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Effect of a Pedometer Based Aerobic Walking Program on Pain and Function among Elderly Patients with Knee Osteoarthritis

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Abstract
Background: *Knee osteoarthritis (KOA) contributes to disability more than other type of arthritis because it affects on the elderly patients' daily living activity level and increases the level of dependency on their caregivers. Walking is a simple and safe form of isotonic exercise that can be effectively used to decrease knee joint pain, enhance the joint function.* ***Objective:*** *evaluate the effect of aerobic walking program on pain and function of elderly patients with KOA.* ***Methods:*** *randomized control research design was used in this study. Purposive sample of the present study composed of 66 elderly patients of both sexes who met inclusion criteria and divided alternatively into two equal groups.* ***Results****: before the application of aerobic walking program the result indicates that, WOMAC average score in study group was 78.2±13 and for control group was 79±15.6 with no significant difference between both groups P= 0.609. After application of aerobic walking program, a significant improvement in mean total WOMAC score was found in study group (27.6±14.5) than control group (79.8±15.9) (P= 0.000).* ***Conclusion****: Based on findings of the current study, we can conclude that aerobic walking program was successful in improvement of function and decreasing knee pain.*
Keywords : *Elderly patients, Aerobic Walking, Pain, Function, Knee Osteoarthritis.*

Introduction

Osteoarthritis (OA) is a degenerative chronic disorder which has multiple etiology and characterized by cartilage loss, bone margins hypertrophy and sclerosis of the sub-chondral. It is also known as the degenerative disease affecting joints of extremities and spine particularly of weight bearing joints. Progression of knee osteoarthritis (KOA) is usually associated with debilitating and gradual loss of the strength of thigh muscle, decreasing function of knee joint, and mass index of the body. Patient suffering from OA usually complains of pain and stiffness after work or standing for long time. Knee osteoarthritis not only affects health status of the elderly patients physically but also emotionally and socially. It is one of the leading causes for decreasing health status, increasing level of dependency and absence of the elderly patients from workplaces, social gatherings, and festivities (Chmelo et al, 2013; Peeler et al, 2015& Tondare et al., 2017).

Aging is one of the most considerable etiological factors for KOA. It is supposed that the cause was due to cartilage 'wear and tear' through continued mechanical stress (Kristen, 2014). No cure for KOA has been found; rather, current treatment concentrates on slowing the disease progression and management of the symptom (Akhavan etal., 2018). KOA treatment can be divided to nonsurgical or surgical treatment. Non-

surgical treatment comprises pharmacological, and non-pharmacological therapy. Pharmacological treatment may involve the useage of paracetamol, oral or topical non-steroidal antiinflammatory drugs (NSAIDs), or intra-articular corticosteroids. Non-pharmacological treatment comprises weight loss, aquatic, aerobic, and resistance exercises recommended based on individual patient ability preference (Schlenk& Shi., 2019).

Aerobic walking is a simple and safe type of isotonic training that can be efficiently used to decrease pain of knee joint, improve function of joint, and enhance the strength of thigh muscle even in the most serious elderly patient having overweight with KOA and eventually helping for improving functional capacity, health status, and social comfort. Simple and affordable pedometers are generally considered practical for elderly patients as they provide a summary of the daily number of steps and improve exercise tolerance (Peeler et al, 2015; Chang et al, 2015& Gucuk and Erkuran, 2017).

MATERIALS AND METHODS

This randomized controlled study was conducted in rheumatology rehabilitation department outpatients clinic affiliated to Mansoura University Hospital. The researcher obtain an ethical Approval from the committee of the research ethics of the Nursing Faculty – Mansoura University. An informed written consent was obtained from the participants at baseline. The criteria of inclusion involved age 60 years old and above, diagnosed with knee osteoarthritis lasting more than one year, agree for study participation, able to or (have caregiver who can) speak, read, and write, and available for telephone follow-up. Elderly patients using assistive device during ambulation, elderly patients with a history of traumatic hip, knee, or ankle injury or surgery within the last year, elderly patients with a history of cardiovascular disease, and elderly patients undergoing hemodialysis, elderly patients who have osteoarthritis complications, elderly patients with other type of osteoarthritis were excluded. Sixty six patients meet inclusion criteria and agreed to participate in the study. Each patient was assigned a number ,then patients were randomly assigned by the study nurse into two equal groups using Microsoft Excel (Simple RAND). All participants , physicians and nurses (except research team) were blinded to group assignment. Data collection cover four months, begins from April 2019 and ends in August 2019.

