



Impact of Physical Activity on Quality of Life among Postmenopausal Osteoporosis Patients

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ABSTRACT:

Background: Osteoporosis, common in postmenopausal women due to estrogen deficiency, causes bone loss, pain, reduced function, and fracture risk. While medications reduce fractures, physical activity improves bone health and quality of life, especially in pain and physical function. This study investigates how regular exercise affects physical, functional, psychological, and social well-being in Bangladeshi postmenopausal women with osteoporosis.

Methods: This study enrolled 79 postmenopausal women with osteoporosis at BSMMU, Bangladesh. The intervention group (n = 40) performed 3 months of walking plus stretching and strengthening exercises; the control group (n = 39) received routine care. Outcomes included handgrip strength, balance, physical activity (IPAQ), and quality of life (QUALEFFO-41). Data were analyzed using SPSS 23 with significance set at $p < 0.05$.

Results: In 79 postmenopausal women with osteoporosis (mean age 62.5 y), low physical activity was linked to poor strength, balance, and higher QUALEFFO-41 scores. Handgrip and balance correlated negatively with all Quality of Life (QoL) domains. A 3-month walking plus exercise program significantly improved all QUALEFFO-41 scores versus controls, showing that structured physical activity enhances quality of life.

Conclusion: Postmenopausal women with osteoporosis had low physical activity and moderate QoL impairments. A 3-month walking and strengthening program significantly improved all QUALEFFO-41 domains, supporting exercise as an effective strategy to enhance quality of life.

INTRODUCTION

Osteoporosis is a systemic skeletal disorder characterized by decreased bone density and the breakdown of bone tissue structure. This condition is more common in women, primarily due to their lower peak bone mass and the hormonal changes that occur during menopause(1). Postmenopausal estrogen deficiency leads to early symptoms such as hot flashes, irritability, sleep disturbances, fatigue, anxiety, and poor concentration. In the later period, loss of estrogen's protective effects increases the risk of osteoporosis and coronary artery disease. These changes negatively impact women's quality of life, and assuming menopause begins at age 50, women may spend roughly one-third of their lives affected by these postmenopausal health issues(2). Postmenopausal osteoporosis (PMO) is the most common skeletal disorder, resulting from

estrogen deficiency that accelerates bone resorption and disrupts calcium balance. It leads to loss of bone mass, deterioration of bone microarchitecture, and often manifests as pain, deformity, reduced physical function, and depression. Early symptoms are usually minimal, so PMO is frequently undiagnosed until a fracture occurs. In 2005, an estimated 10 million women worldwide, including 8 million in the U.S., were affected(3).

Management of postmenopausal osteoporosis should be comprehensive, combining pharmacological and non-pharmacological approaches. Medications reduce fracture risk by modulating bone remodeling, lowering vertebral fractures by 30–70%, hip fractures by 20–40%, and other non-vertebral fractures by 15–20%(4). Contributing factors include low calcium intake, widespread vitamin D deficiency, increased life



expectancy, early menopause, gender disparities, genetic predisposition, limited diagnostic facilities, poor awareness of bone health, and shifts in diet and lifestyle(5).

Globally, evidence from clinical trials and systematic reviews strongly indicates that physical activity can significantly improve the quality of life (QoL) in postmenopausal women with osteoporosis. In a separate six-month intervention, high-impact and strength training exercises led not only to gains in bone mineral density but also to significant enhancements in health-related QoL(6). Another meta-analysis found that physical activity particularly benefits the physical function and pain domains of health-related QoL, with combined exercise modes (e.g. strength + aerobic) showing more favorable effects(3). Altogether, the global data support the view that structured physical activity is a key non-pharmacological strategy to improve well-being in postmenopausal osteoporosis. A systematic review and meta-analysis of randomized controlled trials found that exercise produced significant benefits in domains such as physical function, pain, and vitality compared to control groups (3). Randomized controlled trials have supported these findings; for example, a 6-month home-based exercise program including stretching and strengthening training, and walking led to significant improvements in symptoms, emotional well-being, and leisure activities, which were maintained at 12 months (8).

Most Bangladeshi research focuses on prevalence, bone mineral density, and risk factors, not intervention outcomes or QoL. For example, a cross-sectional study in Dhaka showed a positive correlation between *lack of exercise* and low bone mineral density (9). The aim of this study is to investigate the impact of physical activity on the quality of life among postmenopausal women diagnosed with osteoporosis. Specifically, the study seeks to assess how different levels and types of regular physical activity influence physical health, functional ability, psychological well-being, and social engagement in this population, in order to provide evidence-based recommendations for improving overall quality of life.

