Effect of Retro Walking Versus Balance Training on Pain and Functional Disability of Geriatric Patients with Knee Joint Osteoarthritis: Randomized Controlled Trail

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Abstract

Background: Knee joint osteoarthritis is a prevalent condition among geriatric population, leading to chronic pain and functional disability that significantly impact quality of life. Traditional approaches to managing knee osteoarthritis have included medication, physical therapy, and in severe cases, surgery. However, there is a growing interest in non-pharmacological and non-surgical interventions that can alleviate symptoms and improve functionality. **Aim of the study:** Determine the effect of retro walking versus balance training on pain and functional disability of geriatric patients with knee joint osteoarthritis **Subjects and Methods; Research design:** A randomized controlled trial research design was utilized in this study. **Setting:** The study was conducted at outpatient clinic of rheumatology and rehabilitation department affiliated to Mansoura University Hospital. **Subjects:** A purposive sample of 72 geriatric patients diagnosed with knee joint osteoarthritis were included in the study and randomly divided into three equal groups; training group (retro walking group and balance training group) and control group 24 participant each. **Tools of data collection:** The data were collected through demographic and health-related characteristics interview sheet, Intermittent and constant osteoarthritis pain measure, and Ibadan knee/hip osteoarthritis measure. **Results:** Study findings showed statistical difference in pain and functional disability in the three groups with significantly better improvement in the intervention groups (retro walking and balance raining) compared with the control group (p<0.001). **Conclusion:** Training comprising retro walking as an adjunct to conventional therapy resulted in greater pain reduction and enhanced functional performance of geriatric patients with OA knee. **Recommendation:** For such patients, it is recommended to practice this application as a part of their daily walking action.

Key words: Balance Training, Functional Disability, Geriatric Patients, Knee Joint Osteoarthritis, Pain, Retro Walking

Introduction:

Knee joint osteoarthritis (KOA) is a chronic, progressive condition described as the degeneration of the articular cartilage in the knee joint, accompanied by alterations in the basic bone and other joint structures. This degenerative process leads to pain, stiffness, swelling, and functional impairment [(1)]. The World Health Organization (WHO) estimates that 40% of people over 70 years of age feel pain from knee joint osteoarthritis and as a result fully 25% of this population cannot perform major activities of daily life [(2)].

Over 5 million Egyptians suffer from OA. KOA is characterized by discomfort, stiffness in the morning, decreased mobility, and joint tenderness. Osteoarthritis (OA) of the knee joint may cause severe functional impairments in elderly, affecting their

capacity to carry out everyday tasks and lowering their general quality of life [3].

Knee joint osteoarthritis (OA) is a widespread and debilitating disorder among the geriatric population, characterized by chronic pain, stiffness, and functional disability. As the most communal form of arthritis, knee OA significantly impairs the quality of life and independence of geriatric individuals, posing a considerable burden on healthcare systems worldwide. The management of knee OA in geriatric patients often involves a multifaceted approach, including pharmacological treatments, physical therapy, and lifestyle changes pointed at lessening symptoms and enhancing joint function [2].

Exercise therapy has emerged as a cornerstone in the non-pharmacological management of knee OA, with numerous studies demonstrating its efficacy in reducing pain and enhancing physical function. Traditional exercise interventions often focus on forward walking, strength training, and flexibility exercises. However, innovative exercise modalities such as retro walking (backward walking) and balance training are gaining attention for their potential therapeutic benefits in this population [4].

Retro walking is a unique form of exercise that alters the typical gait pattern, potentially reducing the load on the knee joints and engaging different muscle groups related to forward walking. The distinctive effort may offer specific advantages in terms of pain relief and functional improvement for patients with knee OA. Additionally, retro walking has been suggested to develop proprioception and balance, which are crucial for preventing falls and maintaining mobility in the elderly [3].

Balance training, on the other hand, is designed to improve stability and coordination, which are often compromised in individuals with knee OA due to ache, joint variability, and muscle weakness. Enhanced balance can lead to better functional performance and reduced risk of falls, which are common and serious concerns among the elderly population [2].

Despite the recognized aids of both retro walking and balance training, there is a paucity of research directly comparing these two interventions in terms of their effectiveness to manage pain and functional incapacity in geriatric patients with knee OA. A comparative analysis of these exercise modalities could provide valuable insights into optimizing rehabilitation strategies for this vulnerable group.

Aim of the study:

The aim of the study was to determine effect of retro walking versus balance training on pain and functional disability of geriatric patients with knee joint osteoarthritis.

Research Hypothesis:

- Geriatric patients with knee joint osteoarthritis who engage in the retro walking training or the balance training program will have a significant improvement in pain and functional disability than those who don't.
- Geriatric patients with knee joint osteoarthritis who engage in retro walking training will have a significant improvement in pain and functional disability than those who engage in balance training program.

Subjects and Method:

Research Design:

A randomized, controlled trial (RCT) research design was utilized in this study. RCT is a type of experimental research design that is considered the "gold standard" for evaluating the effectiveness of interventions or treatments in which participants are randomly assigned to either the intervention group or the control group [5].

Study Setting:

This study was carried out at the Mansoura University Hospital's outpatient rheumatology and rehabilitation clinic. It is made up of one level with four specialty clinics for rheumatic and connective tissue illnesses, a pediatric rheumatism clinic, an obesity treatment and follow-up clinic, and a Chinese needles clinic. Additionally, it has two specialty units: One for musculoskeletal examination and the other for physical medicine and rehabilitation.

Study Subjects:

A purposive sample of 72 geriatric patients diagnosed with knee joint osteoarthritis attending in the above-mentioned setting. Initially, geriatric patients attending outpatient's clinic of rheumatology and rehabilitation department at Mansoura University Hospital were recruited. A total of 107 geriatric patients diagnosed with knee joint osteoarthritis were interviewed for eligibility. Those who met the inclusion criteria and agreed to participate in the study were recruited, resulting in a sample size of 72 geriatric patients [**figure (A)**].

