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STATISTICAL ANALYSIS OF RISK FACTORS OF OSTEOPOROSIS IN YANGON

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MAS 3rd BATCH

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STATISTICAL ANALYSIS OF RISK FACTORS OF OSTEOPOROSIS IN YANGON

This thesis is submitted to the Board of Examination as partial fulfillment of the requirement for the Degree of Master of Applied Statistics

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ABSTRACT

Osteoporosis issues in elders is the most adverse public health disease associated with substantial fracture among male and female. The purpose of this study is to examine the association between demographic and behavioral factors and the prevalence of osteoporosis. Secondary data were collected by Troikaa Pharmaceuticals Co., Ltd were employed in this study. The descriptive analysis, bivariate analysis and logistic regression models were used in this study. According to the descriptive analysis, 34% of the respondents have occurred osteoporosis. Regarding bivariate analysis, it was found that age, gender, low body weight (≤128 lb), smoking, personal history of fracture and low level of calcium/vitamin D intake were related with osteoporosis. According to the logistic regression analysis, risk factors such as age, gender, low body weight (≤128lb), personal fracture and low level of calcium/vitamin D intake played significant role in the prevalence of osteoporosis. The results of this study may be used to facilitate risk-prevention strategies to reduce the prevalence of osteoporosis. This study may drive positive social change by facilitating public health to promote and implement effective behavioral interventions to prevent osteoporosis.

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LIST OF ABBREVIATIONS

BMD	-	Bone Mineral Density
BMI	-	Body Mass Index
BRFSS	-	Behavioral Risk Factor Surveillance System
CI	-	Confidence Interval
df	-	Degree of Freedom
DXA	-	Dual X-ray Absorptiometry
DXL	-	Dual X-ray and Laser Absorptiometry
HERS	-	Heart and Estrogen/Progestin Replacement Study
HBM	-	Health Belief Model
IOF	-	International Osteoporosis Foundation
ISCD	-	International Society for Clinical Densitometry
IU	-	International Unit
MCBS	-	Medical Current Beneficiary Survey
NIH	-	National Institute of Health
NOF	-	National Osteoporosis Foundation
OR	-	Odds Ratios
PQCT	-	Peripheral Quantitative Computed Tomography
PTH	-	Parathyroid Hormone
RCT	-	Randomised Controlled Trial
RR	-	Relative Risk
SD	-	Standard Deviation
US	-	United States
WHI	-	Women's Health Initiative
WHO	-	World Health Organization

CHAPTER I
INTRODUCTION

Osteoporosis is a major risk factor for fracture and one of the major silent health problems in the world. According to the B-Dawson (1997), the number of men and women aged 65 years and older, will increase steadily and the most dramatic changes will occur in the very elderly, in whom the incidence of osteoporotic fracture is greatest in the European Community. As the people gets older, the morbidity, mortality and financial costs attributed to osteoporosis are expected to rise. Therefore, it is important to investigate the association between demographic factors and behavioral factors when examining the prevalence of osteoporosis among postmenopausal women age 50 and older who have undergone hysterectomy prior to reaching natural menopause. By using the WHO definition of osteoporosis, the disease affects approximately 6.3% of men over the age of 50 and 21.2% of women over the same age range globally.

1.1 Rationale of the Study

Osteoporosis is a silent disease common in both men and women and diagnosis either occurs during as assessment with a physician or when a fragility fracture occurs. Fragility fractures occur with minimal trauma, such as falling from standing height, and may results in mortality, morbidity, chronic pain and high economic costs. According to the Centers for Disease Control and Prevention (2013), death related to osteoporosis also have increased over the past 10 years. WASHINGTON, DC (June 2, 2014)- The National Osteoporosis Foundation (NOF) released the updated prevalence data estimating that a total of 54 million U.S adults age 50 and older are affected by osteoporosis and low bone mass. Based on the above study of NOF, by 2030, the number of adults over age 50 with osteoporosis or low bone mass will increase from 54 million to 71.2 million (a 29% increase from 2010); and the number of fractures will grow proportionally.

The economic costs related to osteoporotic fractures are substantial and will almost certainly increase further unless effective preventive interventions are widely

implemented. The peak bone mass soon after puberty and the bone are lost with various "insults" including ageing and postmenopausal changes. Factors influencing peak bone mass and lost range from nutrition, to lifestyle, to certain medical disorders. Educational level may also have an effect on bone mineral density as there is relationship between educational level and reproductive factors such as pregnancy and lactation and other lifestyle factors. Early menopause or premenopausal estrogen reduction may increase the risk of osteoporosis. Inadequate intakes of calcium and vitamin D, sedentary lifestyle, excessive betel chewing and alcohol use may also add to this condition. Secondary osteoporosis is a consequence of chronic conditions that contribute to an accelerated bone loss. Some of these chronic conditions include: endogenous and exogenous thyroxine excess, cancer, hyperparathyroidism, gastrointestinal disease, medications, connective tissue diseases, renal failure, and a variety of other conditions. As bone mineral density (BMD) is such an important predictor of future fracture, concerted efforts have been undertaken to understand the factors that influence BMD. However, these efforts have been complicated by the need to consider the dynamic properties of bone growth, as bone density at any given point in time reflects the cumulative balance of processes contributing to bone formation and bone resorption. Nevertheless, epidemiologic studies have revealed a number of environmental and lifestyle factors to be associated with reduced BMD, such as lean body size, cigarette smoking, steroid use, nutritional deficiency, and early menopause. However, at least some of this ethnic variability can likely be accounted for by ethnic differences in other known risk factors for BMD such as body size.

Osteoporosis is a global problem, which is increasing in significance as the population of the world both grows and ages. Worldwide, lifetime risk for osteoporotic fractures in women is 30-50%. In men risk is 15-30% by using the International Osteoporosis Foundation (IOF).

Currently, the prevalence of osteoporosis in Myanmar is unknown due to lack of proper diagnostic facilities. The only data available are from studies done at the out-patients department- of Yangon Orthopedic Hospital, Rehabilitation Wards of North-Oakkalar General Hospital and East Yangon General Hospital by using ultrasound densitometry.

Osteoporosis is closely associated with substantial morbidity, mortality, health-related quality of life, and socioeconomic burden (Bleibler et al., 2014). Today, an osteoporotic fracture is considered to be the most adverse health event in older adult

people and is strongly associated with age and a previous bone fracture. Several previous studies have reported that the prevalence of osteoporosis is associated with menopause with the aging process. Premature menopause prior to the age of 40 or early menopause prior to the age of 40-47 is correlated with an amplified risk of bone osteoporosis in later life and premature death (Svejme etal., 2013). The earlier the age when menopause occurs, the greater the adverse effect on bone health. Hysterectomy among reproductive – aged women is one of the factors that contributes to the early onset of menopause (Hunter et al., 2012). Therefore, it was necessary to investigate the risk factors for osteoporosis, which is a major and growing health problem in many counties.

1.2 Objectives of the Study

The main objectives of the study are as follows:

(1) To describe the characteristics of the osteoporotic patients.

(2) To examine the association between demographic factors and behavioral factors and osteoporosis.

(3) To identify the prevalence of risk factors related to the development of osteoporosis in Yangon.

1.3 Method of Study

In this study, secondary data that is collected by Troikaa Pharmaceuticals Co., Ltd from November 2021 to October 2022. Descriptive Statistics is used to describe the characteristics of the osteoporotic patients. Regarding bivariate analysis, Chi-square test is used to study the relationship between demographic factors and behavioral factors and osteoporotic patients and logistic regression is used to determine the risk factors of osteoporosis.

1.4 Scope and Limitations of the Study

In this study, the data is conducted at *Yangon* Region in the year of 2021-2022. Also, the social demographic variables such as gender, age are measured to analyze the osteoporosis status. Additionally, the factor affecting on the lifestyle status are determined in this study.

During the study period, there are some limitations encountered in this study. Firstly, hormones levels, calcium level and Vitamin D level in the body for each study

setting might be observer variations as a limitation. And also, though a well-structured questionnaire is employed as a collection tool for collection of primary data, pilot testing will not be carried out to calculate the reliability of questionnaire due to limited time duration.

1.5 Organization of the Study

This study is organized with five chapters. Chapter I, consists of introduction which describes the rationale of the study, objectives of the study, scope and limitations of the study, method of study and organization of the study. Next, Chapter II consists of literature reviews of theoretical background and conceptual framework. Chapter III is organized with research methodology. In Chapter IV, results and finding are presented. Finally, Chapter V is the conclusion which describes discussion and recommendations.

CHAPTER II
LITERATURE REVIEW

This chapter presents the overview of the osteoporosis, measurement of bone mineral density, risk factors for osteoporosis and osteoporotic fracture and review on related studies and conceptual framework.

2.1 Definition of Osteoporosis

Osteoporosis is defined as a 'progressive systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. (World Health Organization, the Assessment of Osteoporosis at the Primary Health Care Level met in Brussels from 5 to 7 May, 2004.)

National Institutes of Health (NIH), U.S.A. (2000) consensus conference modified this definition as follows: "a skeletal disorder characterized by compromised bone strength predisposing a person to an increased risk of fracture. Bone strength reflects the integration of 2 main features: bone density and bone quality". In the absence of methods of measuring bone quality, the diagnosis of osteoporosis tends to be made on the basis of low bone density.

Generally, osteoporosis in Myanmar is still a neglected disease entity in the national priority health problems. Due to the low level of awareness on osteoporosis and a change in diet to cause osteoporosis and its consequent fragility fractures, limited availability and accessibility of standard diagnostic tools and medications, osteoporosis is mainly under diagnosed and under-treated in daily clinical practice. It is not mentioned in the prioritized diseases in the national health plan. The risk of osteoporosis grows as the age gets older. At the time of menopause, women may lose bone quickly for several years due to changes in hormone. Low levels of certain hormones can increase the chances of developing osteoporosis such as low estrogen levels in women after menopause and low levels of testosterone in men. Men with

conditions that cause low testosterone are at risk for osteoporosis. However, the gradual decrease of testosterone with aging is probably not a major reason for loss of bone.

Nowadays approximately 90 percent of the population does not get enough Calcium and Vitamin - D which strength the bones and to reduce the likelihood of developing osteoporosis. The other important main cause is a change in lifestyle of low levels of physical activity and prolonged periods of inactivity which can contribute to an increased rate of bone loss. In poor physical condition, which can increase your risk of falling and breaking a bone and heavy smoking and drinking of alcohol is a significant risk factor for osteoporosis.

2.2 Measurement of Bone Mineral Density

The diagnosis of osteoporosis is based on an osteoporotic BMD value. It is important to remember that the decision about treatment is a weighted judgement where BMD is one of the risk factors taken into account.

