



**THE EFFECT OF ORAL CALCIUM SUPPLEMENTATION  
ON POST-EXERCISE SERUM CALCIUM LEVEL**

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**MASTER OF SCIENCE  
IN  
ANTI-AGING AND REGENERATIVE SCIENCE**

**SCHOOL OF ANTI-AGING AND REGENERATIVE MEDICINE  
MAE FAH LUANG UNIVERSITY**

**2015**

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I hope my independence study will be useful for anyone who interested in this education filed and research.

Naruechol Chuenjamnong

**Independent Study Title** The Effect of Oral Calcium Supplementation on Post-exercise Serum Calcium Level

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**ABSTRACT**

The previous researches were studied in regard to extensive exercise related with calcium loss and subsequently lead into lower level of Bone Mineral Density (BMD). It was indicated that this loss of calcium during endurance activities could be occurred from excretion of sweat; calcium is a mineral type in electrolyte. With this constant condition, it possibly affects serum calcium and bone health afterward. The study therefore was designed to understand oral supplementation of calcium in sport men is able to remain calcium level in plasma as optimized. The research was completed with 17 healthy men in testing exercise under experimental situation by using standard of Metabolic Equivalents (MET) as a measure of energy expenditure. The exercise of this study was set at 10.4 MET exercise to ensure it was on a level of heavy exercise test. The subjects were repeatedly exercise test on day 1 & 2, however oral supplementation of calcium was taken on testing day 2 as to determine serum calcium on post-exercise. However, the results were statistically significant in serum calcium level after studies. It could be a few factor affected its result; period of study, intension of exercise and its methodology. Further studies with re-designed method on

research is required as to identify the effect of calcium supplementation in heavy exercise men.

**Keywords:** Calcium loss/Heavy exercise/Calcium supplementary/Serum calcium



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## ABBREVIATION AND SYMBOLS

BMI	Body Mass Index
cm	centimeter
IU	International Unit; used to measure fat soluble vitamins including Vitamin A, D and E
kg/m <sup>2</sup>	kilogram per the square of height in meter
MET	Metabolic Equivalent; a standard of resting metabolic quantified the energy cost of activity
METS	A number of Metabolic Equivalent
mg	milligram
mg/dL	milligrams per decilitre
ml	millilitre

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Vitamins are essential organic substances that regularly serve metabolism processes, energy synthesis, neurological processes and prevent destruction of cells, whereas minerals are essential inorganic elements necessary for a host of metabolism processes, supporting as structure for tissue, and regulators of metabolic and neural control. It is noticeably seen that vitamins have a unique role to play in maintaining your health, and minerals are played as messengers who becomes the “good” series of eicosanoid messengers in the best and most receptive position to get the most benefit from the vitamins. The major role of mineral is able to work as a cofactor in body system, which gives the billions of chemical reactions going on effectively. In addition, there are other duties worked in human by mineral. This is why it is stated vitamins and minerals are critical for human body, and it could cause illness if deficient in having those (Peckenpaugh, 2010).

When minerals are important for your body to stay healthy, deficiencies of mineral is a concern in man health that requires the best way to get the minerals your body needs is by eating a wide variety of foods including remaining balance of mineral. There are two kinds of minerals: macrominerals and trace minerals. Macrominerals are minerals your body needs in larger amounts; included calcium, phosphorus, magnesium, sodium, potassium, chloride and sulfur.

Calcium is one of essential mineral in human body; playing a role of in maintaining integrity of the skeletal system. It is about 99% of its calcium kept in the bones and teeth to help growth and strength. The other 1% is played a role in blood, muscle and the fluid between cells to help muscles and blood vessels contract and expand as to secrete hormones and enzymes and to send messages through the

nervous system (Beto, 2015). Insufficient calcium intake is not shown obvious affects in the short term because the body maintains calcium levels in the blood by taking it from bone. Sequentially it definitely causes bone health problem if level of calcium is continually low under the required amount; low bone mass (osteopenia) and risks of osteoporosis and bone fractures (Lanham-new, O’neill, Morris, Skelton & Sutcliffe, 2007)

Rehrer (2001) stated that mineral is lost in sweat and prolonged exercise could lead into status of mineral deficiencies. It is especially the exercise in hot or humid condition; sweat losses may be high therefore it is critical for rapid and complete restoration of fluid balance after exercise. Sawka and Montain (2000) as well indicated that imbalance of fluid and electrolyte could be caused from physical exercise and heat stress. A study was examined concerning electrolyte loss of soccer and found that calcium was a type be losing via sweating after football match in hot environment (Mao, Chen & Ko, 2001). Additionally, Barry and Kohrt (2008) focused on a study of calcium loss of road cyclists from a heavy trip and it showed an association related to lower bone mineral density. As above information, there would a possibility of calcium loss and endurance exercise in adverse effect, therefore the research was intentionally studied how exercise in a heavy level could cause a lower serum calcium.

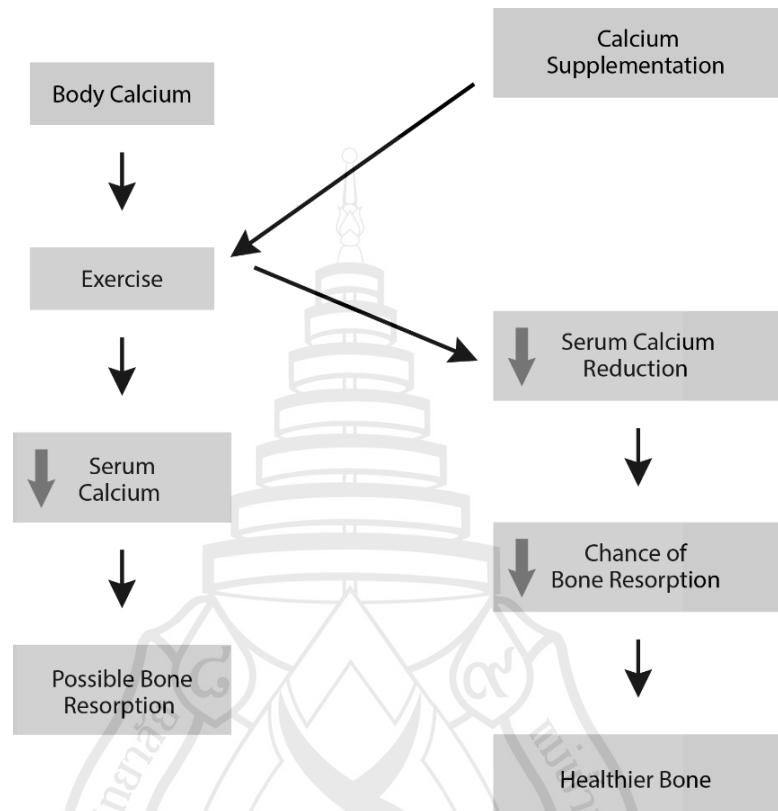
## 1.2 Research Objectives

This study was considerably designed to understand the serum calcium level subsequently oral supplementary taken on post-exercise in heavy energy expenditure.

## 1.3 Hypothesis

Calcium supplementary on heavy exercise is conceivably able to remain the optimal level of calcium in bloodstream.

## 1.4 Conceptual Framework



**Figure 1.1** Conceptual Framework

## 1.5 Beneficial Outcome

The outcome of this study indicates whether the nutritional supplement of calcium in a group of exercise males possibly remains calcium level in bloodstream, and that could control body process to be taken stored calcium level in bones; which caused bone health problems.

## 1.6 Research Limitation

Limitation of this study was concerned with different heavy level of individual exercise in each subject. Furthermore, process of calcium absorption could be varied that effected to serum calcium values in some ways. These two limitations might lead into difficulties of this study.

## 1.7 Operational Definitions

### 1.7.1 Serum Calcium

Serum Calcium is a part calcium deposited in extracellular fluid over the body. Its constant level is typically in between 8.4-9.5 mg/dL that is maintained at optimal level with team of hormones and other substances (Beto, 2015). Any response of lower serum calcium incurred, the body will work within to transfer calcium from other sources to maintain normal level.

### 1.7.2 Calcium Supplementation

To orally intake calcium tablets as supplementary during study research on testing day 2. It was consumption with a glass of water and leave for 60 minute before starting exercise test.

### 1.7.3 Exercise Test by Metabolic Equivalent (MET) Unit

Jette, Sidney and Blumchen (1990) studied Metabolic Equivalent (MET) that is defined a standard of resting metabolic in calculating of the energy cost in each activity, and 1 MET is 1.2 Kcal per minute for 70-kg person. It was a level of 10.3 METS in the activity applied as for exercise test of this research.

