Rehabilitation Program Effect on Functional Status among Osteoporotic Patients

Suzan Khalifa Abd Elhafeez Desouky *, Hanaa Ahmed Sadek **,
Eman Fadl Abdel-khalik ***, Rokaia Fathi Mohamed ****.

1. Clinical Instructor of Medical Surgical Nursing- Faculty of Nursing - Minia University.
2. Professor of Rheumatology and Rehabilitation -Faculty of Medicine - Minia University.
3. Assistant Professor of Medical Surgical Nursing, Faculty of Nursing – Minia University.
4. Assistant Professor of Medical Surgical Nursing (Geriatric Nursing), Faculty of Nursing – Minia University.
*Email of the corresponding author: souzankh26@gmail.com

Abstract

Background: Osteoporosis is a chronic condition characterized by reduced bone mass and increasing the risk of fractures. Improving functional status through rehabilitation programs is essential to enhance quality of life and minimize disabilities among osteoporotic patients. **Aim:** evaluate rehabilitation program effects on functional status among osteoporotic patients. **Design:** A quasi-experimental research design was utilized to fulfill purpose of the study. **Subjects**: A purposive sample included (60) adult patients classified equally into two equal groups study and control group (n = 30). **Setting:** The research was conducted in Minia University Hospital's Orthopedic and Rheumatology Rehabilitation Department at Minia Governorate, Egypt. **Tools:** Three tools were utilized: **Tool I** Structured Interviewing Questionnaire that included three parts (demographic characteristics, medical data and anthropometric measurement). **Tool II** Osteoporosis Knowledge Assessment Tool (OKAT). **Tool III Physical Activity Assessment Tools** included three main sections (Physical Functional Scale, Muscle Strength Scale and Berg Balance Sale). **Results:** Findings revealed that 96.7% of the study group who received the educational program had a satisfactory level of knowledge about osteoporosis at posttest (after 8 weeks) versus 16.7% before. Additionally, there was a marked elevation in the mean score of muscle for the study group post-application of the rehabilitation program: 40.3 ± 4.82 and 48.9 ± 3.98 after 4 weeks and 8 weeks, respectively, versus the control group, 22.8 ± 4.37 and 27.6 ± 5.44, with a highly statistically significant difference between both groups (P value 0.001**)**.Conclusion:** The study findings concluded that the application of the rehabilitation program was effective in improving the functional status among the study group compared to the control group. **Recommendations: Regular** Replication of this study on a larger probability sample is highly recommended.

Key Words: Effect on Functional Status, Patient, Program, Osteoporosis

Introduction

Osteoporosis is considering the most frequent form of chronic metabolic bone disorders and defined as a "skeletal disorder characterized by gradual compromised loss of bone density predisposing a person to an increased risk of fracture"**(Aparisi Gómez et al., 2024).** Furthermore, it is a "silent" disease that can occur at any age and in both genders. It is typically an age related disease that frequently affects women more than men **(Ismail., 2024).**

Physical rehabilitation has a main role in the comprehensive management of osteoporosis and its consequences, considering the positive effects of therapeutic exercise not only in the functional recovery after fragility fractures, but also for prevention of falls, major determinants of fracture occurrence and improvement of bone strength**(Wang et al., 2022)**

Nursing care of patients with osteoporosis includes assessing the patient's physical functioning and ability to complete self-care. Nursing management should include encouraging weight-bearing activity, assisting the patient with self-care as needed, and providing ambulatory aid for patients who have an unsteady gait. In addition, the nurse is responsible for providing patient education relating to healthy dietary intake rich in calcium and vitamin D., beside smoking cessation and limited alcohol intake**(Porter et al., 2023)**

SIGNIFICANCE of THE STUDY

Osteoporosis is a major public health problem, and a projected rising prevalence is expected in an aged society. However, it is often asymptomatic until osteoporotic fractures occur. According to statistics from the International Osteoporosis Foundation (IOF), 158 million adults aged 50 years and above are at high risk of osteoporotic fracture worldwide, and this number is predicted to double by 2040**(Anish et al., 2024).**

Epidemiological studies, in the Western world, revealed that one in three postmenopausal women and 1 in 5 men aged 50 years and above will have an osteoporotic fracture in their lifetime**(Khanal et al., 2024).**

The prevalence of osteoporosis is relatively high among the Egyptian population and is associated with a wide range of risk factors and medical conditions. Based on different studies, carried out in Egypt, it has been estimated that 53.9% of postmenopausal women have osteopaenia and 28.4% have osteoporosis. On the men side, earlier data revealed that 26% of men have osteopaenia and 21.9% have osteoporosis **(El Miedany et al., 2024).**

Rural areas of Upper Egypt, the prevalence of osteoporosis in postmenopausal women was even higher reaching up to 47.8%. Such high prevalence highlights the magnitude of the problem in terms of public health and the importance of having up-to-date guidelines for the management of osteoporosis in Egypt **(El Miedany, et al 2022).**

This highest prevalence of osteoporosis is associated with increased burden to the health care system and have negative impact on patient's mobility, **(Caldirol**i **et al., 2025)**. so this research is conducted to assist osteoporotic patients to increase their knowledge, maintain their functional level and limit disabilities.

Aim

The present study aimed to evaluate the effect of rehabilitation program on functional status among osteoporotic patients.

Hypotheses

H1: The level of knowledge about osteoporosis will be increased among the study group who will have been exposed to the rehabilitation program versus the control group

H2: The mean score of muscle strength will have been higher among the study group after the program as compared with the control group.

H3: The applied rehabilitation exercise program will increase the functional status for the study group more than the control group.