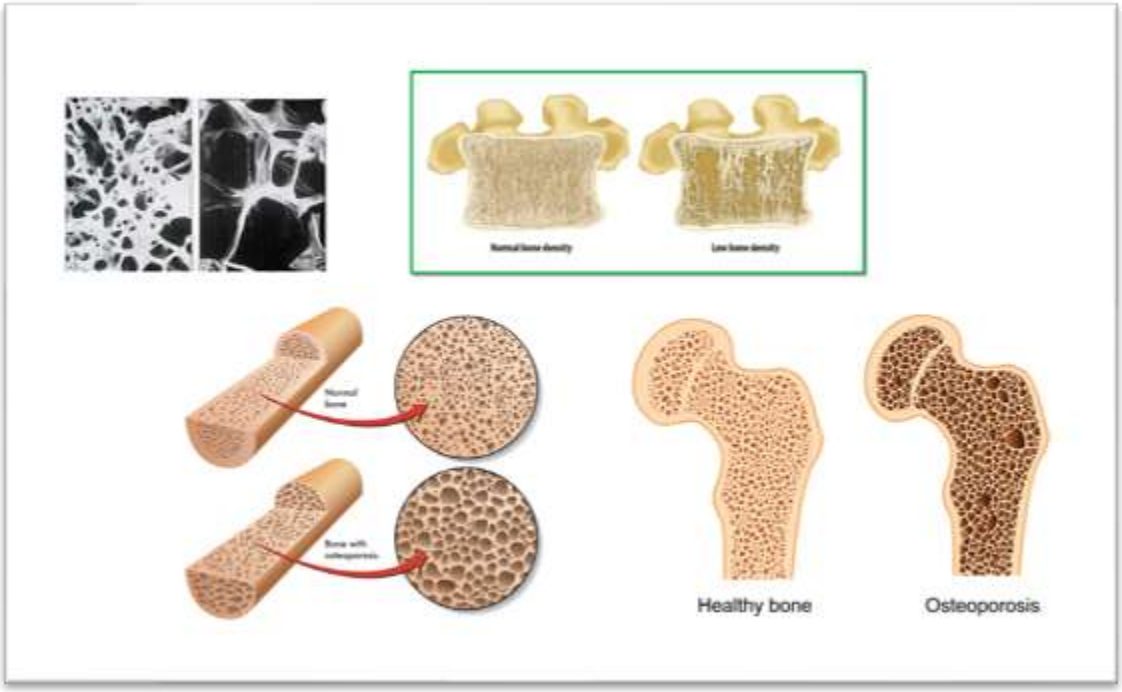
Measuring bone mineral density is the best available non-invasive method to assess bone strength in clinical practice, but there are other skeletal factors, often called bone quality, contributing to bone strength such as bone shape, bone microarchitecture and bone turnover (Heaney, 2003).

2.2.1 Bone Structure

Bones have a honeycomb structure with small gaps in between a lattice of bones. In osteoporosis, the gaps become bigger, causing the bones to become thinner, which weakens the bone structure. The bones are undergoing a constant state of regeneration old bone is broken down (resorbed) and new bone is made.

Osteoporosis literally means ‘porous bone’. It is a condition where bones become thin and lose their strength, as they become less dense and their quality is reduced. This can lead to broken bones, which cause pain, disability, and make everyday activities extremely difficult. From birth to adulthood, the bones develop and grow until, in our early 20s, they reach what is called peak bone mass – the time when the bones are at their strongest, densest and least likely to fracture. Throughout life, bone is constantly being renewed, with new bone replacing old bone- and this helps to keep our skeleton strong. But for people with osteoporosis, more and more bone are lost and not replaced. This means that the bones gradually become brittle and more likely to break.

Figure (2.1) Comparison of Normal Bone and Osteoporosis Bone



Source: from internet

2.2.2 DXA Technology

Bone mineral density is accurately measured with DXA (Dual X-ray Absorptiometry). X-rays with two different energies are passed through the bone, some of the energy is absorbed, and the rest is detected on the other side of the body. In every "picture element" two variables can be defined. Two energies allow an estimation of the content of soft tissue (which contains water and fat) separated from the bones. The greater the bone mineral content of the skeleton, the more energy is absorbed. This radiation energy is detected and converted into an areal density measured in g/cm2. A problem with the DXA method is that we do not fully know how the soft tissue content outside the bone differs from the soft tissue inside the bone. The amount of fat inside the skeleton differs at different ages and increases in elderly. This introduces an error in determining the amount of hydroxy apatite inside the bone, an error that can reach 10–20% (Bolotin, Sievanen et al., 2001).

Basically, the traditional DXA technology is a two - component system but it can be used to determine the content of water, fat and bone in the body. This is done by determining the content of water and fat in all picture elements outside the bone and then extrapolating the same fat and water content to exist inside the bone, introducing a minor error in the estimation.

The DXA technology is most often used for measurements of the lumbar spine and the hip, but there are also DXA technologies for peripheral sites such as the radius and the calcaneus. Light portable devices have been developed for measuring BMD in the calcaneus. This equipment offers a possibility to perform measurements at the local primary health care center. These devices do not occupy much space, are easy to handle and do not cost as much as the central DXA devices. Several previous studies have compared methods for measuring heel BMD with axial measurements. The studies have shown that calcaneal measurements of bone density with DXA technique can discriminate quite well between groups of osteoporotic subjects and those without the condition. Some of the studies have also proposed other cut-off points than –2.5 SD for the heel devices and have not found the WHO cut-off point to be applicable to the heel (Williams and Daymond, 2003).

2.2.3 DXL Technology

DXL stands for Dual X-ray and Laser technique. It was developed in Sweden by Kullenberg and co-workers. It combines the DXA technology with a laser beam measurement of the thickness of the object. Thus, in every "picture element", three known variables can be measured (the absorption of the two X-ray energies and the thickness of the object) and three variables inside the bone can be determined: the content of hydroxy apatite, the amount of fat and the amount of water. DXL can be described as a three-component system. The DXL method is described by Hakulinen and colleagues (Hakulinen, Saarakkala et al., 2003).

According to the International Society for Clinical Densitometry (ISCD), the heel DXL devices have gained popularity in recent years in Sweden but have not been evaluated enough. The journal of the Swedish Medical Association, there has been a discussion and also warnings from a group of experts on osteoporosis, about the widespread use of heel DXA measurements. There is insufficient knowledge as to whether the same cut-off point of –2.5 SD is also appropriate for heel BMD measurements. Further, we do not know the fracture-prospective value of a calcaneal measurement. It cannot be used for monitoring treatment because there are very few studies evaluating the calcaneus response to osteoporosis treatment. Furthermore, using measurement of a peripheral site for diagnostic purpose, is not recommended by the experts of (Leib, Lenchik et al., 2002).

In this study, ultrasound bone densitometer / Osteo-Pro Series is used. By using WHO's diagnostic standard parameter, osteo-pro provides the reliable diagnostic results. Osteo-pro uses oil medium that is similar to water, but is not affected by temperature changes, thus reducing diagnostic errors and improving reproducibility remarkably. Accuracy of diagnostic results has been improved by adopting calcaneus thickness data.

Osteo-pro produces more accurate prognosis by using bone density data that have been achieved through a variety of clinical diagnosis. It adopts the osteoporosis diagnosis standards established by WHO.

2.2.4 T-scores and Z-scores

Values of bone mineral density are measured in g/cm2 and then converted into T- scores and Z-scores. The origin of the T-score is described by Faulkner (2005).

T-scores are related to the young mean peak bone mass (the young normal healthy mean BMD) of the reference population of the same gender and are calculated according to the following formula:

$$\text{T-score} = \frac{\text{patient's BMD} - \text{young adult mean BMD of the reference population}}{\text{standard deviation (SD) of the young mean peak BMD}}$$

Z-scores are related to the mean BMD in the reference population with the same age group as the patient and are calculated according to the following formula:

$$\text{Z-score} = \frac{\text{patient's BMD} - \text{mean BMD of age-matched reference population}}{\text{standard deviation (SD) of the young mean peak BMD}}$$

T-scores are used for the densitometric diagnosis of osteoporosis:

1. Normal: T-score > –1
2. Osteopenia: T-score < –1 and > –2.5
3. Osteoporosis: T-score < –2.5
4. Established or severe osteoporosis: T-score< –2.5 and the presence of one or more fragility fractures.

2.3 Main Risk Factors for Osteoporosis

Risk factors for osteoporosis, such as advanced age and reduced bone mineral density (BMD), which have been established by virtue of their direct and strong relationship to the incidence of fractures; however, many other factors have been considered risk factors based on their relationship to BMD as a surrogate indicator of osteoporosis.

2.3.1 Age

Advanced age is the strongest individual risk factor for fragility fracture, demonstrated in many studies The highest bone mass, peak bone mass, is reached in young adults in both genderes 20-30 years of age. For men, the decrease in bone mass is slow and continuous throughout life, while for women, the estrogen deficiency initiated by menopause accelerates the bone losses between age 50 and 60. Thereafter, the decrease is slower, resembling that of men but even between 60 and 80, women had greater bone losses than men, 19% in women compared with 10% in men. Peak bone mass of women is not as high as that of men and when bone losses accelerate at menopause, the risk of fragility fracture increases rapidly. The most common first fragility fracture is the wrist fracture followed by vertebral compression fractures and hip fractures. The mean age for a woman to get her hip fracture is 81 years while that for men is 86 years, and then therefore many men may already have died of other causes. (Siris, Miller et al.,2001)

2.3.2 Anthropometric Factors

BMI below 19-20 in elderly is often associated with osteoporosis while individuals with a weight over 70 kg are seldom affected. Low Body weight and low body mass index (BMI) have consistently been shown to be associated with an increased risk of osteoporosis. In the age category of the subjects in the study, low body weight rather than low BMI has the strongest association with osteoporosis. This may due to the fact that many individuals lose height due to the deformities in spine, and perhaps also due to vertebral fractures, often undiagnosed. The reduction in height over 4-5 cm may be caused by vertebral fractures. Also, tall individual has an increased risk of some osteoporotic fractures. Weight variability and weight change are also risk factors for hip fractures. (Kantor, Ossa et al.,2004)

2.3.3 Low Bone Mineral Density

One of the main risk factors for osteoporotic fracture is low bone mineral density, as has been shown in several studies. These studies have established that both axial and peripheral bone density predict fractures in elderly women. A one SD decrease in bone mineral density at all measured sites was shown to have a predictive ability for future osteoporotic fracture with a pooled RR of 1.5 in an analysis made by the Swedish Council of Technology Assessment in Health Care. In this analysis calcaneus had a predictive ability of RR 2.0 for each SD decline of BMD for future hip fracture and a slightly higher predictive ability than the lumber spine to predict a future vertebral fracture (RR 2.4 and 2.3 respectively). Measurement of BMD at the site of the future fracture region is considered to have the best predictive ability. The ability of the BMD measurement of the hip to predict a future hip fracture showed a RR of 2.6 for a decline of 1 SD in BMD. In another meta-analysis by Cummings and co-workers the calcaneal BMD was found to have a RR of 1.8 for a decline of 1 SD in BMD to predict future hip fracture (Cummings and Melton, 2002).