### 1.7.4 Body Mass Index (BMI)

Body Mass Index (BMI) can be calculated as body weight (in kilograms) divided by the square of body height (in meters) that gives its result with a measure unit by  $\text{kg}/\text{m}^2$ . For healthy weight, BMI is ranged from 18 to  $25 \text{ kg}/\text{m}^2$ .

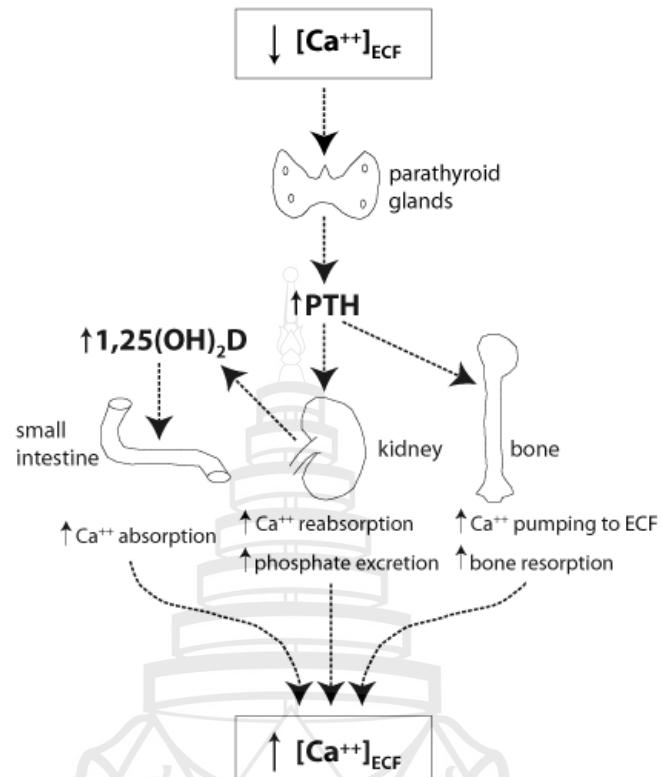
## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Calcium, Hormonal Regulation of Bone and Bone Biology

From major minerals the body required, calcium is the most abundant mineral in the body playing a number of critical roles in physiology. It is not only required for muscle contraction acted as an enzyme co-factor, but as well as a second messenger. Calcium generally plays two main roles in the body; (1) required for vascular contraction and vasodilatation, muscle function, nerve transmission, intracellular signaling and hormonal secretion though less than 1%, and (2) stored in the bones and teeth where it supports their structure and function with remaining 99% of the body's calcium (Dietary calcium and health). Since calcium is kept as key component of bone, therefore the bone can always act as a reservoir once the level of serum calcium is required to be maintained in the body; however, it can lead to health problem in bone if it is excessive (Theobald, 2005).

It is a dynamic process in order to sustain level of calcium in serum in body which involves with a variety of different organs. In remaining a constant calcium concentration in extracellular fluid is mainly related with Parathyroid glands. It works, when the plasma concentration of calcium is falling by secreting a higher parathyroid hormone (PTH) then calcium level is back to normal range (Fox, 2011).



**Source** Parathyroid Hormones Action related to Calcium level (n.d.)

**Figure 2.1** Parathyroid Hormones Action related to Calcium level

Fox (2011) stated all three mechanisms in process worked by parathyroid hormones as to raise calcium level in blood if needed as following (Figure 2.1);

1. PTH stimulates osteoclasts to resorb bone, thereby adding calcium and phosphate to the blood as primary mechanism of its action.
2. PTH stimulates the kidneys to reabsorb calcium, but do decreasing the renal reabsorption of phosphate. This action is completed without a cause of calcium phosphate deposition in bone.
3. PTH stimulates the kidneys to produce the enzyme required to convert 25-hydroxyvitamin D<sub>3</sub> into the active hormone, 1, 25-dihydroxyvitamin D. It effects the absorption of calcium and phosphate from the diet in intestinal.

In body system, it is roughly 1 gram of total calcium being in the extracellular fluid; that the concentration of serum calcium is fixed at  $9.5 \pm 1$  mg/ dL (2.5 mM). The bone is active and remodeled in continue as a major of repository for calcium. When bone resorption is occurred, it causes bone deposit consequently which is called as bone remodeling with its procedure by five phases (Rodan, 1992).

1. Activation: pre-osteoclasts are stimulated and differentiate under the influence of cytokines and growth factors into mature active osteoclasts
2. Resorption: osteoclasts digest mineral matrix (old bone)
3. Reversal: end of resorption
4. Formation: osteoblasts synthesize new bone matrix
5. Quiescence: osteoblasts become resting bone lining cells on the newly formed bone surface.

It is critical to continue an optimum level of calcium in body system; extracellular fluid, and bone resorption plays a major character in function. However, it can result in destruction of the bone, and eventually affects bone health.

## 2.2 Exercise and Bone Health

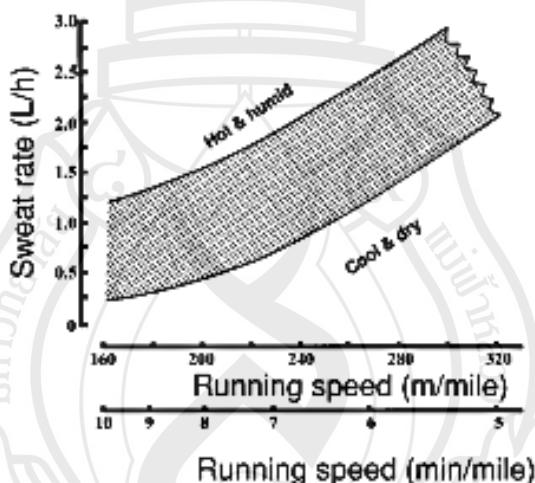
Lanham-New et al. (2007) stated that physical activities in the appropriate level is commonly accepted in both developing health skeleton and possible maintaining skeletal health when aged up to adulthood. Forms of exercise are given different benefits for bone health; it can be varied design of workout as to maximize its advantage that can be as well included of weight-bearing exercise such as intermittent jogging, high-impact aerobic exercise class and following by a session of weight-training. It can be considered individual basic principles of all training to a great understanding in its use.

It is although bone health is positively built from an exercise in a level of moderate. Conversely, it is seen that the over-exercise may not be optimal for bone health after heavy endurance cycle training which showed about 17% decreased of bone quality (Lanham-New et al., 2007). Additionally, some female athletes who retained intensive exercise, had some affects in oestrogen deficiency and

amenorrhoea that was a sign in related to osteopenia. This was about reduction of bone mass, calcification and/or bone density caused (Theobald, 2005).

### 2.3 Calcium Loss in Sweat

It is cited that there is a loss of minerals in sweat; especially prolonged exercise in heat environment is conceivably caused mineral deficiencies. Calcium is one of mineral losing in sweat; its concentration of calcium in sweat is about 28 milligrams per a liter of sweat (Nutrition of Sports).



**Source** Sawka and Montain (2000)

**Figure 2.2** An approximation of hourly sweating rates as a function of climate and running speed

It is a difference of amount of sweat rate in liter per hour with varied climate (Figure 2.2). In addition to climatic conditions, clothing and exercise intensity can be influenced number of losing sweat. It can be stated that physical exercise and heat

stress can lead into a condition of imbalance in both fluid and electrolyte (Sawka & Montain, 2000).

## 2.4 Research and Previous Studies

Mao et al. (2001) studied electrolyte loss from all extravagant sweating in a group of soccer players; and found that calcium was contained in sweating after endured match in hot environment. The subjects of this study was divided into two groups; thirteen of soccer players and a hundred of sedentary student. The first method was experimental conditions in training from 2.30 PM to 5.30 PM; three hours in the afternoon for 5 afternoons per week for three months with air temperatures were between 30°C and 35°C. It was following by body weight measurement, sweat and urine collection and lastly electrolyte concentration. The result showed  $12.6 \pm 4.7$  mg/l as for the mean concentration of calcium. The mean losses of calcium via sweating during an hour gram was 20 mg while it is required 1.2 g for calcium as daily intake of the electrolytes in human. It is significant that heat-stressed players or heavy workloads was associated with loss of electrolyte by sweating.