To confirm statistical power and account for potential waster, assessment of sample size was completed using research software (https://clincalc.com/stats). According to the results of a similar previously published study done by **Krishnan and Pithadia** [6], that noticed a pronounced improvement in all the 3 treatment protocols with statistically significant improvement for both pain and functional disability at the end of 6 weeks in intragroup analysis for pain using Wilcoxon signed ranks test in the intervention groups (Group A, B, & C) by mean ±SD, of, 27.95 ±9.62, 34.51±12.83, and 33.95 ±11.08 pre intervention respectively, compared to 18.65±6.55, 12.46±4.58, and 19.17±8.29 post intervention respectively. At Power (1-β error probability) = 0.80 and α error probability = 0.05. Then the sample size required is 66 geriatric patients and added 10% due to drop out. Thus, final sample size was 72 geriatric patients. (24 geriatric patients in Retro Walking Training group, 24 geriatric patients in Balance Training group, and 24 geriatric patients in control group).

To be recruited in this study, the participants in the three groups should meet the following criteria: Older adults (aged 60 years or more), have no cognitive impairment (mini-mental state examination score ≥24 [7], regular attendance at the rehabilitation center, not participating in other knee joint osteoarthritis-related intervention or similar intervention, and able to communicate and accept to participate in the research. While, geriatric patients had history of lower limb trauma or surgery in the last 6 months, congenital deformities, other systemic arthritis, elderly with significant chest pain, dyspnea, orthopnea and trouble in walking for 10 min constantly were excluded.

Eligible participants were divided into three equal groups; training group (retro walking and balance training) and control group 24 subjects each, group A (receiving conventional treatment with retro walking training), group B (receiving conventional treatment with balance training), and group C (control group, receiving conventional treatment only). Based on a random order of letters A and B, and C which were written on small cards and reserved in a cover. Then, at the beginning of each week, one card would be chosen out to detect if the intervention should be conducted or it is the period for the control group. Accordingly, all eligible patients would be distributed to either the intervention or the control group. In addition, this method could decree out the likely of information revelation among those patients in the study setting. Due to dropouts, this course persistent until the needed number of each group was realized. Subjects in the intervention group were enrolled to 4 sessions of program according to the steps of the training program.

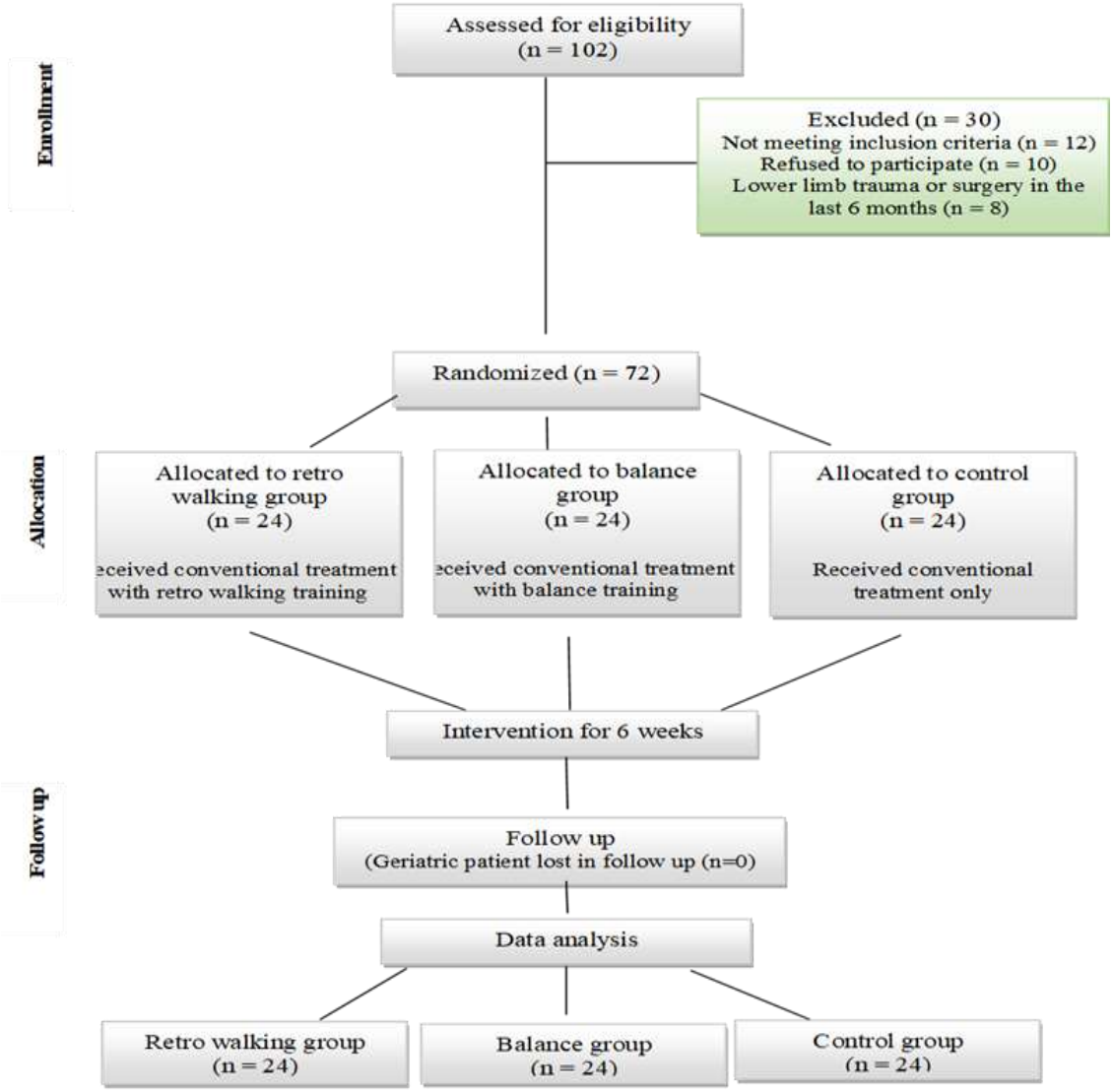

Figure A: Flowchart of the participants enrolled in the study

Tools for data collection:

Tool: Demographic and health-related characteristics interview sheet :

It was settled by the researchers grounded on review of related literatures [8 - 10] and separated into two parts:

- **Part I: Demographic data** such as (age, gender, educational level, source of income, occupation before retirement, and marital status).
- **Part II: Medical health history of the study participants** such as current medical diagnosis, current and past history of chronic disease, family history, previous surgery, medications taken, and current exercise behaviors.