Despite the fact that low BMD is a major risk factor for osteoporotic fracture, over 80% of the fractures in postmenopausal women occur in those women who did not have a peripheral measurement showing osteoporosis. It is also important to remember that the decision about treatment is based not only on a BMD value showing osteoporosis. All individuals with low BMD values do not require treatment and sometimes, especially in the presence of a fragility fracture or treatment with corticosteroids, BMD values above the cut-off point of osteoporosis do not exclude the need for bone specific agents. (Siris, Chen et al.,2004)

2.3.4 Previous Fracture

The previous fracture is a major risk factor for subsequent fractures The most common site of fragility fractures are the radius, humerus, vertebrae and hip. The life time risk of a hip fracture for a Swedish middle-aged woman is 23% and the combination of decreased bone mineral density and several risk factors leads to a greatly elevated risk of fracture, as shown in several studies. The most risk factors in combination with low bone density had up to 25-fold higher risk of fracture. (Kanis, Johnell et al., 2000).

2.3.5 Propensity to Fall

The osteoporotic skeleton is like a fragile vase, it does not break until it is tipped over. For more osteoporotic fractures with the exception of vertebral compression fractures, which may occur spontaneously, some kind of stress, mostly a fall, is required in order to incur a fracture. The rate of falls increases with age and the skeleton gets more and more fragile, thus creating a high-risk combination. The origin of these falls is multifactorial: impaired balance, impaired vision, some medications, weaker muscles and the degenerative changes contributing.

In the report on osteoporosis from the Swedish Council on Technology Assessment in Health Care ,2003, the working group concludes that individual training of muscle strength and balance have proved to decrease the risk falls (SBU,2003).

In a randomized controlled trial by Bischoff-Ferrari and colleagues, vitamin D was shown to reduce the odds of falling by 46% in ambulatory older women during a three-year supplementation with 500 mg calcium and 700 IU of vitamin D (Bischoff-Ferrari, Orav et al.,2006).

A recent randomized trial of Bore and colleagues showed in a group of 124 nursing home residents (average age 89 years), who were randomly assigned to receive one of four vitamin D supplement doses (200 IU, 400 IU, 600 IU, or 800 IU) or placebo daily for 5 months, that participants in the 800 IU group had a 72% lower adjusted-incidence rate falls the incidence rate of placebo over the 5 months of the trial (Broe, Chen et al.,2007).

2.3.6 Smoking

Smoking is the strong risk factor which doubles the risk of osteoporosis, Studies have shown a direct relationship between tobacco use and decreased bone density. Analyzing the impact of cigarette smoking on bone health is complicated. It is hard to determine whether a decrease in bone density is due to smoking itself or to other risk factors common among people who smoke. For example, in many cases people who smoke are thinner than nonsmokers, tend to drink more alcohol, may be less physically active, and have poor diets. Women who smoke also tend to have an earlier menopause than nonsmokers. These factors place many people who smoke at an increased risk for osteoporosis apart from their tobacco use.

In addition, studies on the effects of smoking suggest that smoking increases the risk of having a fracture. As well, smoking has been shown to have a negative impact on bone healing after fracture (NIH Smoking and Bone Health,2018).

2.3.7 Heredity and Ethnicity

Bone mineral density may by determined by genetics up to about 70%. The risk of osteoporotic fracture is doubled if the patient's mother has suffered a hip fracture. In a meta-analysis Kanis and colleagues showed that a family history of hip fracture in parents was associated with a significant risk increase of about 50% of all osteoporotic fracture (RR 1.54; 95CI= 1.25-1.88) and of hip fracture (RR= 2.27; 95%CI=1.47-3.49)

The lifetime risk of a 50-year-old Swedish woman suffering from an osteoporosis-related fracture is 50%, compared with the lifetime risk of a Swedish man of the same age which is 25%. (Kanis, Johansson et al.,2004). The other risk factors include menopause before the age of 45 years, physical inactivity and high consumption of alcohol (SBU, 2003).

2.3.8 Estrogens (Postmenopausal Women)

Estrogen deficiency is the most important cause of postmenopausal bone loss in women. Women lose annually in average 3% of their bone mass in the years after menopause, compared with men who only lose 0.5-1% of their bone mass per year during the same period. Estrogen is believed to play an important role for women as well as for men in the maintenance of bone mass. Endogenous estrogens have an important role for bone health even after menopause. Women over 65 years of age with estrogen levels lower than 5pg/ml had lower bone mass than women who had higher estrogen levels, and that these women also had a higher risk of vertebral and hip fractures (Guthrie, Dennerstein et al.,2000).

The attitude towards treatment with estrogens has changed dramatically that the result of two large-scale randomized controlled trials with estrogen, the HERS (Heart and Estrogen/Progestin replacement study) and the WHI (Women's Health Initiative) trial (Anderson et al.,2002).

2.3.9 Calcium Intake

The human skeleton contains approximately 1kg of calcium (for a male of 70 kg) and is the principal mineral of the skeleton. About 150-200 mg of calcium is

absorbed from the intestine and the same amount of calcium is excreted mainly via urine every day. Calcium is an important element of the hydroxy apatite, needed to mineralize the skeleton. Calcium and vitamin D are also needed to prevent secondary hyperparathyroidism in the elderly. Whenever the absorbed calcium intake does not meet the demands and the losses, increased bone re-modelling will be stimulated by PTH to keep balance in the extracellular fluid calcium ion homeostasis. When the calcium intake is appropriate for the demands, the PTH-stimulated re-modelling increases immediately (Wastney, Martin et al., 2000).

A sufficient calcium intake around 1000mg per day lowers the bone re-modelling rate by 10-20%. Calcium supplementation reduces both bone loss and tends to affect fracture rate in elderly as shown in the meta-analysis by Shea in 2002 (Shea, Wells et al.,2002).

2.3.10 Vitamin D Intake

Vitamin D is a steroid hormone and its effects on bone are mediated through the active form $1,25(OH)_2D$. Its main effect is to maintain serum calcium level within normal limits. It accomplishes its effect by increasing calcium absorption from the intestines and by facilitating osteoclast precursors to become mature osteoclasts, which in turn mobilizes calcium from the skeleton into circulation. The keeping of serum calcium within a narrow window is important for its function in a wide-variety metabolic functions, signal transduction and in neuromuscular activity. With increasing age, there is a decrease in the ability of our skin to build precursors of the active vitamin D in the skin when exposed to sun. At the same time, the ability of our kidneys to activate 25(OH)D decreases. In the gut, both calcium and phosphorous absorption from food is enhanced. With adequate vitamin D concentrations, 30-40% of dietary calcium is absorbed, this absorption covering the daily losses via kidneys of about 160-200mg (Holick ,2003).

2.4 Review on Related Studies

The level of magnesium and calcium in the early hysterectomized women (34 participants), the late hysterectomized women (32 participants), and healthy women controls (28 participants). An ANOVA statistical analysis was used and Pearson's correlation coefficient for a correlation analysis. The results found that the levels of magnesium and calcium were more likely to be decreased in the early-hysterectomized

women compared to late-hysterectomized women. The study also found that hysterectomy was associated with osteoporosis development due to an imbalance of hormone level after the surgery (Sreekantha et al., 2011).

The prevalence and medical cost related osteoporosis in older adults using 2002 data from Medical Current Beneficiary Survey (MCBS) consisting of health survey interviews of Medicare recipients. The prevalence rate of osteoporosis and osteoporosis related medical costs were estimated with randomly selected Medicare participants, including elderly who live in either institutions or communities in the United States. For the study statistical analysis, a multiple regression analysis was used. The study found that 1.6 million (5%) and 7.2 million (24%) among 30.2 million Medicare recipients were treated for fractures and osteoporosis with no bone fractures. The medical costs for osteoporosis were an average $500 per drug treatment and $2 billion for the nationwide treatment. The estimated annual mean medical cost for the fractures was $14 billion for the U.S. costs. For the prevalence of osteoporosis and fractures in women, women's age group between 65 and 74 was estimated 4 times greater than that of the same men's age group. Women's age group between 75 and 84 was estimated 5 times greater than that of the same men's age group. For 85 years and older of women group, the women's age group was estimated 3 times greater than that of the same men's age group and fracture was approximately double on women than men (Blume & Curtis, 2011).

The study discussed that the proportion of postmenopausal women with osteoporosis among those referred for a bone mineral density measurement and risk factors for osteoporosis. 645 postmenopausal women were evaluated. Osteoporosis was diagnosed in 57.6%, osteopenia in 38.7% and a normal bone mineral density in 3.7%. The main risk factors for fracture were personal history of fracture (40%), family fracture (23%), smoking (15%) and glucocorticoids use (15%). Anti-osteoporosis drug was recommended for 93% of women with osteoporosis and for 45% of women with osteopenia. A logistic regression analysis showed that a T-score=-2.5 was the most important factor related to the treatment decision-making. Cluster analysis identified five types of women with different combinations of fracture risk factors. The percentage of postmenopausal women (96.3%) referred for bone mineral density and for whom a treatment could be recommended had osteoporosis or osteopenia (Pascal et al., 2011).

Physical activities engagement and osteoporosis studied that cross-sectional study in Korea. The study participants (n =6,477) were collected data from May 2001 to April 2007 of the National Cancer Center in Korea. The leisure-time physical activity was examined using a questionnaire asking the type of activities, frequency per week, and duration in minutes. Measurement of bone mineral activity at the lumbar (L1 - L4) and femur neck region was measured using dual energy X-ray absorptiometry (DXA) every month. *t*-test statistical analysis was performed to compare the age, height, weight, BMI, and lumbar and femoral bone mineral density based on menstrual status. Chi-Square tests were conducted to examine the distribution of duration and intensity of the physical activity by menstrual status. The association between the BMD and physical activity was evaluated using a generalized linear regression statistical analysis. The study indicated that physical activity was positively associated with BMD at the lumbar and femoral regions in postmenopausal women ($p<0.001$). Increases in physical activity levels were also positively associated both pre- and postmenopausal women groups. (Kim et al., 2012)

The study was targeted in women aged 40 and older years that were diagnosed with osteoporosis or osteopenia with or without taking osteoporosis medication. Annual U.S. 2006 family income was characterized and treated as an ordinal variable. A logistic regression analysis was used to assess factors that are associated with osteoporosis treatment. According to the study results, the socioeconomic factor was correlated with the higher ratio of monthly medication expenditure, and higher income was significantly associated with medical treatment (Meadows et al., 2012).

