Original Article

The Effectiveness of Physical Exercise Training in Pain, Mobility, and Psychological Well-being of Older Persons Living in Nursing Homes

Mimi M. Y. Tse, RN, PhD,[*] *Shuk Kwan Tang, RN, MSc,*[†] *Vanessa T. C. Wan, RN, MSc,*[‡] *and Sinfia K. S. Vong, PT, MPhil*[*]

Abstract:

Pain is common in the aging population, particularly among older residents of nursing homes. It has been found that 50% of older people living in the community have been experiencing chronic pain, and the number increased to 80% for older residents of nursing homes. Exercise is an effective non-pharmacological intervention that can reduce pain and improve physical and psychological functions. A quasi-experimental study with a pretest–posttest control group designed was conducted to evaluate the effects of a physical exercise program (PEP) on older residents of nursing homes who have chronic pain. Three-hundred-ninety-six older residents with chronic pain were recruited from 10 nursing homes run by non-governmental organizations in Hong Kong. The average age of the older residents was 85.44 ± 6.29. Five nursing homes were randomized to the experimental group with PEP (n = 225, age = 85.45 ± 6.25); the other five nursing homes were randomized to the control group without the PEP (n = 171, age = 85.44 ± 6.35). PEP was an eight-week training program given by a physiotherapist and nurses once a week. It consisted of warm-up exercises, muscle strengthening, stretching, balancing, and self-administered massage to acupressure points. At the end of each PEP session, pamphlets with pictures illustrating the "exercise of the day" were given to the older residents of nursing homes as a tool to enhance their self-management skills. The control group received no training during the eight weeks. Upon completion of the PEP, the experimental group experienced a significantly greater reduction in pain intensity from 4.19 ± 2.25 (on an 11 point scale) to 2.67 ± 2.08, as compared to the control group ($p < .05$). In addition, the

*From the *School of Nursing, Hong Kong Polytechnic University; †Department of Orthopaedics and Traumatology, United Christian Hospital; ‡M&G, Prince Margaret Hospital, Kowloon, Hong Kong.*

Address correspondence to Mimi M.Y. Tse, RN, PhD, Hong Kong Polytechnic University, School of Nursing, Kowloon, Hong Kong. E-mail: mimi.tse@polyu.edu.hk

Received July 7, 2013;
Revised August 16, 2013;
Accepted August 16, 2013.

1524-9042/$36.00

http://dx.doi.org/10.1016/j.pmn.2013.08.003

psychological well-being (happiness, loneliness, life satisfaction, and depression) of the experimental group was significantly improved ($p < .05$).

Pain is common in the aging population, particularly among older residents of nursing homes (Hollenack et al., 2007). Most age-related diseases and illnesses cause chronic pain and disability. Studies showed that 50% of the community-dwelling adults aged 60 years or above had experienced pain, and the number increased to 45% to 80% in residents of nursing homes (American Geriatric Society, Panel on Chronic Pain in Older Persons, 1998; Chung & Wong, 2007; Ferrell et al., 1990). Older residents of nursing homes are also at a higher risk of their pains not being assessed and the treatments they are receiving being inadequate even though their pains are documented (Achterberg et al., 2010).

Pain in the elderly is mostly degenerative and can cause mobility decline, role changes, and psychological disorders. Pain results from acute or chronic conditions are associated with a decrease of physical and social functions and quality of life, and it is seen as a key indicator of physical impairment (Horgas et al., 2008; Parker et al., 2013). The overall level of physical activity in older adults with chronic pain is significantly lower than their non-pain counterparts (Stubbs et al., 2013).

The impact of pain is a cycle of disuse and inactivity (Griffin, Harmon, & Kennedy, 2012; Martin, 2007). Pain causes a decrease in muscle strength, mobility, and physical fitness, which results in reduced functional use. People who reduce their physical activities experience more pain and disability in the long run.

Psychological effects of pain include misconceptions about pain, decreased self-confidence in one's ability to cope with pain, fear of causing harm, avoiding performing activities, less life satisfaction, and worsening mood (Griffin, Harmon, & Kennedy, 2012; Meredith, Strong, & Feeney, 2006; Sowden, Hatch, Gray, & Coombs, 2006; Turk et al., 2003;).