Outcome measures:

- Pain and functional disability of the patients were evaluated by the researchers using **Intermittent and constant osteoarthritis pain measure (ICOAP)** [11, 12] and **Ibadan knee/hip osteoarthritis measure (IKHOAM)** [13]. The patients were assessed at the baseline and then at the end of the intervention at 6 weeks.

Primary outcomes:

- **Pain:** This outcome was measured by **Intermittent and constant osteoarthritis pain measure (ICOAP)**. It is a firsthand tool planned to assess pain in hip/ knee osteoarthritis. The ICOAP knee version was used. It is an 11-item tool proposed to react to recent pain, i.e., pain in the last 7 days. It contains 2 sections-constant pain and intermittent pain. The scores of the two together account for the total pain reported by the patient [(11)]. Knee pain characteristics (constant and intermittent) during the previous week were scored by the Intermittent and Constant Osteoarthritis Pain (ICOAP) instrument (range 0 no pain - 100 extreme pain). Constant and intermittent knee pain was separately categorized into 3 pain levels: 1) no pain (pain score = 0), 2) low pain (0 < pain score < median), and 3) moderate/high pain (pain score ≥ median) [(12)].

Secondary outcomes:

- **Functional disability:** This outcome was measured by Ibadan knee/hip osteoarthritis measure (IKHOAM). It is a 33-item instrument within three domains of activity limitations, participation restrictions, and physical performance test. Activity limitations domain included 25 ADL items that are patient rated. The degree of difficulty and assistance necessary in execution the activities are rated on a 5 point (0-4) ordinal scale. Second, participation restriction domain has three restricted activities in societal participation due to knee/hip OA. The activities restrictions experienced in carrying out the activities are rated on a 4 point (0-3) ordinal scale that are patient rated. Third, physical performance tests domain which contains five tests that are graded by the clinician. These tests are; (1) 250m walk test rated on a 6 point (0-5) ordinal scale, (2) one leg stance test rated on a 6 point (0-5) ordinal scale, (3) stairs climbing test rated on a 5 point (0-4) ordinal scale, (4) squat test rated on a 5 point (0-4) ordinal scale, and (5) balance test rated on a 6 point (0-5) ordinal scale. The maximum score on IKHOAM is 232 (200+9+23). The score was designed in percentage as individual's score/total possible score × 100. It takes about 15 min to accomplish the test [(13)].

Method:

I. Preparatory phase:

- An approval from the Faculty of Nursing, Mansoura University was supplied. Permission was obtained from the director of outpatients' clinic of rheumatology and rehabilitation department Mansoura University Hospital to perform study after being informed about the study purpose and data collection time.
- The tool I of the study (Demographic and health-related characteristics interview sheet) was developed by the researchers after reviewing the related literatures.
- The study tools Intermittent and constant osteoarthritis pain measure (ICOAP) and Ibadan knee/hip osteoarthritis measure (IKHOAM) were transformed into Arabic language by the researchers. The expert in English language, back translation was performed to certify the tools' translation validity.
- By numbers of experts in the related fields of the study (five experts; 3 in gerontological nursing department, faculty of nursing and 2 in Rheumatology and Rehabilitation faculty of medicine - Mansours University), the study tools were verified for its validity. Therefore, the recommended modifications were performed.
- Reliability of the study tools (Intermittent and constant osteoarthritis pain measure

(ICOAP) and Ibadan knee/hip osteoarthritis measure (IKHOAM)) was assured by the degree to which the scores remained constant after numerous administrations for each tool. The r coefficient of 0.87, and 0.83 respectively assured the reliability.

- Before beginning the collection of data procedure, a pilot study was done on ten percent (8) of geriatric patients from outpatients' clinic of rheumatology and rehabilitation department Mansoura University Hospital to determine the study tools' clarity, and applicability. These patients were omitted from the study sample and the necessary modifications performed.
- Subsequent viewing of related literatures and the outcomes of the study participants' pre assessment, the recommended training sessions were developed and implemented for the study participants.
- The researchers created a simple Arabic booklet with illustrations, participants were given printed copies, and high text sizes for presentations. Experts then assessed the credibility for confirming the quality and correctness of the content.
- For ensuring ethical compliance, the study was accepted by the Mansoura University Faculty of Nursing Research Ethics Committee (**Approval No: P.0475**). Every geriatric patient gave their informed consent, underlining their freedom to take away at any stage and the voluntary nature of their participation. The information provided by participants was handled with confidentiality and anonymization, guaranteeing privacy, security, and confidentiality. The fact that their data would only be utilized for study was disclosed to the participants.

II. Implementation phase (Field work):

- The study's multi-step data collection process was carried out between the beginning of June 2023 to the end of November 2023.
- The researchers reviewed the literature before developing the training program for geriatric patients [14 - 19].
- A thorough explanation of the training demonstration was given to each patient, and re-demonstration was conducted. The training was applied to each patient individually. Every week, the researchers spent three days in the outpatient's clinic and apply the training to three to five geriatric patients daily.
- Depending on the geriatric patient's attention span and the necessary tasks that needed to be completed in each session, each one lasted between 25 and 30 minutes.
- At the beginning of first session, the researchers introduce themselves to patients and explain the purposes and content of the training.
- The next sessions, beginning with brief summary about the previous session and answer any questions.
- Training program consisted of 4 sessions, 1 session weekly lasting 25-30 minutes [**Table (I)**].
- After the participants were distributed to their respective groups, they done warm-up exercises followed by the involvement protocol designed for each group and then cool down exercises which involved general body stretching and breathing exercises.
- The exercises were administered by the researchers 3 days per week for 6 weeks. Patients were trained to note any adverse actions such as improved pain,

inflammation, and decreased range of motion and report directly.