Patients and Methods

Research Design:

A quasi-experimental research design (pre, posttest and follow up for study group) was utilized to fulfill the aim of this study.

Setting:

This study was conducted at Orthopedic Outpatient Clinic and Rheumatology Rehabilitation Department at Minia University Hospital in Minia Governorate, Egypt.

Study Duration:

The total data collections were collected over a period of eight months starting from May 2023 to December 2023

Subjects:

A purposive sample of sixty adult patients (male and female) selected by non-probability sampling technique according to certain inclusion and exclusion criteria and classified equally into two group (n=30) for a control group and (n=30) for study group according to the following sample calculate formula.

Sample Size

Description

N= required sample size

T= confidence level at 95% (standard value of 1.960)

P= estimated prevalence of osteoporosis among patients at orthopedic and rehabilitative department unit located at Minia University Hospital 2021 = (0.041).

m = margin of error at 5 % (standard value of 0.050)

$$N = \frac{t^2 \times p(1-p)}{m^2}$$

$$N = \frac{1.96^2 \times 0.041(1-0.041)}{0.05^2}$$

$$N = 60$$

Inclusion Criteria: -

1- Age 18-65 years of both genders.
2- Newly diagnosed with osteoporosis within three months.
3- Patients able to communicate.

Exclusion Criteria:

1- Patients used corticosteroid therapy for longer than 3 months.
2- Patients with uncontrolled chronic diseases.
3- Morbid obesity.
4- Patients who have neurological disorders.

Tools of Data Collection:

Three tools used by the researcher to gather data for this study after revising extensive literature review.

Tool I: A Structured Interviewing Questionnaire:

It was developed by **(Mohammed, et al. 2018)** and modified by the investigator, based on reviewing related literatures and designed to collect the following parts:

Part 1: Demographic Characteristics of patients included (age, gender, level of education, marital status, nature of work, residence).

Part 2: Patient Medical Data to assess past medical history about presence of chronic diseases (diabetes mellitus, hypertension, cardiac disease, thyroid disease, kidney disease, liver disease, arthritis, rheumatoid arthritis), previous fracture, medication, diet and physical activity, chief complains and risk factors).

Part 3: Anthropometric Measurements:

It was designed to assess osteoporotic patient's anthropometric measurements " height, weight and body mass index (BMI)" that calculated for each patient then classified according to **(World Health Organization criteria 2011)** (underweight (BMI< 18.5), healthy weight (BMI18.5 < 25.0), overweight (BMI25.0 < 30.0) or obese (BMI≥ 30.0).

Tool II: Osteoporosis Knowledge Assessment Tool (OKAT)

It was developed by **(Winzenberg et al., 2003) and** used for the assessment of knowledge for patients who have osteoporosis. It comprises 20 items consisted of five items on general information about osteoporosis, seven items on risk factors and four each on consequences and treatment. It consists of multiple-choice questions with each question having 3 answers (true, false, and I don't know). Items total global score of 20 for 20 items, was rated on 1 for a correct response and 0 for an incorrect or "I don't know" response.

Scoring System:

The total score classified into two categories:

- Satisfactory ≥60% of this mean
- Unsatisfactory < 60% of this mean

Tool III: Physical Activity Assessment Tools It included three parts:

Part I: Physical Functional Scale: composed of two sections:

Section 1: The Upper Extremity Functional Index-15 (UEFI):

It was developed by **(Hamilton, et al. 2013),** it used to identify whether the osteoporotic patients having any difficulties in doing daily activities (such as usual work, housework, usual hobbies, recreational or sporting activities, lifting, grooming hair…. etc).

Scoring System:

Total score = sum of activity scores/number of activities = 60,

- 50% and more satisfactory performances.
- Less than 50% unsatisfactory performances

Section 2: The Lower Extremity Scale

It was developed by **(Binkley, et al. 1999),** it was done to recognize whether the osteoporotic patients are having any difficulty at all with doing activities (such as usual work, housework, or school activities, usual hobbies, recreational or sporting activities, walking between rooms, squatting …. etc.)

Scoring system:

- Scoring system divided into 2 levels as follows:
- Total SCORE = sum of activity scores/number of activities = 80,
  - 50% and more satisfactory performances.
  - Less than 50% poor performances

Part II: Muscle Strength Scale

It was developed by **(Ciesla, et al. 2011)**. It is used to obtain an overall picture of patient's motor function in a selected muscle groups by asking the patient to attempt normal range of motion movement against my resistance.

Scoring System:

Rate Muscle Strength Scale from 0 to 5

Grade	**Muscle Strength**
0	No visible or palpable contraction (None)
1	Visible or palpable contraction with no motion (Trace)
2	Full ROM gravity eliminated (Poor)
3	Full ROM against gravity (Fair)
4	Full ROM against gravity, moderate resistance (Good)
5	Full ROM against gravity, maximal resistance (Normal)

Part III: Berg Balance Scale

It was developed by **(Berg, et al. 1989).** It included 14 items about balance exercises which used to measure patients' level regarding several tasks as (sitting to standing, standing unsupported, sitting with back unsupported but feet supported on floor or on a stool, standing to sitting…. etc.).

Scoring System:

Berg balance scale scoring ranges from 0 to 56. Patients with lower score are riskier for losing balance. It was interpreted as following:

- 0 to 20: "wheelchair bound."
- 21 to 40: "walking with assistance"
- 41 to 56: "independent

Validity:

Content validity testing was performed on the proposed tools by inspecting the items to determine whether the tools measured what supposed to measure through a panel of five experts' opinion from different academic categories (professors and assistant professors) of the medical – surgical nursing at the faculty of nursing, Minia University. The tools were modified somewhat after being examined by specialists who ensured their clarity, relevance, comprehensiveness, and simplicity.

