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Geographic Variances of Osteoporosis: What Interventions Can be Implemented to Raise  
Awareness and Reduce the Risk of Fractures in Latin America?

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## Abstract

Osteoporosis is a major public health problem worldwide. Its complications are those related to fragility fractures, which cause considerable morbidity, mortality, and resource utilization. The socioeconomic burden is relatively well understood in the United States, but less studied in developing regions of the world. This paper will compare the epidemiology and socioeconomic burden of osteoporosis between the United States and Latin America. It will also review the current prevention, screening, diagnosis, and treatment methods, with an emphasis on raising awareness, improving management, and prioritizing osteoporosis as a public health problem. Information was gathered through a PubMed literature review and an interview with a provider from San Jose, Costa Rica. It is estimated that nearly 200 million elderly people suffer from osteoporosis worldwide. Geographical variances do exist; in general countries farther from the equator are at a greater risk. The National Osteoporosis Foundation (NOF) conducted a regionalized study that demonstrated the geographical variances, with the purpose to raise awareness, improve education, and incorporate more osteoporosis training in developing countries. The Latin American Vertebral Osteoporosis Study (LAVOS) determined that only 1 out of 4 women over the age of 50 in Argentina had normal bone mineral density, demonstrating that osteoporosis is actually more common than previously thought in Latin America. Despite recent efforts to highlight its burden, osteoporosis is not considered a health priority in Latin America. There is a need to improve prevention strategies, clinical assessment, and raise awareness in order to lessen the considerable human and economic impact of the disease.

## Introduction

Osteoporosis is a major health concern that affects nearly half of the elderly population worldwide. The skeletal disease is oftentimes referred to as a “silent killer” because there are

often no presenting symptoms until a fracture occurs. Osteoporosis was previously thought to be a normal part of aging, but advances in medical research and technology have shifted this understanding. It is now considered preventable and treatable with more adequate screening measures and management guidelines available.<sup>1</sup> Another challenge is that many of the fractures that occur as a result of osteoporosis happen without any trauma or significant mechanism of injury. Unfortunately, 1 in 3 women and 1 in 5 men over the age of 50 will experience an osteoporotic fracture in their lifetime.<sup>2</sup> Osteoporotic fractures negatively impact quality of life and even lead to an increased rate of mortality in the elderly population.<sup>3</sup> Furthermore, the prevalence of osteoporosis and its consequential fractures are only projected to rise with the world's rapidly increasing elderly population.

Osteoporosis is a disease characterized by a decrease in bone mass, which predisposes individuals to an increased risk of fracture.<sup>4</sup> It is estimated that nearly 200 million people are suffering from osteoporosis worldwide.<sup>5</sup> In the United States, 1.5 million people suffer from osteoporotic fractures every year.<sup>3</sup> Osteoporosis is four times more common in women than in men, with postmenopausal women at the highest risk. According to the United States Preventative Services Task Force (USPSTF), screening is recommended to begin at the age of 65 for women, but no formal guidelines are available for assessing men.<sup>1</sup> Men typically have greater bone mass, slower bone loss, and tend to have fractures 5-10 years later than women.<sup>6</sup> The most commonly fractured sites are the vertebrae, hip, and wrist. The World Health Organization (WHO) recognizes that the majority of osteoporotic fractures occur as a result of low energy mechanical forces that would not ordinarily result in a fracture, referred to as a fragility fracture.

The gold standard predictor of decreased bone mineral density (BMD) and resulting fracture risk is determined by using dual-energy x-ray absorptiometry (DXA) of the hip and

spine. The primary risk factor for developing osteoporosis is increasing age. Other factors include prolonged glucocorticoid therapy, excess alcohol intake, cigarette smoking, low levels of androgens, low physical activity, small body size, low vitamin D and calcium intake, and family history. Despite numerous identifiable factors, screening for and diagnosing osteoporosis is oftentimes overlooked, or simply forgotten. As a result, many cases of osteoporosis go unnoticed until a significant fragility fracture occurs. Unfortunately, research has shown that these fractures directly impact quality of life by increasing the likelihood of dependent living situations, permanent disability and in some cases even premature death.<sup>4</sup>