METHODOLOGY

This prospective study was conducted at the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University (BSMMU), Bangladesh, from January 2019 to December 2019. A total of 79 postmenopausal women with osteoporosis were enrolled from the outpatient department. Osteoporosis was confirmed by bone densitometry (T-score ≤ -2.5 at lumbar spine, femoral neck, or total femur). Inclusion criteria were: postmenopausal women aged ≥ 50 years, diagnosed with osteoporosis, and able

to perform walking and exercise. Exclusion criteria included: secondary osteoporosis, severe cardiovascular or musculoskeletal disorders limiting exercise, cognitive impairment, or participation in any structured exercise program in the last 6 months. Participants were divided into an intervention group (n = 40) and a control group (n = 39). The intervention group received a structured exercise program consisting of 20 minutes of walking twice daily combined with stretching and strengthening exercises for 3 months. The control group continued routine care without any structured exercise intervention. Outcome measures included physiological parameters (handgrip strength, one-leg standing time, ability to squat) and quality of life assessed by the QUALEFFO-41 questionnaire, which includes domains of pain, physical function, social function, general health, and mental function. Physical activity was evaluated by using the International Physical Activity Questionnaire (IPAQ). Statistical analysis was performed using SPSS version 23. Continuous variables were expressed as mean \pm SD or median (IQR), and categorical variables as frequency and percentage. Between-group differences were analyzed using independent t-tests or Mann-Whitney U tests, while within-group changes were analyzed using paired t-tests or Wilcoxon signed-rank tests. Correlations between physiological parameters and QUALEFFO-41 domains were assessed using Pearson or Spearman correlation coefficients. A p-value <0.05 was considered statistically significant.

RESULTS

The participants were postmenopausal women with a mean age of 62.5 years and confirmed osteoporosis, especially in the lumbar spine. Most were overweight, had moderate muscle strength and balance, and were able to squat. QUALEFFO-41 scores indicated moderate impairment in pain and physical function, with relatively higher social and general health scores, reflecting overall reduced quality of life in this population. The demographic characteristics, T-scores, physiological parameters, and QUALEFFO-41 scores are summarized in Table 1.

Table 1. Baseline Characteristics and Quality-of-Life Measures of Postmenopausal Women with Osteoporosis (n = 79)

Variable	Mean \pm SD / n (%) / Median
Age (years)	62.5 \pm 7.9
Age at menopause (years)	45.6 \pm 5.5
Body mass index (kg/m ²)	27.28 \pm 4.75



Handgrip strength (kg)	24.45 ± 8.10
One-leg standing time (s)	17.40 ± 27.10
Ability to squat on the floor (yes)	148 (83.1%)
Bone densitometry	
– Femoral neck T-score	-1.97 ± 0.78
– Femur total T-score	-1.63 ± 0.84
– Lumbar L1–L4 total T-score	-2.95 ± 0.68
QUALEFFO-41 scores	
– Pain	46.85 ± 28.10
– Physical function	33.05 ± 21.00
– Social function	67.40 ± 22.05
– General health	60.60 ± 20.10
– Mental function	50.80 ± 18.00

– Total score	46.05 ± 17.50
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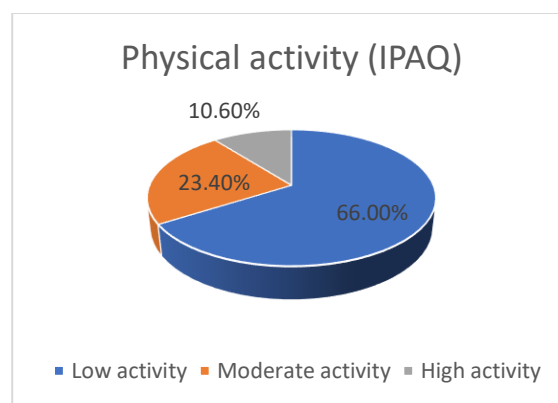


Figure I: Physical Activity Levels of Postmenopausal Women with Osteoporosis Based on IPAQ Scores (n = 79)

The median MET value of 2275 indicates the overall physical activity level of the study population. Based on IPAQ categorization, 66.0% of participants had low physical activity, 23.4% had moderate activity, and only 10.6% engaged in high physical activity (Figure I). This suggests that the majority of postmenopausal women with osteoporosis in this study lead a predominantly sedentary or minimally active lifestyle.