Reliability:

Cronbach's Alpha test was used to determine the stability of the internal consistency and evaluate how well they consistently measure. Cronbach's Alpha reliability was (0.89% & 0.81 & 0.86 & 0.82) for the upper extremity functional Index, lower extremity functional Index, muscle strength scale, and berg balance scale respectively.

Pilot Study

A pilot study was carried out on 10% (6 patients) of the total sample to test the feasibility, objectivity, and applicability of the data collection tool. Based on the results of the pilot study, no modifications were made by the researcher, so, they included in the current study.

Ethical Consideration

An official permission to conduct the study was obtained from the ethical committee of the Faculty of Nursing, the dean of the Faculty, the Minia University Hospital director, and the Rheumatology Rehabilitation Department director. Subjects' participation in this study was voluntary, and they were informed about the study's purpose, procedure, benefits, nature, and follow-up, and they had the right to withdraw at any time without explanation. Added to, oral and written consent was obtained from subjects those who accepted to participate in this study, informing them that obtained data would not be included in any further research without a second consent. The confidentiality and anonymity of each subject were ensured by coding all data and protecting the obtained data.

Field work (procedure)

It was conducted in three phases:

A-Preparatory Phase:

This phase involves reviewing current and relevant literature, along with theoretical knowledge related to various aspects, utilizing textbooks, articles, and periodicals to develop the data collection tools. The researcher prepared an illustrated guideline booklet in simple Arabic to help patients assimilate and refresh the information provided to achieve the aim of the study. In addition, obtaining a formal paper agreement, this was taken in duration one month before conducting the study. The selected sample was admitted to the orthopedic outpatient clinic and rheumatology rehabilitation department. The patient who met the inclusion criteria was informed by the researcher individually about the purpose and nature of the study.

B- Implementation phase:

Data collection from the study group

- At initial interview, the researcher introduced herself to initiate line of communication, explained the nature and purpose of the program, filled out the three study tools and scheduled with them the educational sessions.
- Then the study group was divided into small groups (3-5 patients in each group)
- Firstly, the researcher collected demographic characteristics and medical data and anthropometric measurements (using the first tool) from both the study and control groups (pre-knowledge test, pre-practice test as baseline assessment for all patients). Secondly, the researcher asks the patient about his knowledge regarding osteoporosis general information, risk factors, consequences, and treatment to assess their knowledge related to osteoporosis (by using the second tool (OKAT)), and then physical activity is examined by using scales to assess their level of activity before implementing the intervention (third tool). This took about 30-40 minutes .
- The program was implemented by offering five educational sessions classified into two sessions for the theoretical part and three sessions for the practical part.
- Each session lasted for 30-40 minutes, including face-to-face lectures, videos, and demonstrations, firstly by the researcher and then by the patient re-demonstrating skills.
- These sessions were repeated for each group as follows:

Session1: Welcoming and introduction and assess patient knowledge about what is osteoporosis mean, signs and symptoms, risk factor, consequences and complication, prevention and treatment and exercise program for osteoporosis.
Session 2: - Summary about the previous session -Instructions about proper diet, adherence to medications and supplementations, adequate exposure to sunlight and physical exercise.
Session3: - Summary about the previous session -concerning the practical part (physical activity), it aimed to train osteoporotic patients best exercises for osteoporosis that include (weight bearing exercises as walking, jogging, step aerobics, climbing stairs and lifting small weights, resistance and flexibility exercises, strength and balance exercises) researcher demonstrate educational video about exercises.
Session4: - Summary about the previous session -Patients were instructed to practice physical activity at least five times per week for 30 minutes each time at least 150 minutes of moderate-intensity physical activity throughout the week. For additional health benefits, they should increase moderate intensity physical activity to 300 minutes per week, or equivalent.
Session5: - Summary about the previous session -Discussion, motivation and reinforcement during program. -Obtain feedback from the participants to evaluate the effect of rehabilitation program.

- An educational booklet prepared by the investigator was given to each study subject to ensure that they will perform exercises accurately.
- After the implementation of the rehabilitation program the researcher followed the participants through the first four weeks to ensure that all studied cases were adhered to the rehabilitation program through personal meetings or calling them by telephone.

C. Evaluation Phase:

The evaluation phase was emphasizing on determining the effect of proper rehabilitation program on functional status among osteoporotic patients

This phase done after implementation the rehabilitation program by study group to evaluate the effect of rehabilitation program on improving physical activity among patients with osteoporosis by using the second and third tools.

1st evaluation done after one month from implementation of the rehabilitation program and **2nd evaluation** done after two months using the second and third tools

Results

Table (1): Numbers and Percentage Distribution of the Study and Control Groups Regarding to Their Demographic Characteristics (n=60)

Demographic Characteristics	Study (n=30)		Control (n=30)		X^2	P-value
	N	%	N	%		
Age						
18 - 34 years	0	0	0	0	0.616	0.735
35 - 44 years	4	13.3	3	10		
45- 54 years	15	50	18	60		
55- 65 years	11	36.7	9	30		
Mean ± SD	52.3 ± 7.87		51.4 ± 5.9			
Gender						
Male	11	36.7	11	36.7	0.000	1.000
Female	19	63.3	19	63.3		
Education Level						
Illiterate	15	50	15	50	1.04	0.729
Read and write	1	3.3	0	0		
Primary	2	6.7	2	6.7		
Secondary	12	40	13	43.3		
Marital Status						
Single	1	3.3	0	0	2.16	0.339
Married	26	86.7	29	96.7		
Widow	3	10	1	3.3		
Divorced	0	0	0	0		
Nature of Work						
Employ	3	10	4	13.3	2.14	0.710
Housewife	17	56.7	17	56.7		
Hard work/farmer	6	20	3	10		
Handicrafts/ free work	3	10	3	10		
Retired/doesn't work	1	3.3	3	10		
Residence						
Rural	15	50	18	60	0.606	0.436
Urban	15	50	12	40		