Previous study of Barry and Kohrt (2008) was as well indicated that endurance exercise was negatively linked into lower bone mineral density (BMD) values. The studied was examined over one year of training and competition; in a group of 14 male road cyclists aged from 27-44 year old. Random subjects were received 1500 mg of calcium supplementary (500 mg with meals) for daily intake. It was measurements of BMD among pre-, mid-, post- and off-season all through the period of study. A patch collection technique was used as to estimate dermal calcium loss during exercise. The result of the study indicated a decreasing number of BMD considerably in a whole season; pre- to off-season. However, there were no differences in changes shown in a value of BMD in another group who had calcium supplementation. This study identified that a cycle training in form of high intensity may adversely affect BMD which was perhaps from dermal calcium loss in excessive amount during exercise (Barry & Kohrt, 2008).

## CHAPTER 3

### RESEARCH METHODOLOGY

#### 3.1 Types of Study Design

Experimental research

#### 3.2 Population and Sample Size

##### 3.2.1 Population

The population was a group of healthy male aged in range from 25-40 year with a routine exercise; either in the fitness or outdoor exercise. The subject was chosen from a football club located in Bangkok who regularly played football at least four days a week.

##### 3.2.2 Sample Size

The sample size of this study was calculated by this formula;

$$n_0 = \frac{Z\alpha^2 PQ}{d^2}$$

Where

$n_0$  = required sample size; 17 subjects

Set confident interval at 95%  $\alpha = 0.05$

$P$  = the anticipated prevalence of serum level of hypocalcemia at 8.5 mg/dl decreased to serum level of optimal calcium in body at 9-11mg /dl;  $P = 0.77$

$Q = 1 - P; = 0.23$

$\alpha$  = 0.05 Set confident interval at 95% value is 1.96

$d$  = precision (in proportion of one; if error = 20%)

17 males were chosen by purposive sampling design according to population design in order to complete research methodology. All subjects were required two days of testing under two different groups; control and experimental. For the experimental group, a tablet of 1000 mg calcium was given to the subject for oral supplementation.

### 3.3 Variables

#### 3.3.1 Independent Variables

3.3.1.1 Heavy Exercise designed in a continuous 20 minute time.

3.3.1.2 Calcium to be orally supplementary by individually subjects before exercise test.

#### 3.3.2 Dependent Variables

Level of serum calcium on post-exercises of all subjects

### 3.4 Research Design

This study was to compare serum calcium in exercise healthy subjects. It was an experimental situation for exercise session to work out with a standard measure by Metabolic Equivalent (MET) which is a standard of resting metabolic quantified the energy cost of activity. It is rated at 3.5 ml of oxygen per kilogram per minute; equally to 1.2 kilocalories per minute for 70-kg person (Jette et al., 1990).

**Table 3.1** Energy Expenditure of Sport Activities

Activities	metabolic rate	A multiple of resting		Intensity			
		Light		Moderate		Heavy	
		METS*	METS*	W	METS*	W	METS*
Tennis (single)	6.8	4	70	6	105	10	175
Volleyball	6	5	88	6	105	8	140
Boxing	13.4	6	105	9	158	12	210
Soccer	10.3	5	88	7	123	11	193
Basketball	11.1	6	105	8	140	11	193

**Note.** \*METS stands for Metabolic Equivalents which is a number of standard resting metabolic

**Source** Jette et al. (1990)

From previous study, the research was studied in soccer team who played the match in the field that comparing with Table 3.1, it was 10.3 METS as a multiple of resting metabolic rate according to METS in exercise testing (Jette et al., 1990). This study was required a condition of exercise test at heavy level to determine how serum calcium would be affected, therefore stepping (up-down on box) was applied in order to generate energy expenditure of the activity. Table 3.2 shows energy expenditure in METS during stepping at different rates on steps of different heights. To creating a heavy exercise same as soccer game, stepping test was set at a course of 30 steps in a minute stepping on 36 cm height.

**Table 3.2** Energy Expenditure in METS of Stepping

Step Height (cm)	Steps/ min			
	12	18	24	30
4	1.5	2.3	3.1	3.8
8	1.9	2.8	3.7	4.6
12	2.2	3.3	4.4	5.5
16	2.5	3.8	5.0	6.3
20	2.8	4.3	5.7	7.1
24	3.2	4.8	6.3	7.9
28	3.5	5.2	7.0	8.7
32	3.8	5.7	7.7	9.6
36	4.1	6.2	8.3	10.4
40	4.5	6.7	9.0	11.2

**Source** Jette et al. (1990)

### 3.5 Research Protocol

#### 3.5.1 Calcium Supplementary

Key forms of calcium in supplements are carbonate and citrate. Calcium carbonate is more regularly available and is both economical and convenient. Since stomach acid involved absorption, calcium carbonate is given the most efficient of absorption when taken with diets, whereas calcium citrate is absorbed equally well when taken with or without food. Calcium citrate is also practical for people with achlorhydria, inflammatory bowel disease, or absorption disorders. In the market, there are some other calcium forms in supplements or fortified foods; including gluconate, lactate, and phosphate.

Two tablets of 500 mg calcium were prepared for all subjects to intake before doing exercise 60 minutes. A tablet contained of active ingredients as follows;

Calcium	500 mg
---------	--------

Vitamin D3 (Cholecalciferol)	200 IU
------------------------------	--------

It was manufactured in Australia under Blackmores LTD NSW Australia. It was however imported into Thailand by Blackmores (Thailand) Company Limited located in 21 A floor, Mahanakorn Gypsum Bldg. 539/2 Sri-Ayuddhaya Rd. Ratchathewi Bangkok 10400 Thailand as shown on Figure 3.1 (Blackmore Thailand, n.d.)



**Figure 3.1** BLACKMORES Calcium Supplementary

### 3.5.2 Stepping Box for Heavy Exercise Test

A box was made of thick wood with required height as per energy expenditure table. However, to be safe for the subject, the box was designed with its width of 55 cm. and depth of 55 cm. for a plenty space in stepping up and down completed by the subjects (Figure 3.2).



**Figure 3.2** Stepping Exercise Test

### **3.5.3 Serum Calcium Lab Test**

Serum Calcium was examined on pre- & post-exercise from all subjects. Blood sample was kept individually as per a check list paper to ensure that there was no error occurred during its process. Name of each subject was written on each tube and arranged for sending at professional laboratory; N Health which has been operated by National Healthcare Systems Company Limited, as to receive its result of serum calcium level accordingly.



**Figure 3.3** Lab Test of Serum Calcium

Subject No.	Day 1 Blood Test 1 (Before Exercise)	Day 1 Blood Test 2 (After Exercise)	Day 2 Blood Test 1 (Before Exercise)	Day 2 Blood Test 2 (After Exercise)

**Figure 3.4** Blood Serum Record

### 3.5.4 Testing Days

Testing day was divided into two days; (1) the first day - a group of subject was taken a tablet x 1000 mg calcium and waiting for 60 minutes before starting 20-minute exercise, and (2) the second day – the group of subject was straightforwardly doing 20-minute exercise without any supplements previously. Afterwards, blood test was recorded for serum calcium level check. During study day, it was not accepted to have all subjects consumed high calcium diets including milk and dairy products as to control calcium level in the body. All subjects signed in the informed consent form before participation according to the study procedure. None of the subjects are not

taken calcium supplement and must avoid high-contained calcium diets for two days in advance of, and during the study day.

#### Day 1

The subject was formerly required meeting up in fitness room at 10.00 am and started blood test as a pre dose before going testing exercise continuously for 20 minutes. When the exercise was complete, second blood test was required to be kept for its process

#### Day 2

Same as the first day, however a 1000 mg calcium supplement was prepared for oral administration for each subject. After taking, it was required to be waiting for another 60 minutes for body absorption before exercise tested.

### **3.5.5 Subject Preparation**

These procedures and assessments were compulsory to be completed before the study day including;

- 3.5.5.1 Demographic information documented
- 3.5.5.2 Body weight measured
- 3.5.5.3 Blood pressure, temperature, and heart rate measured
- 3.5.5.4 Running number to all subjects assigned
- 3.5.5.5 Inclusion and exclusion criteria verified
- 3.5.5.6 Administered medication recorded

### **3.5.6 Study Procedures**

#### Day 1

1. Pre-exercise blood tested.
2. Exercised with 10.4 METS level on stepping for 20 minutes
3. Blood sample for serum calcium analysis as post-test from individual subject, in 4 ml lithium heparin tube. The samples were be kept in ice pack boxes, before immediately transferred to laboratory for centrifuge.
4. Lunch provided, and
5. Subject discharged from the clinic

## Day 2

1. Pre-exercise blood tested
2. Oral supplementation of 1000 mg. calcium
3. Applied exercise with 10.4 METS level on stepping for 20 minutes
4. Blood sample for serum calcium analysis as post-test from individual subject, in 4 ml lithium heparin tube. The samples were be kept in ice pack boxes, before immediately transferred to laboratory for centrifuge.
5. Lunch provided, and
6. Subject discharged from testing room.

