International Journal of Medical and Pharmaceutical Case Reports
5(1): 1-6, 2015; Article no.IJMPCR.19244
ISSN: 2394-109X

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Osteoporosis Reduction in Pre and Postmenopausal Women Using a High Intensity Exercise Program

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Authors' contributions

This work was carried out in collaboration between all authors. Author JB reviewed the results of the laboratory studies and provided interpretations, Authors RB and CDS contributed to the literature review and writing of the initial drafts. Author DTB reviewed the weightlifting data and completed the final manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJMPCR/2015/19244
Editor(s):
(1) Daniel Laubitz, Steele Children's Research Center, Department of Pediatrics /Gastroenterology and Nutrition, Arizona Health Sciences Center, University of Arizona, Tucson, USA.
Reviewers:
(1) Alexander Berezin, Internal Medicine Department, Medical University, Zaporozhye, Ukraine.
(2) Claudiu Popescu, Internal Medicine and Rheumatology Department, University of Medicine and Pharmacy, Romania.
Complete Peer review History: http://sciencedomain.org/review-history/9969

Case Study

Received 31st May 2015
Accepted 16th June 2015
Published 29th June 2015

ABSTRACT

Aim: This manuscript describes how a weekly high intensity weight lifting exercise regimen was able to improve the osteoporotic state in women with a previous diagnosis of low bone mineral density.
Case Presentation: This series reviews the cases of four women (average age of 50) with a previous diagnosis of low bone mineral density (BMD). These women sought out and participated in a high intensity exercise regimen (Gravitational Wellness System) to improve their osteoporotic state. They women had their BMD assessed prior to and after at least 10 weeks of participation. When comparing the assessments we observed that the patients gained an average of 4.92% in the femur BMD.
Discussion: A focused review of literature was performed on the efficacy of high intensity weight lifting programs. Previous studies have demonstrated some improvement in bone mineral density; however, the reduction in osteoporosis seen by utilizing this weight lifting method is higher then

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previous published work using exercise as a bone loss retardant.
Conclusion: This retrospective study is the first to demonstrate the capacity of the Gravitational Wellness System to improve the bone mineral density on pre and post-menopausal women with a diagnosis of osteoporosis.

Keywords: Osteoporosis; bone mineral density; gravitational wellness method; high intensity exercise.

1. INTRODUCTION

Low bone mineral density (BMD) and resultant fractures are a major public health concern. Ten million Americans have osteoporosis and another thirty million are affected by low BMD [1]. Bone mass decreases by approximately 0.5% per year or more after the age of 40 [1]. It is estimated that 30%-50% of women and 15%-30% of men will suffer an osteoporotic fracture in their lifetime [1].

Osteoporosis is defined by the World Health Organization as a systemic skeletal disease characterized by low bone mass with micro-architectural deterioration of bone tissue leading to bone fragility and susceptibility to fracture [1]. Dual-energy x-ray absorptiometry (DXA) scan is the current gold standard for measuring BMD. A T score of - 2.5 or less (2.5 standard deviations below the mean peak bone mass for a young adult) is indicative of osteoporosis. Risk factors for osteoporosis include prior fractures as an adult, family history, chronic tobacco/alcohol abuse, chronic glucocorticoid use, and hypovitaminosis D [2].

Exercise is thought to be a strong preventive measure against bone loss and osteoporosis. Although bone mass can be maintained through pharmacologic therapy, physical activity maintains BMD and aids in improving balance/decreasing falls through increased strength [3-4]. It is through both the ground reaction forces of weight bearing exercise and the muscle contraction forces of resistance training that physical activity maintains bone mass. The most generally accepted strategies for optimal bone health and preventing fracture are maximizing gain in BMD in the first three decades of life and minimizing the rate of bone loss after the age of 40 [5].

Activities that generate high intensity loading forces across the bone, including running, plyometrics and high intensity resistance training, augment bone growth and delay bone loss [6-10]. Though these aforementioned studies have provided insight, however, the ideal exercise prescription remains unclear. The exercise prescription most recently published by the American College of Sports Medicine (ACSM) for bone health recommends moderate to high intensity weight bearing endurance activities 3-5 times/weekly and/or resistance training 2-3 times/weekly [5].