Measurement of variables:

The researcher used three tools in this study. Tool I Sheet of Structured Interview Schedule that the researcher developed relying on relevant literatures review **(Stempky., 2015& El fadawy et al., 2018)** and divided into two parts: part 1: demographic data as gender, age, level of educational, occupation before retirement, marital status, income source. part 2: medical health history of the studied elders as current medical diagnosis, present and past history of chronic disease, family history, previous surgery, current medications, and current exercise habits.

Tool II Western Ontario and McMaster Universities Osteoarthritis scale (WOMAC). This scale was developed by **Bellamy et al, (1988)**. It is originally designed to evaluate the symptoms of stiffness, physical function and pain in patients having KOA. It was translated into Arabic language by **Guermazi et al, (2004)**. This scale consists of three domains namely pain, stiffness, degree of difficulty in accomplishing daily life activities. Total score range from 0 to 4, a score of zero for none, a score of 1 for mild degree, a score of 2 for moderate degree, a score of 3 for severe degree and a score of 4 for extreme degree. Likert scale scores for each domain was calculated by summing item scores and dividing by the number of items in each domain, transformed to a percent through dividing the total by the items number, then multiplying the result by one hundred. Higher scores in the WOMAC reflecting more stiffness, pain and poorer physical function **(Guermazi et al, 2004& Raeissadat et al, 2017)**.

Tool III: Aerobic Walking Exercise Flow Sheet which was developed by the researcher based on thorough recent literature review. It was used to follow up step count weekly. Step count was assessed in this study using a pedometer. The main objective of the program of aerobic walking for studied elders is to improve daily step-count mean by three thousand accumulated steps more than their baseline score on 5 days per week or above. This score is relied on the belief that walking at moderate pace making one hundred steps per minute, so three thousand steps equal to about thirty minutes of physical activity at moderate pace, agreeing with recent recommendations of physical activity. Mean weekly Step count was categorized into four levels: a) sedentary with only basal activity had less than 2500 step per day, b) sedentary with limited activity had 2500 – 4999 step per day, c) low active had 5000-7499 and d) active had ≥ 7500 step per day **(Tudor locke et al, 2011)**.

Content validity and reliability

The researcher test all tools and booklet for validity of the content by a panel of 7 experts in the fields of Gerontological Nursing, Medical Surgical Nursing, Physical Medicine, Rheumatology and Rehabilitation, as a jury to test its content validity and feasibility and necessary modification were done.

Control group

They received routine hospital care which includes taking patient history, physical examination, answering patient queries. After finishing the data collection the control group was interviewed and instructed about all items of aerobic walking program ,also they received a colored Arabic booklet as a disease guide and pedometer

Study group:

They were subjected to routine care, educational sessions about pedometer self monitoring, aerobic weekly step count goals and weekly telephone follow up.

The theoretical and practical content were presented to patients in the form of sessions using educational booklet which aims to improve patient's knowledge level based on patient knowledge deficit and their learning needs, In addition to demonstration and re demonstration of practical contents. They took 2 hours distributed on four sessions at first day , after 1 week , at week 4 and at week 8. Patients received their individualized daily step count goals every week to increase gradually by 10% of baseline steps/d for weeks 2-12. Patients were taught to walk at a cadence of 100 step \ minute which elicit a moderate, noticeable increase in depth and rate of breathing, while patient can talk with slight effort. A valid measurement of the day means more than three hundred steps and pedometer wearing at least eight hours during the day while the patient is awaken. Readings of < three hundred steps per day were omitted, because they mean that the pedometer wasn't worn and the inclusion of them would result in inaccurate estimation of daily steps. Patient received weekly telephone call that last for 10 to 15 minutes and it aimed to the following: recording patient previous 7 days step count reading, give the patient feedback about readings, providing the patient with the new step count goals, discuss with patient barriers for pedometer use or walking , participate with patient to provide alternative plans to increase walking and motivate patient to increase walking (benefits & risks).

Statistical analysis

Data was stored and analyzed using the "SPSS" 16.0. The P value of < 0.05 indicate a significant result. Mann–Whitney U test was used between group analysis and the Wilcoxon test was used within-group analyses.