This study evaluated the prevalence of osteoporosis and its associated factors in Brazilian women over 50 years of age and to obtain information on factors related to the early onset of the disease. 622 women over 50 years of age in Brazil was conducted between May 10 and October 31, 2011 in the form of a population survey. Statistical analysis was carried out by chi-square test, Poisson regression analysis, and Cox multiple regression model. The mean age of the women was 64.1 years. The prevalence of self-reported osteoporosis was 21.3 %. A longer time since menopause (prevalence ratios (PR), 1.04; 95 % CI, 1.03-1.05; $p < 0.001$); self-perception of health as fair/poor/very poor (PR, 1.73; 95 % CI, 1.29-2.33; $p < 0.001$); having arthrosis (PR, 1.83; 95 % CI, 1.30-2.59; $p < 0.002$) and having problems maintaining balance when taking a bath or going down stairs (PR, 1.52; 95 % CI, 1.07-2.14; $p = 0.020$) were associated with osteoporosis. The variables associated with early onset of the disease

were: self-perception of health as fair/poor/very poor (coefficient, 0.77; $p < 0.001$), menopausal treatment with natural remedies (coefficient, 1.01; $p < 0.001$), smoking or having smoked >20 cigarettes/day (coefficient, 1.02; $p = 0.003$), and problems in running/lifting something heavy/practicing sports/doing heavy work (coefficient, 0.60; $p = 0.029$). The results showed that the factors such as poor self-perception of health, menopausal treatment with natural remedies, smoking, and decreased functional capacity are associated with early onset of the osteoporosis (Luiz et al., 2013).

The prevention of osteoporosis and bone fractures are associated with intake of calcium/vitamin D. The postmenopausal women with intake of calcium plus vitamin D supplements reduced osteoporosis and hip fractures significantly. The study data was collected from the Women's Health Initiative (WHI). The study participants of 32,282 women aged 50-79 years were randomly selected at 40 medical clinic sites in the United States. This clinical trial was randomly assigned to those women had either daily supply of 1,000 mg calcium plus 400 IU vitamin D3 or its placebo for average seven years of the intervention period. Medical records of semiannually self-reported clinical outcomes were analyzed using Cox regression model. The study showed that long-term intake of calcium/vitamin D supplements was beneficial to reduce a critical risk factor for osteoporosis among women (Prentice et al., 2013).

The study focused on the incidence and prevalence of osteoporosis determining the association between regular daily physical exercise and bone mineral density in postmenopausal women aged 75 years and older. The physical activity level, BMD, health habits and drug treatments. The physical activity level was classified by type of exercise, intensity of exercise and duration of exercise to prevent bone loss. In this study, moderate exercise such as housework, walking, bicycling and intense – exercise such as tennis and swimming performed the physical activity level. The duration was classified by hours by hours. To determine the relationship between the physical activity and BMD, linear regression analysis was used. To determine the intensity of exercise and BMD, multiple regression analysis was used. The study found that the greater in the physical activities, the greater the positive results on BMD (Muri et al.,2013)

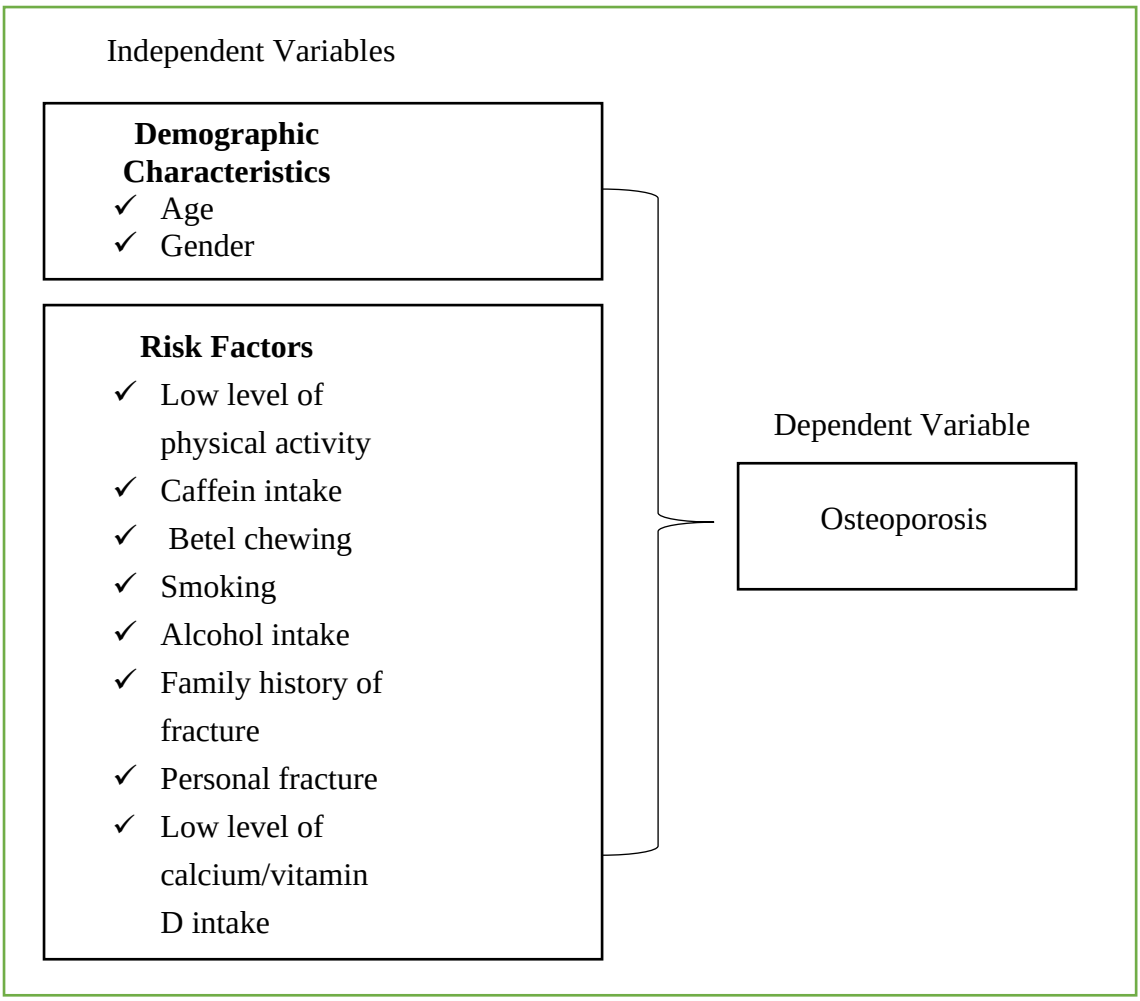
The study aimed to identify the effect of a prevention program based on health belief model on osteoporosis among women. The study focused on 120 patients under the health centers in Fasa City, Fars Province, Iran that selected in 2014. Health Belief Model (HBM) constructs was used to measure nutrition and walking performance for

prevention of osteoporosis before, immediately after the intervention and six months later. Data were analyzed by using chi-square test, independent t-test, and Repeated Measures ANOVA at significance level of 0.05. Immediately and six months after the intervention, the study showed a significant increase in the knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, internal cues to action, nutrition and walking performance compared to the control group. Six months after the intervention, the value of lumbar spine BMD T-Score in the case group increased to 0.127, while in the control group it reduced to -0.043. The value of the Hip BMD T-Score in the intervention group increased to 0.125 but it decreased to -0.028 in the control group. This study showed the effectiveness of knowledge, walking and diet on bone mass by HBM model for the osteoporosis prevention (Khani et al., 2015)

2.5 Conceptual Framework

The conceptual framework presents a description of the variables that are included in the model to explore the factors affecting the prevalence of osteoporosis. This study focuses on the demographic and risk factors characteristics of the prevalence of osteoporosis. Age, gender, low level of physical activity, daily caffein intake, excessive betel chewing, smoking, alcohol intake, family history of fracture, personal fracture and low level of calcium/vitamin D intake are used as independent variable and the prevalence rate of osteoporosis as dependent variable.

Figure (2.2) Conceptual Framework of Osteoporosis



Source: Own complication (2022)

CHAPTER III
RESEARCH METHODOLOGY

In this chapter, the theoretical background of the statistical techniques used by correlation analysis because of the association between risk factors and osteoporosis, ANOVA model and some measures of binary logistic model are presented.

3.1 Source of Data

Troikaa Pharmaceutical Co., Ltd conducted a survey in November 2021 to October 2022. The survey data were used to analyze for this study. The objective of survey is to get data on the demographic characteristics and daily life styles and health care behavior and daily exercises. In this survey, the target population is patients at out - patients departments of rehabilitation wards of North – Oakkalar General Hospital, East Yangon General Hospital and Yangon Orthopedic Hospital in Yangon. Sample design was the two-stage random sampling method. In the first stage, three general hospital from six general hospital were chosen by using random sampling method. In the second stage, 20% of the sample from Yangon Orthopedic Hospital, 20% of the sample from North-Oakkalar General Hospital and 20% of the sample from East Yangon General Hospital were chosen. Number of patients in the selected hospital were selected by using random sampling with proportional probability to size. To determine the require sample size, Krejcie and Morgan's (1970) formula adjusted to Cochran's method for qualitative variables was used.

The required sample size was;

$$n_0 = \frac{pq\ (z)^2}{e^2} = \frac{0.5\ \times 0.5\ \times (1.96)^2}{0.5^2} = 385$$

Where,

n_0 = Sample size

z = 1.96 for 5% significance level

e = 50% (acceptable margin of error for proportion)

Cochran's (1977) correction formula was used to calculate the final sample size. Therefore, the final sample size becomes;

$$n = \frac{n_0}{1 + \frac{n0}{N}}$$

$$n = \frac{385}{1 + \frac{385}{1600}} = \frac{385}{1.240625} = 310$$

In many education and social research surveys, the response rates are normally well below 100%. If the patients' response rate was assumed 97%, the minimum sample size was

$$n = \frac{310}{0.97} = 319.58 \cong 320$$

Therefore, the required minimum sample size was 320 patients. Proportional allocation of sample size at least for each hospital was shown in Table (3.1).