Osteoporotic-related fractures are a major global epidemic. The fragility fractures often require significant medical management, need for surgery, prolonged hospitalizations, long-term nursing home placement, and chronic pain management.<sup>7</sup> A recent study analyzed over 200,000 patients who had experienced an osteoporotic hip fracture and required surgery, 50% were permanently disabled, and 20% eventually led to premature death.<sup>8</sup> Another prospective cohort study, over the course of eight years, followed a group of osteoporotic women who suffered vertebral fractures. The data revealed that these women had a 1.5-fold increased risk of dying of “other causes” while hospitalized, specifically, pulmonary disease and cancer.<sup>9</sup> It should be noted that no single factor can predict an excess risk for cancer, chronic disease, or death. However, many well-conducted studies have depicted the staggering clinical consequences, cost, and worldwide societal impact associated with osteoporosis-related fractures in the elderly population.

In addition to morbidity and mortality, osteoporosis poses an important public health concern due to the substantial medical costs associated with fragility fractures. The economic burden has been well-studied in the United States. The high medical costs are related to the

numerous consequences of an osteoporotic fracture: hospitalizations, surgery, outpatient care, long-term care, chronic pain management, disability, and even premature death.<sup>10</sup> A study in the United States determined the estimated cost associated with osteoporotic fractures was US\$17 billion in 2005, likely higher now.<sup>3</sup> A worldwide analysis also predicts that due to the increasing elderly population and longer life expectancies, the annual costs related to osteoporosis will exceed \$132 billion by 2050.<sup>3</sup> The Mayo Clinic compared hospital costs related to osteoporosis (US\$ 5.1 billion), myocardial infarction (US\$ 4.2 billion), stroke (US\$ 3 billion), and breast cancer (US\$0.5 billion).<sup>11</sup> Although hospital costs associated with osteoporotic fracture complications were the greatest, osteoporosis is rarely considered a priority in many health systems and continues to be underdiagnosed and undertreated amidst the staggering economic losses.

Osteoporosis is a common disorder that affects individuals and health systems worldwide. Its impact and economic burden are well-studied in the United States; however, less data are available in developing countries. Recently, new studies have begun to show similar socioeconomic burdens in other areas of the world. A study conducted in 2018 estimated the economic burden in four Latin American countries: Brazil, Mexico, Colombia, and Argentina. The total combined cost associated with osteoporosis for the four countries was US\$ 1.17 billion.<sup>12</sup> This cost is substantial, especially considering many of these countries have a smaller overall budget for medical care and resources. Many Latin American countries lack the facilities, screening tools, rehabilitation centers, evidence-based guidelines, and educated providers to properly treat osteoporosis.<sup>13-15</sup> A sobering study from a public university hospital in Venezuela focused on mortality rates following hip fractures; it found for those who did not receive surgery that the mortality rate was as high as 92% in the first year after the fragility fracture.<sup>15</sup>

Despite the recent efforts to highlight its growing economic burden, osteoporosis is not considered a health priority in many Latin American countries. There is a need to improve prevention strategies, clinical assessment, and raise awareness in these regions in order to lessen the considerable human and economic impact of the disease. This paper will compare the epidemiology and socioeconomic burden of osteoporosis between the United States and Latin America. It will also review the current prevention, screening, diagnosis and treatment methods of osteoporosis, with an emphasis on raising awareness, improving management, and prioritizing osteoporosis as a top public health problem.