Maintaining the functional capacity in older people is crucial for breaking the cycle of disuse and inactivity. Physical exercise is effective in improving functions or delaying the functional decline in older people (Binder et al., 2002; Rydwik, Kerstin, & Akner, 2005). Exercise can significantly improve the gait velocity and limb strength and decrease psychological disorders such as depression in older persons (De Carvalho & Filho, 2004; Callahan, 2009).

Performing physical exercise can be seen as a skill for pain management. It has been shown that physical exercises, if performed regularly as a habit, can bring health benefits such as pain relief and improved functional capacity for older people. Effective physical exercise can be introduced as a self-management skill to older residents of nursing homes who have chronic pain.

The objective of this study is to investigate the effectiveness of a physical exercise program (PEP) in reducing pain, enhancing mobility, and improving psychological function for older residents of nursing homes. The authors hypothesized that the PEP would significantly improve the outcomes in terms of pain intensity, physical mobility, quality of life, and psychological function.

METHODS

Design

It was a randomized-controlled study to explore the effect of an eight-week PEP for older residents living in nursing homes in pain intensity, physical mobility, quality of life, and psychological function. The study was approved by the Human Subject Ethics Subcommittee of the Hong Kong Polytechnic University. Ten nursing homes in Hong Kong, including Hong Kong Island, Kowloon, and the New Territories, were recruited by convenience sampling. These nursing homes were run by non-governmental organizations and had similar social support, healthcare, and pension policies. Among them, five nursing homes were randomized to the experimental group; another five nursing homes were randomized to the control group by using a computerized randomization table. Participants in the experimental group received the PEP while the control group received no treatment during the study period (Figure 1).

Participants

Older persons who had suffered from musculoskeletal pain six months prior to the study were recruited. A total of 396 older persons were enrolled. Inclusion criteria were aged 60 or above, able to communicate in Chinese, and were oriented to time and place. Older persons with a history of mental disorder or cognitive impairment were excluded. Each participant gave written informed consent to participate.

Procedure

Demographic data, medical data, psychological parameter, and physical parameter were collected in both the experimental and the control group two to three days before the PEP and two to three days after the PEP.