Table (3.1) Number of Patients in each Hospital in Yangon

Selected Hospital	Selected Department	Number of Patients	Number of Sample Patients
Yangon Orthopedic Hospital	Orthopedic Department	500	100
North-Oakkalar General Hospital	Rehabilitation Department	300	60
East Yangon General Hospital	Rehabilitation Department	800	160
	Total	**1600**	**320**

Source: Troikaa Pharmaceuticals Co., Ltd (Nov, 21- Oct ,22)

3.2 Chi-square Test of Independence

The Chi-square test of independence is a statistical hypothesis test used to determine whether two categorical or nominal variables are likely to be related or not. The frequency of each category for one nominal variable is compared across the categories of the second nominal variable. The data can be displayed in a contingency table where each row represents a category for one variable and each column represents a category for the other variable.

Before calculation the test statistic, it is need to find the expected counts.

$$E_{ij} = \frac{R_i \times C_j}{N}$$

The formula is for an *i & j* contingency table. That is a table with *i* rows and *j* columns. For example, E_{ij} is the expected count for the cell in the first row and first column. The formula shows R_i as the row total for the ith row, and C_j as the column total for the jth row. The overall sample size is *N*.

Then, to calculate the test statistic $\chi 2$ test,

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (3.1)$$

In the formula above, O_{ij} shows the Observed count for the *ij*- th combination and E_{ij} shows the Expected count for the combination. The statistic follows χ^2 distribution with (r-1) (c-1) degree of freedom, so that p value can be calculated.

3.3 Binary Logistic Regression Model

The logistic regression model was used in this study because dependent variable has binary responses. The following present the theoretical background of logistic regression is used the outcome is a proportion. Logistical regression model, it's widely used in social, financial, marketing and medical statistics for such applications as credit-scoring and predicting disease severity and progression to inform health care management. Logistic regression is very similar to ordinary regression, but the Y variable is logistic (p) instead of p itself. We can interpret the coefficients in logistic regression as an increase in the log-odds of the dependent variable, for each unit change of the X variable. When the coefficients are not too large, the increase in the log-odds can be interpreted as the proportional increase per unit change of X. In logistic regression start with tables of Y variable with each of X variables, grouping the X's if necessary. Be sure to calculate the per cents for dependent variable. When all variables are included together in a logistic regression, the factors are adjusted for each other.

The dependent variable in logistic regression is usually dichotomous, that is the dependent variable can take value with a probability of success, P(Y=1) =θ, or the value 0 with probability of failure P (Y=θ) = 1- θ. This type of variable is called a binary variable.

The binary logistic regression model is

$$\gamma = E(Y_i) + \varepsilon_i$$

Since the distribution of the error term ε_i depends on the Bernoulli distribution of the response Y_i. The expected value of each Y_i is

$$E(Y_i) = \pi_i = \frac{\exp(\beta_0 + \beta_1 + \chi_1 + \ldots\ldots\ldots\ldots \beta_i\chi_i)}{1 + \exp(\beta_0 + \beta_1 + \chi_1 + \cdots \ldots\ldots \beta_i\chi_i)}$$

Where $E(Y_i)$ = conditional mean given the value of X_i

β_o = the constant of the equation

β_i = the coefficient of the predictor variable i

An alternative form of the logistic regression equation is:

$$\log[\pi(\chi)] = log\left[\frac{\pi_i}{1-\pi_i}\right] = \beta_0 + \beta_1 + \chi_1 + \ldots \beta_1\chi_i \quad (3.2)$$

In binary logistic model the problem of multicollinearity will occur when the independent variables are correlated with each other.

3.3.1 Assumptions of Binary logistic Regression Model

Binary logistic regression does not make many of the key assumptions of linear regression and general linear models that are based on ordinary least squares algorithms – particularly regarding linearity, normality, homoscedasticity, and measurement level. The assumptions of binary logistic regression model are as follow;

(1) Binary logistic regression does not require a linear relationship between the dependent and independent variables
(2) The dependent variable in logistic regression needs to be binary and it cannot be measured on an interval or ratio scale.
(3) The error terms (residuals) do not need to be normally distributed
(4) Homoscedasticity is not required
(5) There is no multicollinearity among the independent variables
(6) Binary logistic regression typically requires a large sample size

3.3.2 Goodness of Fit in Logistic Regression Model

The Hosmer-Lemeshow Test

Goodness-of-fit statistic assess the fit of a logistic model against actual outcomes. The inferential goodness-of-fit test for logistic model is the Hosmer-Lemeshow (H-L) test.

The null hypothesis is that the observed and expected proportions are the same across all doses. The alternative hypothesis is that the observed and expected proportions are not the same. The H-L statistic, $\hat{C}$ is as follows:

$$\hat{C} = \Sigma_{k=1}^{g} \frac{(o_k - n'_k \bar{\pi}_k)^2}{n'_k \bar{\pi}_k (1-\bar{\pi}_k)} \quad (3.3)$$

Where n'_k is the total number of subjects in k[th] group, C_k denotes the number of covariate patterns in the k[th] decile,

$$O_k = \sum_{j=1}^{ch} yi$$

is the number of responses among the C_k covariate patterns, and the average estimated probability is

$$\bar{\pi}_k = \sum_{j=1}^{ch} \frac{m_j \pi_j}{n_{k'}}$$

A large value of Chi-square (with small p-value < 0.05) indicates poor fit and small Chi-squared values (with large p-value closer to 1) indicate a good logistic regression model fit.

3.3.3 Omnibus Test

Omnibus tests are a kind of statistical test. They test whether the explained variance in a set of data is significantly greater than unexplained variance, overall. In addition, Omnibus test as a general name refers to an overall or a global test. Other names include F-test or Chi-Square test. Omnibus test as a statistical test is implemented on an overall hypothesis that regarding coefficients $\beta_1 = \beta_2 = \cdots = \beta_k$ vs. at least one pair $\beta_j \neq \beta_j$, in Multiple linear regression or in Logistic regression. Usually, it tests more than two parameters of the same type and its role is to fins general significance of at least one of the parameters involved. Omnibus test commonly refers to either one of those statistical tests:

- ANOVA F test to test significance between all factor means and/or between their variance's equality in Analysis of Variance procedure
- The Omnibus multivariate F test in ANOVA with repeated measures
- F test for equality/inequality of the regression coefficients in Multiple Regression

- Chi-Square test for exploring significance differences between blocks of independent explanatory variables or their coefficients in a logistic regression.

3.3.4 Likelihood Ratio Test

The likelihood ratio test is performed to see where the inclusion of an explanatory variable in a model tells us more about the outcome variable than a model that does not include that variable.

The likelihood ratio test is based on likelihood function. The likelihood ratio is

$$\frac{L(R)}{L(F)}$$

Where L(F) = the likelihood value for full model, L(R) = the likelihood value for the reduced model. The actual test statistic for likelihood radio test is denoted by χ^2.

$$\chi^2 = -2\log_e\left[\frac{L(R)}{L(F)}\right] = 2\log_e(L(F) - 2\log_e L(R)) \quad (3.4)$$

3.3.5 Cox and Snell R-Square

Cox and Snell's defines R square as a transformation of the statistic of -2ln [L ($M_{intercept}$) /L (M_{full})] that is used to determine the convergence of a logistic regression. The ratio of the likelihoods reflects the improvement of the full model over the intercept model (the smaller the ratio, the greater the improvement). The Cox and the Snell R- square is

$$R^2 = 1 - [\frac{L(M_{intercept})}{L(M_{Full})}]^{2/N} \quad (3.5)$$

L(M) is the conditional probability of the dependent variable given the independent variable. If there are N observations in the dataset, then L(M) is the product of N such probabilities. Thus, taking the n^{th} root of the product L(M) provides an estimate of the likelihood of each Y value. Cox and Snell's pseudo - R-square has a maximum value that is not 1. If the full model predicts the outcomes perfectly and has a likelihood of 1, Cox and Snell's R-Square will be (1- $L(M_{intercept})^{2/N}$, which is less than one.

3.3.6 Nagelkerke R- Square

If adjust Cox and Snell's so that the range of possiblr values extends to 1. To achieve this, the Cox and Snell's R square is divided by its maximum possible value, 1- $L(M_{intercept})^{2/N}$.

$$R^2 = \frac{1-[\frac{L(M_{intercept})}{L(M_{full})}]^{2}/_{N}}{1-(M_{intercept})^{2}/_{N}} \quad (3.6)$$

Then, if the full model perfectly predicts the outcome and has a likelihood of 1, Nagelkerke R - Square will equal one.

3.4 Statistical Significance of Individual Logistic Regression Coefficients

The logistic regression coefficient for the i^{th} independent variable shows the change in the predicted log odds of having an outcome for one-unit change in the i^{th} independent variable, all constant. That is, if the i^{th} independent variable is changed 1 unit while all of the other predictors are held constant, log odds of outcome is expected to change b_i units. There are a couple of different tests designed to assess the significance of an independent variable in logistic regression, the likelihood ratio test and the Wald statistic (Menard,2001).

3.4.1 Wald Statistic

The Wald statistic is the ratio of the square of the regression coefficient to the square of the standard error of the coefficient. The Wald statistic is asymptotically distributed as a Chi-square distribution.

$$W_j = \frac{\beta_j^2}{SE_{\beta_j}^2} \quad (3.7)$$

Each Wald statistic is compared with a Chi-square with 1 degree of freedom. Wald statistics are easy to calculate but their reliability is questionable.

3.4.2 Odds Ratios with 95% Confidence Interval

The 95% CI is used to estimate the precision of the OR. A large CI indicates a low level of precision of the OR, whereas a small CI indicates a higher precision of the OR. An approximate confidence interval for the population log odds ratio is

$$95\%\ CI\ for\ the\ In(OR) = In(OR) \pm 1.96 \times \{SE\ In\ (OR)\} \quad (3.8)$$

Where ℓn(OR) is the sample log odds ratio, and SE $\ell n(OR)$ is the standard error of the log odds ratio (Morris & Gardner, 1988). Taking the antilog, the 95% confidence interval for the odds ratio can be obtained as follows:

$$95\%\ CI\ for\ OR = e^{In\ (OR) \pm 1.96 \times \{SE\ In\ )OR)\}} \quad (3.9)$$

3.5 Description of Variables

This study used a binary logistic model because of the outcome dependent variable, osteoporosis has binary responses. The explanatory independent variables are age, gender, low body weight (≤ 58 kg/ 128 lb), daily alcohol intake, caffein intake, tobacco use, smoking, gonadal hormone deficiency, immobilization and inadequate activity, family history of fracture, personal history of fracture and low Calcium or Vitamin D intake.