## **Background**

### **Epidemiology**

Osteoporosis affects people all over the world. Numerous factors contribute to overall bone health and osteoporotic fractures, but genetics and environment do play a role in the etiology.<sup>5</sup> According to an analysis by The Endocrine Society in 2012, all populations are affected by osteoporosis, but not equally. There is an overall lack of multiregional studies, but recent research has demonstrated a geographic variance of the disease. Recently the International Osteoporosis Foundation (IOF) conducted regionalized research with the purpose to improve awareness, education, and training worldwide. Five epidemiological audits have been completed in the major regions of the world: Europe, Middle East, Africa, Asia-Pacific, and Latin America. The Latin American Regional Audit (LARA) was the first major analysis of the region and was completed in 2012 by a group of expert clinicians and national osteoporosis societies.<sup>14</sup> Importantly, the various audits revealed that indeed all areas of the world suffer from complications related to osteoporosis; however, the highest hip fracture rates were seen in Northern European countries. Asian countries demonstrated an intermediate risk, whereas Latin

America and Africa had the lowest overall risk.<sup>5,14</sup> It is important to consider these epidemiologic variances, along with a thorough history, when determining an individual's risk for developing osteoporosis.

A limited number of recent reviews have revealed the differing rates of hip fractures and osteoporosis across ethnicities. The largest multiethnic study, the National Osteoporosis Risk Assessment (NORA), showed significant BMD variances across ethnicities.<sup>16</sup> Black women had the highest BMD and white women had the lowest. Interestingly, Hispanic and Native American women's measurements were not statistically different than white women.<sup>16</sup> Additionally, an analysis of Europe found differences, as much as 7-fold, between northern and southern European countries.<sup>5</sup> This study along with others have concluded that countries farther from the equator have a higher incidence of fracture. It is important to understand that a complex combination of factors ultimately affect bone mineral density, including genetics, gender, skeletal size, bodily calcium excretion, vitamin D intake in populations closer to the equator, and differences in diet pertaining to calcium intake.<sup>16,17</sup>

It is evident there is a major gap in osteoporotic research across different geographic regions. In Latin America the lack of data is likely attributed to many factors, including, lack of national databases, surveillance methodology, reporting issues, and geographical and cultural barriers.<sup>18</sup> It is worthwhile to track differences in fracture incidence in order to acknowledge osteoporosis as a major worldwide public health concern.<sup>5,15,18,19</sup> Nearly all of the recent studies agree that due to the increasing lifespan and aging population, the rates of osteoporosis and devastating fractures are only going to become more apparent, especially in developing regions of the world.<sup>5</sup> These countries lack the resources, diagnostic centers, and drug therapy to



properly manage fractures.<sup>20</sup> These limitations combined with the lack of available data make it a challenge to address the burden of osteoporosis in certain ethnic groups and countries.

With life expectancies increasing in nearly all regions of the world, the effects of osteoporosis are anticipated to become more widespread and detrimental.<sup>5</sup> The relationship between ethnicity, BMD, and fracture risk is complex. Neither ethnicity nor geographic location alone can fully explain an individual's risk for osteoporosis or subsequent fractures. A multitude of other factors contribute to bone health and fracture risk, including, lifestyle, skeletal strength, comorbidities, economic status and other social factors.<sup>16</sup> Osteoporosis is an established problem in countries like the United States and Europe, with numerous health campaigns and accessible methods of diagnosis. In the last decade, data from developing countries are beginning to raise awareness and shed light on the serious complications of the condition. Although, more efforts are needed to prioritize osteoporosis in order to diminish the socioeconomic burden on individuals and health systems worldwide, especially in countries where medical resources are limited.<sup>4,15</sup> In developing countries the magnitude of the problem is increased, and an individual's experience presents with a disproportionate morbidity and mortality related to osteoporotic fractures.<sup>18</sup> Thus, there is an urgent need to continue to gather epidemiological data on the burden of the disease to improve awareness and education to decrease fragility fracture incidence in all areas of the world.