It was firmly concerned that a week in advance of study day, was wash out period which the subject was not supplementing calcium and consuming any high calcium contained diets.

## 3.6 Participant Selection

Volunteers were recruited generously, which each one required to provide informed consent form. By completing this required document, study assessment was subsequently needed in implementation as to conclude subject's qualification for this study. A certain number of volunteers were screened until number of subject was completely attained as targeted. Nevertheless, these prospective volunteers had to accurately meet inclusion and exclusion criteria study as a final process of participant selection.

### 3.6.1 Inclusion Criteria

3.6.1.1 Healthy as determined by the result of laboratory record, medicinal history and vital sign.

3.6.1.2 Male with Body Mass Index (BMI) 18-25 kg/m<sup>2</sup>

3.6.1.3 Age ranged in between 25-40 years old

3.6.1.4 Willing to participate and sign consent form as requested

### **3.6.2 Exclusion Criteria**

- 3.6.2.1 History of alcoholism
- 3.6.2.2 Cardiac conditions
- 3.6.2.3 Duodenal ulcer or gastric ulcer, gastritis, hiatus hernia, or gastroesophageal reflux disease (GERD) within past 3 months
- 3.6.2.4 History of kidney stones
- 3.6.2.5 Use of medications known to interact with calcium
- 3.6.2.6 Use of supplements containing calcium
- 3.6.2.7 Use of anticoagulants (warfarin), barbiturates, tetracycline antibiotics, beta-blockers, cyclosporine, prednisone, tricyclic antidepressants, diuretics and nitrate medications
- 3.6.2.8 History or current diagnosis of cancer
- 3.6.2.9 History of diabetes, renal disease and/or liver disease
- 3.6.2.10 Unstable psychiatric disorder
- 3.6.2.11 History of allergy or sensitivity to test articles, foods or beverages provided during the study
- 3.6.2.12 Non-caffeine addicted

### **3.6.3 Discontinuation Criteria**

- 3.6.3.1 Suddenly decreasing performance
- 3.6.3.2 Physical appearance in act of being fatigue, pain or lack of ability

All subject has the right to immediately withdrawal from the exercise testing at any time for any reason, or if necessary.

## **3.7 Data Collection**

- 3.7.1 Recruited all subject with participant selection of this research from the football club; inclusive & exclusive criteria applied.
- 3.7.2 Invited the subjects to testing room; located on 3rd floor of Mea Fah Luang University at 10.00 am both on testing day 1 & 2.
- 3.7.3 Initiated study procedure as designed; day 1 & 2.

3.7.4 Blood draw was completely stored and sent for laboratory for serum calcium result.

### 3.8 Statistical Analysis

Demographic data of volunteers were demonstrated as descriptive statistic. Sample group was considered as small size and described as non-parametric statistic. The study method of analysis was performed by paired t-test and independent sample test as to compare between mean of pre-exercise and post-exercise calcium (95% level of confidence, P value  $\leq 0.05$ ).

## CHAPTER 4

### RESEARCH RESULTS

The objective of this study was focused on the level of serum calcium after exercise to identify whether endurance exercise could possibly less serum calcium which causes high risk of osteoporosis. Total number of sample size was 17 males with the criteria of heavy sport players from aged 25-40 sport men with healthy condition. The study was designed to understand changes of serum calcium level of control and treatment subjects. There were two sample groups set; one was the control group who did exercise under the outlined method without any oral calcium supplement, and another group with the same program but applied an experiment with 1000 mg calcium supplementary. Subsequently, it was comparison of its value to look at the different value of serum calcium in order to verify how calcium supplement on exercise was effectively worked to maintain optimized level of calcium.

The research result reported into parts as follows;

#### 4.1 Comparison of Serum Calcium Level on Pre- and Post exercises

**Table 4.1** Comparison of Serum Calcium Level on Pre- and Post-exercises between the control and the experimental

Subjects	Control		Experimental	
	Pre-exercise	Post-exercise	Pre-exercise	Post-exercise
	Serum Calcium (mg/dL)	Serum Calcium (mg/dL)	Serum Calcium (mg/dL)	Serum Calcium (mg/dL)
1	9.8	10	9.8	10.3
2	9.4	9.6	9.4	10.2
3	9.8	9.8	9.8	10.3
4	9.6	9.7	9.5	10.2
5	8.9	9	9.4	9.5
6	9.1	9.3	9.2	9.7
7	9.2	9.5	9.9	10.2
8	9.8	9.9	10.3	10.2
9	9.1	9.6	9.3	10.2
10	9.6	10	10.1	10.6
11	9.6	9.8	9.7	10.2
12	8.8	9	9.4	9.3
13	9.4	9.6	9.7	9.8
14	9.4	9.7	9.8	10.1
15	9.7	9.9	10.5	10.5
16	9.2	9.2	9	9.1
17	9.5	9.7	9.8	10.1
<b>Mean <math>\pm</math> SD</b>		<b>9.41 <math>\pm</math> 0.31</b>	<b>9.61 <math>\pm</math> 0.32</b>	<b>9.68 <math>\pm</math> 0.39</b>
				<b>10.02 <math>\pm</math> 0.41</b>

The first day was required to have a calcium 1000 mg taken by subjects as supplement before exercise 20 minutes while the second day was no calcium supplementary consumption. Pre- and post-exercise's blood test were kept on both test days to determine its difference of serum calcium of pre- and post-exercises. In prior of the test days in 2 weeks, it was not allowed subjects to have high calcium dietary consumed as to keep calcium maintained as normal. To be a standardized exercise, it was presumed situation for heavy exercise at 10.3 MET for 20 minutes.

## 4.2 Serum Calcium Level on Pre- and Post-exercises

**Table 4.2** Comparison of Serum Calcium Level on Pre- & Post exercises in Control Group

Exercises	Serum Calcium (mg/dL)		t	df	p-value
	Mean	Standard Deviation			
Pre-exercise	9.41	0.31	-6.47	16	< 0.001***
Post-exercise	9.61	0.32			

**Note.** \*\*\* p < 0.001

From blood test of serum calcium in pre- & post-exercise, the study firstly examined that there was a different value between in calcium level by applying paired t-test as to verify whether calcium could possibly to cause a lower calcium level in blood. The result indicated that the calcium level of pre- & post exercise was statistical significant at 95% confident interval ( $t (16) = -6.47$ ;  $p < 0.0001$ ). The average value of calcium level in serum was at 9.41 mg/dL and 9.61 mg/dL, respectively, with standard derivation of 0.31 and 0.32, respectively (Table 4.2).

### 4.3 Serum Calcium Level of Pre- and Post-exercises in testing day 1 and testing day 2

**Table 4.3** Different Value of Serum Calcium Level in both groups

Subjects	Control		Experimental		Different Value	
	Pre-exercise	Post-exercise	Pre-exercise	Post-exercise	Pre-exercise	Post-exercise
	Serum	Serum	Serum	Serum	Serum	Serum
	Calcium	Calcium	Calcium	Calcium	Calcium	Calcium
	(mg/dL)	(mg/dL)	(mg/dL)	(mg/dL)	(mg/dL)	(mg/dL)
1	9.8	10	9.8	10.3	0.20	0.50
2	9.4	9.6	9.4	10.2	0.20	0.80
3	9.8	9.8	9.8	10.3	0.00	0.50
4	9.6	9.7	9.5	10.2	0.10	0.70
5	8.9	9	9.4	9.5	0.10	0.10
6	9.1	9.3	9.2	9.7	0.20	0.50
7	9.2	9.5	9.9	10.2	0.30	0.30
8	9.8	9.9	10.3	10.2	0.10	-0.10
9	9.1	9.6	9.3	10.2	0.50	0.90
10	9.6	10	10.1	10.6	0.40	0.50
11	9.6	9.8	9.7	10.2	0.20	0.50
12	8.8	9	9.4	9.3	0.20	-0.10
13	9.4	9.6	9.7	9.8	0.20	0.10
14	9.4	9.7	9.8	10.1	0.30	0.30
15	9.7	9.9	10.5	10.5	0.20	0.00
16	9.2	9.2	9	9.1	0.00	0.10
17	9.5	9.7	9.8	10.1	0.20	0.30
Mean $\pm$	<b>9.41 <math>\pm</math> 0.31</b>	<b>9.61 <math>\pm</math> 0.32</b>	<b>9.68 <math>\pm</math> 0.39</b>	<b>10.02 <math>\pm</math> 0.41</b>	<b>0.20 <math>\pm</math> 0.13</b>	<b>0.20 <math>\pm</math> 0.13</b>
SD						