Safety Considerations

- Ensure a safe environment with good lighting and non-slip surfaces.
- Have patients wear supportive footwear.
- Provide close supervision, especially for higher-risk exercises.
- Monitor for signs of fatigue or dizziness and adjust accordingly.
- An audiovisual DVD and pictures as well as booklet pertaining to training exercises were provided to geriatric patients in order to assist them in practicing the technique on their own homes. These materials provide instruction and serve as reminders for their daily practice. In addition, patients could join and engage with the researchers via a WhatsApp group or get in touch with them directly in order to reorganize communication and address any queries or worries. Additionally, participants received a weekly phone call from researchers to address any concerns and guarantee that the training exercises ware being applied.
- The time taken with each geriatric patient to fulfill the study tools was ranged from 25-30 m.

Retro walking training (group A)

- **Warm-up (5-10 minutes):**
  - Gentle seated leg exercises (e.g., ankle circles, knee raises).
  - Seated side-to-side movements.
- **Retro Walking Progression (20-30 minutes):**

1. Assisted Retro Walking**:**
   - Start with the individual holding onto a stable surface (e.g., walker, table) and practice taking small, controlled steps backwards.
   - Gradually increase the distance and duration of the retro walking.
   - Provide verbal cues and physical assistance as needed.
2. Unassisted Retro Walking:
   - Have the individual try retro walking without any assistive devices, with the caregiver providing close supervision for safety.
   - Focus on maintaining good posture, taking heel-to-toe steps, and keeping the head up.
   - Vary the terrain, incorporating small obstacles or uneven surfaces to challenge balance.

- **Cool-down (5-10 minutes):**
  - Gentle stretching and relaxation exercises.
- Review the session and provide feedback.
- Encourage the individual to continue practicing retro walking at home.
- The researcher adjusted the intensity, duration, and specific exercises based on the individual's abilities, progress, and any medical considerations. Provided ample rest breaks and ensure the safety of the participant throughout the session.
- The researchers stranded nearby the elderly, offered them moral upkeep, and steered them through the walking path till the elderly were self-assured to walk by self.
- The elderly was also reinforced to raise their speed during the 6 weeks of rehabilitation.

Balance training (group B)

- **Warm-up (5-10 mins):** Light aerobic activity, dynamic stretching.
- **Simple Balance Exercises (10-15 mins):**
  - Side leg raise

- Hip flexion
- Hip extension
- Knee flexion

- **Balance Training (10-15 mins):**
  - Plantar flexion Static balance (e.g. standing on one leg, tandem stance).
  - Dynamic balance (e.g. walking heel-to-toe, turning/pivoting).
  - Perturbation training (e.g. standing on uneven surfaces).
- **Cool-down (5 mins): Gentle movements, deep breathing.**
- Each of these exercises was first done with eyes open and then eyes closed. Static position were maintained for 30 s, 1 set firstly then proceeded to 3 sets by the 6th week.

Table (I): Sessions of the training program

Week	Sessions	
	Retro walking group	**Balance group**
1st week (Theoretical)	- Description of keen joint, brief information about keen joint OA	- Description of keen joint, brief information about keen joint OA
	- Precautions to protect knee joint	- Precautions to protect knee joint
2nd week (Theoretical)	- Importance of practicing exercise to improve pain and disability.	- Importance of practicing exercise to improve pain and disability.
	- Overview about retro walking training	- Overview about balance exercise training
3rd week (Practical)	- Warm-up exercises - Assisted Retro Walking	- Warm-up. - Simple Balance Exercises
	- Demonstration of retro walking by researchers and re-demonstration was done by the elderly	- Demonstration of balance exercise by researchers and re-demonstration was done by the elderly
4th session (Practical)	- Unassisted Retro Walking - Cool-down exercises	- Balance training exercises - Cool-down exercises
	- Demonstration of retro walking by researchers and re-demonstration was done by the elderly	- Demonstration of balance exercise by researchers and re-demonstration was done by the elderly

Control group (Group C):

Participants in the trial who were assigned to the control group were received the traditional rehabilitation program provided in the outpatient clinic. In accordance with research ethics, geriatric persons who participated in the study were given a one-hour summary of the key subjects covered in the other groups, along with answers to any questions they may have had. The educational booklet was also distributed.

III. Evaluation Phase:

Evaluation of the program: Evaluation of the program was done after 6 weeks after implementation of the training program.

Statistical analysis:

Data were analyzed using Statistical Package for Social Science, Version 22. Whereas categorical data were unfilled as numbers and percentages, continuous variables were unfilled as means and standard deviations. The one-way analysis of variance (ANOVA) is used to decide whether there are any statistically significant differences between the means of two or more independent (unrelated) groups The Chi-square test and Fisher's exact test were cast-off for three group comparisons in term of baseline demographic and health-related data. The repeated measures ANOVA test was used to compare differences in term of the research

consequences with different measures of the same variable between the study groups. Paired t test was used to compare pre and post the intervention in each group. Pearson's correlation coefficient was used to test correlation between variables. A post-hoc test is done to identify exactly which groups differ from each other. The significant level was fixed at 0.05 or less.

Results:

Table (1): Shows demographic characteristics of the studied geriatric patients. A total of 72 geriatric patients were included in this trail. The studied geriatric patient mean age was 68.52±5.36. Male constituted 54.2% of the study participant, 62.5% were married, 31.9% had secondary educational. Geriatric patients who work before retirement was 58.3% of participants, 73.6% were hadn't enough monthly income and 47.2 were lived with husband. The result shows that there is no statistically significant differences between the three groups concerning demographic characteristics as p = <0.05 for all.

Table (2): Shows the medical history of the studied geriatric patients in the three groups. It was found that body mass index (BMI) was 25.34±4.18. The duration of osteoarthritis was 6.18±2.76 years. Right knee was the most affected in more than half of the study participant (51.4%). Presence of comorbidity was reported by (77.8%) of the studied geriatric patients. The result shows that there were no statistically significant differences between the three groups regarding medical history as p = <0.05 for all.