### **Latin America**

Despite the studied clinical and societal effects of osteoporosis, it remains underdiagnosed, undertreated and underrecognized. In 2012 the LARA the first of its kind to address the burden of osteoporosis in the 14-country region. One of the main findings was that Latin America's elderly population is expected to increase by 280% in the next three decades,

which will undoubtedly lead to a problematic surge of osteoporosis and fragility fractures.<sup>14</sup> Another major concern is that many people in Latin America lack access to adequate screening methods and follow-up care, especially those living in the rural communities. Of the utmost concern is an overall lack of awareness, both on behalf of the medical providers and the patients. According to the Latin American Vertebral Osteoporosis Study (LAVOS), only 1 out of 4 women over the age of 50 in Argentina had normal bone mineral density. Similarly, according to the WHO one of every 12 Mexican women over 50 years will sustain a hip fracture.<sup>14</sup> The findings demonstrate that osteoporosis and fragility fractures are actually quite common in Latin American, despite what may be discerned from its geographical proximity to the equator.<sup>13,14</sup> According to the LARA, statistics from the 14 countries were only slightly lower than similar studies of Caucasian women in Europe.<sup>14,21</sup>

Costa Rica was included as one of the 14 Latin American countries. Significantly, Costa Rica is expected to have the greatest increase in the elderly population over the next three decades, with a percentage increase of 389%, higher than any other Latin American country.<sup>14</sup> The country currently operates on a statewide public health system, referred to as Social Security, which accounts for 92% of the population. Private healthcare options are also available to the public, but at a significant cost.<sup>14</sup> In 1999 Costa Rica developed its own osteoporosis foundation, The *Asociación Costarricense de Climaterio Menopausia y Osteoporosis* (ACCMYO). With the help of ACCMYO, providers and the general population started to recognize osteoporosis. ACCMYO reported an alarming prevalence rate of 40% osteopenia and 22% osteoporosis among postmenopausal Costa Rican women. Another significant study by ACCMYO found that of the 5,580 DXA scans completed, 63% were either diagnostic for osteopenia or osteoporosis; although, many of these patients did not receive a diagnosis nor did

they follow-up for preventative care.<sup>14</sup> Overall, osteoporosis is not recognized as a major health problem in Costa Rica, as there are no government funded health professional training programs or standard guidelines available. Furthermore, osteoporosis training is only incorporated into the medical school curriculum of endocrinologists and rheumatologists, so general doctors are not trained and are, thus poorly equipped to implement prevention strategies, diagnose, or provide care for those with osteoporosis.<sup>14</sup> Actions are needed to improve osteoporosis training programs for all providers in order to recognize and treat patients at high risk for developing osteoporosis and subsequent fragility fractures.

### **General Screening**

The main goals of managing osteoporosis are (a) to promote prevention through non-pharmacological and healthy lifestyle changes, (b) to identify high risk individuals with adequate screening methods and a thorough clinical history, and (c) to diagnose and begin pharmacological treatment to prevent future fractures.<sup>22</sup> Multiple different organizations have provided evidence-based guidelines; here we will focus on those of the USPTF. The key to reducing the morbidity and mortality associated with fragility fractures according to USPTF is to place a greater emphasis on prevention and evaluation of known risk factors, as well as conduct formal imaging methods to screen patients.<sup>23</sup> In 2011 the USPTF recommended screening all women over the age of 65. According to the USPTF there is insufficient evidence available to suggest recommendations for men. Therefore, the clinician should use his or her judgment and periodically perform individualized assessments in older men.<sup>1,6</sup> When pertaining to the timing intervals between scans, the USPTF recommends a minimum of 2 years between screening measurements.<sup>24</sup> As always the clinician should use his or her own judgement in determining if screening should occur sooner or more frequently based on a patient's risk factors.<sup>22,23,25</sup>

Screening, diagnosis, and treatment of osteoporosis use BMD to assess bone strength, as determined by the most widely used method, or DXA.<sup>22,26</sup> DXA measures bone mineral density at the hip and spine. DXA scores compare the subject to a population at peak bone mass, which is referred to as the T-score. The World Health Organization (WHO) defines the diagnosis of osteoporosis as a low BMD with a T-score of -2.5 or less. A T-score between -1 and -2.5 is referred to as osteopenia.<sup>1</sup> The diagnosis of osteoporosis can also be made by a single occurrence of a fragility fracture, whether or not a DXA scan has been obtained.<sup>25</sup> Other techniques that are available, include peripheral DXA, computed tomography based absorptiometry, and quantitative ultrasound densitometry; although these are not preferred due to high radiation exposure and higher cost.<sup>27</sup> Early detection and treatment of high-risk individuals, particularly post-menopausal women, is paramount in reducing hip fractures.