**Table 4.4** Comparison of Serum Calcium Level of Pre- and Post-exercises in Testing day 1 and Testing day 2

Exercises		Serum Calcium (mg/dL)		t	df	p-value
		Mean	Standard Deviation			
Pre-Exercise	Control	9.41	0.31	-2.28	32	0.03*
	Experimental	9.68	0.39			
Post-Exercise	Control	9.61	0.32	-2.28	32	0.002**
	Experimental	10.03	0.41			

**Note.** \* $p \leq 0.05$ ; \*\*  $p \leq 0.01$

From sample tests, it was analyzed that serum calcium of pre- and post-exercise was increased in both control and experimental group. The result was valued ( $t (-2.28) = -32$ ;  $p = 0.03$ ), and ( $t (-2.28) = -32$ ;  $p = 0.002$ ) respectively. It was statistical significant at  $p$  valued  $< 0.05$  (Table 4.4)

#### 4.4 Serum Calcium Level between The control and The Experimental Group

**Table 4.5** Comparison of Serum Calcium Level between The control and The experimental group

Exercises	Serum Calcium level in			t	df	p-value			
	Pre- & Post-Exercise (mg/dL)		Standard Deviation						
	Mean								
Control group	0.20	0.13		-1.85	32	0.074			
Experimental group	0.35	0.30							

Based on Table 4.3, it was found that the average level of serum calcium in pre- and post-exercises showed no statistical difference ( $t (32) = -1.85$ ;  $p=0.074$ ). This visibly demonstrated that a heavy exercise was not possibly caused a lower serum calcium. In addition, this study was designed to understand how calcium supplementary on post-exercise effectively works in treatment group and its result also presented no different value as relative accordingly.

## CHAPTER 5

### CONCLUSION AND DISCUSSION

#### 5.1 Conclusion

From the previous studies about calcium loss and mechanism of calcium processing in the body when calcium imbalance, it lead into this study how serum calcium could be remained at the optimal level by oral calcium supplementation. The research was noticeably designed to understand serum calcium level after oral supplementary consumed on post-exercise in heavy energy expenditure. It was assumed that calcium supplementary on heavy exercise was able to maintain calcium in bloodstream. The study design was experimental research with calculated sample size at 17 subjects. The subjects was from purposive sampling design, whom was healthy male and always doing exercise at least 4 days a week. Study procedure was included two day in testing exercise; day 1 & 2 that both are on same methodology, excepting oral calcium supplementation on day 2. Test days were required a heavy exercise by using Metabolic Equivalent (MET) from its study of Jette et al. (1990). Jette et al. (1990) stated that soccer is 10.3 MET exercise, which was applied in this study by doing stepping exercise test on a 36-cm wooden box with 30 steps per min. Blood draw was required to be stored for a laboratory as to check serum calcium. All data were reviewed and analyzed its result.

The result of examination; no oral calcium supplement intake, in comparing pre- and post-exercise, it presented that there was no significance at a higher level of serum calcium; testing exercise was not possibly prompting calcium level in serum increasingly change. Subsequently it was two groups of subjects; in the condition of pre- and post-exercise, compared as independent sample test in order to analyze the change of serum calcium, it was also non-significant at statistic. The different value of serum calcium was as well calculated and compared by paired t-test, however it was

no significance. From all output value, it provided an indication that calcium in serum was increased on post-exercise, while calcium supplementary had no effect.

## 5.2 Discussion

Serum calcium on pre- & post-exercise was both increased from paired t-test study. The result was significant to prove that calcium level in serum on post-exercise was not decreasing as assumed. Further study of data analysis by independent sample test of two groups compared; pre- & post-exercise group in both control and experimental, it as well showed its result of increasing serum calcium at statistical significant, which indicated that calcium supplementation might not be effective in consumption of study test. In additional, it was further considered about different value of serum calcium of individual subject; one by one, and using that different value for another examination. It was an outcome that presented it was a sign of higher level of serum calcium, however it is not statistical significant.

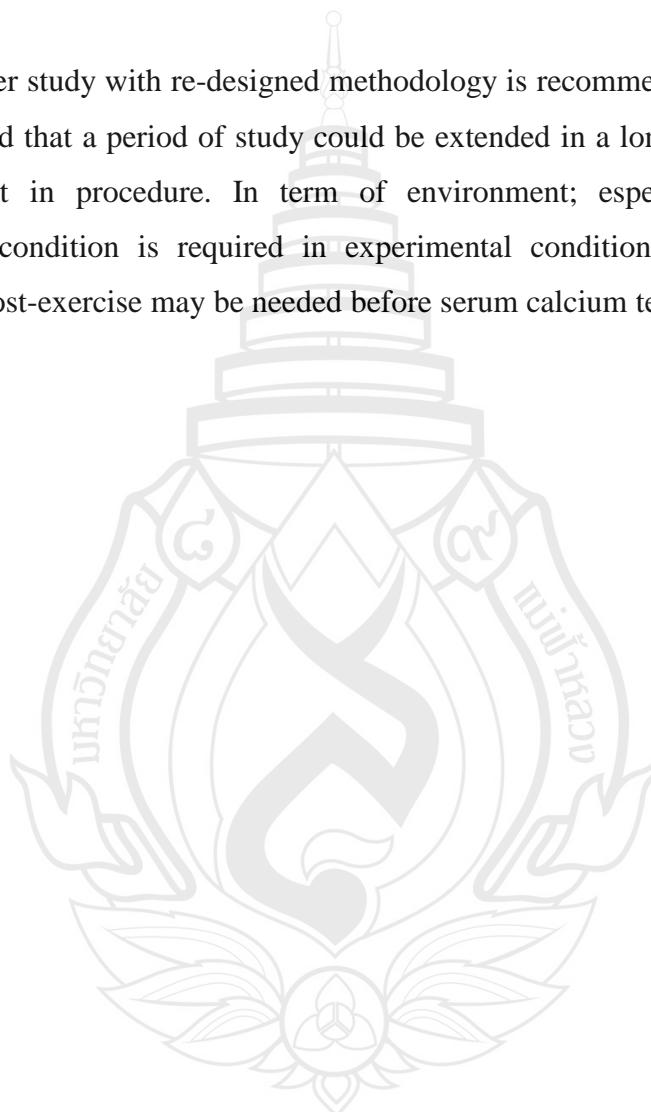
All analyzed result lead into a few concern in regard to calcium concentration and active parathyroid hormones, which could impact serum calcium on post-exercise. Apostu (2014) cited that sweat output often exceeds water intake during exercise which causes a deficit of water in body, and it consequences hypertonicity and hypovolemia in plasma if water is both in intracellular and extracellular diminishing lower. An increasing of serum calcium on post-exercise from the control and treatment group was occurred from a cause of hypovolemia since water in body was losing excessively after heavy exercise. Additionally, calcium loss through sweat during exercise, it maybe activates body process working to remain balance of system. As sweat is come from plasma, losing sweat of exercise could lead into a declining of serum ionized calcium (Barry & Kohrt, 2008).

