behavioral Control	62-63
3.1.4 Recommendation Providing	63
3.1.5 Data Collection	63-64
3.1.6 Development of Nutrient Composition Database	64
3.1.7 Statistical Analysis	65- 67

## **CHAPTER 4 - RESULTS AND DISCUSSION**

4.1 Sample Characteristic	68-70
4.2 Assessment of nutritional status	70-79
4.3 Assessment of calcium intake	80-89
4.4 Assessment for measures of behaviour	91
4.4.1 Attitude	92
4.4.2 Subjective norms	93
4.4.3 Perceived behavioural control	94
4.5 Recommendation	95-100

## **CHAPTER 5 – CONCLUSION** 101-102

## **REFERENCE** 103-108

## **APPENDIX**

Annex 1 – Questionnaire	109-116
Annex 2 – Tabulated data sheet of information of participants, consuming Calcium supplements	117
Annex 3 - Information of participants does not consuming Calcium supplements but having intention	118- 121

## LIST OF FIGURES

1. Figure 1. Relationship between calcium intake vs. bone accumulation and retention	18
2. Figure 2. Normal bone and osteoporotic bone	18
3. Figure 3. Role of calcium in different types of muscles	27
4. Figure 4. Relationship between RDA, EAR and UL	37
5. Figure 5. Proposed relationship between variables in this study based on the TPB	57
6. Figure 6. Maharagama location map, Western province, Sri Lanka	59
7. Figure 7. Composition pattern of dairy products in study sample	71
8. Figure 8. Composition pattern of vegetables in study sample	73
9. Figure 9. Composition pattern of fruits in study sample	73
10. Figure 10. Composition pattern of cereal and cereal products in study sample	74
11. Figure 11. Composition pattern of grains in study sample	75
12. Figure 12. Composition pattern of Sweets/Beverages in study sample	76
13. Figure 13. Composition pattern of Fish/Meat & their Products in study sample	77
14. Figure 14. Composition pattern of most demanded calcium sources in study sample	79
15. Figure 15. Calcium intake of male population in study sample	81
16. Figure 16. Calcium intake of female population in study sample	81
17. Figure 17. Relationship between calcium intake and RDAs in study sample	82
18. Figure 18. Relationship between calcium intake of male and female population	83
19. Figure 19. Relationship between calcium intake and education level in study sample	86
20. Figure 20. Relationship between calcium intake and house hold income in study sample	88
21. Figure 21. Relationship between calcium intake and employment in study sample	89

22. Figure 22. Scatter plot diagram for Intention opposed to Perceived behavioural control	92
23. Figure 23. Scatter plot diagram for Intention opposed to Subjective norms	93
24. Figure 24. Scatter plot diagram for Intention opposed to Attitude	94

## LIST OF TABLES

1	Table 1. Description of functions and sources of major minerals.	10
2	Table 2. Description of functions and sources of trace minerals.	11
3	Table 3. Dietary Reference Intakes: Estimated Average Requirements.	18
4	Table 4. Calcium Dietary Reference Intakes by Life Stage	38
5	Table 5. Gender opposed to population distribution in study sample	68
6	Table 6. Educational level vie population distribution in study sample	69
7	Table 7. Household income vie population distribution in study sample	69
8	Table 8. Employment opposed to population distribution in study sample	70
9	Table 9. Composition pattern of cereal and cereal products in study sample	75
10	Table 10. Composition pattern of most demanded calcium sources	78
11	Table 11. Relationship between calcium intake and RDA and EAR	84
12	Table 12. Relationship between calcium intake and education level	86
13	Table 13. Relationship between calcium intake and house hold income	87
14	Table 14. Relationship between calcium intake and employment	88



## ACKNOWLEDGMENT

Firstly, I would like to express my sincere gratitude to my supervisor Dr. J.M.J.K. Jayasinghe, Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura for the continuous support his patience, motivation, and immense knowledge extended to me in completing my M.Sc. research study. His guidance helped me in all the time of research and writing of this thesis.

I thank my fellow batch mates for the stimulating discussions, and for their valuable advices given throughout this time period. Without their precious support it would not be possible to conduct this research.

I appreciate the assistance provide by the Secretary, Western Provincial Council, and Grama Niladhari and Samurdhi Niyamaka at the Divisional Secretariat Division of Maharagama.

Last but not the least; I would like to thank my parents and my loving husband for supporting me spiritually throughout completing this study and writing the thesis.

## **ABSTRACT**

The objective of this study was to understand whether people in study area are obtaining adequate amount of calcium from available sources, and the factors influencing the use of calcium supplements and providing recommendations for an initially introducing calcium supplement into the market of study area. Survey is a legitimate and scientific process of acquiring data and opinion of the public. Such information was used to provide recommendations to the new type of calcium source. A food frequency questionnaire that was based on several theories, feedback of experts, and personal interviews with members of the target group was distributed among a random sample of 175 households (673 respondents) in the Maharagama secretarial division in Colombo. Variables based on the theory of planned behaviour were assessed through questionnaire items that were constructed to form scales measuring attitudes, subjective norms, perceived behavioural control, and intention to consume calcium supplements. Attitudes toward calcium supplements and perceived behavioural control contributed to the model for predicting intention, whereas subjective norms of the respondents showed the intention towards the calcium supplements. Among the population which in-between the age 20 to age 65 had more positive attitudes, normative beliefs and higher self-efficacy expectations with respect to using calcium supplements than other age categories. Subjects, who already using calcium supplements were more often female and already familiar with the advice and had more positive attitudes and normative beliefs than non users. Their attitude in the direction of the health concern and the awareness headed for the osteoporosis also higher than the others.