Results

In the present study no significant differences were found between study and control groups in relation to demographic characteristics and health history data Regarding demographic characteristics, females were more prevalent in the study group, they constituted 63.6% of the study group comparing to 48.5% of the control group, 81.8% and 78.8% of the study and control group subjects respectively were aged from 60->70 years old, 78.8% and 66.7% respectively were married and university education was prevailing among 51.5% and 45.5% of the study and control groups respectively. Furthermore, 87.9% and 69.7% of the study and control groups respectively have an adequate source of income, and 81.8% of the study group compared to 84.8% of the control group were living with the family (table1). For medical history, 48.5% of study group and 42.4% of control group had KOA for less than 5 years. Also 90.9% and 81.8% of the studied elders in both study and control group respectively reported OA in both knees, 93.9% and 93.3% of the studied elders in both study and control group respectively didn't perform any type of physical activity, 90.9%, and 93.9% of the studied elders in both study and control group respectively followed pharmacological treatment for KOA. Furthermore, 48.5% of the study group compared to 42.4% in control group had one associated disease (table2). At baseline, the mean step count for study group was 1494.7± 975.7 and for control group was 1481.2 ± 791.3 with no significant difference in mean step count between both groups at base line (p= 0.658). At end of study, the mean step count for study group was 5086.6± 2298.33 with significant difference from base line (p= 0.000*) and for control group was 1465.6± 799.35 with no significant difference from baseline (p= 0.492). In addition a significant difference was found at the end of study between both study and control groups regarding mean step count (p= 0.000*) (Table 3). At first week, 78.8% of elderly patients in study group and 87.9% of elderly patients in control group were in sedentary category and no patients in both groups were in active level with no significant difference between both groups (P= 0.322). At the end of study

90.9% of elderly patients in control group were in sedentary level while 15.1% of elderly patients in the study group were in active level with statistically significant difference between both groups (P= 0.000*) (Table 4).

Before application of the proposed program, WOMAC average score in study group was 78.2±13 and for control group was 79±15.6 with no significant difference between both groups (P= 0.609). There was no significant difference between two studied groups regarding WOMAC items score. After application of the proposed program, there is a significant improvement in all WOMAC items score in study group. Also a significant improvement in mean total WOMAC score was found in study group (27.6±14.5) than control group (79.8±15.9) (P= 0.000) (Table 5).

Table (1): Demographic characteristics of the studied elderly patients in both groups

Items	Study group		Control group		Significance test P value
	n= 33	%	n= 33	%	
Sex					
Male	12	36.4	17	51.5	χ^2=1.538
Female	21	63.6	16	48.5	P= 0.215
Age group					
60-<70	27	81.8	26	78.8	χ^2=0.096
>=70	6	18.2	7	18.2	P= 0.757
Mean ± SD	65.55±4.99		66.91±5.83		Z=0.946
Median (range)	65(18)		65(26)		P= 0.344
Social status					
Single	7	0.0	11	3.0	χ^2=1.222
Married	26	78.8	22	66.7	P= 0.269
Education					
Illiterate	6	18.2	5	15.2	
Read / write	8	24.2	11	33.3	χ^2=.859
Secondary	2	6.1	2	6.1	P=.917 FET
University	17	51.5	15	45.5	
working before retirement					
Working	29	87.9	25	75.8	χ^2=1.630
Not working	4	12.1	8	24.2	P= 0.202
Income source					
Adequate	29	87.9	23	69.7	χ^2=3.264
inadequate	4	12.1	10	30.3	P= 0.071
Living condition					
With family	27	81.8	28	84.8	χ^2=0.109
Alone	6	18.2	5	15.2	P= 0.741

χ2= Chi-Square test
Z Mann-Whitney test
FET=Fisher Exact Test
P>0.05 (insignificant)
*p < 0.05 (significant)

Table (2): The medical history among the studied elderly patients in both groups

Items	Study group		Control group		Significance test (P value)
	n= 33	%	n= 33	%	
Duration of KOA					
Less than 5 years	16	48.5	14	42.4	χ^2=0.602 P= 0.740
5-10years	10	30.3	13	39.4	

+10years	7	21.2	6	18.2	
Knee affected					
Right	1	3.0	3	9.1	
Left	2	6.1	3	9.1	χ^2=1.356 P= 0.584FET
Both	30	90.9	27	81.8	
Physical activity performance					
Yes	2	6.1	2	6.1	χ^2=2.063 P= 0.492FET
No	31	93.9	31	93.3	
Therapeutic regimen					
Pharmacological	30	90.9	31	93.9	χ^2=0.216 P= 1. 0 FET
Non- pharmacological	3	9.1	2	6.1	
Number of associated diseases					
No	9	27.3	10	30.3	
One	16	48.5	14	42.4	χ^2=0.929 P= 0.885 FET
Two	6	18.2	8	24.2	
More than 3	2	6.1	1	3.0	