Table (3): Shows the comparison pain score among the studied geriatric patients in the study groups in the study occasions (Pre and post). It was found that there were no statistically significant differences between study groups before the program as p=<0.05. While there were statistically significant differences between study groups post intervention in all pain domains (constant, intermittent pain, and total pain) as p=<0.001. It is also observed from the table that, there was significant reeducation in pain score in the three groups in intragroup analysis compared pre- and post-6 weeks in each group (p=<0.001).

Figure (1): Shows comparison of constant pain level among the studied geriatric patients in the study groups. It was found that in retro walking group had 54.2% moderate/high constant pain pre that reduced to 8.3% post intervention, similarly in balance group reduced from 50.0% to 16.7%, but slightly reducing in control group from 41.7% to 25%.

Figure (2): Shows comparison of intermittent pain level among the studied geriatric patients in the study groups in the study occasions, it was found that in retro walking group had 41.7% moderate/high intermittent pain pre and reduced to non (0.0%) post intervention, similarly in balance group reduced from 50.0% to 4.2%, but slightly reducing in control group from 54.2% to 37.5%.

Table (4): Shows Comparison of functional disability among the studied geriatric patients in the study groups in the study occasions (Pre and post). It was found that there were no statistically significant differences between groups before the intervention as p=<0.05. While there were statistically significant differences between groups post the intervention as p=<0.001** in activity limitation, participation restriction, and physical performance. It is also observed from the table that, there was significant improvement in functional performance the three groups in intragroup analysis compared pre- and post-6 weeks in each group (p=<0.05).

Table (5): Post hoc analysis for pain and physical function in the studied geriatric patients in the study groups. Therefore, the multiple comparison tests indicate that Retro walking versus balance group were highly significant regarding pain and physical function as p= 0.048* and

0.014* respectively. Post hoc analysis with Bonferroni correction shows that retro walking showed a statistical significance in pain and physical function compared to balance training and conventional therapy ($p < 0.05$) implying the superiority of retro walking training. However, statistical significance was observed on comparing conventional therapy with balance training ($p < 0.05$).

Table (6): Correlation between the study variables after the training program of the retro walking and balance groups. It was found that there was positive correlation between pain and physical function in both groups as r= 0.899, & 0.729 respectively.

Discussion:

Knee joint osteoarthritis (KOA) is a potentially crippling condition that mainly affects older persons. It has negative properties on their life quality on the physical, social, and psychological levels. Osteoarthritis (OA) is a civic health problem that has a great economic, mental, and expressive cost for patients. KOA has a noteworthy harmful effect on patients' lives and is interrelated with pain, functional disability, need, worry, and depression. It also compromises interpersonal relationships, physical and mental status, and causes disability due to chronic pain [(20)]. Exercise therapy is basic treatment in KOA and is strongly recommended as 1st line treatment by international strategies with strong proof supporting its effectiveness [(21, 22)]. Exercise-based interventions are often suggested to manage symptoms, but the comparative effectiveness of different exercise approaches is not well-established [(23)]. Therefore, this study aimed to determine effect of retro walking versus balance raining on pain and functional disability of geriatric patients with knee joint osteoarthritis.

The present study's results set our expectations, as it was illustrious that the retro walking versus balance training program were highly effective strategies for reducing pain and functional disability in geriatric patients with knee joint osteoarthritis. Interestingly, geriatric patients who promised in the retro walking program evidenced a relatively great progress than those in the balance program. These findings confirm to the study's accomplishment of its aim and validate the success and applicability of the interventions.

Knee osteoarthritis (KOA) pain is a subjective and individual experience, building it challenging to characterize patients' experiences and evaluate their pain [(24)]. KOA pain is a major contributor to disability and reduced quality of life in the elderly population that can significantly limit mobility, physical activity, and the ability to make activities of daily living [(25)]. This study revealed that the studied geriatric patient suffered from moderate constant and intermittent pain pre the intervention. Similar average knee pain intensity level was supported by the research of **Carlesso et al.** [(26)]; **Hoteit et al.** [(27)]; **Pan et al.** [(28)]; **Davison et al.** [(29)]. Moreover, the studied geriatric patient suffered from physical disability as reflected in lower mean score of activity limitation domain, participation restriction domain, and physical performance test. Several studies supported lower physical task in elderly with KOA [(30 - 32)].

The primary causes of pain and physical disability in geriatric people with knee osteoarthritis (KOA) include: Structural Joint Change (Cartilage degeneration and loss, Bone spurs (osteophytes) & Joint deformity), Muscle Weakness and Instability (Quadriceps muscle weakness & Reduced sense of joint position and movement), Synovial inflammation, Comorbid Conditions and Psychosocial Factors (Depression and anxiety, Pain catastrophizing & Maladaptive coping strategies). The interplay of these structural, neuromuscular, inflammatory, comorbid, and psychosocial factors contributes to the complex pain

experience and functional limitations observed in geriatric individuals with knee osteoarthritis [33]. Supporting this, **Gazar et al.** [34] and **Foo et al.** [35] who reported that majority of the patients with knee OA had moderate level of knee pain and functional disability in daily living.

Since there is no identified therapy for knee OA, the main objectives of cure are to reduce pain, maintain functional independence, and improve quality of life. Based on the guidelines of the Osteoarthritis Research Society International (OARSI), patients with OA knees should engage in frequent walking programs to enhance their ability to perform daily duties. Walking has been shown to reduce discomfort, increase functional ability, and activate the knee muscles [36]. Additionally, various researches have shown that OA knee affects joint proprioception, which impairs a person's ability to balance and come to the conclusion that balance exercises aid in improving kinesthetic state and neuromuscular coordination [37 - 39]. The research provided shows that retro walking and balance training are beneficial for knee OA recovery. The current research therefore was performed to highlight the effects of retro walking and balance training as assistants to the conservative exercise protocol.