One high intensity weight training program; the Gravitational Wellness System (GWS), has recently been shown to have capacity to load the musculoskeletal system with extremely high weights, leading to rapid weekly strength gains using only short weekly training sessions [11]. This system created by Anatoly Samodumov and brought to the United States by physical therapist Vladimir Chubinsky and is patented in both countries.

This case series presents the cases of four women with low BMD who participated in the GWS training regimen and were found to have a significant improvement in their osteoporotic state following participation in the program.

2. METHODS

This retrospective case series includes data concerning four women who had been part of a larger study of the effects of the GWS [12]. During their participation these women reported having had a diagnosis of and or concern about low BMD. These women reported seeking a weightlifting program as a means to improve their osteoporotic state. Included in this report are the observations of their participation, which includes DXA scans before beginning the program, and repeat studies after completing at least 10 weeks of the program (the recommended minimum duration from previous work) [11]. The women described in this case series reported no other interventions during their time of weightlifting, including medications, to address their BMD. The review of the data collected during training sessions and DXA scans were authorized by the Emory Institutional Review Board.

2.1 Exercise Program

At each exercise session, the participant engaged in four separate exercises, all involving free weights using a barbell system. The **Belt lift** (Fig. 1A) involved the use of a barbell connected to a hoisting belt, which was attached at each end of the barbell to a connecting star. With the belt placed over the lower back, the participant was instructed to inhale, hold their breath, and to extend the knees from the starting angle of approximately 45° to near full extension, avoiding the locking of the knees. Weights were added until the instructor detected that the form of the lift was faltering, thus indicating that the maximal weight lifting capacity was being approached. After this lift, the weight was reduced by 30 % and the participant was asked to complete three additional repetitions, as a cool down maneuver. The total number of lifts at this station average 10.

The second lift (Fig. 1B) using a barbell system positioned within a metal track, such that the starting point of a lift could occur with the patient's arms fully extended, and the knees bent at 45°. The subject was asked to keep the back aligned in an upward position, to lean away from the bar at 15°, and to retract the scapula. From this position the knees were extended, lifting the weights for a period of approximately 3 seconds. The weights were sequentially increased, until the instructor again noted a faltering of form, indicating that the maximal weightlifting capacity was being approached.

The third lift (Fig. 1C) was performed from a lying position using weightlifting gloves. A chest press maneuver was then completed to full extension. As with the other exercises, weight was added until the subject demonstrated a faltering of form, indicating that the maximal weightlifting capacity was being approached. When this weight was achieved, the weight was reduced by 30% and then the participant completed the cool down.

The fourth lift (Fig. 1D) was performed from a lying position using a barbell system contained within upright metal tracks.