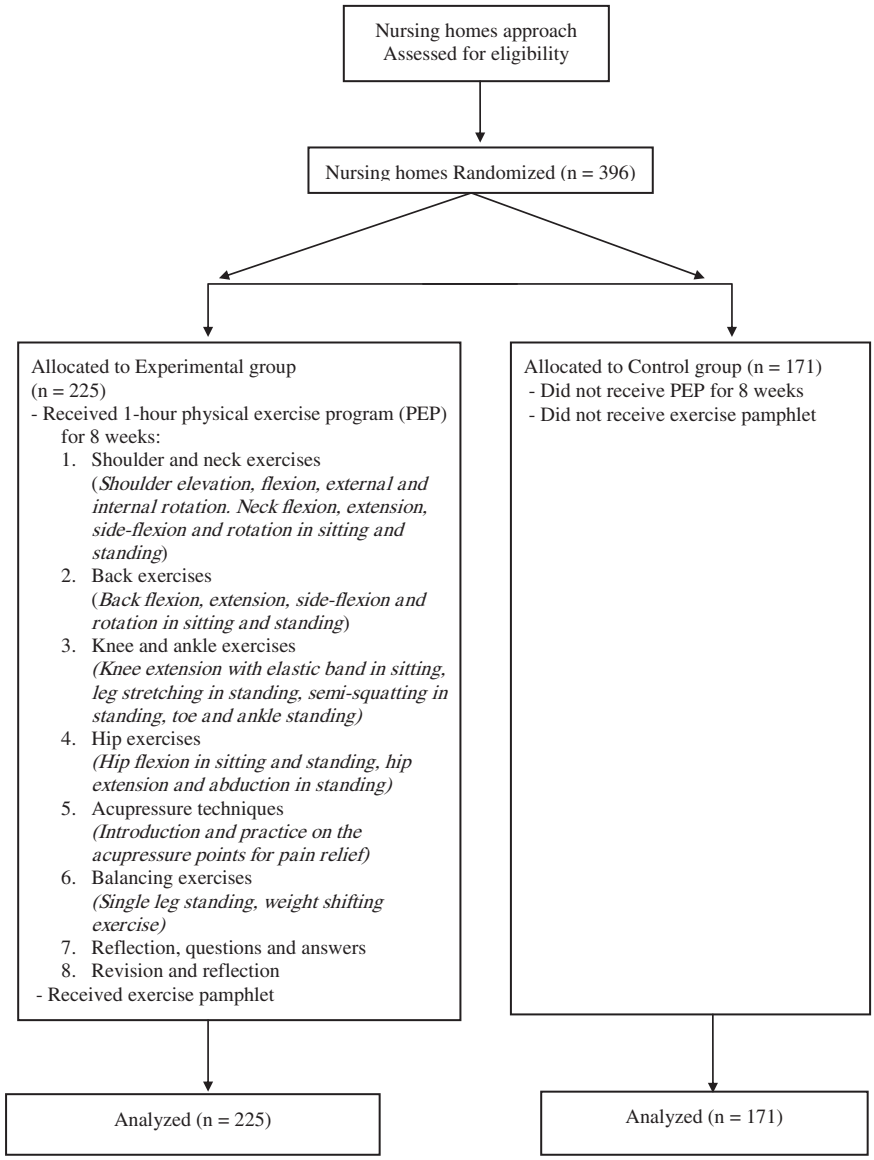

Figure 1. ■ CONSORT flow diagram of the study.

The demographic data included age, gender, marital status, educational level, previous occupation, and personal health condition. The medical data included information on pain history, use of oral analgesic drug, and non-drug methods for pain control. The psychological parameter included happiness, loneliness, life satisfaction, depression, and quality of life. For physical parameter, the authors assessed the range of motion (ROM) of the participants, and the Barthel ADL Index and the Elderly Mobility Index were used to assess the activities of daily living and mobility.

Three research assistants with nursing background were on the research team. Training, as well as demonstration and returned demonstration, were given to prepare them to use various instruments. One research assistant received training, demonstration, and return demonstration from a physiotherapist to learn how to take pain history and use a protractor to measure the ROM of the participants.

The Physical Exercise Program

The physical exercise program (PEP) was led by a physiotherapist and research assistants with nursing backgrounds. It was carried out in a multi-function room of the nursing homes. The PEP was delivered to the intervention group one time a week for eight weeks. Each session lasted for an hour.

The participants' physical condition and capacity to perform the exercises were carefully monitored throughout the program. Continual encouragement

and reinforcement were given to the participants to enhance their performances.

The PEP was designed by a physiotherapist based on his/her clinical practice on pain management and health education experiences with patients. Each session of the PEP was made up of a 15-minute warm-up exercise and a 45-minute exercise training. Different types of exercises were offered in each session. Examples included muscle strengthening using an elastic band, stretching, balancing, towel dance, and the skill of self-administered acupressure and massage.

The 45-minute exercise training was designed to help the participants to relieve their pain in the shoulder, neck, back, and knee areas. The theme of each PEP session and the exercises performed are shown in Figure 1. Upon completion of each PEP session, pamphlets with pictures illustrating the "exercise of the day" were given to all participants to encourage them to continue to practice the exercises by themselves.

Instruments

The 11-point Numerical Rating Scale (NRS) was used to assess the presence, location, and intensity of pain among the participants. The scale was presented vertically, with 0 representing no pain and 10 the worst pain imaginable. The Spearman's correlation coefficient for validity was 0.74 (Lara-Munoz, De Leon, Feinstein, Puente, & Wells, 2004).

The Barthel Index was used to evaluate the self-care functional ability for the activities of daily living (Mahoney and Barthel, 1965). The index consists of 10 items including presence or absence of fecal and urinary incontinence and independence in grooming, toileting, feeding, personal hygiene, transfers, walking, dressing, climbing stairs, and bathing. The score varies from item to item, and the maximum total score is 20, which indicates total independence (Shyu, et al., 2008).

The Elderly Mobility Scale (EMS) was used to assess the mobility of the participants. The scale consists of seven activities that evaluate an individual's mobility independence including position changes and walking mobility (Smith, 1994). The score varies from item to item and the maximum total score is 20, which indicates total independence (Proser, 1997; Ng, Tong, & Li, 2008).

The range of motion (ROM) of the participants was measured by the degree of movement from the alignment of body, including left and right neck rotation, left and right shoulder flex, left and right shoulder abduction, left and right knee flex, lumbar flex, left and right lumbar rotation, and left and right hip flex. A half circle protractor, which is made of transparent plastic and marked in degrees (180°), was used to measure angles.