Student t-test-
χ2= Chi-Square test
FET=Fisher Exact Test
P >0.05 (insignificant)
*p < 0.05 (significant)
Mc Monte carlo

Table (3) Comparison between studied elderly patients in both groups in relation to mean step count at 1st& 12th weeks

Week	Study group No (33)		Control group No (33)		Significance test (P value)
	Mean ±SD	Median (range)	Mean ±SD	Median (range)	
1st week	1494.7± 975.7	1026.3 (3180.1)	1481.2 ± 791.3	1178.3 (3011.1)	Z=0.442 P= 0.658
12th week	5086.6± 2298.33	4583.85 (10826.7)	1465.6± 799.35	1101.3 (3050.7)	Z=6.457 P= 0.000*
P	Z^b =5.012, P= 0.000*		Z^b =0.688, P= 0.492		———

P > 0.05 (insignificant)
*P < 0.05 (significant)
Z Mann-Whitney U test
Z^b Wilcoxon test

Table (4) Comparison between studied elderly patients in both groups in relation to step count levels at 1st& 12thweeks

Step	Sedentary basal		Sedentary limited		Total sedentary		Low active		Active		Significance test (P value)
	< 2500		2500-4999				5000-7499		≥7500		
Week	No	%	No	%	No	%	No	%	No	%	
1st Week											
Study (N=30)	26	78.8	7	21.2	33	100	0	0.0	0	0.0	χ^2=0.982 P=0.322
Control (N=30)	29	87.9	4	12.1	33	100	0	0.0	0	0.0	
12th Week											
Study (N=30)	3	9.1	15	45.5	18	54.6	10	30.3	5	15.1	χ^2=48.765 P= 0.000* FET
Control (N=30)	30	90.9	3	9.1	33	100	0	0.0	0	0.0	

FET=Fisher Exact test P>0.05 (insignificant) *p < 0.05 (significant)

Table (5) Comparison of WOMAC mean score among studied elderly patients in both groups before and after the proposed program

WOMAC items score	**Before**			**After**		
	Study group n (33)	**Control group n (33)**	**Significance test (P value)**	**Study group n (33)**	**Control group n (33)**	**Significance test (P value)**
	Mean ±SD	**Mean ±SD**		**Mean ±SD**	**Mean ±SD**	
Pain severity	74..8±13.7	75.9±16.7	Z = 0.806, P= 0.420	17.5±18.1	77±17.3	Z = 6.70, P= 0.000*
Stiffness	72.3± 39	78±37.8	Z=1.328, P= 0.184	27.3± 22.2	79.2±37.6	Z=4.670, P= 0.000*
Physical functioning	80±12.9	79±15	t= 0.300, P= 0.765	30±14.8	79.9±15.5	t= 6.67, p= 0.000*
Total WOMAC score	78.2±13	79±15.6	Z = 0.512, P=0.609	27.6±14.5	79.8±15.9	Z = 6.703, P=0.000*

P>0.05 (insignificant) *P < 0.05 (significant) Z Mann-Whitney U test t independent t test

Discussion :

Osteoarthritis of knee joint has been known as one of the main cause of global disability among elderly. Pain of knee, stiffness of the joint and weakness of muscle in lower limb are the most common complaints caused by KOA that lead to impairment of mobility and thus functional limitations. Aerobic walking programs are known to have beneficial effects on knee pain, and functional capacity for elderly patients with mild to moderate KOA **(Wallis et al., 2017)**. We undertook the present study to evaluate the effect of aerobic walking on function and pain in elderly patients with KOA. At baseline, this study revealed that both study and control groups mean step count was at sedentary level, the majority in both groups had a sedentary level compared to no elderly patients were in active category. This may be attributed to the common belief that patients who have knee osteoarthritis must take rest and give up form walking to save the knee. This agree with a study conducted at USA by **Zoellner et al. (2010), Paula *et al*, 2015** in Brazil and **Savage&**

Ades, 2008 in USA which reported that about half, three quarters and three fifths of patients respectively were in sedentary category. This finding is in contrast to a study conducted by **Hart et al, (2020)** in Australia which reported that baseline mean step count for both study and control group of patients with KOA was at active level.