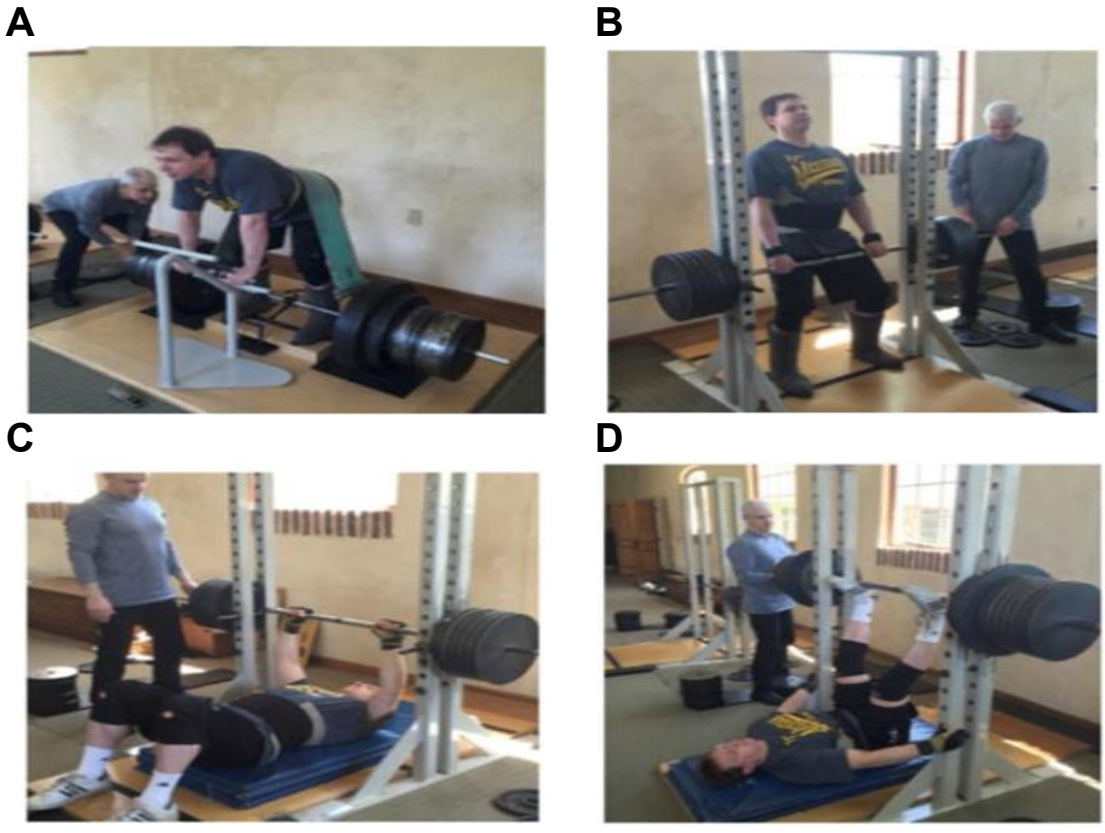

Fig. 1 (A, B, C, D): Barbell system positioned according to the GWS

The starting position was determined such that the knees were bent at a 45° angle and with the participant instructed to extend the knees. The weights were lifted for a period of less than three seconds. Weights were then added, until the instructor determined that the maximal weightlifting capacity was being approached. The weight was then reduced by 30% and then the subject completed the cool down.

3. RESULTS

The clinical history and bone mineral densities (Table 1) for each patient as summarized.

Subject A was a 60 year-old female, with a height of 1,68 m and a weight of 65 kg. Her initial BMD measurement occurred in 1999. Two years after this BMD study was obtained, the patient enrolled in the gravitational wellness program. A follow-up report in 2005 demonstrates that the Lumbar Spine (LS) spine BMD was 0.3, with % change calculated at 6.7%. This was a 1.1% change in BMD per year. Data concerning the femoral neck revealed a follow-up BMD of 0.876, with a calculated improvement of 26%. This was a 4.4% change per year from baseline. She reported no injuries during the weightlifting program.

Subject B was a 29-year-old female with an initial BMD completed in 1999, and a follow up in 2005. The LS BMD was initially calculated at 1.350, with follow-up calculated at 1.5. This demonstrated an 11% increase. This was an average of 1.9% yearly increase. In addition, the femoral neck was measured in 1999 at 0.982, and in 2005 to be 1.052. This was an 8.1% increase, with a 1.4% increase per year from baseline. Her weight training began 2001 and ended 2007.

Subject C was a 57-year-old female at the time of the follow-up BMD study with a height of 62 inches and a weight of 100 pounds. As with the first subject, the initial BMD was collected in 2011 (raw data not available.) At her 2013 follow up study, the patient's physician noted an interval decline in BMD in both her hips and spine. She repeated a DXA scan in April of 2014 after 24 sessions of the weightlifting regimen. The patient's physician commented that the lumbar spine BMD was noted to have stabilized (change in BMD considered not statistically significant.) The left femoral neck BMD was reported to have an 11.8% improvement since the 2013 study.