Walking is an activity that has been created and refined over decades and is one of the primary functions of people. It is a widely advised, risk-free form of physical activity [30]. Retro walking is still an uncommon chore for most people despite this. Compared to forward walking, it entails reversing leg actions, changing trajectories, and having entirely different biomechanics. Backward walking has been shown to have numerous positive benefits, including increased knee extensor muscle stimulation and proprioception, muscle reflex initiation, altered motor control pattern, decreased stride length and gait speed, decreased knee joint stresses, and raised hamstring and back muscle flexibility [40,18]. It is also advised to lessen sting and functional disability and improved quadriceps muscle strength and performance in individuals with knee OA [9]. The reversal of movement in retro walking results in greater demand placed on the ankle joint to assist in foot clearance, especially with the role reversal of the muscles to extensor activation pattern.

Retroactive walking also counteracts the external knee adduction moment that occurs during forward walking, which causes crop armies and firmness of the knee's medial compartment. Foot contact idea to ground reaction powers are produced by the hip and knee extensor muscles working in tandem with the ankle muscles, according to biomechanical study and EMG research. By doing this, the powers acting on the knee joint are lessened, especially the compressive forces on the patella. Retro walking has also been demonstrated for enhance neuromuscular coordination and balance [10]. Our study clearly shows how these methods have improved knee OA patients' functional performance and helped to reduce discomfort.

In the same context, **Alghadir et al.** [9], **Shabbir et al.** [41] reported that 6-week retro walking program compared with forward walking or control groups caused greater reduction in pain and functional impairment and enhanced quadriceps muscle strength and performance in individuals with knee OA. Also, **Krishnan and Pithadia** [6] concluded that 6-week rehabilitation protocol comprising retro walking as an adjunct to conventional therapy resulted in greater pain reduction and enhanced functional performance of patients with knee OA than balance training. Moreover, recent RCT done in Egypt by **Omar et al.** [42] revealed Retro walking added to conventional is an effective usage method to relieve pain among patients with mild and moderate degrees of knee osteoarthritis.

This study also addresses the significance of proprioception and balance because of compelling findings. For targeted balance benefits, traditional therapy was supplemented with target-specific training in the study of **Ahmed** [43], **Moitra and Sharma** [44] who identified the benefits of balance restoration in individuals with osteoarthritis (OA) in the knee. Recent systematic review from 2022 done by **Pirayeh et al.** [45] concluded that balance exercises significantly enhance balance and functionality in knee OA patients and advised that rehabilitation of knee OA patients should integrate balance training as a part of their ordered protocol. Those evidences care the results of the present study and the significance of balance exercises.

Furthermore, improvement in control group observed in our study though lesser than the experimental group may be due to the fact that exercise involved in conventional treatment do stimulates proprioception. This result was supported by **Ganu and Merchant** [46], **Menaka et al.** [47], and **Shabbir et al.** [41].

Pointed to correlation between the study variables, the results showed a highly statistically significant relation between pain and functional limitation. This result may be due to knee pain can limit the patient's ability to move the joint and engage in physical activity, leading to muscle weakness, joint stiffness, and reduced range of motion. This impairment in joint function and mobility directly translates to reduced functional capacity and increased difficulty with everyday tasks. In the same line, **Prado et al.** [20], **Faonbi et al.** [48], and **Iijima et al.** [49] reinforced our results.

Nevertheless, from our knowledge, this study was the first in Egypt to evaluate the effectiveness of retro walking versus balance training on pain and functional disability of geriatric patients with knee joint osteoarthritis. According the findings of the present study, all the three protocols used for rehabilitation of KOA promoted the patients when the study parameters were compared pre- and post-6 weeks. The study established that retro walking along with conventional therapy more effectively enhanced the performance of knee OA patients with detail to pain and functional disability when compared to balance training and conventional therapy. This study also exhibited that balance training was superior to conventional therapy.

Conclusion:

Rehabilitation of either retro walking or balance exercise is effective in controlling pain and functional disability in geriatric patient with knee osteoarthrosis than conventional therapy. Interestingly, these findings evidenced the superiority of retro walking training to be a brilliant adjunct to conventional therapy for the rehabilitation of OA knee geriatric patients.

Recommendations:

- Health care providers should educate patients on the aids of both retro walking and balance training, and encourage them to incorporate these exercises into their daily walking activity for optimal outcomes in managing knee joint osteoarthritis.
- Health care providers have to be reinforced for integrating such programs (retro walking and balance training) in rehabilitation program in geriatric patients with knee joint osteoarthritis to reduce pain and functional disability.
- Further researches in this regard should be measured with large samples to authenticate the findings in order to raise the likelihood of the result generalization.

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Table (1): Demographic characteristics of the studied geriatric patients

Item	Total		Retro walking group		Balance group		Control group		Test of significance	
	No	%	No	%	No	%	No	%	χ^2	p
Age (Years)										
Mean ±SD	68.52±5.36		68.58±3.843		67.750±6.00		68.58±3.843		F=0.463	0.631
Sex										
Male	39	54.2	13	54.2	14	58.3	12	50.0	0.336	0.845
Female	33	45.8	11	45.8	10	41.7	12	50.0		
Marital status										
Married	45	62.5	14	58.3	16	66.7	15	62.5	0.356	0.837
Unmarried	27	37.5	10	41.7	8	33.3	9	37.5		
Educational level										
Illiterate	18	25.0	5	20.8	7	29.2	6	25.0	3.261	0.776
Below secondary	16	22.2	4	16.7	5	20.8	7	29.2		
Secondary education	23	31.9	10	41.7	8	33.3	5	20.8		
University education	15	20.8	5	20.8	4	16.7	6	25.0		
Occupation before retirement										
Work	14	58.3	14	58.3	17	70.8	14	58.3	1.067	0.587
Don't work	10	41.7	10	41.7	7	29.2	10	41.7		
Monthly income										
Enough	19	26.4	4	16.7	7	29.2	8	33.3	1.859	0.395
Not enough	53	73.6	20	83.3	17	70.8	16	66.7		
Living condition										
With husband	34	47.2	11	45.8	13	54.2	10	41.7	FE=2.049	0.727
With the family	25	34.7	10	41.7	7	29.2	8	33.3		
With one of the children	13	18.1	3	12.5	4	16.7	6	25.0		