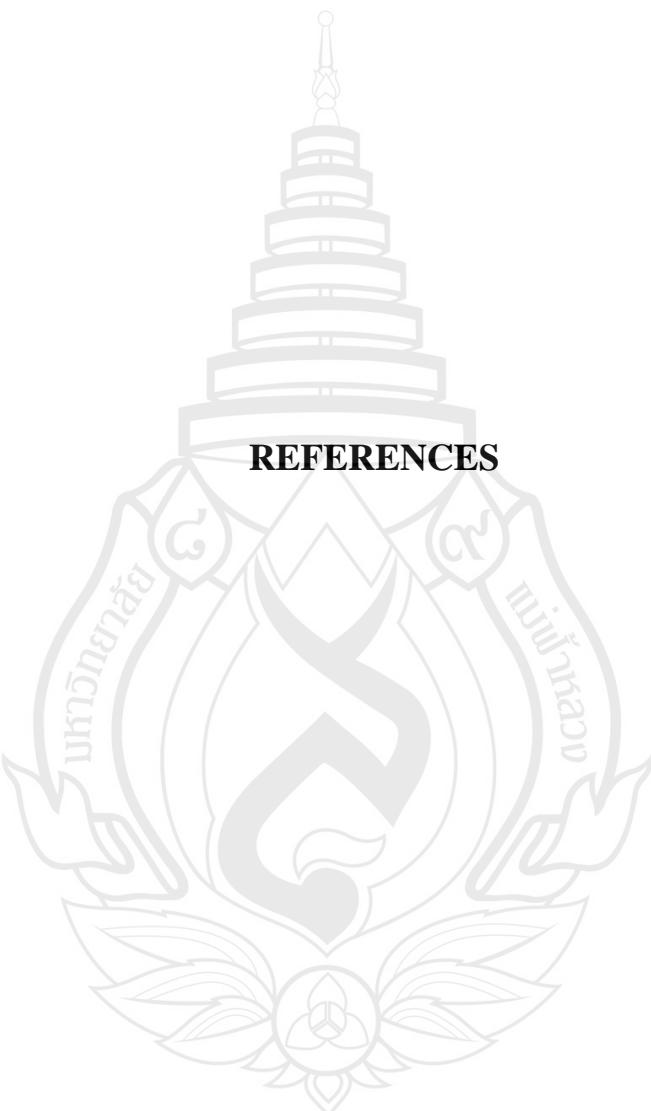
In addition, Fox (2011) stated serum calcium is always needed to be energetically protected even small amount with an action of parathyroid hormone. When its range is gone lower than normal, PTH will be directly working in its system

as to generate bone resorption for remaining serum calcium in balance. This could be a reason that calcium in serum of most subjects was increased on post-exercise.

### 5.3 Recommendation

Further study with re-designed methodology is recommended for the research. It is suggested that a period of study could be extended in a longer period as to have sustain result in procedure. In term of environment; especially heat or high-temperature condition is required in experimental condition. Additionally, water balance on post-exercise may be needed before serum calcium test.





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## REFERENCES

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## APPENDICES

## APPENDIX A

### INFORMED CONSENT FORM

#### หนังสือยินยอมเข้าร่วมโครงการวิจัย

#### (Informed Consent Form)

วันที่.....เดือน.....พ.ศ. ....

ข้าพเจ้า (นาย/นาง/นางสาว)..... อายุ..... ปี อายุบ้านเลขที่.....

หมู่ที่..... ถนน..... ตำบล..... อำเภอ.....

จังหวัด..... รหัสไปรษณีย์.....

ขอทำหนังสือแสดงความยินยอมเข้าร่วมโครงการวิจัยเพื่อเป็นหลักฐานแสดงว่า

1. ข้าพเจ้ายินยอมเข้าร่วมโครงการวิจัยของ นางสาวนฤชล ชื่นจำนงค์ เรื่อง ผลการศึกษา  
ของการรับประทานแคลเซียมกับระดับแคลเซียมในเลือดหลังออกกำลังกายด้วยความสมัครใจ โดย  
มิได้มีการบังคับ หลอกลวงแต่ประการใดและพร้อมจะให้ความร่วมมือในการวิจัย

2. ข้าพเจ้าได้รับการอธิบายและตอบข้อสงสัยจากผู้วิจัยเกี่ยวกับวัตถุประสงค์การวิจัย  
วิธีการวิจัย ความปลอดภัย อาการหรืออันตรายที่อาจเกิดขึ้น รวมทั้งประโยชน์ที่จะได้รับจากการ  
วิจัย โดยละเอียดแล้วตามเอกสารซึ่งแจ้งผู้เข้าร่วมการวิจัยแนบท้าย

3. ข้าพเจ้าได้รับการรับรองจากผู้วิจัยว่าจะเก็บข้อมูลส่วนตัวของข้าพเจ้าเป็นความลับ จะ  
เปิดเผยได้เฉพาะในรูปแบบของการสรุปผลการวิจัยเท่านั้น

4. ข้าพเจ้าได้รับทราบจากผู้วิจัยแล้วว่า หากเกิดอันตรายใด ๆ จากการวิจัย ผู้วิจัยจะ  
รับผิดชอบค่ารักษาพยาบาลที่เป็นผลลัพธ์เนื่องจากการวิจัยนี้

5. ข้าพเจ้าได้รับทราบว่า ข้าพเจ้ามีสิทธิจะถอนตัวออกจากวิจัยครั้งนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบใด ๆ ต่อการรักษาพยาบาลตามสิทธิ์ที่ข้าพเจ้าควรได้รับ

ข้าพเจ้าได้อ่านและเข้าใจข้อความด้านหนังสือนี้แล้ว จึงได้ลงลายมือชื่อไว้เป็นสำคัญพร้อมกับหัวหน้าโครงการวิจัยและพยาบาล

ลงชื่อ.....ผู้อำนวย/ผู้ปกครอง

(.....)

ลงชื่อ.....หัวหน้าโครงการ

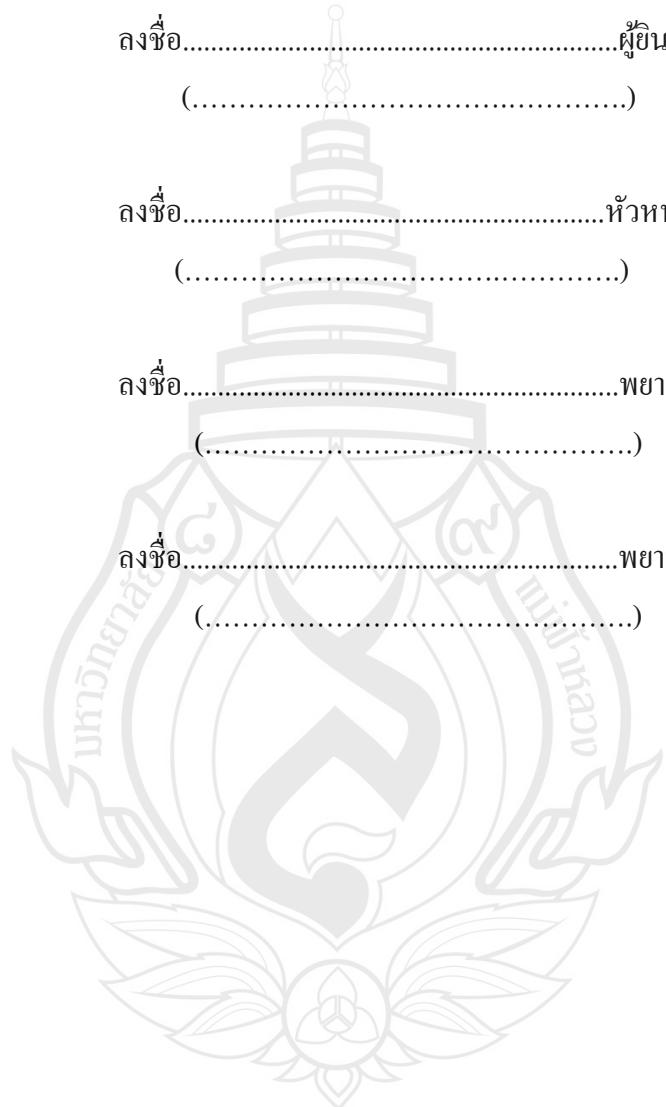
(.....)

ลงชื่อ.....พยาบาล

(.....)

ลงชื่อ.....พยาบาล

(.....)