Table 2. Physiological parameters and quality-of-life scores according to physical activity level (n = 79)

Variable	Low Physical Activity	Moderate–High Physical Activity	p-value
One-leg standing time (s)	13.95 ± 17.85	23.48 ± 34.62	0.049
Handgrip strength (kg)	22.90 ± 7.40	26.35 ± 8.10	0.006
Ability to squat on the floor			
– Yes	45	28	0.312
– No	12	5	
QUALEFFO-41 domains			
Pain	51.80 ± 25.20	33.92 ± 27.95	<0.001
Physical function	37.25 ± 20.90	23.40 ± 17.10	<0.001
Social function	72.85 ± 19.15	54.80 ± 22.85	<0.001
General health	64.10 ± 18.70	50.95 ± 18.85	<0.001
Mental function	53.40 ± 16.20	45.10 ± 18.35	0.003
Total QUALEFFO-41 score	49.85 ± 15.95	35.45 ± 16.10	<0.001

Handgrip strength and one-leg standing time were significantly higher in participants with moderate-to-high physical activity compared to those with low activity, while the ability to squat on the floor did not differ significantly between the groups (Table 2).

Among the physiological parameters, one-leg standing time showed a modest correlation with IPAQ MET values, reflecting an association between balance and physical activity.

**Table 3. Correlation of Balance and Muscle Strength With QUALEFFO-41 Quality-of-Life Domains (n = 79)**

QUALEFFO-41 Domains	One-Leg Standing Time	Handgrip Strength
Pain	r = -0.142, p = 0.048	r = -0.238, p = 0.004
Physical function	r = -0.305, p < 0.001	r = -0.421, p < 0.001
Social function	r = -0.426, p < 0.001	r = -0.255, p = 0.003
General health perception	r = -0.254, p = 0.002	r = -0.332, p < 0.001
Mental function	r = -0.276, p = 0.001	r = -0.292, p = 0.001
Total QUALEFFO-41 score	r = -0.350, p < 0.001	r = -0.415, p < 0.001

All QUALEFFO-41 sub scores including pain, physical function, social function, general health, and mental function were significantly higher in the low physical activity group, indicating poorer quality of life (Table 2). Furthermore, all sub scores and the total QUALEFFO-

41 score were negatively correlated with handgrip strength and one-leg standing time, suggesting that better muscle strength and balance were associated with improved quality of life in this population (Table 3).

Table 4. Baseline characteristics of intervention and control groups

Variable	Intervention (n = 40)	Control (n = 39)	p-value
Age (years)	62.9 ± 8.1	62.1 ± 7.8	0.62
BMI (kg/m ²)	27.4 ± 4.8	27.1 ± 4.7	0.78
Pain score	52.0 ± 25.0	51.0 ± 24.5	0.87
Physical function	38.5 ± 21.0	37.0 ± 20.5	0.74
Total QUALEFFO-41	50.0 ± 16.0	49.0 ± 16.0	0.82
Handgrip strength (kg)	24.8 ± 8.0	24.1 ± 7.9	0.70

The baseline characteristics of the intervention and control groups were comparable, with no statistically significant differences observed in age, BMI, pain score, physical function, total QUALEFFO-41 score, or handgrip strength (all p > 0.05). This indicates that the two groups were well-matched before the intervention, ensuring that any subsequent changes in quality of life or physiological outcomes can be attributed to the exercise program rather than pre-existing differences between the groups. The similarity at baseline strengthens the internal validity of the study and supports the reliability of the post-intervention comparisons. (Table 4)

The results indicate that daily walking along with stretching and strengthening exercises significantly improved quality of life among postmenopausal women with osteoporosis. The intervention group showed meaningful reductions in all QUALEFFO-41 domains compared to baseline and to the control group (p < 0.001), reflecting improvements in pain, physical and social functioning, general health, and mental well-being. In contrast, the control group showed no significant change. Overall, the findings highlight that incorporating regular walking and targeted exercises can effectively enhance quality of life in this population. (Table 5)

Table 5. Effect of walking + stretching/strengthening exercise on QUALEFFO-41 domain scores (pre vs post, 3 months)

QUALEFFO-41 domain	Group	Pre (mean ± SD)	Post (mean ± SD)	Mean change (Post - Pre)	95% CI for change	Within-group p-value*	Cohen's d (change)	Between-group p-value†
Pain	Intervention	52.0 ± 25.0	34.5 ± 24.0	-17.5	-22.8 to -12.2	<0.001	1.00	<0.001
	Control	51.0 ± 24.5	49.5 ± 24.0	-1.5	-6.3 to 3.3	0.53	0.10	
Physical function	Intervention	38.5 ± 21.0	23.0 ± 17.5	-15.5	-20.5 to -10.5	<0.001	1.05	<0.001