#### **Methods of screening in Latin America (Costa Rica)**

The use of DXA and clinical assessment of risk factors are considered the most accurate predictors or “gold standard” for osteoporosis screening.<sup>1</sup> However, in many developing regions of the world DXA is unavailable due to high cost, making diagnosing osteoporosis difficult.<sup>28</sup> In regions where DXA is unavailable, a recently implemented alternative way to evaluate fracture risk is called the Fracture Risk Assessment Tool (FRAX). The tool uses a series of risk factors including, age, sex, height, weight, fracture history, rheumatoid arthritis, current tobacco smoking, steroid use, and alcohol intake to predict a patient’s 10-year fracture risk.<sup>29,30</sup> The tool includes a section to manually insert a BMD measurement; however, this section can be omitted if DXA measurements are not available.<sup>18</sup> A retrospective study was performed analyzing 239 patients who underwent BMD measurement and FRAX. The study found that 86.61% of the patients had identical fracture risk predictions with or without the BMD incorporated into the

FRAX calculation. FRAX is an effective tool to predict osteoporotic fracture risk and would be an inexpensive, accessible, and alternative method when DXA is unavailable.<sup>30,31</sup>

As discussed earlier in this paper there are geographic and ethnic differences that affect fracture risk, so FRAX can be specifically programmed to a particular country. It is predicted that nearly 127 countries are now using FRAX. In 2012 at the time of the LARA only four countries in Latin America were utilizing FRAX, but that has now doubled. In 2019 it is now being utilized in Argentina, Columbia, Ecuador, Mexico, Chile, Brazil, and Venezuela.<sup>14,18</sup> The use of FRAX has grown and is incorporated into many country-specific guidelines for osteoporosis screening. It is now widely accessible, being available in 27 languages, incorporated into handheld calculators that do not require internet access, an application for smartphones, and even available in paper forms for patients to fill out themselves.<sup>31,32</sup> The early detection of high-risk individuals is the foundation of osteoporosis management. The development of the FRAX tool plays a major role in lessening the impact of osteoporosis complications by identifying high-risk individuals, where DXA or other screening techniques may not be available.<sup>25</sup>

### **Primary Prevention and Treatment**

In the past, osteoporosis was considered a normal part of aging; however, the bone disease is now considered to be preventable and treatable. Some of the most important aspects of primary prevention include adequate calcium and vitamin D intake, eating a healthy diet, increasing weight bearing exercise, refraining from smoking, and avoiding fall hazards.<sup>27</sup> A meta-analysis examined the use of combined calcium and vitamin D supplementation for osteoporosis prevention in 11 different trials with over 30,000 participants. The analysis

concluded that the combination vs. placebo resulted in a statistically significant 30% decrease in hip fractures.<sup>33</sup> Additionally, weight-bearing exercise not only improves balance and strength to prevent falls, but it has also been shown to actually increase bone mass.<sup>34</sup> A recent Cochrane review concluded that resistance training and high force exercise did indeed prevent bone loss and fractures in postmenopausal women.<sup>23,34</sup> Eating a healthy diet, as well as avoiding smoking and excess alcohol are also important components for promoting optimal bone health in order to prevent fragility fractures.<sup>27</sup> Providers and the general public must first have an understanding of the true burden of osteoporosis to fully embrace the importance of preventative lifestyle measures.