Quality of life was measured by the Health Survey Short Form questionnaire (SF-12), which consists of 12 questions to generate physical and mental component subscale scores (Ware, Kosinski, & Keller, 1996). Each score ranges from 0 to 100, higher scores indicating better health status. A Chinese version of the SF-12 was used which has been found valid and equivalent for the Hong Kong Chinese (Lam, Tse, & Gandek, 2005).

The Chinese version of the Subjective Happiness Scale was used to assess the happiness level of older persons (Lyubomirsky & Lepper, 1999). The scale consists of four items rated on a 7-point Likert Scale. The total scores range from 4 to 28 with higher scores signifying higher subjective happiness. The Cronbach's alpha is 0.79 to 0.94. The test-retest reliability ranges from 0.55 to 0.90.

The revised UCLA Loneliness Scale was used to measure people's loneliness (Russell, 1996). The scale consists of 20 items to measure feelings of loneliness and social isolation. A four-point Likert Scale with a rating 1 = never, 2 = seldom, 3 = sometimes, and 4 = always was used. The range of total scores is 20 to 80. Higher scores indicate greater loneliness. The Chinese version of the revised UCLA Loneliness Scale was used in this study with a Cronbach's alpha of 0.90 (Chou, Jun, & Chi, 2005).

The Chinese version of the Life Satisfaction Index, a form scale, was used. The index consists of 18 questions around five components: zest, resolution and fortitude, congruence between desired and achieved goals, positive self-concept, and mood tone. Items are scored 1 = agree and 0 = disagree (Chi and Boey, 1992). Higher scores indicate greater life satisfaction. The Cronbach's alpha is 0.7 and internal consistency is 0.62.

The Chinese version of the Geriatric Depression Scale was used to measure depression (Mui, 1996; Yesavage, Brink, Rose, & Lum, 1983). The scale consists of 15 questions with a rating of 1 = yes and 0 = no. Higher scores indicate more depression. Cronbach's alpha of internal consistency is 0.89, and the test-retest reliability is 0.85.

Statistical Analyses

The Statistical Package for the Social Sciences (SPSS, version 17) for Windows was used for all statistical analysis. Descriptive statistics calculated the means and standard deviations. The authors used the Chi-square test to analyze the differences in the demographic data between the experimental group and the control group. Changes in outcome measures were regarded as the difference between pre- and posttreatment (posttreatment minus pretreatment).

TABLE 1.
Demographic Data of the Study Participants

	Total with Pain (N = 396)		Experimental Group (N = 225)		Control Group (N = 171)		Group Difference p Value
	N	%	N	%	N	%	
Gender							.632
Male	79	19.9	43	54.4	36	45.6	
Female	317	80.1	182	57.4	135	42.6	
Age	Mean ± S.D. 85.44 ± 6.29		Mean ± S.D. 85.45 ± 6.25		Mean ± S.D. 85.44 ± 6.35		.984
60-70	11	2.8	7	3.1	4	2.3	.821
71-80	74	18.7	41	18.2	33	19.3	
81-90	258	65.2	147	65.3	111	64.9	
91-100	52	13.1	30	13.3	22	12.9	
Above 101	1	0.3	0	0	1	0.6	
Marital status							.132
Single	27	6.8	16	7.1	11	6.4	
Married	69	17.4	31	13.8	38	22.2	
Divorced	7	1.8	3	1.3	4	2.3	
Widowed	293	74.0	175	77.8	118	69.1	
Education level							.074
No formal education	237	59.8	146	61.6	91	53.2	
Primary education (year 1-6)	131	33.1	67	29.8	64	37.4	
Secondary education (year 7-11)	27	6.8	12	5.3	15	8.8	
Tertiary education (University education)	1	0.3	0	0	1	0.6	
Previous occupation							.054
Primary industry (agriculture, fishing, manual work)	70	17.7	31	13.8	39	22.8	
Second industry (servicing)	138	34.8	88	39.1	50	29.2	
Tertiary industry (indoor office work)	73	18.4	39	53.4	34	19.9	
Housework	115	29.1	67	29.8	48	28.1	
Year(s) in nursing home							.193
1-3 years	148	37.4	74	32.9	74	43.3	
4-6 years	61	15.4	34	15.1	27	15.8	
7-9 years	71	17.9	43	19.1	28	16.4	
10 years or above	116	29.3	74	32.8	42	24.6	
Past health history							
Post Stroke	98	74.2	46	20.4	52	30.4	.023*
Hypertension	266	76.0	151	67.1	115	67.3	.976
DM	82	73.2	44	19.6	38	22.2	.411
Heart disease	127	80.4	72	32.0	55	32.2	.516
Cataract	192	82.1	123	54.7	69	40.4	.005