Table (1): Shows that the mean ages were 52.3 ± 7.87 and 51.4 ± 5.9 for study and control groups respectively and more than half of both groups were females. Regarding educational level, half of studied group were illiterate constituting (50%). As regards marital status for both studied group, the highest percentage were married. In addition, more than half of both studied groups were housewives. Lastly, 50% and 60% of study and control group had lived in rural area respectively. Finally, no statistically significant differences in demographic characteristics.

Table (2): Number and Percentage Distribution of Study and Control Groups Regarding to Their Medical Data (n=60)

Medical Data	Study (n=30)		Control (n=30)		X^2	P-value
	N	%	N	%		
Chief Complaint						
- Back pain	11	36.7	15	50	1.42	0.490
- knee pain	15	50	13	43.3		
- Shoulder pain	4	13.3	2	6.7		
History of Chronic Disease						
- None	24	80.1	27	90.1	3.97	0.409
- Diabetes mellitus	4	13.3	1	3.3		
- Hypertension	0	0	1	3.3		
- Cardiac disease	1	3.3	0	0		
- Rheumatoid Arthritis	1	3.3	1	3.3		
History of Previous Fracture						
- Yes	7	23.3	11	36.7	1.27	0.260
- No	23	76.7	19	63.3		
Presence of Kyphosis						
- Yes	0	0	1	3.3	1.01	0.313

Medical Data	Study (n=30)		Control (n=30)		X^2	P-value
	N	%	N	%		
- No	30	100	29	96.7		
Does the Patient Smoke?						
- Yes	3	10	4	13.3	0.162	0.688
- No	27	90	26	86.7		

Table (2): Revealed that knee pain and back pain were the most observed complaints for the study and control groups respectively. Also, 80.1% & 90.1% of both groups didn't have history of chronic illnesses respectively. Furthermore, there were 76.7% & 63.3% of study and control group hadn't history of fracture respectively Finally, no statistical significant differences between studied groups regard to medical data.

Table (3): Percentage Distribution of Studied Groups Regarding Predisposing Factors (n=60) **Cont,**

Predisposing Factors	Study (n=30)		Control (n=30)		X^2	P-value
	N	%	N	%		
Does the patient practice any type of exercise?						
- No	13	43.3	12	40	0.083	0.774
- Low	13	43.3	18	60		
- Moderate	4	13.3	0	0		
- Vigorous	0	0	0	0		
Does the patient expose their skin to sunshine?						
- No	17	56.7	16	53.3	0.067	0.795
- 10-15 min twice/week	8	26.7	14	46.7		
- 15-30min three/week	4	13.3	0	0		
- 10 min/day	1	3.3	0	0		
Does the patient take calcium or vitamin D supplements?						
- Yes	2	6.7	0	0	2.06	0.150
- No	28	93.3	30	100		
Is the patient post-menopausal?						
- Yes	10	33.3	6	20	1.36	0.243
- No	20	66.7	24	80		
Does the patient used or administer contraceptive method?						
- Yes	10	33.3	14	46.7	3.23	0.355
- No	20	66.7	16	53.3		
Does the patient get enough calcium in the diet?						
- Yes	10	33.3	6	20	1.36	0.243
- No	20	66.7	24	80		
Weight						
Mean ± SD	65.5 ± 9.78		62.10 ± 6.70		1.60	0.115
Height						
Mean ± SD	162.07 ± 6.70		162.60 ± 5.28		0.342	0.733
Body Mass Index						
- Healthy weight: (18.5 - 24.9 kg/m2)	17	56.7	20	66.7	4.45	0.092
- Overweight / pre-obese: (25 – 29.9 kg/m2)	13	43.3	10	33.3		
- BMI	24.9 ± 3.38		23.4 ± 2.02		2.03	0.056

Table (3): Clarified that 43.3% & 40% of study and control group respectively didn't practice any exercise and 56.7% & 53.3% of them didn't expose their skin to sunshine and 93.3% of study group compared to100% of control group didn't take calcium or vitamin D supplements.

In regard to post menopause, 33.3% of study group compared to 20% of control group were post-menopause and 66.7% of study group compared to 53.3% didn't use or administer contraceptive method. Also,

table illustrated that 66.7% of study group compared to 80% of control groups didn't take diet rich with calcium. No statistical significant differences detected between both groups.

Table (4): Comparison between Study and Control Groups Regarding to Their Total Osteoporosis Knowledge Score Before and Post Four & Eight Weeks of Rehabilitation Program (n=60)

Total Knowledge Score	Pre (Baseline)				Post 4 weeks				Post 8 weeks				Friedman test	P value
	Study (n=30)		Control (n=30)		Study (n=30)		Control (n=30)		Study (n=30)		Control (n=30)			
	N	%	N	%	N	%	N	%	N	%	N	%		
- Satisfactory ≥60%	5	16.7	4	13.3	28	93.3	4	13.3	29	96.7	6	20	59.1	0.001**
- Unsatisfactory <60%	25	83.3	26	86.7	2	6.7	26	86.7	1	3.3	24	80		
X^2 (p value)	1.11 (0.775)				42.00 (0.001**)				32.8 (0.001**)					

** Highly Statistical significant difference (P ≤ 0.01)

Table (4) documented that 93.3% of study group compared to 13.3% of control group had satisfactory knowledge post 4 week while 96.7% of study group compared to 20% had satisfactory knowledge post 8 week at post tests after the implementing of rehabilitation program with a high statistical significance between two groups reflected by (p value (0.001**). This table answered the research hypothesis.