F: ANOVA, χ2: Pearson's chi-square test, FE: Fisher Exact Test

Table (2): Medical history of the studied geriatric patients in the three groups

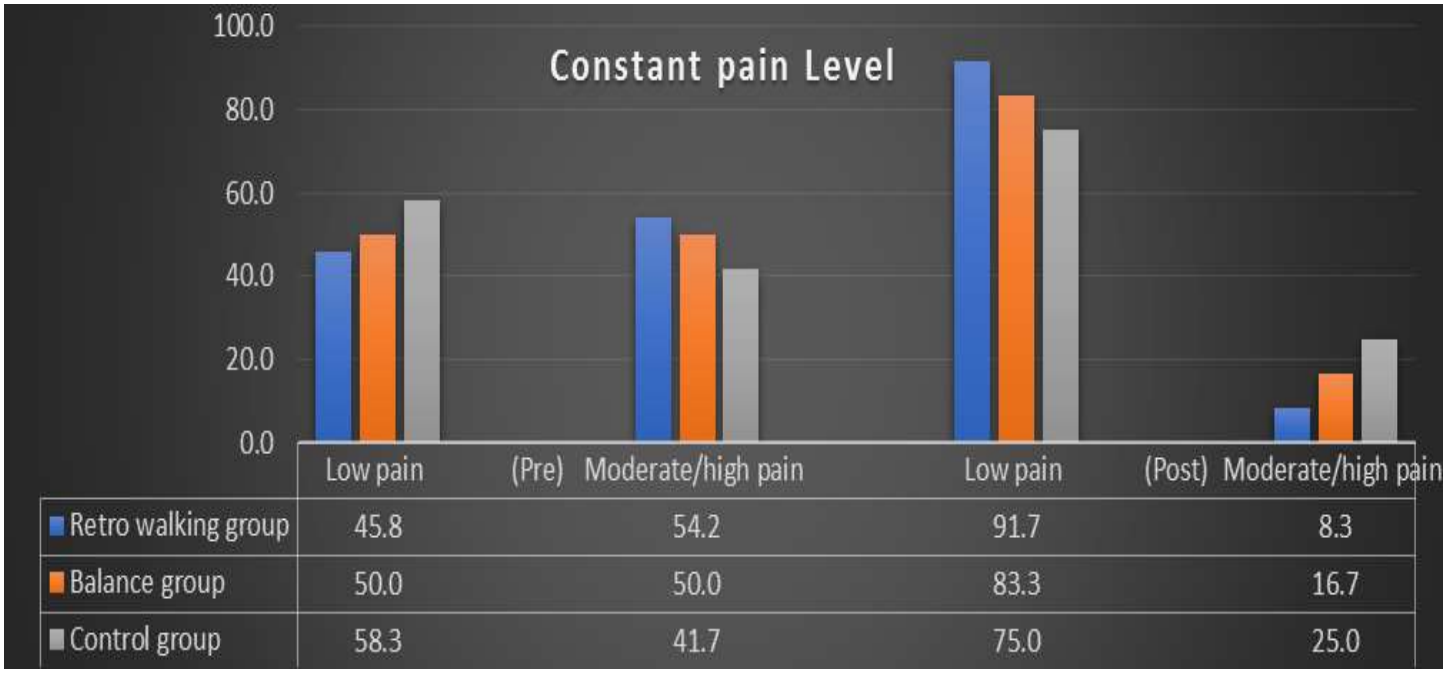
Item	Total		Retro walking group		Balance group		Control group		Test of significance	
	No	%	No	%	No	%	No	%	F/χ^2	p
BMI										
Mean ±SD	25.34±4.18		25.25±3.89		24.33±4.25		26.43±4.29		1.533	0.223
Duration of OA										
Mean ±SD	6.18±2.76		5.5±2.54		6.25±2.89		6.79±2.8		1.339	0.269
Affected Knee										
Right	37	51.4	15	62.5	11	45.8	11	45.8	1.779	0.411
Left	35	48.6	9	37.5	13	54.2	13	54.2		
Presence of comorbidity										
No	16	22.2	7	29.2	6	25.0	3	12.5	2.089	0.352
Yes	56	77.8	17	70.8	18	75.0	21	87.5		

F: ANOVA, χ2: Pearson's chi-square test,

Table (3): Comparison of Pain score among the studied geriatric patients in the study occasions (Pre and post)