The treatment of osteoporosis combines preventative strategies and available pharmacologic agents. According to the NOF, postmenopausal women and men should be treated if they have a history of a fragility fracture or if their T-score is less than -2.5. Of note, the National Osteoporosis Foundation (NOF) recommends adequate calcium and vitamin D intake prior to incorporating other medical therapies, encouraging 1200mg/day for individuals 51 and older and 800-1000 IU/day of Vitamin D for individuals 51 and older.<sup>1</sup> Currently, bisphosphonates, which prevent or decrease bone loss, such as alendronate are considered first-line therapy.<sup>32</sup> Several studies have demonstrated that treatment significantly reduces fracture risk.<sup>1,23</sup> According to a large meta-analysis, treatment with alendronate for three years increased BMD in postmenopausal women and those with established osteoporosis.<sup>35</sup> A study comparing alendronate to a placebo demonstrated a significant 70% decrease in vertebral fractures.<sup>1,35,36</sup> Other pharmacologic agents exist such as selective estrogen-receptor modulators (SERMs), hormone therapy, parathyroid hormone, calcitonin, and denosumab. Bisphosphonates are considered first-line therapy primarily because of available long-term safety and efficacy data,

tolerability and cost effectiveness.<sup>1</sup> The costs of bisphosphonates, taken once daily for up to 5 years, vary in different regions of the world, but according to Farmacia CV in San Jose, Costa Rica the cost for 5 pills is only about US\$ 7. According to the LARA when medically indicated pharmacological treatment can potentially be covered by Social Security. All told, medication therapy is considerably less than the direct hospital cost of a hip fracture, which is estimated to be US\$ 8000. Furthermore, it should also be noted that this amount only accounts for the initial surgical treatment and does not include additional post-operative and social costs related to the fragility fractures, which would likely be significantly higher due to long-term care often needed following hip surgery. However, to date no studies have determined the all-encompassing economic impact of osteoporosis in Costa Rica.<sup>14</sup>

### Methods

Literature searches were completed using PubMed database for prevention and management of osteoporosis in the United States, Latin America and Costa Rica. Search terms included: prevalence of osteoporosis in Latin America, burden of osteoporosis in Latin America, screening, prevention and treatment of osteoporosis, epidemiology of osteoporosis, incidence of osteoporotic hip fracture worldwide, and osteoporosis treatment. Interviews were conducted regarding prevention and education practices of osteoporosis and fragility fractures in Costa Rica.

### Discussion

There is a sharp contrast between Latin America and the United States pertaining to the awareness, education, and prioritization of osteoporosis. The societal and economic impact of osteoporosis has been well documented in the United States, but in Latin America osteoporosis is considered a health priority in only three of the 14 countries analyzed.<sup>14</sup> The combination of the

silent nature of the disease, lack of screening and diagnostic tools, and a limited health budget make it extraordinarily difficult to diagnose osteoporosis. Although some recent studies have now demonstrated that osteoporosis does have a greater impact than previously thought on elderly populations in regions closer to the equator.<sup>14,18</sup> Unfortunately, its burden is only going to become more detrimental as the elderly population in Latin America is expected to triple by 2050.<sup>12</sup> A few distinct challenges exist in developing countries when implementing effective strategies to either prevent or treat diseases, including, fragmented health systems, cost and access to care, medical education, and overall awareness of the importance of a condition. One must consider methods that are cost effective, accessible, yet successful for prevention interventions and management.<sup>18</sup> In Latin America, there is a demand for physicians, patients, health authorities, and the government to move osteoporosis up in the ladder of importance in order to reduce its disease burden.<sup>10,13,14,20</sup> Especially given the morbidity, mortality and large economic impact of the disease, and the relatively cheap cost of preventative measures and pharmacologic agents, improvements are urgently needed in Latin America. By focusing on increasing the community's understanding of osteoporosis, effective screening, treatment, and education strategies can be implemented to limit fracture complications.