Y = Osteoporosis
= 1, if getting osteoporosis
= 0, if not getting osteoporosis

X_1 = Age
= 1, age (≥ 45 years)
= 0, age (< 45 years)

X_2 = Gender
= 1, male
= 0, female

X_3 = Low level of physical activity
=1, yes
=0, no

X_4 = Low Body Weight (≤ 58 kg/ 128 lb)
= 1, yes
= 0, no

X_5 = Alcohol intake
= 1, yes
= 0, no

X_6 = Caffein Intake

= 1, yes

= 0, no

X_7 = Betel chewing

= 1, yes

= 0, no

X_8 = Smoking

= 1, yes

= 0, no

X_9 = Gonadal Hormone Deficiency

= 1, yes

= 0, no

X_{10} = Immobilization and inadequate activity

= 1, yes

= 0, no

X_{11} = Family History of fracture

= 1, yes

= 0, no

X_{12} = Personal History of fracture

= 1, yes

= 0, no

X_{13} = Low Calcium or Vitamin D intake

= 1, yes

= 0, no

CHAPTER IV
ANALYSIS OF FACTORS INFLUENCING ON OSTEOPOROSIS

This chapter presents the results of the descriptive statistics, bivariate analysis and logistic regression analysis. Descriptive statistics was used to analyze the demographic characteristics and risk factors and daily life style of getting osteoporosis in Yangon Township. Bivariate analysis was used to investigate the association between osteoporosis and risk factors. Logistic regression analysis was applied to explore the factors affecting the osteoporosis.

4.1 Demographic Characteristics and Risk Factors of Osteoporosis

The descriptive analysis presents the demographic and daily life style and health care situation of respondents by the getting osteoporosis in Yangon Township are presented in this section. Table (4.1) shows the prevalence rates of osteoporosis.

Table (4.1) The Osteoporosis Prevalence Rates in Yangon

Disease Name	Frequency	Percentage (%)
Osteoporosis	109	34.1
No osteoporosis	211	65.9

Source: Troikaa Pharmaceuticals Co., Ltd (Nov, 21- Oct, 22)

According to the Table (4.1), there are 109 respondents (34.1%) who are getting osteoporosis, but 211 respondents (65.9%) are not getting osteoporosis**.** The following Tables from (4.2) to (4.14) show the distributions of demographic factors and risk factors for respondents who getting osteoporosis.

Age

Table (4.2) also presents the distribution of age for respondents who are getting osteoporosis. Age can be classified into ≤45 years of age and > 45 years of age.

Table (4.2) Distribution of Age

Age	Frequency	Percentage (%)
≥45 years of age	99	90.8
< 45 years of age	10	9.2
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

According to the Table (4.2), 90.8% of the respondents who getting osteoporosis are at least 45 years of age and the rest 9.2% are less than 45 years of age. Based on the result, age is directly associated with the prevalence of osteoporosis. Therefore, the older the age, the higher the prevalence rates of osteoporosis in the people.

Gender

Table (4.3) shows the gender group of respondents.

Table (4.3) Distribution of Gender

Gender	Frequency	Percentage (%)
Male	30	27.5
Female	79	72.5
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

Based on the results, 72.5% of the respondents who getting osteoporosis are female group and the rest 27.5% of the respondents are male group because naturally female who have menopause stage have lower estrogen hormone that is the key regulator of bone metabolism in both male and female. Therefore, estrogen deficiency is the most important cause of osteoporosis in female after menopause.

Low Level of Physical Activity

Table (4.4) shows the distribution of low level of physical activity in the prevalence rates of osteoporosis.

Table (4.4) Distribution of Low Level of Physical Activity

Low Level of Physical Activity	Frequency	Percentage (%)
Yes	58	53.2
No	51	46.8
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

Based on the results of Table (4.4), the low level of physical activity has 53.2% of the prevalence rate of osteoporosis and the rest 46.8% have no. Therefore, physical activity is inversely associated with the prevalence of osteoporosis. The lower the physical activity level, the higher the prevalence rate of osteoporosis among men and women.

Low Body Weight (≤128 lb)

Table (4.5) shows the distribution of low body weight (≤128 lb) in the prevalence rates of osteoporosis.

Table (4.5) Distribution of Low Body Weight (≤ 128 lb)

Low body weight (≤ 128 lb)	Frequency	Percentage (%)
Yes	48	44
No	61	56
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

According to the Table (4.5), the people who have the low body weight (≤ 128 lb) have 44% of the prevalence rate of osteoporosis and followed by high body weight was 56%. Low Body weight increases fracture risk, possibly because low body weight is associated with low bone mineral density (BMD), less soft tissue, and muscle weakness.

Caffein Intake

Table (4.6) shows the distribution of daily caffein intake in the prevalence rates of osteoporosis.

Table (4.6) Distribution of Caffein Intake

Caffein intake	Frequency	Percentage (%)
Yes	79	72.5
No	30	27.5
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

Based on the Table (4.6), the daily caffein intake has 72.5% of the prevalence rate of osteoporosis than people who have no daily caffein intake. The result of daily intake of caffein was directly associated with the prevalence of osteoporosis among men and women because higher intake of caffein can double the amount of calcium lost in urine and calcium is the principal element of the bone mineral density and increases bone re-modelling.

Alcohol Intake

Table (4.7) shows the distribution of alcohol intake in the prevalence rates of osteoporosis.

Table (4.7) Distribution of Alcohol Intake

Alcohol intake	Frequency	Percentage (%)
Yes	4	4
No	105	96
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

Based on the results of Table (4.7), the percentage of alcohol intake in osteoporosis is 4% and the percentage of no alcohol intake is 96%.

Betel Chewing

Table (4.8) shows the distribution of betel chewing in the prevalence rates of osteoporosis.

Table (4.8) Distribution of Betel Chewing

Betel chewing	Frequency	Percentage (%)
Yes	10	9
No	99	91
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

In the case of betel chewing, the percentage of the betel chewing in osteoporosis is 9% and the percentage of the no betel chewing in osteoporosis is 91%.

Smoking

Table (4.9) shows the distribution of smoking in the prevalence rates of osteoporosis.

Table (4.9) Distribution of Smoking

Smoking	Frequency	Percentage (%)
Yes	5	5
No	104	95
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

In the use of smoking, the percentage of smoking in osteoporosis is 5% and the percentage of the no smoking in osteoporosis is 95%.

Gonadal Hormone Deficiency

Table (4.10) shows the distribution of gonadal hormone deficiency in the prevalence rates of osteoporosis.

Table (4.10) Distribution of Gonadal Hormone Deficiency

Gonadal Hormone Deficiency	Frequency	Percentage (%)
Yes	2	2
No	107	98
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

Furthermore, the distribution of gonadal hormone deficiency in osteoporosis is 2% and the distribution of no gonadal hormone deficiency in osteoporosis is 98%.

Immobilization and Inadequate Activity

Table (4.11) shows the distribution of immobilization and inadequate activity in the prevalence rates of osteoporosis.

Table (4.11) Distribution of Immobilization and Inadequate Activity

Immobilization and Inadequate Activity	Frequency	Percentage (%)
Yes	4	4
No	105	96
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

According to the Table (4.11) results, the percentage of people who have immobilization and inadequate activity have 4% and the people with non-immobilization and inadequate activity have 96%.

Family History of Fracture

Table (4.12) shows the distribution of family history of fracture in the prevalence rates of osteoporosis.

Table (4.12) Distribution of Family History of Fracture

Family History of Fracture	Frequency	Percentage (%)
Yes	16	15
No	93	85
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

According to the Table (4.12) results, the people who have family history of fracture have 15% of the prevalence rate of osteoporosis and the people who have no family history of fracture have 85%.

Personal fracture

Table (4.13) shows the distribution of personal fracture in the prevalence rates of osteoporosis.

Table (4.13) Distribution of Personal Fracture

Personal Fracture	Frequency	Percentage (%)
Yes	23	21
No	86	79
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

And then the percentage of people who have personal history of fracture is 21% and the percentage of people who have no personal history of fracture is 79%.

Low level of calcium/vitamin D intake

Table (4.14) shows the distribution of low level of calcium/vitamin D intake in the prevalence rates of osteoporosis.

Table (4.14) Distribution of Low Level of Calcium/vitamin D

Low Level of Calcium / Vitamin D Intake	Frequency	Percentage (%)
Yes	107	98
No	2	2
Total	109	100

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

Based on the results of Table (4.14), people who have low level of calcium/vitamin D intake have 98% of the prevalence rate of osteoporosis and the people who have no low level of calcium/vitamin D intake have 2%. Therefore, the low level of calcium/vitamin D intake and the prevalence of osteoporosis was directly associated because low calcium intake contributes to diminished bone density, early bone loss and an increased risk of fractures. Low vitamin D intake decreases the absorption of calcium and phosphorus from the body and then both calcium and phosphorus are the important elements in bone formation. That's why the lower level of calcium/vitamin D intake, the higher the prevalence of osteoporosis among men and women.

Overall, age, gender, low level of physical activity, daily caffein intake and low level of calcium/vitamin D was directly associated with the prevalence rates of osteoporosis.

4.2 Association between Osteoporosis and Risk Factors

Bivariate analysis presents the relationship between osteoporosis and risk factors such as age, gender, low level of physical activity, low body weight (≤128 lb), caffein intake, alcohol intake, tobacco use, smoking, gonadal hormone deficiency, family history of fracture, personal history of fracture and low level of calcium/vitamin D intake. Table (4.15) shows that the association between osteoporosis and risk factors.

Table (4.15) The Association between Osteoporosis and Risk Factors

No.	Risk Factors	Chi-square	P-value
1	Age	15.603	0.000***
2	Gender	5.847	0.016**
3	Low level of physical activity	1.138	0.286
4	Low body weight (≤128 lb)	4.710	0.030**
5	Alcohol intake	2.894	0.089
6	Caffein Intake	1.648	0.199
7	Tobacco use	1.839	0.175
8	Smoking	6.609	0.010**
9	Gonadal hormone deficiency	0.096	0.757
10	Immobilization and inadequate activity	2.894	0.089
11	Family history of fracture	0.219	0.640
12	Personal history of fracture	10.166	0.001***
13	Low level of calcium/vitamin D intake	8.201	0.004***

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

** Indicates statistical significance at the 5%

***Indicates statistical significance at the 1%

According to the Table (4.2) results, it is showed that the association with age, personal history of fracture, low level of calcium/vitamin D intake and osteoporosis has statistical impact of osteoporosis at 1% significance level (P-value= < 0.01). The prevalence of osteoporosis has significant association with age, personal history of fracture and low level of calcium/vitamin D intake.

Based on the results of Table (4.2), it is found that the prevalence of osteoporosis has related to gender group, low body weight (≤128 lb) and smoking at 5% significant level (P-value=<0.05).

According to the results of Table (4.2), Low level of physical activity, alcohol intake, caffein intake, tobacco use, gonadal hormone deficiency, immobilization and inadequate activity and family history of fracture have no significant association with the prevalence of osteoporosis at 10% significant level.