(*Continued*)

TABLE 1. Continued

	Total with Pain (N = 396)		Experimental Group (N = 225)		Control Group (N = 171)		Group Difference p Value
	N	%	N	%	N	%	
Parkinsonism	15	75.0	8	3.6	7	4.1	.781
Previous fracture	86	76.8	52	23.1	34	19.9	.440
Psychiatric disease	30	71.4	20	8.9	10	5.8	.257
Impaired renal function	16	76.2	11	4.9	5	2.9	.325
Arthritis	88	83.8	47	23.7	41	26.3	.582
Respiratory disease	57	74.0	32	16.2	25	16.0	.972
Gouty	18	78.3	12	12.5	6	10.3	.687

Chi-square test was used to compare the experimental group and the control group.
*$p < .05$ was considered statistically significant.

Independent t-test to analyze the between-group differences of the outcome variables was used. The significance level was set as $p \leq .05$.

RESULTS

Participant Characteristics

Descriptive characteristics of the participants are presented in Table 1. There was no baseline difference between the experimental group and the control group in all demographic data, but there were significantly more post stroke participants in the experimental group. The scores in the experimental group were significantly higher than those of the control group in most outcome measures (except the Barthel index and EMS) (Table 1).

Pain Intensity

The baseline pain intensity among the participants was 4.10 ± 2.20. After the completion of PEP, the participants' pain intensity was reduced in both groups. The pain score (as measured by VRS) in the experimental group was significantly lower than the control group (PEP group 2.67 ± 2.08 vs control group 3.29 ± 2.24; Change of VRS: -1.70 ± 2.53 vs -0.69 ± 2.45, $t = -4.164$, $p < .001$) (Table 2). The pain scores for each painful site are shown in Figure 2.

Physical Parameters

The experimental group had significantly higher scores in the Barthel index and the EMS at baseline than the control group ($p < .01$). Yet, no significant difference between the two groups regarding the score changes in the Barthel index and the EMS upon completion of the PEP ($p > .05$) (Table 3). In the experimental group, the ROMs of the neck, shoulder, back, hip, and knee joints of the participants had increased significantly upon completion of the PEP (all $p < .001$), as shown in Table 3.

Quality of Life

There was no significant change in the quality of life (both physical and mental components) of the PEP group and control group (Table 3).

Psychological Parameters

Score changes in the psychological measures (happiness, loneliness, life satisfaction, and depression) were more significant in the PEP group than in the control group (all $p \leq .05$) (Table 3), which indicated participants in the PEP group had a higher self-perception of happiness and life satisfaction and lower perception of loneliness and depression after receiving the PEP.

TABLE 2.
Pain Score in the Experimental Pain Group and the Control Pain Group, Mean ± SD

	Experimental Group (N = 225)			Control Group (N = 171)			Group Difference	
	Pre Mean ± SD	Post Mean ± SD	*p* Value β^1	Pre Mean ± SD	Post Mean ± SD	*p* Value β^2	*p* Value α^1	*p* Value α^2
Pain Score (Change of pain score)	4.19 ± 2.25	2.67 ± 2.08 (−1.70 ± 2.53)	.000*	3.98 ± 2.13	3.29 ± 2.24 (−0.69 ± 2.45)	.009*	.379	.008* (.000*)

β^1 : Baseline VS Post: Experimental pain group (Paired Sample t-test); β^2: Baseline VS Post: Control pain group (Paired Sample t-test); α^1 : Baseline Experimental pain group VS Control pain group (Independent Sample t-test); α^2 : Post : Experimental pain group VS Control pain group (Independent Sample t-test).
*$p \leq .05$ was considered statistically significant.