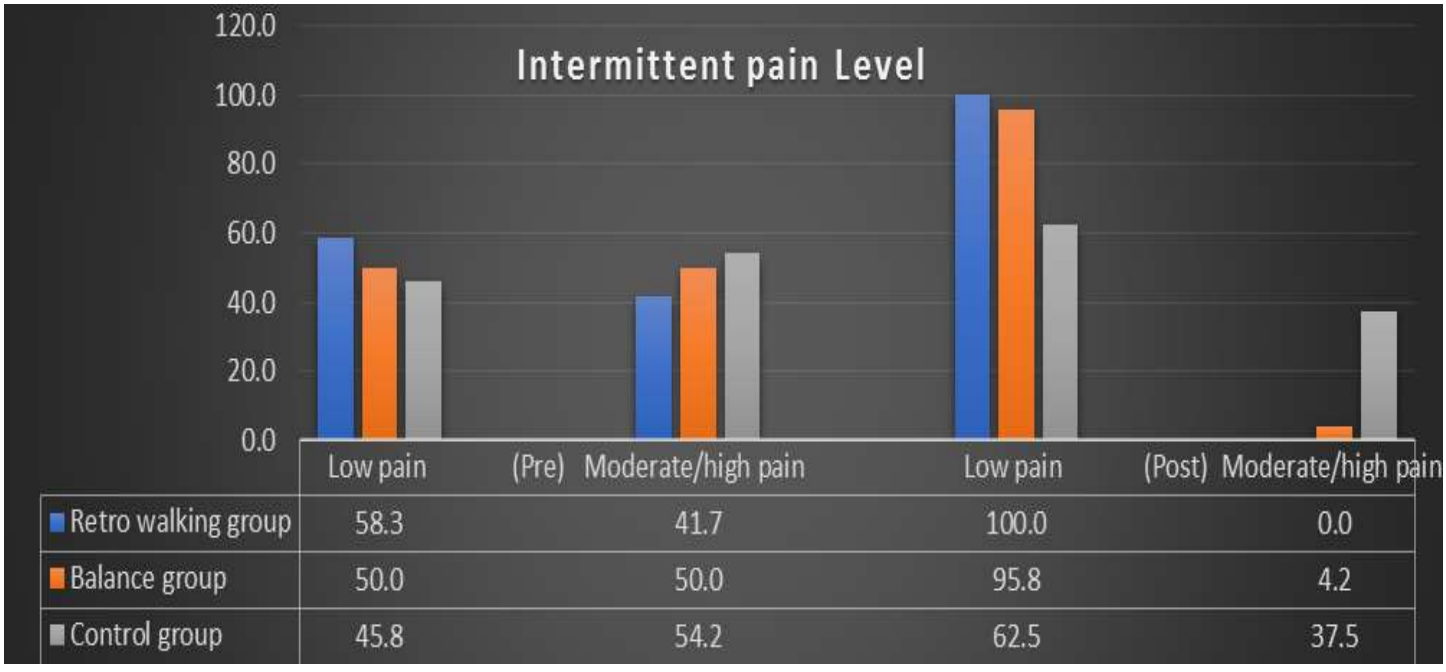
Item		Retro walking group	Balance group	Control group	Test of significance	
		Mean ±SD	Mean ±SD	Mean ±SD	F	P
Constant pain	**Pre**	45.63±11.55	47.92±13.1	45.00±10.43	0.411	0.665
	Post	24.17±10.39	33.46±12.02	37.5±10.43	9.320	(<0.001) **
t test / p		19.420 / (<0.001) **	10.574/ (<0.001) **	8.724/ (<0.001) **		
Intermittent pain	**Pre**	50.52±13.42	52.08±15.15	50.87±22.52	0.053	0.949
	Post	24.65±8.59	29.06±8.8	39.46±22.99	8.117	(<0.001) **
t test / p		12.169/ (<0.001) **	8.038/ (<0.001) **	5.493/ (<0.001) **		
Total pain	**Pre**	48.07±9.95	50±9.85	47.93±12.46	0.273	0.762
	Post	24.41±7.54	31.26±8.1	38.48±12.46	12.840	(<0.001) **
t test / p		17.011/ (<0.001) **	13.493/ (<0.001) **	8.254/ (<0.001) **		

F: Repeated ANOVA, t: Paired test



	Low pain (Pre)	Moderate/high pain (Pre)	Low pain (Post)	Moderate/high pain (Post)
Retro walking group	45.8	54.2	91.7	8.3
Balance group	50.0	50.0	83.3	16.7
Control group	58.3	41.7	75.0	25.0

Figure (1): Comparison of constant pain level among the studied geriatric patients in the study groups



	Low pain (Pre)	Moderate/high pain (Pre)	Low pain (Post)	Moderate/high pain (Post)
Retro walking group	58.3	41.7	100.0	0.0
Balance group	50.0	50.0	95.8	4.2
Control group	45.8	54.2	62.5	37.5

Figure (2): Comparison of intermittent pain level among the studied geriatric patients in the study groups

Table (4): Comparison of functional disability among the studied geriatric patients in the study occasions (Pre and post)

Item		Retro walking group	Balance group	Control group	Test of significance	
		Mean ±SD	Mean ±SD	Mean ±SD	F	P
Activity limitation	Pre	48.04±2.2	47.71±9.17	51.33±12.62	1.164	0.318
	Post	72.5±4.75	62.63±15.94	56.75±12.72	10.405	(<0.001) **
t test / p		19.804/ (<0.001) **	5.912/ (<0.001) **	2.630/ (0.015) *		
Participation restriction	Pre	49.29±1.33	50.92±12.42	56.96±16.35	2.776	0.069
	Post	73.29±1.55	65.54±15.66	60.29±12.06	7.833	0.001**
t test / p		76.733/ (<0.001) **	6.164/ (<0.001) **	2.186/ (0.039) *		
Physical performance	Pre	32.64±3.62	31.2±7.73	32.46±8.85	0.297	0.744
	Post	42.48±5.31	36.92±9.37	34.53±7.12	7.184	0.001**
t test / p		8.103/ (<0.001) **	4.120 / (<0.001) **	2.532/ (0.019) *		
Total	Pre	43.33±1.29	43.27±8.34	46.92±10.45	1.742	0.183
	Post	63.45±3.36	56.92±10.81	50.52±7.15	16.780	(<0.001) **
t test / p		27.543/ (<0.001) **	6.381/ (<0.001) **	2.833/ (0.009) **		

F: Repeated ANOVA, t: Paired test Higher score lower functional disability.

Table (5): Post hoc analysis for Pain and Physical function in the studied geriatric patients in the study groups

Group	Pain			Physical function		
	Post hoc analysis (Bonferroni)			Post hoc analysis (Bonferroni)		
	Mean Difference	95% CI	Sig.	Mean Difference	95% CI	Sig.
Retro walking versus balance group	6.85	0.034-13.66	0.048*	6.53	1.06-12.00	0.014*
Retro walking versus control group	14.07	7.25-20.88	<0.001**	12.92	7.45-18.39	<0.001**
Balance versus control group	7.22	0.41-14.03	0.034*	6.39	11.86-0.92	0.017*

*. The mean difference is significant at the 0.05 level.

Table (6): Correlation between the study variables after the training program of the retro walking and balance groups

Variable		Physical function	
		Retro walking group	Balance group
Pain	r	0.899	0.729
	p	(<0.001) **	(<0.001) **

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