4.3 Analyzing the Effect of Osteoporosis and Risk Factors

This section described the association between risk factors (age, gender, low level of physical activity, low body weight (≤128 lb), caffein intake, alcohol intake, betel chewing, smoking, gonadal hormone deficiency, family history of fracture, personal history of fracture and low level of calcium/vitamin D intake) and osteoporosis by using logistic regression model.

4.3.1 Model Fitting Information for Logistic Regression Model

The study tests the model fitting criteria with Omnibus tests of model coefficients, Hosmer and Lemeshow (H-L) tests, -2 log likekihood, Cox & Snell R^2 and Nagelkerke R^2. The summary results of logistic regression model are shown in Table (4.16).

Table (4.16) Model Fitting Information for Logistic Regression Model

Model Fitting Criteria	χ^2 Value	d.f	P-value
Omnibus Test of Model Coefficient	58.647	13	0.000***
Hosmer and Lemeshow (H-L) Tests	7.349	7	0.393
-2 Log Likelihood	351.881		
Cox & Snell R^2	0.167		
Nagelkerke R^2	0.232		

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

***Indicates statistical significance at the 1%

According to the Omnibus test of model coefficient gives a Chi-square of 58.647 with d.f 13, significant beyond 0.000. It has concluded that the model for the risk factors such as (age, gender, low level of physical activity, low body weight (≤128 lb), caffein intake, alcohol intake, betel chewing, smoking, gonadal hormone deficiency, family history of fracture, personal history of fracture and low level of calcium/vitamin D intake) of osteoporosis are significant. There is no evidence of lack of fit base on the H-L statistic (χ^2 = 7.349, d.f = 7, P-value = 0.393).Since it is can be concluded that the data fits the model well. -2 Log Likelihood statistic is 351.881, it can be said that the existence of a relationship between the independent variables and dependent variable is supported.

And then, the parameters estimate of binary logistic regression model for osteoporosis are showed in the Table (4.17).

Table (4.17) Parameters Estimate of Binary Logistic Regression Model for Osteoporosis

Independent Variables	Coefficients	Odds ratio	Standard Error	P - Value	95% Confidence Interval	
	B				Lower	Upper
Constant	-5.024	0.007	1.201	0.000		
Age ≥ 45 years < 45 years (ref)	1.685***	5.395	0.410	0.000	2.418	12.038
Gender Female Male (ref)	0.784**	0.456	0.360	0.030	0.225	0.925
Low level of physical activity Yes No(ref)	0.218	1.244	0.264	0.408	0.742	2.085
Low body weight (≤ 128 lb) Yes No(ref)	0.642**	1.900	0.275	0.020	1.108	3.258
Alcohol Intake Yes No(ref)	-0.185	0.831	1.166	0.874	0.085	8.160
Caffein Intake Yes No(ref)	0.401	1.494	0.292	0.170	0.842	2.650
Betel Chewing Yes No(ref)	0.037	1.038	0.600	0.950	0.320	3.364
Smoking Yes No(ref)	2.257	9.556	1.261	0.073	0.808	113.068
Gonadal Hormone Deficiency Yes No(ref)	-0.965	0.381	1.178	0.413	0.038	3.832

Table (4.17) Parameters Estimate of Binary Logistic Regression Model for Osteoporosis (Continued)

Independent Variables	Coefficients	Odds ratio	Standard Error	P - Value	95% Confidence Interval	
	B				Lower	Upper
Immobilization and inadequate activity Yes No(ref)	0.126	1.134	1.142	0.912	0.121	10.632
Family History of fracture Yes No(ref)	0.259	1.295	0.383	0.500	0.611	2.745
Personal Fracture Yes No(ref)	1.016***	2.763	0.388	0.009	1.292	5.906
Low calcium/vitamin D intake Yes No(ref)	1.957**	7.080	0.773	0.011	1.556	32.226

Source: Troikaa Pharmaceuticals Co., Ltd (Nov 21-Oct 22)

***Indicates statistical significance at the 1%

** Indicates statistical significance at the 5%

Based on the results of Table (4.17), risk factors such as age, gender, low body weight (≤ 128 lb), personal fracture and low level of calcium/vitamin D intake are positive and significant effect on osteoporosis but low level of physical activity, alcohol intake, caffein intake, betel chewing, smoking, gonadal hormone deficiency, immobilization and inadequate activity, family history of fracture have no significant effect on osteoporosis.

According to the Table (4.17), the coefficient of age group has positive effect on osteoporosis and it is statistically significant at 1% level. It is found that the age group (≥ 45years) are 5 times more likely to get osteoporosis than (< 45 years) age group (reference group). The 95% confidence interval suggests that the magnitude of the effect could be anywhere from 2.418 to 12.038- fold increasing in osteoporosis.

Regarding gender, the coefficient of female group has positive effect on osteoporosis and statistically significant on osteoporosis at 5% level. It is found that female have about 0.5 times more likely to get osteoporosis than male (reference group). The 95% confidence interval suggests that the magnitude of the effect could be anywhere from 0.225 to 0.925 - fold increasing in osteoporosis.

The coefficient of low body weight (≤ 128 lb) has positive effect on osteoporosis and it is statistically significant at 5% level. It is found that people who have low body weight (≤ 128 lb) have about 2 times more likely to get osteoporosis than people who have greater body weight than 128 lb. The 95% confidence interval suggests that the magnitude of the effect could be anywhere from 1.108 to 3.258 - fold increasing in osteoporosis.

Personal fracture has positive effect on osteoporosis and statistically significant at 1% level. It is found that people who had history of personal fracture have about 3 times more likely to get osteoporosis than people who did not have history of personal fracture. The 95% confidence interval suggests that the magnitude of the effect could be anywhere from 1.292 to 5.906 - fold increasing in osteoporosis.

The coefficient of low calcium/vitamin D intake has statistically significant and positive effect on osteoporosis at 1% level. It is found that people who have low calcium/vitamin D intake have about 8 times more likely to get osteoporosis than people who do not have low calcium/vitamin D intake. The 95% confidence interval suggests that the magnitude of the effect could be anywhere from 1.556 to 32.226 - fold increasing in osteoporosis.

CHAPTER V
CONCLUSION

This chapter describes findings, discussions, suggestions, recommendations and needs for further research.

5.1 Findings and Discussions

The main objective is to analyze the risk factors impact on the prevalence of osteoporosis in Yangon Township. There were 320 respondents in this study. According to the descriptive statistics, age, gender, low level of physical activity, daily caffein intake and low level of calcium/vitamin D was directly associated with the prevalence of osteoporosis. But low body weight (≤128 lb), alcohol intake, betel chewing, smoking, gonadal hormone deficiency, family history of fracture and personal fracture was inversely associated with the osteoporosis prevalence

Bivariate analysis presents the relationship between osteoporosis and risk factors such as age, gender, low level of physical activity, low body weight (≤128 lb), caffein intake, alcohol intake, tobacco use, smoking, gonadal hormone deficiency, family history of fracture, personal history of fracture and low level of calcium/vitamin D intake.

According to the logistic regression analysis, risk factors such as age, gender, low body weight (≤ 128 lb), personal fracture and low level of calcium/vitamin D intake are positive and significant effect on osteoporosis and low level of physical activity, alcohol intake, caffein intake, tobacco use, smoking, gonadal hormone deficiency, immobilization and inadequate activity, family history of fracture has no significant effect on osteoporosis.

This study determined the risk factors affecting on osteoporosis. Risk Factors such as age, gender, low body weight (≤128 lb), smoking, personal history of fracture and low level of calcium/vitamin D intake are influence on the prevalence of osteoporosis. This finding is in similar with other studies of Walden University (2016) revealed that the prevalence of osteoporosis or bone fracture is preventable through

engagement with several daily health behaviors, such as physical activity, calcium/vitamin D intake, regular check-up, and managing medications.

It was found that the low levels of calcium intake, physical activity were significant predictors of osteoporosis in this study. It is consistent with the results of Zeki et al., (2005) indicated that the low levels of dietary calcium intake, physical activity and longer duration of menopause are independent predictors of the risk of low bone density in Turkish women.

When compared with the results of Wright et al.'s (2014), the prevalence of osteoporosis and low bone mass among adults age 50 and older are positively associated. It was found that as people got older, the prevalence of osteoporosis increased as follows: age 50-59 was 6.8% (SE = .83); age 60-69 was 12.3% (SE = 1.44); age 70-79 was 25.7% (SE = 1.56); and age 80 and older was 34.9 % (SE = 2.44).

Furthermore, findings from (Moreira et al., 2014) is similar because moderate recreational activity has long been suggested to prevent osteoporosis. Engaging physical activity positively influences on preventing bone mineral density. The study stated that moderate to intensity exercise with a high speed during short intervals of time considering duration and intensity physical activities to improve muscle strength to prevent osteoporosis. For the physical activity analysis, moderate recreational activities such as walking, dancing, running, jumping, step climbing, gardening and even swimming. These types of exercise work directly on the bones in your legs, hips and lower spine to stimulate bone metabolism. People should engage in moderate to intensity exercises to prevent fractures.

5.2 Suggestions and Recommendations

The findings of this study have potential impact on positive social change at the individual, family, and community level as well as policy to improve health care of older who had ≥ 45 years of age. According to the study findings, demographic factors (age, gender, daily life-style behaviors, physical activity and calcium/vitamin D) are significantly associated with osteoporosis.

Potential positive social change implications at the individual level should be designed to increase awareness of osteoporosis among individuals. Promote awareness of appropriate calcium/vitamin D intake and moderate recreational activity levels and an individual's education, income, daily life style behaviors and age affecting

osteoporosis. An individual's behavior change should lead to improvement of education level and family finance, as well as a regular medical checkup.

Public health related to health promotion through osteoporosis education should be designed to assist family members with low socioeconomic status, such as low education and annual family income levels. At the community level, positive social change includes appropriate modifications of community supports through private or public organizations, non- or government-organizations, and negotiated partnerships. Within the community level, to easily access osteoporosis health education and resource availability, building sport parks with safety, and promoting weight bearing moderate recreational activity and calcium/vitamin D intake promotion would promote health of bone.

At the policy level, social change would include improving socioeconomic status (education and annual family income), promoting moderate recreational activity and calcium/vitamin D intake. An increase in socioeconomic status, moderate recreational activity and calcium/vitamin D supplement intake should promote bone health. This approach may decrease the burden of cost associated with short-term health care due to bone fractures, its related-bone health problems, and death affected by natural causes due to fractures of bones. Therefore, these study findings may aid public health policymakers to promote and implement effective behavioral interventions to prevent osteoporosis.