## APPENDIX B

### INFORMATION SHEET

เอกสารคำชี้แจง โครงการวิจัยแก่ผู้เข้าร่วมโครงการ  
(Information Sheet)

#### ชื่อโครงการวิจัย

การศึกษาระดับแคลเซียมในเลือดภายในหลังรับประทานแคลเซียมหลังการออกกำลังกาย

#### วัตถุประสงค์การวิจัย

เพื่อศึกษาระดับแคลเซียมในเลือดภายในหลังรับประทานแคลเซียมหลังการออกกำลังกายในกลุ่มประชากรที่ออกกำลังกายหนักอย่างเป็นประจำ

#### ความเป็นมาและความสำคัญของโครงการ

แคลเซียมเป็นแร่ธาตุที่สำคัญต่อร่างกายมนุษย์เป็นอย่างมาก ซึ่งมีแหล่งสะสมอยู่ในร่างกายคือกระดูกและอัซซิรัมกับของเหลวในร่างกาย เมื่อใดที่ร่างกายมีระดับแคลเซียมในเลือดไม่สมดุล ร่างกายจะทำงานทันทีโดยสั่งการให้แคลเซียมที่สะสมในกระดูกได้สลายตัวออกมานะเพื่อเติมให้แคลเซียมในเลือดสมดุล มีการศึกษาเกี่ยวกับการสูญเสียแคลเซียมพบว่าแคลเซียมสามารถมาจากการขับออกทางเหงื่อได้ในหมู่นักกีฬาที่มีการออกกำลังกายอย่างหนักเป็นประจำ ซึ่งอาจเป็นสาเหตุหนึ่งในการทำให้เกิดภาวะของแคลเซียมไม่สมดุล และต้องเป็นเหตุให้กระดูกสลายตัวเป็นประจำ ทำให้ก่อให้เกิดความเสี่ยงโรคกระดูกกระพูนอย่างสูง การรับประทานแคลเซียมในปริมาณที่เหมาะสมอาจจะเป็นปัจจัยที่ควบคุมระดับแคลเซียมเลือดไม่ให้ต่ำลงจนเกิดความไม่สมดุลหลังจากการออกกำลังกายได้ อย่างไรก็ตาม ไม่มีการศึกษาที่มุ่งเน้นถึงผลการศึกษาอย่างชัดเจน ทำให้ผู้วิจัยต้องการทำการศึกษาระดับแคลเซียมในเลือดภายในหลังรับประทานแคลเซียมหลังการออกกำลังกายในกลุ่มผู้ที่ออกกำลังกายอย่างหนัก เพื่อแสดงถึงผลกระทบกระดับแคลเซียมในเลือดให้อยู่ในระดับปกติแก่ผู้

ออกกำลังอย่างหนักด้วยผลิตภัณฑ์เสริมอาหารแคลเซียม ทั้งนี้เพื่อที่จะได้นำมาเป็นแนวทางในการตัดสินใจแก่ผู้บริโภคในการเลือกใช้ผลิตภัณฑ์ในการดูแลตนเองต่อไปอีกด้วย

#### **สถานที่และระยะเวลาที่ต้องทำการวิจัยกับอาสาสมัคร**

การศึกษานี้ดำเนินการแก่อาสาสมัครที่มารับการตรวจที่โรงพยาบาลมหาวิทยาลัยแม่ฟ้าหลวง กรุงเทพมหานคร โดยใช้ระยะเวลาในการดำเนินการทั้งหมด ประมาณ 2 วัน เริ่มตั้งแต่เวลา 10.00 น. จนถึง 15.00 น.

#### **รายละเอียดที่จะปฏิบัติต่ออาสาสมัคร**

ในระยะเวลา 2 วันที่ทำการทดลอง ในวันที่ 1 อาสาสมัครจะได้รับตรวจประเมินสุขภาพโดยทั่วไป รวมทั้งรับคำแนะนำเกี่ยวกับขั้นตอนการวิจัยโดยละเอียด จากนั้นผู้อาสาสมัครจะได้รับการเจาะเลือดคุณค่าระดับแคลเซียมในเลือดก่อนการทดลองออกกำลังกาย การทดลองการออกกำลังนั้นจะทำด้วยวิธีก้าวขึ้น-ลงบนแท่นไม้ขันดกว้าง 55 เซนติเมตรและยาว 55 เซนติเมตรและมีความสูง 36 เซนติเมตรเป็นจำนวน 40 ครั้งต่อนาทีในระยะเวลา 20 นาทีโดยเฉลี่ย หลังการการออกกำลังจะมีการเจาะเลือดอีกรังเพื่อส่งเข้าห้องทดลอง สำหรับวันที่ 2 นั้น จะดำเนินการเหมือนตามรายละเอียดของวันที่ 1 หากแต่วันที่ 2 นั้นจะมีการรับประทานแคลเซียมเสริมก่อนการทำการทดลองออกกำลังกาย

## ข้อควรปฏิบัติในระยะเวลาที่เข้าร่วมโครงการวิจัย

1. งดอาหารประเภท นม เนย ชีส ก่อนวันทดลองเป็นเวลา 7 วัน รวมถึงอาหารเสริม แคลเซียมก่อนเริ่มการวิจัยเป็นเวลา 7 วันและตลอดการวิจัย 2 วัน
2. ไม่อนุญาตให้ใช้ผลิตภัณฑ์เสริมอาหารอื่น ๆ ระหว่างการวิจัย
3. ไม่อนุญาตให้อาสาสมัครดื่มกาแฟเกินวันละ 2 แก้วมาตรฐาน

## ประโยชน์ที่คาดว่าจะเกิดขึ้นกับอาสาสมัครและผู้อื่น

ได้มีส่วนร่วมในการศึกษาวิจัยเพื่อพัฒนาองค์ความรู้ในอุบัติเหตุทางร่างกายที่เหมาะสมเพื่อดูแลรักษาสุขภาพต่อไป

## ความเสี่ยงหรือผลข้างเคียงที่จะเกิดขึ้นต่ออาสาสมัคร

การอุบัติเหตุทางร่างกายของโครงการวิจัยนี้อาจจะมีความเสี่ยงในเรื่องของอุบัติเหตุทางร่างกายได้ หรือมีผลข้างเคียงในร่างกายเมื่อร่างกายรู้สึกอุบัติเหตุทางร่างกาย เมื่อต้องรับประคับมาตรฐานของตน ทางผู้วิจัยได้เตรียมหน่วยพยาบาลสำหรับปฐมพยาบาลเบื้องต้นในทุกรุน และสำรองรถพยาบาลฉุกเฉินในกรณีจำเป็น

### วิธีการป้องกันและแก้ไขในกรณีที่เกิดปัญหาขึ้นกับอาสาสมัคร

1. แนะนำวิธีการอุบัติเหตุทางร่างกายอย่างถูกต้อง
2. หากเกิดอุบัติเหตุใด ๆ ผู้เข้าร่วมวิจัยจะได้รับการรักษาโดยทันที และผู้ป่วยมีสิทธิ์ที่จะถอนตัวจากการศึกษา ณ เวลาใดก็ได้
3. ผู้วิจัยหลักจะให้เบอร์โทรศัพท์ติดต่อโดยตรงแก่ผู้เข้าร่วมวิจัยเพื่อที่จะสามารถติดต่อได้ตลอดเวลาหากมีข้อซักถามหรือเกิดปัญหาใดๆ ขึ้นระหว่างการวิจัย

## ขอบเขตการดูแลรักษาความลับของข้อมูลต่าง ๆ ของอาสาสมัคร

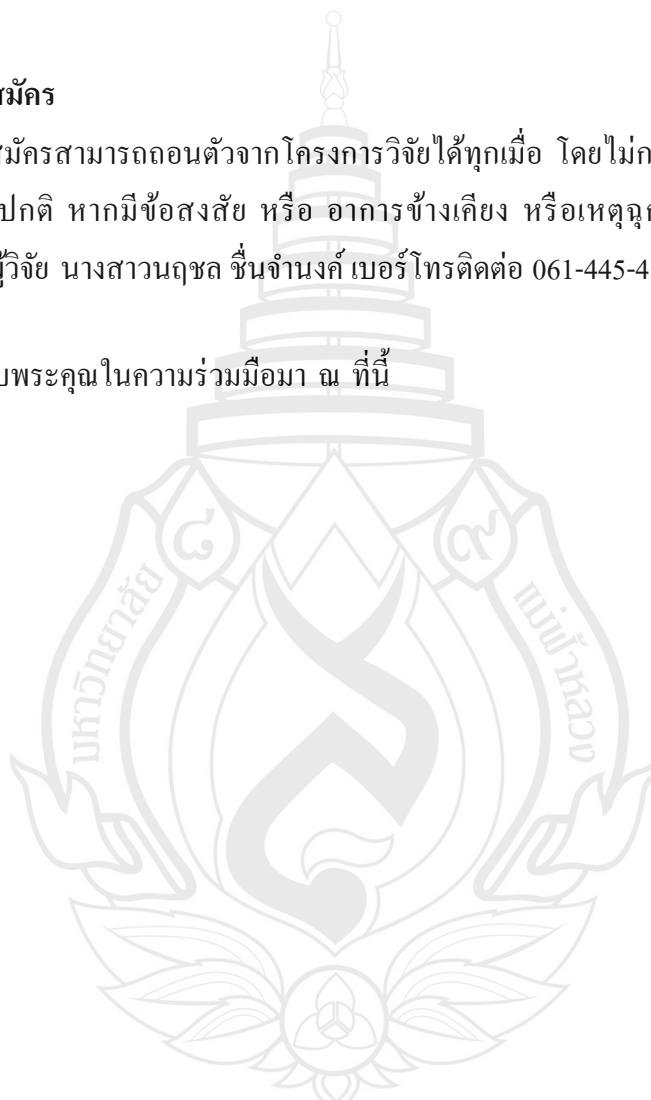
ผู้วิจัยจะรักษาข้อมูลส่วนบุคคลของผู้เข้าร่วมการทดลองไว้เป็นความลับ ไม่เปิดเผยต่อสาธารณะ การนำเสนอผลการวิจัยจะเสนอเป็นภาพรวม ไม่แสดงรายละเอียดเป็นรายบุคคล ข้อมูล และผลที่ได้จากการวิจัยทั้งหมดจะถูกเก็บเป็นความลับระหว่างผู้เข้าร่วมวิจัยและผู้วิจัยเท่านั้น ค่าตอบแทนอาสาสมัคร ค่าชดเชย กรณีเกิดอันตรายหรือผลที่ไม่พึงประสงค์จากการวิจัยแก่อาสาสมัคร