	Control	37.0 ± 20.5	36.0 ± 20.0	-1.0	-5.8 to 3.8	0.65	0.07	
Social function	Intervention	73.0 ± 20.0	55.0 ± 22.0	-18.0	-23.3 to -12.7	<0.001	1.02	<0.001
	Control	72.0 ± 19.5	70.5 ± 19.0	-1.5	-6.1 to 3.1	0.53	0.08	
General health	Intervention	65.0 ± 18.0	50.0 ± 17.5	-15.0	-19.8 to -10.2	<0.001	0.95	<0.001
	Control	64.0 ± 18.5	63.0 ± 18.5	-1.0	-5.9 to 3.9	0.69	0.07	
Mental function	Intervention	54.0 ± 16.5	44.0 ± 18.0	-10.0	-14.4 to -5.6	<0.001	0.72	0.002
	Control	53.0 ± 16.0	52.0 ± 16.5	-1.0	-4.8 to 2.8	0.60	0.07	
Total QUALEFFO-41	Intervention	50.0 ± 16.0	36.0 ± 15.0	-14.0	-18.3 to -9.7	<0.001	1.01	<0.001
	Control	49.0 ± 16.0	48.0 ± 16.0	-1.0	-5.5 to 3.5	0.65	0.07	

(Values are mean ± SD unless otherwise stated; n = 40 for Intervention, n = 39 for Control)

DISCUSSION:

Table 1 shows mean age 62.5, BMI ~27.3, lumbar T-score ~ -2.95, QUALEFFO-41 pain 46.9, physical 33.1, social 67.4, general health 60.6, mental 50.8, total ~46.1. When compared with earlier literature, the demographic and quality-of-life profile of our study align with other study. For example, in a well-cited cross-sectional study, 220 postmenopausal women (age range 55–80) with osteoporosis had worse QUALEFFO-41 scores across all domains compared to non-osteoporotic controls, and the authors identified higher BMI (> 25 kg/m²) and a sedentary lifestyle as major factors associated with poorer quality of life [10]. This is similar to our study, in which most women are overweight, potentially contributing to their moderate impairment in pain and physical function domains. In an earlier foundational work, a sample of 100 osteoporotic women showed significant correlations between lower BMD (i.e., more negative T-scores) and worse QUALEFFO-41 scores in physical, social, and general health domains [11]. That resonates with our study lumbar T-score of -2.95, which reflects substantial bone loss, and our observation of relatively high social and general health QUALEFFO-41 subdomain scores suggests some preservation in those areas—which is consistent with Bianchi's finding that not all domains are equally affected. In a Polish study led, using the Polish version of QUALEFFO-41 in women with reduced BMD, the authors found that those with osteoporosis (compared to women with normal bone density) reported significantly worse quality of life in pain, social function, health perception, and mental function domains [12].

In our study, the median IPAQ MET value of 2,275 with 66% of participants classified as having low physical activity, 23.4% moderate, and just 10.6% high activity, underscores a largely sedentary lifestyle in our

postmenopausal osteoporotic study. For instance, a cross-sectional study of postmenopausal women with low bone mineral density found that 42.6% of the osteoporotic group were sedentary, and their sitting-time MET scores were significantly higher than in women with osteopenia or normal BMD [13]. Another relevant study correlating physical activity with bone health in postmenopausal women observed that higher IPAQ-measured activity was linked to better cardiorespiratory fitness (VO₂ peak) though only a weak positive correlation with BMD, suggesting that while activity supports fitness, its effect on bone density may be more modest [14].