5.3 Needs for Further Study

The study recommends that more research should be carried out on the prevalence of osteoporosis and the research topics that would help in more intervention to other areas and regions in Myanmar. Data remain to be analyzed from the cross-sectional study and RCT on the balance of the subjects and then to analyze further the relationship between osteoporosis and the other demographic and risk factors and the other medical conditions. Therefore, government should also conduct additional health policy for osteoporosis and support for other studies.

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APPENDIX

STATISTICAL ANALYSIS OF RISK FACTORS OF OSTEOPOROSIS IN YANGON

1. Information of Respondent

Patient Record Card for Osteoporosis Camp

Date -

Name ----------

Age ----------

Sex ----------

Residence ----------

Risk Factors of Osteoporosis

1. Menopause before 45 years of age Yes / No
2. Low level of Physical Activity Yes / No
3. Increased Age (= 50 years) Yes / No
4. Low body weight (< 58 kg/128 lb) Yes / No
5. Alcohol Intake Yes / No
6. Caffein Intake Yes / No
7. Tobacco Use Yes / No
8. Smoking Yes / No
9. Gonadal Hormone Deficiency Yes / No
10. Immobilization and inadequate Activity Yes /No
11. Family History of Osteoporotic Fracture Yes / No
12. Personal History of Fracture Yes / No
13. Low Calcium or Vitamin D intake Yes / No

Screening

T – score ---------- Z- score ----------

Result ----------

Bifosa 35/70 *Troikaa* *Troyvit D3*

Patient Record Card for Osteoporosis Camp

Date -

Name ----------

Age ----------

Sex ----------

Residence ----------

Risk Factors of Osteoporosis

1. Menopause before 45 years of age Yes / No
2. Low level of Physical Activity Yes / No
3. Increased Age (= 50 years) Yes/ No
4. Low body weight (< 58 kg/128 lb) Yes / No
5. Alcohol Intake Yes / No
6. Caffein Intake Yes / No
7. Tobacco Use Yes / No
8. Smoking Yes / No
9. Gonadal Hormone Deficiency Yes / No
10. Immobilization and inadequate Activity Yes /No
11. Family History of Osteoporotic Fracture Yes / No
12. Personal History of Fracture Yes / No
13. Low Calcium or Vitamin D intake Yes / No

Screening

T – score ---------- Z- score ----------

Result ----------

Bifosa 35/70 *Troikaa* *Troyvit D3*

2. Statistical analysis outputs

Crosstabs

Result * Age_Group Crosstabulation

Count

		Age_Group		Total
		1.00	2.00	
Result	.0	60	151	211
	1.0	10	99	109
Total		70	250	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.603[a]	1	.000		
Continuity Correction[b]	14.496	1	.000		
Likelihood Ratio	17.433	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	15.554	1	.000		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.84.

b. Computed only for a 2x2 table

Result * Gender Crosstabulation

Count

		Gender		Total
		Male	Female	
Result	.0	34	177	211
	1.0	30	79	109
Total		64	256	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.847[a]	1	.016		
Continuity Correction[b]	5.156	1	.023		
Likelihood Ratio	5.654	1	.017		
Fisher's Exact Test				.018	.012
Linear-by-Linear Association	5.829	1	.016		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.80.

b. Computed only for a 2x2 table

Result * Low level of physical activity Crosstabulation

Count

		Low level of physical activity		Total
		.0	1.0	
Result	.0	112	99	211
	1.0	51	58	109
Total		163	157	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.138[a]	1	.286		
Continuity Correction[b]	.901	1	.343		
Likelihood Ratio	1.139	1	.286		
Fisher's Exact Test				.291	.171
Linear-by-Linear Association	1.135	1	.287		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 53.48.

b. Computed only for a 2x2 table

Result * Low body weight (≤128 lb) Crosstabulation

Count

		Low body weight(≤128 lb)		Total
		.0	1.0	
Result	.0	144	67	211
	1.0	61	48	109
Total		205	115	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.710[a]	1	.030		
Continuity Correction[b]	4.192	1	.041		
Likelihood Ratio	4.656	1	.031		
Fisher's Exact Test				.037	.021
Linear-by-Linear Association	4.695	1	.030		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 39.17.

b. Computed only for a 2x2 table

Result * Alcohol Intake Crosstabulation

Count

		Alcohol Intake		Total
		.0	1.0	
Result	.0	209	2	211
	1.0	105	4	109
Total		314	6	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.894[a]	1	.089		
Continuity Correction[b]	1.604	1	.205		
Likelihood Ratio	2.698	1	.100		
Fisher's Exact Test				.186	.105
Linear-by-Linear Association	2.885	1	.089		
N of Valid Cases	320				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.04.

b. Computed only for a 2x2 table

Result * Caffein Intake Crosstabulation

Count

		Caffein Intake		Total
		.0	1.0	
Result	.0	73	138	211
	1.0	30	79	109
Total		103	217	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.648[a]	1	.199		
Continuity Correction[b]	1.340	1	.247		
Likelihood Ratio	1.672	1	.196		
Fisher's Exact Test				.209	.123
Linear-by-Linear Association	1.643	1	.200		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 35.08.

b. Computed only for a 2x2 table

Result * Tobacco Use Crosstabulation

Count

		Tobacco Use		Total
		.0	1.0	
Result	.0	200	11	211
	1.0	99	10	109
Total		299	21	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.839[a]	1	.175		
Continuity Correction[b]	1.250	1	.264		
Likelihood Ratio	1.758	1	.185		
Fisher's Exact Test				.233	.133
Linear-by-Linear Association	1.833	1	.176		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.15.

b. Computed only for a 2x2 table

Result * Smoking Crosstabulation

Count

		Smoking		Total
		.0	1.0	
Result	.0	210	1	211
	1.0	104	5	109
Total		314	6	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.609[a]	1	.010		
Continuity Correction[b]	4.563	1	.033		
Likelihood Ratio	6.320	1	.012		
Fisher's Exact Test				.019	.019
Linear-by-Linear Association	6.588	1	.010		
N of Valid Cases	320				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.04.

b. Computed only for a 2x2 table

Result * Gonadal Hormone Deficiency Crosstabulation

Count

		Gonadal Hormone Deficiency		Total
		.0	1.0	
Result	.0	206	5	211
	1.0	107	2	109
Total		313	7	320

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.096[a]	1	.757		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.099	1	.753		
Fisher's Exact Test				1.000	.554
Linear-by-Linear Association	.096	1	.757		
N of Valid Cases	320				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.38.

b. Computed only for a 2x2 table

Result * Immobilization and inadequate activity

Crosstabulation

Count

		Immobilization and inadequate activity		Total
		.0	1.0	
Result	.0	209	2	211
	1.0	105	4	109
Total		314	6	320

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.894[a]	1	.089		
Continuity Correction[b]	1.604	1	.205		
Likelihood Ratio	2.698	1	.100		
Fisher's Exact Test				.186	.105
Linear-by-Linear Association	2.885	1	.089		
N of Valid Cases	320				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.04.

b. Computed only for a 2x2 table

Result * Family History of fracture Crosstabulation

Count

		Family History of Fracture		Total
		.0	1.0	
Result	.0	184	27	211
	1.0	93	16	109
Total		277	43	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.219[a]	1	.640		
Continuity Correction[b]	.087	1	.768		
Likelihood Ratio	.216	1	.642		
Fisher's Exact Test				.730	.379
Linear-by-Linear Association	.218	1	.640		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.65.

b. Computed only for a 2x2 table

Result * Personal Fracture Crosstabulation

Count

		Personal Fracture		Total
		.0	1.0	
Result	.0	193	18	211
	1.0	86	23	109
Total		279	41	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.166[a]	1	.001		
Continuity Correction[b]	9.072	1	.003		
Likelihood Ratio	9.631	1	.002		
Fisher's Exact Test				.002	.002
Linear-by-Linear Association	10.134	1	.001		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.97.

b. Computed only for a 2x2 table

Result * Low Calcium or Vitamin D intake Crosstabulation

Count

		Low Calcium or Vitamin D intake		Total
		.0	1.0	
Result	.0	23	188	211
	1.0	2	107	109
Total		25	295	320

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.201[a]	1	.004		
Continuity Correction[b]	6.991	1	.008		
Likelihood Ratio	10.161	1	.001		
Fisher's Exact Test				.004	.002
Linear-by-Linear Association	8.176	1	.004		
N of Valid Cases	320				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.52.

b. Computed only for a 2x2 table

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Result * T-score	320	100.0%	0	0.0%	320	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	314.064[a]	176	.000
Likelihood Ratio	402.889	176	.000
Linear-by-Linear Association	195.210	1	.000
N of Valid Cases	320		

a. 352 cells (99.4%) have expected count less than 5. The minimum expected count is .34.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Result * Z-score	320	100.0%	0	0.0%	320	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	281.561[a]	177	.000
Likelihood Ratio	361.130	177	.000
Linear-by-Linear Association	133.481	1	.000
N of Valid Cases	320		

a. 354 cells (99.4%) have expected count less than 5. The minimum expected count is .34.

3. Logistic Regression Outputs

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	58.647	13	.000
	Block	58.647	13	.000
	Model	58.647	13	.000

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7.349	7	.393

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Age_Group	1.685	.410	16.939	1	.000	5.395	2.418	12.038
	Gender	-.784	.360	4.738	1	.030	.456	.225	.925
	Lowlevelofphysicalactivity	.218	.264	.684	1	.408	1.244	.742	2.085
	Lowbodyweight≤128lb	.642	.275	5.449	1	.020	1.900	1.108	3.258
	AlcoholIntake	-.185	1.166	.025	1	.874	.831	.085	8.160
	CaffeinIntake	.401	.292	1.885	1	.170	1.494	.842	2.650
	TobaccoUse	.037	.600	.004	1	.950	1.038	.320	3.364
	Smoking	2.257	1.261	3.206	1	.073	9.556	.808	113.068
	GonadalHormone Deficiency	-.965	1.178	.672	1	.413	.381	.038	3.832
	Immobilizationandinadequateactivity	.126	1.142	.012	1	.912	1.134	.121	10.632
	FamilyHistoryoffracture	.259	.383	.455	1	.500	1.295	.611	2.745
	PersonalFracture	1.016	.388	6.872	1	.009	2.763	1.292	5.906
	LowCalciumorVitaminDintake	1.957	.773	6.409	1	.011	7.080	1.556	32.226
	Constant	-5.024	1.201	17.489	1	.000	.007		

a. Variable(s) entered on step 1: Age_Group, Gender, Lowlevelofphysicalactivity, Lowbodyweight≤128lb, AlcoholIntake, CaffeinIntake, TobaccoUse, Smoking, Gonadal Hormone Deficiency, Immobilizationandinadequateactivity, FamilyHistoryoffracture, PersonalFracture, LowCalciumorVitaminDintake.