Subject D was a 54-year-old woman with height of 64 inches the weight of 130 pounds. She had been identified as having osteoporosis that one or more sites in November of 2003, with a worsening of BMD in the spine, by a report generated in 2005. She began the gravitational wellness program in September 2004 and last participated in July 2005. At her 2005 follow up DXA scan the data indicated an increase in BMD of 6.7% in the LS and an increase of 4.2% in the total hip.

4. DISCUSSION

This case series was part of a larger retrospective study, designed to assess the effect of a unique, weekly, very high intensity weight lifting program. The results of that initial study demonstrated that patients could bear extremely high weights, while reporting improvements in their subjective health [11]. During that study, several individuals were identified who had presented to the weightlifting gym to address concerns regarding their BMD. From these we identified four women (three postmenopausal and one premenopausal) who had their bone mineral densities measured before and after their weightlifting program without any additional changes in their medication or exercise regimens. A review of their GWS performance and medical data found that all subjects had improvements in their bone mineral densities after completing at least ten 10-minute sessions.

Table 1. Pre and Post GWS participation BMD measurements

Patient	First DXA scan			Second DXA scan		
	Date	BMD LS	BMD H	Date	BMD LS	BMD H
A	1999	1.153 g/cm^2	0.692 g/cm^2	2003	1.231 g/cm^2	0.876 g/cm^2
B	1999	1.350 g/cm^2	0.982 g/cm^2	2005	1.500 g/cm^2	1.032 g/cm^2
C	2013	0.959 g/cm^2	0.612 g/cm^2	2014	0.854 g/cm^2	0.684 g/cm^2
D	2003	0.768 g/cm^2	0.716 g/cm^2	2005	0.819 g/cm^2	0.746 g/cm^2

BMD – bone mineral density; LS – lumbar spine; H – hip

This case series is unique as it not only corroborates results from previous studies that high intensity resistance training yield improvements in BMD [13-16], but, the improvements seen in this study appear to be greater than the BMD increases observed with similar exercise regimens previously published [17]. Additionally, these results are novel in that significant increase in BMD occurred with only one 30-minute training session weekly. This protocol may give insight into the establishment of an ideal regimen for bone stimulation/osteoporotic reduction given the minimal time commitment, positive results and no injuries reported.

Currently, when exercise regimens are not effective in osteoporotic prevention, the mainstay pharmacological method is bisphosphonates. These drugs are thought to inhibit osteoclast resorption of bone and are available in daily oral formulations as well as yearly/quarterly IV formulations [13]. Though beneficial, bisphosphonates produce adverse effects such as GI distress, an acute phase flu-like response formulation, osteonecrosis of the jaw and atypical femoral fractures [2,13].

In a recent study evaluating the adherence of bisphosphonates and change in BMD, the investigators uncovered that when their subjects were adherent 75% of the time the annual percentage change in femur BMD was 1.5% [18]. When comparing the annual percentage change femur BMD of the subjects in this study, their average change was 4.92%. This observation suggests that this weightlifting program may be an effective non-pharmacological alternative. A larger prospective study is warranted to further review the benefits of this technique.

This case series does reveal positive effects of this weightlifting program, there are significant limitations to these data. The first of these; is the retrospective and uncontrolled nature of the data. Even though all subjects had BMD recorded both before and after the weightlifting program, these occurred at different facilities, and at different times. The changes in BMD therefore cannot be assumed to be equivalent between subjects. In addition, there was no control of the patient's lifestyle or diet including supplements, which may have additional effects on BMD. However, none reported significant changes in exercise, medications, or other factors that may have influenced the outcome.

5. CONCLUSION

In conclusion, this retrospective case series of four women involved in once weekly, high intensity weight lifting suggests that such an exercise program may result in improvement of critical BMD. Further studies are necessary to prospectively study this effect, and to explore whether this may influence the risk of osteoporotic fractures.

CONSENT

Data collected for this study were retrospective, with data collected from records within the GWS gym. The review of the data collected during training sessions was authorized by the Emory Institutional Review Board.

ETHICAL APPROVAL

The review of the data collected during training sessions was authorized by the Emory Institutional Review Board. No patient identifiers were used in the preparation of the manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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