DXA was the first imaging tool developed for osteoporosis screening in the mid-1980's.<sup>27</sup> In the United States and other industrialized regions DXA is considered relatively accessible; however, in developing regions it is extremely limited.<sup>18</sup> According to interviews conducted with Dr. Luis Jimenez in Costa Rica, there are only three DXA Machines available to members of the Social Security system. Dr. Luis Jimenez also admitted that only certain providers can refer for the scans and that only very high-risk individuals are referred. Of these high-risk individuals many of them do not complete the scans because average wait times for a



DXA scans can be up to two years.<sup>14</sup> Another issue related to DXA utilization in Costa Rica is that the technicians who operate the equipment are seldomly certified by the International Society of Clinical Densitometry (ISCD), so this directly calls into question the quality and interpretation of the scans. Despite the incorporation of FRAX by many other countries, it is not used routinely in Costa Rica.<sup>14</sup> Although in other Latin American countries, for example in Mexico, FRAX has been adapted to a paper test to make it more widely available. This approach using FRAX would help detect individuals who would otherwise potentially suffered an unnecessary fracture.

There is an urgent need for (a) more widespread DXA equipment and (b) utilization of FRAX to improve diagnosis of osteoporosis in Latin America. Attention should be focused on implementing FRAX due to its accessibility, adaptability, and cheap cost. Some efforts have been made in training providers using webinars and courses.<sup>18</sup> In 2012, it was estimated that over 10,000 primary care clinics in Latin America had started using FRAX, but not routinely.<sup>18</sup> Some studies have determined that FRAX can be an effective alternative when DXA is limited, but more research is needed to demonstrate its effectiveness.<sup>29,30</sup> The ongoing efforts to train providers on FRAX and the importance of obtaining a history that includes an analysis of risk factors are essential to detect high-risk individuals and prevent fragility fractures.

Numerous studies have determined the effectiveness of pharmacologic treatments in reducing fractures.<sup>35,36</sup> According to the LARA, pharmacologic agents are indeed available in all Latin America countries, but many patients do not properly receive prescriptions. The lack of treatment is largely due in part to countries not having standardized guidelines for osteoporosis management and the silent nature of the disease remaining undetected until a fragility fracture occurs. Furthermore, the NOF requires DXA measurements to make a formal diagnosis and

begin treatment.<sup>1</sup> The problem with treating osteoporosis is further convoluted by the overall lack of awareness, both on behalf of the providers and the general public in regions like Latin America.<sup>18,20</sup> According to Dr. Luis Jimenez, pharmacologic agents are available and covered in certain situations by Social Security in Costa Rica, but the majority of patients actually end up having to buy their own medications. Other pharmaceutical agents like ibandronate, zoledronate, denosumab, and teriparatide can be purchased by those who have private health care. Dr. Luis Jimenez also mentioned, “some doctors are reluctant to use osteoporosis medication due to rare side effects like osteonecrosis of the jaw and atypical fractures.” Despite the availability of effective and cheap treatment options, osteoporosis remains largely undiagnosed and therefore undertreated.

Another component and challenge of treating osteoporosis with the first-line medication class, bisphosphonates, is that patients must have adequate vitamin D and calcium stores prior to using the medication.<sup>1</sup> However, many individuals in Latin America do not consume enough calcium in their diets. A study conducted in Costa Rica examined vitamin D and calcium intake in adolescents. It found that 80% of those surveyed reported calcium intake less than the recommended level of 1,300 mg/d, with the lowest levels of reported dietary intake found among rural females.<sup>37</sup> One of the largest dairy companies in Costa Rica, Dos Pinos, has been working with ACCYMO in an attempt to raise awareness, but more efforts are needed to educate the general public. The staggering lack of self-awareness pertaining to osteoporosis risk was examined in Brazil. Post-menopausal women were identified as being “high-risk” according to FRAX; of the high-risk women surveyed 80% identified as only having “little to no risk.”<sup>18</sup> It is clear that there is a gap and misunderstanding of the importance and burden of osteoporosis, even among the groups at the highest risk. The use of the media and other public awareness

campaigns need to address proper nutrition, physical activity, smoking cessation, and the prevention of falls as directly related to osteoporosis.<sup>18</sup> For example, in the United States three major organizations, Office of Women's Health (OWH), NOF, and CDC worked together to generate a successful osteoporosis prevention campaign aimed at adolescent girls, called "Best Bones Forever," among many others.<sup>38</sup> Latin America must reevaluate the importance of using marketing strategies to improve prevention and management of osteoporosis, especially since preventative and evidence-based treatment options are widely available and affordable.<sup>39</sup>