Study revealed that 98.2 percent of people from the sample population are not obtaining the adequate amount of calcium. Major demanded sources of the calcium are full cream milk, white bread, brown rice and cooked fish. Apart from that calcium obtaining is varying with age and the gender.

With reference to new calcium supplement launching, therefore it can be recommended that, more attention should be provided to the female population who were in between the 20 to 64 age categories and also product necessitate to meet their requirements.



## CHAPTER 1 – INTRODUCTION

### 1.1 Introduction

#### 1.1.2 Nutrition and human health

Nutritional Requirements for an average individual may lead to “the apparent contradiction of attempting to meet the requirements of populations based on the diverse and heterogeneous needs of individuals, it is in fact, a necessary step in providing optimal health – a long life, free of physical and mental disability – to all individuals.” (FAO/WHO, 2002).

#### 1.1.3 Minerals and human health

All forms of living matter require many minerals for their life processes. The animal body requires many minerals (among them are Na, K, Ca, Mg.) in relatively large amounts (gram quantities) and some (include Fe, Cu, Zn) in lesser quantities (1, 2). It is important to recognize that, just as proteins, carbohydrates and fats do not play independent roles in human nutrition, the minerals are inter-related and balanced against one another. The importance of these and other elements in maintaining a state of complete physical, mental and social wellbeing is well documented.

#### 1.1.4 Calcium and human health

Calcium is essential for humans, as it is a major material used in the mineralization of bone and teeth and is also important for critical metabolic functions of the body. The blood calcium is tightly regulated and does not fluctuate with changes in dietary intake. Bone is the reservoir for, and source of calcium used to maintain constant concentrations of calcium in blood, muscle, and body fluids. 99% of the body's calcium supply is stored in the bones and teeth where it supports their structure and function.

### 1.1.5 Calcium deficiency situation in Sri Lanka

Milk contains plenty of calcium, proteins, vitamins and minerals, but average low income families in Sri Lanka cannot afford a glass of milk daily for their children. Yogurt and cheese supply enough calcium, but again, poor people in Sri Lanka may not be able to afford them? Sri Lanka is largely self-sufficient in most animal products – apart from dairy products. The consumption of dairy products has increased dramatically since the 1970s when the government adopted open economic policies. At present, Sri Lanka is about 20 percent self-sufficient in its milk products, though that level has been achieved mostly with imported milk powder. Average family cannot afford to purchase imported milk, as the cost is exorbitant when they include other household necessities. It resulted in increasing malnutrition among schoolchildren.

### 1.1.6 Importance of Calcium supplements

Calcium supplementation is contraindicated in patients with hypercalcemia. Hypercalcemia may be caused by sarcoidosis, hyperparathyroidism, hypervitaminosis D, and certain types of cancer. Several different kinds of calcium compounds are used in calcium supplements. Each compound contains varying amounts of the mineral calcium (referred to as elemental calcium). The two main forms of calcium supplements are carbonate and citrate. Calcium carbonate is cheapest and therefore often a good first choice. Other forms of calcium in supplements include gluconate and lactate.

### 1.1.7 Food Frequency Questionnaire

The Food Frequency Questionnaire (FFQ) is the most common dietary assessment tool used in large epidemiologic studies of diet and health. This FFQ calculator is based on the participant's frequency of consumption; amount of the item consumed and amount of nutrient

in the serving size indicated. Nutrient values for each food item were derived from the 2008 United States Department of Agriculture (USDA) National Nutrient Database for Standard

#### 1.1.8 Theory of planned behaviour

A better understanding of important psychosocial variables that influence dietary behaviour is needed to develop effective interventions involving an increase in calcium sources consumption by population. Use of an appropriate theoretical framework provides structure to the identification of factors influencing calcium sources consumption. The Theory of Planned Behaviour (TPB) has recently been used to identify important factors influencing calcium sources intake by population.

The TPB includes three constructs that explain intention to perform health behaviours. They include attitudes toward the behaviour, subjective norms, and perceived behavioural control. Attitudes are determined by beliefs about the likelihood of outcomes and their importance. Subjective norms are determined by what others think the individual should do and the individual's motivation to comply. Perceived behavioural control is determined by control beliefs that can facilitate or inhibit the behaviour, such as internal factors (skills, abilities) and external factors (opportunities, barriers). Both intention and perceived behavioural control have direct influence on behaviour of the person. Inadequate consumption of calcium sources can be related to calcium deficiency in the population. In the present study the TPB was used to explain intention to consume as well as consumption of calcium sources among population by examining factors including attitudes, subjective norms, and perceived behavioural control. Addressing important factors that predict consumption of calcium sources by population may contribute to improved effectiveness of educational efforts targeted to this population.