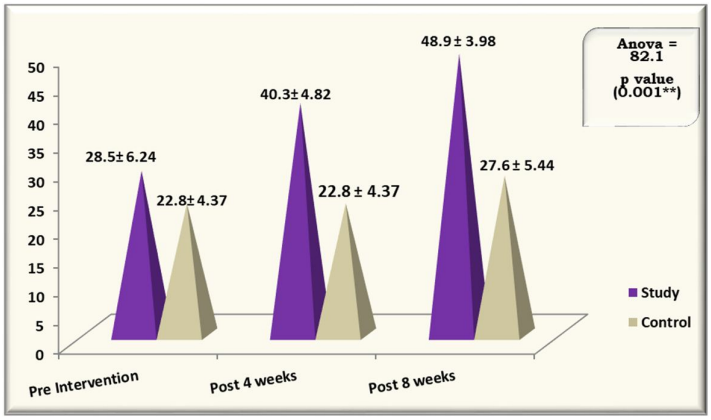

Figure (1): Mean score of Study and Control group regarding Their Muscle Strength Using Upper Extremity Functional Index before and after Rehabilitation Program (n=60)

Figure (1) Clarified that there marked elevation in the mean score of muscle strength among study group post 4 weeks & post 8 weeks of implementing rehabilitation program to be **40.3± 4.82** and **48.9 ± 3.98** compared to mean score of muscle strength among control group to be 22.8 ± 4.37 and 27.6± 5.44with a highly statistical significant difference between both groups.

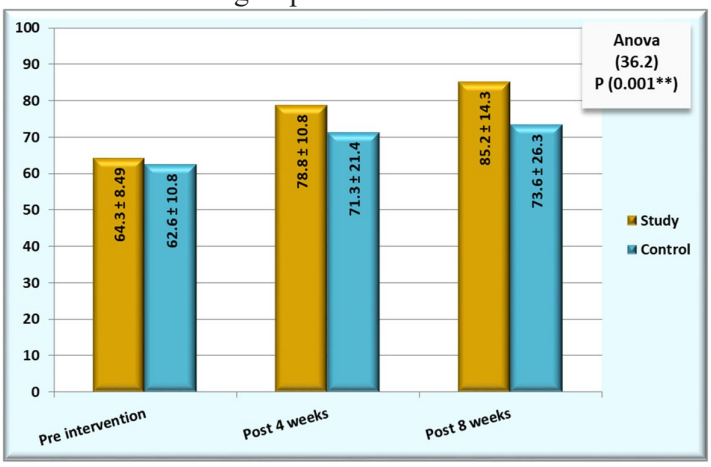

Figure (2): Total Mean Score of Study and Control Groups Regarding to Their muscle strength in Different Positions at Pre and Posttests of Rehabilitation Program (n=60)

Figure (2) Showed that the total mean score of study and control group regarding their muscle strength in different position at Pre implementing the rehabilitation program was 64.3 & 62.6 respectively. Compared to 85.2 & 73.6 post 8 weeks of implementing the rehabilitation exercise program with statistical significant difference P value **(0.001**).**

Table (5): Comparison between the total score of Berg Balance Scale for both groups before and after application of Rehabilitation Program (n=60)

	Pre (Baseline)				Post 4 Weeks				Post 8 Weeks				Friedman test (p value)
	Study (n=30)		Control (n=30)		Study (n=30)		Control (n=30)		Study (n=30)		Control (n=30)		
	N	%	N	%	N	%	N	%	N	%	N	%	
1. wheelchair bound (0 to 20)	0	0	0	0	0	0	0	0	0	0	0	0	54.6 (0.001**)
2. walking with assistance (21 to 40)	21	70	17	56.7	2	6.7	15	50	1	3.3	15	50	
3. Independent (41 to 56)	9	30	13	43.3	28	93.3	15	50	29	96.7	15	50	
X^2 (P value)	1.14 (0.422)				5.45 (0.042*)				5.19 (0.023*)				

*** p = ≤ .05 (Statistical Significance)**
**** p = ≤.01 (Highly Statistical Significance)**

Table (5) Revealed that 70% & 56.7% of both study and control group were able to walk with assistance at pretest, while 96.7% of study group were independent post 8 weeks of implementing the rehabilitation program compared to 50% of control group with statistical significance difference between both groups p-value (0.001**)

Table (6): Correlation between the Total score of patients' knowledge about osteoporosis and their extremity functions, muscle strength, and berg scale scores at pre and post implementation the rehabilitation program (n=60)

Total Physical Activity	Total Patients' Knowledge Score about Osteoporosis			
	Pre-Intervention		Post Intervention	
	r	*p*	*r*	*p*
- **The Upper Extremity Functional**	0.305	0.101	0.513	0.004**
- **The Lower Extremity Functional**	0.327	0.078	0.422	0.020*
- **Muscle Strength**	0.092	0.630	0.579	0.001**
- **Berg Scale**	0.359	0.051	0.350	0.050*

*** p = ≤ .05 (Statistical Significance)**
**** p = ≤.01 (Highly Statistical Significance)**

Table (6) showed no statistical significant positive correlation between patient knowledge about osteoporosis and their extremity functions, muscle strength and berg scale pre implementing the rehabilitation program. While there is a positive statistical significant correlation between the previously mentioned items post implementing the rehabilitation program. This answered the research hypothesis.