It is crucial to implement osteoporosis training into the medical education of primary providers, not just endocrinologists or orthopedists.<sup>18</sup> Providers that deliver primary and secondary prevention are at the center of the issue and must be able to screen individuals and promote healthy lifestyles and prevention strategies in order to prevent fragility fractures.<sup>18,25</sup> With the help of more research, medical providers should be informed of the seriousness and burden of hip fractures on the health system, and retrained on how to detect and properly treat osteoporosis. Unfortunately, even with the best efforts targeted at medical providers, barriers will remain without funding and the acknowledgment from the government.<sup>18</sup> The funding, campaigns, medical training, and guidelines rely on government activity.<sup>13,14,18</sup> According to Dr. Luis Jimenez, some efforts to raise awareness in Costa Rica are currently underway: "We are planning on having some osteoporosis diagnosis workshops with two pharmaceutical companies. But the future is difficult, because the only way to improve diagnosis and treatment is to educate physicians and the public, but that requires funding and many of us cannot effort to pay." Dr. Luis Jimenez explained that 10 years ago, around the time ACCMYO was founded, efforts were based primarily on pharmaceutical companies and the media with some support from providers. Although little progress has been made in the last decade according to Dr. Luis Jimenez: "It

seems that the medical community has forgotten a lot about osteoporosis.” This lack of awareness among the medical providers and general public makes it difficult for the government and other health societies to support or contribute financially to improve osteoporosis management.<sup>14</sup>

Future strategies need to include more research and education demonstrating the socioeconomic burden in Latin America. The lack of awareness and gap in research leads to an ongoing neglect of the consequences of osteoporosis, which imparts an enormous toll on populations. Strategies to raise awareness are complex and require the cooperation of many groups: general public, providers, health authorities, and governmental policy makers.<sup>14,18</sup> All told, until these groups reevaluate the importance of osteoporosis prevention, screening and treatment, unnecessary fractures will continue to negatively impact individuals, as well as the health systems.

### Conclusion

In conclusion, osteoporosis is a major public health problem that imposes a serious socioeconomic burden on health systems worldwide. Osteoporosis-related fractures lead to considerable morbidity, mortality, and resource utilization. Unfortunately, in developing countries like those in Latin America its impact is not as well-studied or understood. As a result, osteoporosis is continually undiagnosed and untreated. On account of the dramatically increasing aging population, the effects of the disease are likely going to become more widespread and problematic. It is predicted that the worldwide incidence of hip fracture will rise to affect nearly 6.26 million people by the year 2050 with an annual cost of nearly US\$ 13 billion.<sup>5</sup> Furthermore, Latin America has limited health resources, diagnostic tools (DXA and FRAX), treatment, rehabilitation centers, and funding.<sup>15</sup> These issues combined with the lack of

awareness and proper provider education, will continue to take a toll on the population and health budget in Latin America.<sup>13</sup> The socioeconomic burden and projected exponential increase of osteoporotic fractures demand attention for adequate, yet cost effective, improvements in awareness, prevention, screening, and treatment methods.

The recognition of osteoporosis as a major health priority in Latin America is required in order for the effects of osteoporosis to be understood. The collective collaboration and financial support of many different groups such as the national government, medical specialists, patients and the general public are needed in order to implement new strategies, and to reevaluate osteoporosis management. Improvements should focus on educating providers on the seriousness of osteoporosis in order to implement effective diagnostic technology, such as FRAX and DXA, which combined with known risk factors can effectively detect high-risk individuals. Latin America must first recognize osteoporosis as a major health priority in order to place a stronger emphasis on prevention and ultimately improve management, and lessen the human and economic burden of unnecessary fractures.

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