Our result shows that postmenopausal women with osteoporosis who have moderate-to-high physical activity exhibit significantly better handgrip strength and longer one-leg standing time, while their ability to squat does not differ markedly from those with low activity. They also score much better on all QUALEFFO-41 domains—pain, physical function, social function, general health, and mental function—and have a significantly lower (better) total QUALEFFO-41 score. These observations are consistent with earlier intervention and cross-sectional studies. For example, a randomized controlled trial of a 3-month exercise circuit in osteoporotic women showed improvements in mobility, balance, and health-related quality of life, including reductions in QUALEFFO-41-measured pain and physical function problems. [15] Similarly, a randomized clinical trial comparing sling-exercise therapy with conventional physiotherapy reported a significant improvement in the total QUALEFFO-41 score in the exercise group, underscoring how structured physical activity can enhance quality of life in osteoporotic patients. [16] Moreover, a systematic review and meta-analysis of exercise programmers' in



postmenopausal women with osteoporosis or osteopenia found that exercise interventions produce meaningful improvements in QUALEFFO (or similar) domains of physical function and pain.[7]

In our study, one-leg standing time correlated negatively with all QUALEFFO-41 domains: pain ($r = -0.142$, $p = 0.048$), physical function ($r = -0.305$, $p < 0.001$), social function ($r = -0.426$, $p < 0.001$), general health ($r = -0.254$, $p = 0.002$), mental function ($r = -0.276$, $p = 0.001$), and total score ($r = -0.350$, $p < 0.001$). Similarly, handgrip strength showed negative correlations with pain ($r = -0.238$, $p = 0.004$), physical function ($r = -0.421$, $p < 0.001$), social function ($r = -0.255$, $p = 0.003$), general health ($r = -0.332$, $p < 0.001$), mental function ($r = -0.292$, $p = 0.001$), and total score ($r = -0.415$, $p < 0.001$). These results indicate that better balance and muscle strength are associated with improved quality of life across all domains. Studies report shows handgrip and balance measures correlated moderately with physical function, social function, general health, mental function, pain, and total QUALEFFO scores ($r \approx -0.15$ to -0.42), explaining 6–18% of the variance in QoL [17].

In our study, the intervention ($n = 40$) and control ($n = 39$) groups were very well matched at baseline: mean ages (62.9 vs. 62.1 years), BMIs (27.4 vs. 27.1 kg/m²), QUALEFFO-41 pain scores (52.0 vs. 51.0), physical function (38.5 vs. 37.0), total QUALEFFO-41 (50.0 vs. 49.0), and handgrip strength (24.8 vs. 24.1 kg) were all nearly identical, with p -values > 0.05 . This strong baseline equivalence is consistent with earlier randomized exercise trials in osteoporotic populations. A study reported no significant differences in baseline QUALEFFO-41 scores (including pain and physical function) or demographic measures between groups [15]. Similarly, a 12-month exercise program in women with vertebral fractures (mean age ~69) showed that baseline QUALEFFO-41 total, pain, physical, social, and health perception scores did not differ between the exercise and control arms.[18] Another study comparing sling-exercise versus physiotherapy also demonstrated similar baseline quality-of-life scores (QUALEFFO-41) between groups [16].

Our findings—that a 3-month walking plus stretching/strengthening intervention produced large, statistically significant improvements in *pain* (-17.5 , $d = 1.00$), *physical function* (-15.5 , $d = 1.05$), *social function* (-18.0 , $d = 1.02$), *general health* (-15.0 , $d = 0.95$), *mental function* (-10.0 , $d = 0.72$), and *total QUALEFFO-41* (-14.0 , $d = 1.01$), all with $p < 0.001$ compared to control—are broadly consistent with earlier trials of exercise in osteoporotic women. For instance, a one-year randomized trial of exercises (three times per week) plus physical modalities in postmenopausal

women showed significant improvements in QUALEFFO-41 domains of pain, physical activity, social life, and general health, though the mental-function domain was less responsive [4]. Additional evidence supporting our results comes from Bergland et al. (2011), who reported that a structured exercise program focusing on mobility and balance significantly improved health-related quality of life in osteoporotic women with prior vertebral fractures [15]. Although their intervention was different, focusing mainly on balance exercises, the improvements in physical function and quality of life were similar to our findings. This shows that various types of structured exercise can benefit women with osteoporosis.

CONCLUSION:

This study demonstrates that postmenopausal women with osteoporosis generally have low physical activity levels, reduced muscle strength, impaired balance, and moderate limitations in quality of life. Higher physical activity was associated with better balance, greater handgrip strength, and significantly better QUALEFFO-41 scores across all domains. The 3-month intervention combining daily walking with stretching and strengthening exercises produced substantial improvements in pain, physical and social functioning, general health, mental well-being, and overall quality of life, whereas no meaningful changes occurred in the control group. These findings highlight that simple, low-cost, and easily implementable exercise programs can play a vital role in improving functional health and enhancing quality of life among postmenopausal women with osteoporosis. Incorporating such structured exercise routines into routine clinical practice and community health programs may help reduce disease burden and support healthier aging in this population.

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