Discussion

The current study findings showed that half of the study group and about more than half of the control group were aged from 45 to 54 years. This may be due to this age range represents a critical period when individuals begin to experience significant changes in bone density due to hormonal shifts, particularly individuals within this age range may be more likely to seek medical attention for musculoskeletal discomfort or mobility issues, leading to their inclusion in studies on osteoporosis rehabilitation. The current study was in an agreement with (Mohamed et al., 2024) whose study results showed that more than half of the study participant their age was ranged between 40-45 years.

The current study was in an contradiction with **(Xu *et al.*, 2024)** whose study results showed

that more than half of the study participant their age was more than sixty years and **(Erhan *et al.*, 2020)** who concluded that the majority of study participants were aged more than sixty five years old.

Regarding to gender, the present study found that, about less than two thirds of studied groups were females. From the researcher point of view, these results render to those women may be undergoing premenopause or menopause. The decline in estrogen levels during this period accelerates bone resorption, increasing the risk of osteoporosis and related complications. This agreement with **(Erhan *et al.*, 2020)** who reported that the highest percentage of study sample were females. At the same time, **(Barker *et al.*, 2020)** reported that more than two thirds of the study participants were females.

Concerning to Educational Qualification, the current study concluded that almost half of studied groups were illiterate. This may be explained with limited educational qualifications can pose challenges in understanding health-related information, including the importance of preventive measures, adherence to treatment plans, and engagement in rehabilitation programs. Illiteracy may also contribute to poor health literacy, which is associated with reduced awareness of osteoporosis risk factors, symptoms, and effective management strategies.

This finding is consistent with **(Spångeus *et al.*, 2023)** who found that high percentage of study participants had low educational level

This finding is contradicted with **(Hassan Saleh *et al.*, 2023)** whose study findings reveled that less than two thirds of the study participants were educated. Also contradicted with **(Mohamed Elsyad *et al.*, 2022)** who concluded that more than half of the study sample had elementary educational level.

The current study reported that the vast majority of both groups were married. This finding is consistent with **(Mohamed Elsyad *et al.*, 2022)** who found that high percentage of study participants were married. Also, **(Sahib, 2018)** reported that more than two thirds of study participants were married.

This finding is contradicted with **(Alhouri et al., 2022)** whose study findings reveled that the majority of the participants were unmarried.

The present study found that almost half of study group and more than half of control group belonged to rural areas. From the researcher point of view this may be due to most of the governorate in Upper Egypt is villages with a low degree of health care services and restricted access to medical care. The current study finding was compatible with the study conducted by **(Kang et al., 2021)** who reported that more than half of study participants were from rural areas. The same as reported by **(Choi et al., 2021)** whose study results showed that high prevalence of study participants were reside rural areas.

Concerning to chief complaint, the current study illustrated that half of study groups complained from knee pain, while, half of control group complained from back pain. This can be attributed to the varying biomechanical and anatomical stresses associated with osteoporosis and daily activities. Knee pain is commonly linked to weight-bearing joints that are subjected to repetitive stress during activities such as walking, climbing stairs, and standing for extended periods. This could explain its prevalence in the study group, particularly if the group was more engaged in such activities.

In contrast, back pain, commonly associated with the control group, may result from vertebral compression fractures, a hallmark of osteoporosis. The spine, particularly the thoracic and lumbar regions, is often compromised due to reduced bone density, leading to micro fractures, postural deformities, and chronic pain.

The current study findings similar to the study conducted by **(Haas *et al.*, 2021)**, they found that nearly half of the osteoporosis patients reported knee pain, while a similar proportion of the control group experienced back pain. This highlights the diverse pain experiences associated with osteoporosis and its impact on quality of life.

The current study finding was opposite to the study conducted by **(Haas *et al.*, 2023)** whose study findings showed that more than half of all study participants complained from low back pain and **(Catalano *et al.*, 2017)** who reported that high percentage of patients complaint was low back pain.

Concerning practicing any exercise, the current study findings showed that more than two quarter of both groups had low exercise. It may be explained by, the lack of consistent exercise may stem from a variety of reasons, such as limited awareness of the benefits of exercise, fear of injury, or physical discomfort related to osteoporosis. Physical inactivity is a significant risk factor for decreased bone density, muscle weakness, and poor balance, all of which increase the likelihood of fractures and mobility issues in osteoporotic patients. This finding is consistent with

(Bahtiyarca et al., 2023) who found that two thirds of study participants had lack of exercise.

Regarding to patient exposure their skin to sunshine, the current study findings showed that more than half of study and control groups didn't expose their skin to sunshine. It can be rationalized by considering environmental, cultural, and behavioral factors. This lack of sunlight exposure could contribute to vitamin D deficiency, a known risk factor for osteoporosis, as it impairs calcium metabolism and reduces bone density.

The current study finding was compatible with the study conducted by **(Lee *et al.*, 2021)** who found around two fifth of study participants didn't expose to sunshine. The current study finding was similar to the study conducted by **(Min et al., 2021)** who concluded that near to half of study sample didn't expose to sun daily.

As regards BMI, the current study findings showed that more than half of study group and two thirds of control group were at health weight. This finding also indicates that BMI alone may not fully protect against osteoporosis, as bone health is influenced by a combination of factors, including age, hormonal status, physical activity levels, and nutritional intake of calcium and vitamin D.

The current study finding was opposite to the study conducted by **(Sarker *et al.*, 2022)** whose study findings concluded that more than two fifth were obese. Also, **(El-Masry *et al.*, 2018)** reported that overweight significantly influence at occurrence of osteoporosis.