1. ผู้เข้าร่วมวิจัยทุกคนจะได้รับค่าใช้จ่ายในการเดินทางคนละ 750 บาทรวมถึงมื้ออาหาร และจะผู้เข้าร่วมวิจัยไม่ต้องเสียค่าใช้จ่ายใดๆตลอดระยะเวลาการศึกษาวิจัย
2. ในกรณีเกิดผลข้างเคียงจากการวิจัย ผู้เข้าร่วมวิจัยจะได้รับการคุ้มครองยาทันทีโดยไม่ต้องเสียค่าใช้จ่าย ผู้วิจัยจะรับผิดชอบค่ารักษาพยาบาลทั้งหมด และมีค่าชดเชยในกรณีที่เกิดอันตราย หรือผลที่ไม่พึงประสงค์จากการวิจัยแก่อาสาสมัคร

#### สิทธิของอาสาสมัคร

อาสาสมัครสามารถถอนตัวจากโครงการวิจัยได้ทุกเมื่อ โดยไม่กระทบต่อการคุ้มครองยาที่พึงได้ รับตามปกติ หากมีข้อสงสัย หรือ อาการข้างเคียง หรือเหตุฉุกเฉินใด ๆ อาสาสมัคร สามารถติดต่อผู้วิจัย นางสาวนฤชล ชื่นจำนงค์ เบอร์โทรศัพท์ต่อ 061-445-4156 ได้ทุกเวลา

ขอขอบพระคุณในความร่วมมือมา ณ ที่นี่



## APPENDIX C

### APPLICATION FORM FOR VOLUNTEER

แบบบันทึกข้อมูลอาสาสมัคร

(Application Form for Volunteer)

วันที่.....

ประวัติส่วนบุคคล

ชื่อ (นาย/นาง/นางสาว)..... นามสกุล.....

เลขประจำตัวประชาชน.....

เพศ ( ) หญิง ( ) ชาย อายุ..... ปี วัน เดือน ปีเกิด.....

เชื้อชาติ..... สัญชาติ..... ศาสนา.....

สถานภาพ ( ) โสด ( ) สมรส ( ) หย่าร้าง

น้ำหนัก..... กิโลกรัม ส่วนสูง..... เซนติเมตร

ที่อยู่ปัจจุบัน

เบอร์โทรศัพท์(บ้าน)..... มือถือ.....

E-mail..... อีเมล.....

บุคคลที่ติดต่อได้ในเวลาฉุกเฉิน

ชื่อ..... นามสกุล..... ความสัมพันธ์.....

เบอร์โทรศัพท์.....

ที่อยู่.....

### ข้อมูลทางการแพทย์

ประวัติการแพ้ยาหรืออาหาร ( )ไม่มี ( )มี โปรดระบุ.....

ประวัติโรคประจำตัว ( )ไม่มี ( )มี โปรดระบุ.....

รับประทานยาอื่น ๆ หรือผลิตภัณฑ์เสริมอาหาร วิตามิน สมุนไพร ( )ไม่มี ( )มี โปรดระบุ.....

การสูบบุหรี่ ( )ไม่มี ( )มี โปรดระบุ.....

การดื่มเครื่องดื่มแอลกอฮอล์ ( )ไม่มี ( )มี โปรดระบุ.....

การบริโภคชาหรือกาแฟ ( )ไม่มี ( )มี โปรดระบุ.....

พฤติกรรมการทานอาหาร.....

พฤติกรรมการออกกำลังกาย.....

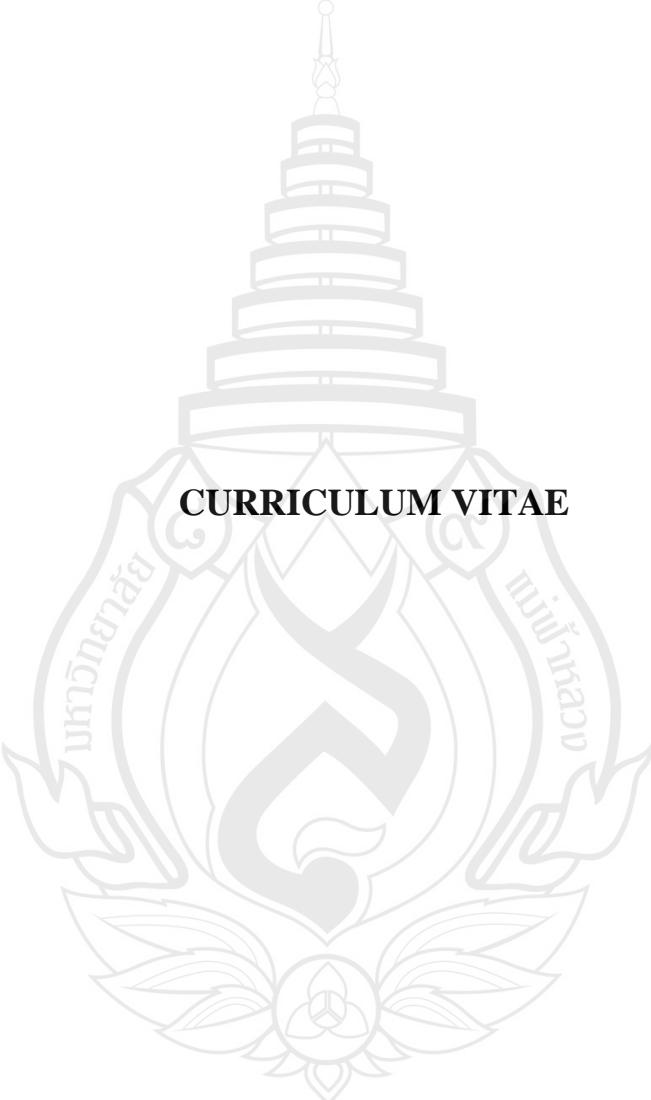


## APPENDIX D

### TABLE OF BLOOD TEST

ตารางตรวจบันทึกของการเจาะเลือด  
(Table of Blood Test)

ลำดับที่	วันที่ 1 เจาะเลือดครั้งที่ 1 (ก่อนออกกำลังกาย)	วันที่ 1 เจาะเลือดครั้งที่ 2 (หลังออกกำลังกาย)	วันที่ 2 เจาะเลือดครั้งที่ 1 (ก่อนออกกำลังกาย)	วันที่ 2 เจาะเลือดครั้งที่ 2 (หลังออกกำลังกาย)
1				
2				
3				
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12				
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14				
15				
16				
17				



# **CURRICULUM VITAE**

## CURRICULUM VITAE

<b>NAME</b>	Ms. Naruechol Chuenjamong
<b>DATE OF BIRTH</b>	18 December 1978
<b>ADDRESS</b>	525/44 Soi Ladprao 130 Wangthonglang Bangkapi Bangkok, Thailand
<b>EDUCATION BACKGROUND</b>	
2000	Bachelor of Arts in Business Chinese Assumption University, Thailand
2007	Master of Management in Marketing Central Queensland University, Australia
<b>WORK EXPERIENCES</b>	
2015-present	Account Manager, Myanmar Business BEC TERO Entertainment Public Limited Company
2012-present	Business Director, 93 MUNfm, Chiangmai Thailand Mahasiang Company Limited
2007-2012	Marketing Manager, Abbeycrest Thailand Ltd., Bangkok Thailand