At 12th week, this study shows that study group increased their mean step count significantly compared to control group with about more than one third and less than one fifth of studied elders were in low active and active level and no elderly patients in control group were in low active or active category. This results come in line with a study done in Toledo by **Stempky, (2015)** who reported that patients increased their average steps per day as well as the steps peak number taken daily following the 8th week of the proposed program implementation. The same results were reported by other studies done in Southern Maine by **Croteau et al., (2013), Kim et al, (2019)** in Korea**, Talbot et al, (2003), Jensen et al,(2004),** and **Swartz et al, (2003)** who reported that the study group significantly increased their daily step counts after 12 weeks of implementation of the proposed program. This finding disagree with a study done in Japan by **Hiyama *et al*, (2011)** and **Shipe, (2009)** in Tennessee which reported that the peak increase in step count was found in the fourth week of implementation of the proposed program. Similar results have been previously reported by **Cupples et al, (2013)** in united kingdom reported that the peak increase in step count was found in the fifth week of implementation of the proposed program. The current study showed that at the baseline, there was no statistical significant difference weas found in the mean score of pain between both groups. This agree with a study conducted by **Abd elFatah et al., (2019)** in Egypt and **Ramadan et al (2016)** in Egypt, **Subazwari et al (2020)** in Pakistan and **Wallis et al (2017)** in Australia who emphasized that all patients having KOA have moderate to very severe knee pain. The current study showed a high significantly improvement in the knee pain of the study group after practicing aerobic walking program for 12 week with a statistical significant differences were found between both groups. This may be attributed to increasing step count of the study group which indicate the effectiveness of walking program. This finding agree with a study conducted in India by **Ganu& Merchant, (2018)** who reported that walking for 4 week was more effective than conventional closed kinematic chain exercises in improving pain in patients with KOA. This come in line with a study conducted in India by **Balraj et al (2018)** who found that after regular walking for 6 week, there was a significant improvement in scores of knee pain among patients with KOA. Similar finding also reported by the study of **Sheth et al, (2014)** in India who stated that 3-week walking program leads to a significant improvement in reduction of pain in knee. This finding disagree with a study done in India by **Sharma et al (2015)** in India who reported that resistance exercise is more effective than walking for 2 weeks in improving knee pain in older adults with KOA. This may be attributed to shortness of the duration of the study that is not sufficient to study the effect of walking in knee pain. The current study reported that at the baseline, there was no statistical significant difference was found in the mean score of functional capacity between both groups. This agree with a study conducted by **Georgiev, (2019), Wallis et al (2017)** in Australia, and **Gorial et al (2018)** in Iraq who reported that the functional capacity in patients with KOA was impaired. This study reported a high significantly improvement in the functional capacity of the study group following practicing aerobic walking program for 12 week with a statistical significant differences were found between both groups. This may be attributed to the improvement in knee pain with walking program which allow elderly patient to perform more activities during the day without fearing of pain. This results agree with a study done by **White et al, (2014)** who stated that a greater number of steps/day was increasingly protective against the development of functional limitation in patients with KOA. This come in line with a study conducted in Turkey by **Evcik& Sonel, (2002)** who reported that after regular walking for 12 week, there was a significant improvement in functional capacity scores among patients with KOA. This finding agree with a study conducted in India by **Ganu et al., (2018)** who revealed that walking was more effective than conventional closed kinematic chain exercises in improving functional capacity in patients with KOA. Similar finding also reported by another studies; the study of **Alghadir et al, (2019)** who stated that 6-week walking program resulted in greater reduction in functional disability in patients with KOA, also the study of **Sharma et al (2015)** in India who revealed that walking is more efficient than resistance exercise in improvement of functional capacity in elderly patients with KOA.

Study Limitations:

Some patients damaged their device or forgot it in washing machine and this cause the researcher to stop the study from such group of patients or correction occurred (2 cases). A number of elderly patients didn't

have a cell phone for follow up. Withdrawal of six cases due to (falls, misconception about walking that it will harm them).

Conclusion:

Based on findings of the current study, we can conclud that elderly patients with knee osteoarthritis can be safely practiced 12 weeks of aerobic walking program. 12 weeks of aerobic walking program was successful in improvement of step count& functional capacity and knee pain. Therefore, aerobic walking program must be considered as a physical therapy in addition to pharmacological treatment in improving functional capacity and symptoms of knee osteoarthritis for elderly patients suffering from knee osteoarthritis.

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Conflict of interest statement

The authors didn't declare any conflict of interests.

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