

## Review Article

# Osteoporosis prevention and osteoporosis exercise in community-based public health programs

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## Abstract

Osteoporosis is a serious public health concern worldwide, and community-based public health programs that increase osteoporosis preventive behaviors are ideal to combat this major public health issue. A review of community-based public health programs for osteoporosis prevention show that programs vary in numerous ways and have mixed results in increasing osteoporosis preventive behaviors, although most programs have had success in significantly increasing calcium intake, only a few programs have had success in significantly increasing weight-bearing exercise. Regarding calcium intake, all community-based public health programs that implemented: 1) at least one theoretical behavior change model, such as the health belief model, or 2) bone mineral density (BMD) testing for osteoporosis screening, have shown success in significantly increasing calcium intake. As community-based public health programs for osteoporosis prevention have shown limited success in increasing weight-bearing exercise, an additional review of community-based public health programs incorporating osteoporosis exercise showed that they have high compliance rates to increase weight-bearing exercise, but require high-intensity weight-bearing exercise of 80–85% 1-repetition maximum to significantly increase BMD to prevent osteoporosis. In the prevention of osteoporosis, for community-based public health programs to be most effective, they should implement theoretical behavior change models and/or BMD testing for osteoporosis screening, along with high-intensity resistance training. Recommendations for future research to further study effective community-based public health programs are also provided.

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**Keywords:** Osteoporosis; Prevention; Calcium; Exercise; Community-based

## 1. Introduction

Osteoporosis is a severe bone disease that increases morbidity and mortality in individuals, and it is also a serious public health concern in populations all around the world. Osteoporosis is clinically diagnosed as having a bone mineral density (BMD) of 2.5 standard deviations below the adult peak mean [1], which weakens bones and makes them more susceptible to fragility fractures, particularly in the hip, spine, and wrist. Osteoporosis is currently incurable as there is no treatment that can fully replenish reduced BMD cause by the disease. This

disease decreases the quality of life from reduced independence and hindered physical, mental, and social well-being [2], as well as increased frailty, morbidity, and mortality in individuals diagnosed with it [3,4]. The United States Surgeon General has addressed the importance of promoting bone health and preventing osteoporosis in public health [5], as it has become both a national public health issue affecting 50 million Americans in the United States [6], as well as a global public health issue affecting hundreds of millions of individuals worldwide [7]. Osteoporosis and osteoporotic fractures, especially hip fractures, can lead to permanent physical disability, decreased self-sufficiency, hospitalization, and increased mortality, requiring the need for public health osteoporosis prevention interventions to prevent the disease and premature death [4].

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Fortunately, the National Institute of Health Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy [8] states that although osteoporosis affects all populations, this disease is preventable by achieving maximal BMD with the osteoporosis preventive behaviors of adequate calcium intake and weight-bearing exercise. Therefore, to combat this global public health problem, public health leadership should place focus on preventing osteoporosis with the implementation of strategies that increase these osteoporosis preventive behaviors throughout populations [9]. For instance, community-based public health programs for osteoporosis prevention will be more impactful towards improving the bone health of populations than the more common individual-based health care programs. Most osteoporosis prevention programs are designed to prevent or manage the disease in individuals, but in order to have a greater impact and prevent the disease among populations, osteoporosis prevention programs must be implemented for communities, not just for individuals. Based on the social ecological model by McLeroy, Bibeau, Steckler and Glanz [10], when adapted for osteoporosis prevention in public health (see Fig. 1), the least direct link to prevent osteoporosis in public health is through the individual approach; however, the most direct connection is through the community, such as with community-based public health programs for osteoporosis prevention, that will directly lead to public health policies to improve bone health in populations. To establish public health policies that successfully promote bone health and reduce the prevalence of osteoporosis in populations, a review of the literature was conducted with the objective to assess the effectiveness of community-based public health programs for osteoporosis prevention, in order to provide evidence-based recommendations that support and regulate public health policies.

## 2. Osteoporosis prevention in community-based public health programs

### 2.1. Community-based public health programs for osteoporosis prevention effectiveness on increasing calcium intake and weight-bearing exercise

To assess the effectiveness of community-based public health programs for osteoporosis prevention, a review of the literature was conducted with a search in four databases:

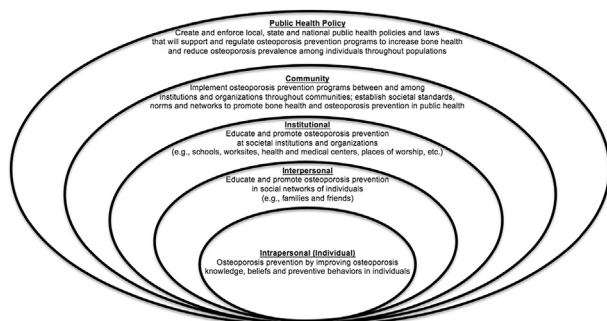


Fig. 1. Social ecological model for osteoporosis prevention in public health.

PubMed (United States National Library of Medicine at the National Institutes of Health), PsycINFO (American Psychological Association), ERIC (Education Resources Information Center: Institute of Education Sciences of the United States Department of Education), and Google Scholar. Search terms entered into these databases were “osteoporosis community,” and after a thorough review of all search results, 14 studies were found to be community-based public health programs for osteoporosis prevention, as each included analysis to assess effectiveness of a community-based osteoporosis prevention intervention designed to increase osteoporosis preventive behaviors. Table 1 provides specifics of different aspects of 14 studies on community-based public health programs for osteoporosis prevention found in the review of the literature [11–24]. Various study designs were used to investigate their effectiveness of increasing osteoporosis preventive behaviors that included the use of experimental, intervention, and prospective cohort designs, and the duration of these studies varied from as short as 6 weeks to as long as 5 years, with 1 study not reporting duration. The community-based public health programs for osteoporosis prevention studies were also conducted in various community settings and in various locations globally, including locations in North America, Europe, Asia, and Australia, which were expected as osteoporosis affects hundreds of millions of individuals worldwide. The specific designs and implementations of the studied community-based public health programs for osteoporosis prevention varied from study to study, with various components used in different studies that included, but were not limited to, BMD testing for osteoporosis screening, use of theoretical behavior change models, lectures and lessons on various osteoporosis-related topics, presentations, demonstrations, counseling, group discussions, and hands-on activities. All 14 studies included participants that were women who were mostly older adults, with only 6 that included men that were mostly a very small portion of the total participants in their respective studies.

The effectiveness of community-based public health programs for osteoporosis prevention is determined by the success of increasing osteoporosis preventive behaviors, particularly the behaviors of calcium intake and weight-bearing exercise. All studies, with the exception of 1 study [15], measured the osteoporosis preventive behaviors of calcium intake and/or weight-bearing exercise, with 8 studies measuring both osteoporosis preventive behaviors [11,12,14,19,20,22–24], 4 studies only measuring calcium intake [13,16,18,21], and 1 study only measuring weight-bearing exercise [17]. One of the 8 studies that measured both calcium intake and weight-bearing exercise also measured fall preventive home safety behaviors [14]. The 1 study that did not measure either calcium intake or weight-bearing exercise instead measured health-directed behaviors, such as positive and active engagement of life, skill and technique acquisition, and social integration and support [15], and although these are general health behaviors, they can be applied to specific osteoporosis preventive behaviors, such as calcium intake and weight-bearing exercise.

In terms of their effectiveness to successfully increase osteoporosis preventive behaviors, 9 of the 12 studies (75%)

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