Regarding to knowledge Total Score level of Osteoporosis Knowledge Assessment Tool (OKAT) after Rehabilitation Exercise Program implementation, the current study findings showed that the vast majority of study group had satisfactory knowledge level regarding osteoporosis. This highlights the effectiveness of educational interventions integrated within the program. This improvement suggests that the structured education provided during the rehabilitation program successfully addressed gaps in participants' understanding of osteoporosis, including its risk factors, prevention, and management strategies.

The current study finding was compatible with the study conducted by **(Hassan Saleh et al., 2023)** who found that educational interventions, including exercise programs, led to substantial improvements in osteoporosis knowledge and self-efficacy among participants. Also, **(Zaki *et al.*, 2022)** reported that a significant percentage of participants improved their understanding of osteoporosis risk factors and preventive measures after educational sessions. Moreover, **(Abumunaser *et al.*, 2024)** reported that more than half of study participants had a good level regarding knowledge of osteoporosis.

Related to mean score of study and control group regarding their muscle strength using upper extremity functional index pre and post rehabilitation exercise program, the current study findings showed there was a marked improvement in the mean score of Muscle Strength for the study group at follow up phases. This result highlights the program's effectiveness in enhancing functional outcomes. Rehabilitation exercises, particularly those targeting resistance and strength training, are known to stimulate muscle hypertrophy and improve neuromuscular coordination. These adaptations are critical for osteoporotic patients, as stronger muscles provide better support for skeletal structures and reduce the risk of falls and fractures.

The current study finding was compatible with the study conducted by **(Kuan et al., 2022)** they found that structured rehabilitation programs, including An 8 weeks of specific back extensor muscle (BEM) strengthening exercises with moderate intensity and higher repetitions (5-8 repetitions for 3 sets; 3 times per week), lead to increase muscle strength and preserve bone density among postmenopausal women. Also, **(Karapinar *et al.*, 2017)** reported that The control groups, which did not engage in structured exercise, showed no improvements, underscoring the necessity of rehabilitation for muscle strength enhancement.

This finding was similar to the study conducted by **(Jahantigh Akbari *et al.*, 2024)** who concluded that exercise therapy notably improves muscle strength, bone mineral density, and quality of life in postmenopausal women with osteoporosis. Moreover, **(Hsu *et al.*, 2024)** reported that significant improvements in shoulder press and knee extension strength, demonstrating the effectiveness of structured resistance training rehabilitation program in this population.

This finding was compatible with the study conducted by **(Alonso Pérez *et al.*, 2021)** who concluded that there was an improvement in mean score of muscle strength after muscle strengthening exercise for postmenopausal women with osteoporosis.

Regarding to Percentage distribution of Study and Control Groups Regarding to Their Berg Balance Scale Pre and Post Rehabilitation Exercise Program, the current study results

revealed significant improvements in the Berg Balance Scale outcomes for the study group compared to the control group after 8 weeks of intervention. Notably, the study group showed higher gains in tasks such as standing without hands, transfers, and standing balance. These findings highlight the effectiveness of the rehabilitation program in enhancing balance and functional mobility.

From the researcher point of view, the results can be attributed to the structured and targeted rehabilitation program, which likely improved muscle strength, postural control, and proprioception in the study group. Regular and guided interventions helped participants practice functional tasks, enhancing their motor coordination and confidence in performing balance-related activities. In contrast, the control group, without similar intervention, showed limited improvement, emphasizing the role of consistent, focused rehabilitation in achieving better functional outcomes.

This finding was compatible with the study conducted by **(Fangxin *et al.*, 2023)** who reported that the Berg Balance Scale (BBS), another measure of dynamic balance, indicated a significant improvement with an MD of 5.31 points, suggesting enhanced balance abilities among participants.

This finding was similar to the study conducted by **(Makarova *et al.*, 2020)**, The study evaluated the effectiveness of a new rehabilitation method combining mechano- and kinesiotherapy for improving balance in patients with osteoporosis (OP) and vertebral compression fractures (VCFs). The study results showed that the physical rehabilitation complex significantly improved balance function in patients with OP and VCFs, correcting pathological shifts in CPV and enhancing stability. Stabilometry and coordination tests were effective in evaluating balance function in this patient group.

The same as reported by **(Zhu *et al.*, 2021)** whose study evaluated the effectiveness of nonpharmacological interventions on balance function in patients with osteoporosis or osteopenia through a network meta-analysis (NMA) of randomized controlled trials (RCTs), they reported that exercise significantly improves balance function in patients with osteoporosis and osteopenia, with balance combined with strength training being the most effective approach.

Concerning Correlation between patient knowledge about osteoporosis and their extremity functions, muscle strength and berg scale pre and post implementing the rehabilitation program, the current study findings showed that positive statistical significant correlation between patient knowledge about osteoporosis and their extremity functions, muscle strength and berg scale post implementing the rehabilitation program.

The positive correlation observed suggests that improved patient knowledge about osteoporosis contributed to better extremity function, muscle strength, and balance post-intervention. Educating patients likely enhanced their understanding of the importance of exercise, posture, and safety, motivating them to actively participate in the rehabilitation program. This increased awareness and engagement may have amplified the program's effectiveness in improving physical outcomes.

This finding was similar to the study conducted by **(Zhang *et al.*, 2022)** who demonstrated that patient education on osteoporosis, combined with targeted exercise programs, leads to significant improvements in muscle strength, balance, and functional performance.

This finding was supported by **(Shojaa *et al.*, 2020)** who reported that strength training has been shown to enhance bone mineral density, increase muscle mass, and improve balance, thereby minimizing the likelihood of falls and fractures these findings align with the observed positive correlation between patient knowledge about osteoporosis and improvements in extremity function, muscle strength, and balance post-rehabilitation.

The same as reported by **(Şahin *et al.*, 2024)** who reported that Increased knowledge correlates with improved physical activity. In a randomized controlled trial, patients receiving educational interventions demonstrated higher Physical Activity Scale for the Elderly (PASE) scores, indicating enhanced physical activity levels

Conclusion

The study findings concluded that the application of the rehabilitation program was effective in improving the functional status among the study group compared to the control group.

Recommendations

- A constant teaching and training sessions should be provided on a regular basis for all osteoporotic patients focusing on weight-bearing, muscle-strengthening as well as balance exercises in

order to enhance muscle strength and reduce fall risk.

- Availability of related posters or brochures at orthopedic department and outpatient clinics given for osteoporotic patients that include rehabilitation exercises, dietary instructions and medication compliance.
- As the orthopedic nurses are responsible for ensuring patients' outcomes, training for them about detection and prevention of osteoporosis risk, rehabilitation excises for osteoporosis should be provided for them.
- To enable results and conclusions to be more broadly applied, the current study should be replicated with a bigger sample from various geographic regions

References

1. Abumunaser, L. A., Abumunaser, I. L., Sharaf, R. M., & Kabouha, Q. (2024). Knowledge and Awareness of Osteoporosis and Its Risk Factors Among the Adult Population in Jeddah, Saudi Arabia: An Analytical Cross-Sectional Study. Cureus, 16(8), e65995.
2. Alhouri, A., Zahrawi, H., Alasaad, S., Alhayek, S. M., Al Houri, H. N., Jomaa, S., ... & Kudsi, M. (2022). Assessing the Knowledge and Attitude towards Osteoporosis among Syrian Women: A Cross-Sectional Study. International Journal of Rheumatology, 2022(1), 6431151.
3. Amin, U., McPartland, A., O'Sullivan, M., & Silke, C. (2023). An overview of the management of osteoporosis in the aging female population. Women's Health, 19, 17455057231176655.
4. Anish, R. J., & Nair, A. (2024). Osteoporosis management-current and future perspectives–a systemic review. Journal of Orthopaedics.
5. Aparisi Gómez, M. P., Vasilevska Nikodinovska, V., Phan, C. M., Petrera, M. R., Sabir, N., & Bazzocchi, A. (2024). Metabolic and Endocrine Disorders.
6. Berg, K., Wood-Dauphine, S., Williams, J. I., & Gayton, D. (1989). Measuring balance in the elderly: preliminary development of an instrument. Physiotherapy Canada, 41(6), 304-311
7. Caldiroli, L., Molinari, P., D'Alessandro, C., Cupisti, A., Alfieri, C., Castellano, G., & Vettoretti, S. (2025). Osteosarcopenia in Chronic Kidney Disease: An Overlooked Syndrome?. Journal of Cachexia, Sarcopenia and Muscle, 16(2), e13787.
8. El Miedany, Y. and E. Miedany (2022). New Horizons in Osteoporosis Management, Springer.
9. Erhan, B. and Y. Ataker (2020). "Rehabilitation of patients with osteoporotic fractures." Journal of clinical densitometry 23(4): 534-538.
10. Fangxin, W., H. Ziqi, H. Ruiyao and W. Yu (2023). "Effects of balance training on balance and fall efficacy in patients with Osteoporosis: A systematic review and meta-analysis with trial sequential analysis." Journal of Rehabilitation Medicine 55.
11. Ismail, M. (2024). Understanding Osteoporosis: Pathophysiology, Risk Factors, Diagnosis, and Management. Advances in Aging Research, 13(3), 25-40.
12. Karapinar, M., Firat, T., & Kirdi, N. (2017). THU0759-HPR Does physiotherapy and rehabilitation program improve mobility and daily living activities in elderly inpatient with osteoporosis? : BMJ Publishing Group Ltd.
13. Khanal, S., Rajbanshi, M., Rana, A., Wagle, S., Aryal, R., Neupane, D. R., & Bhandari, B. (2024). Knowledge, attitude, and practice regarding the prevention of osteoporosis among middle and old-aged women of Kirtipur Municipality, Nepal. Plos one, 19(10), e0312738.
14. Makarova, E., Marchenkova, L., Eremushkin, M., Styazhkina, E., & Razvalyaeva, D. (2020). Efficiency of a new complex rehabilitation method using mechano– and kinesiotherapy for balance disorders correction in patients with osteoporotic compression vertebral fractures. Bulletin of rehabilitation medicine, 97(3), 160.
15. Mohamed, N. S., Elsayed, N. M., & Mohamed, H. A. (2024). Preventive Health Behavior and Osteoporosis Prediction among Perimenopausal Women. Tanta Scientific Nursing Journal, 32(1), 42-66.
16. Porter, J. L., Varacallo, M., & Castano, M. (2023). Osteoporosis (Nursing). In StatPearls [Internet]. StatPearls Publishing.
17. Wang, L., Jiang, J., Li, Y., Huang, J., Wang, R., Liang, Y., ... & Liu, S. (2022). Global trends and hotspots in research on osteoporosis rehabilitation: A bibliometric study and visualization analysis. Frontiers in Public Health, 10, 1022035.
18. Zhang, S., X. Huang, X. Zhao, B. Li, Y. Cai, X. Liang and Q. Wan (2022). "Effect of exercise on bone mineral density among patients with osteoporosis and osteopenia: A systematic review and network meta-analysis." Journal of clinical nursing 31(15-16): 2100-2111