DISCUSSION

The present randomized controlled study confirmed that an eight-week physical exercise program, including muscle strengthening and stretching for the painful areas, balancing, and self-administered acupressure, was effective in reducing pain and improving psychological function and joint mobility. In addition, the participants who attended the PEP had significantly lesser pain than those who had not received the PEP. The exercise is easy for the elderly to do themselves. The PEP

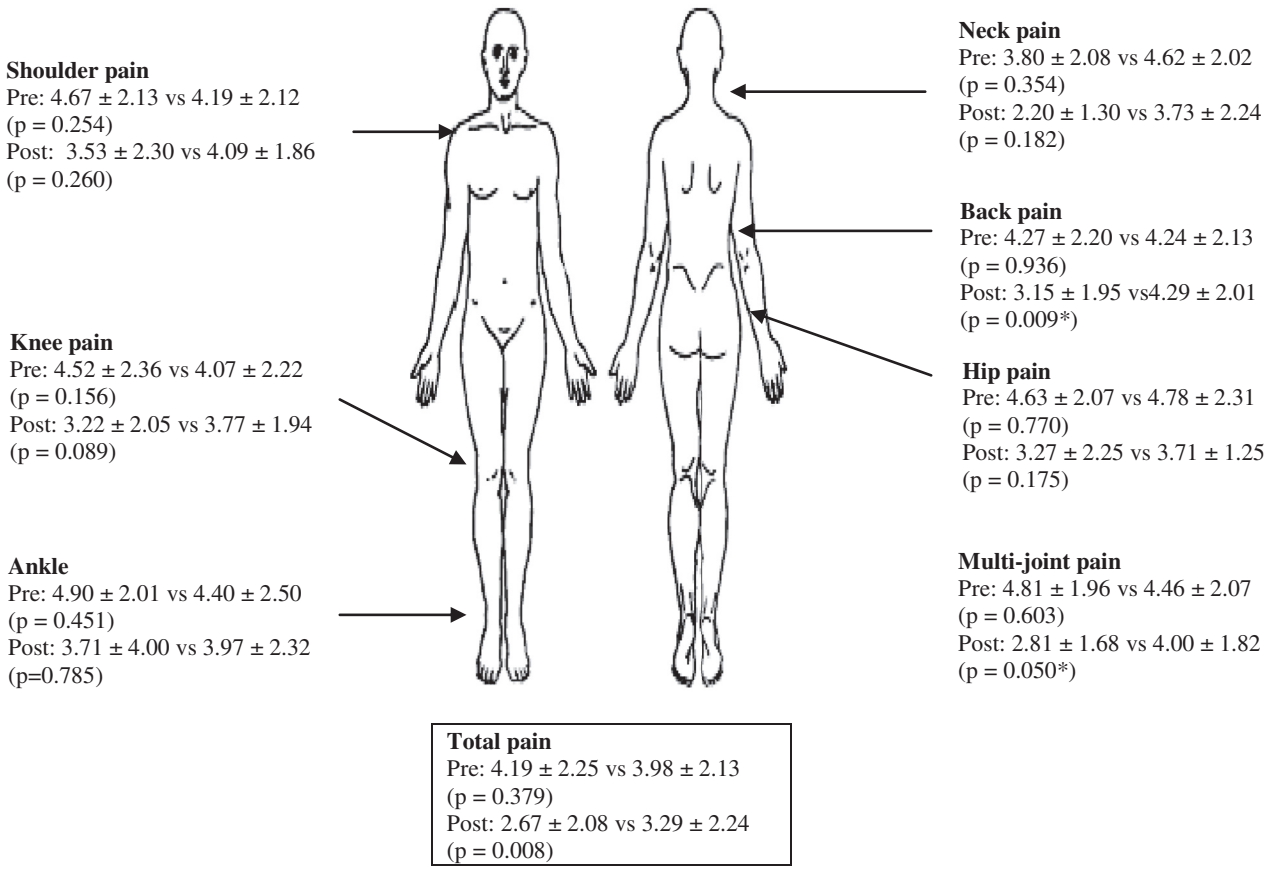

FIGURE 2. ■ Pain intensity (Cantonese verbal rating scales) among the painful sites (Mean ± S.D.: Experimental group vs control group).

TABLE 3.
Physical, Quality of Life and Psychological Parameters, Mean ± SD

	Experimental Group (N = 225)			Control Group (N = 171)			Group Difference	
	Pre Mean ± SD	Post Mean ± SD	*p* Value β^1	Pre Mean ± SD	Post Mean ± SD	*p* Value β^2	*p* value α^1	*p* Value α^2
Physical								
Elderly Mobility (Change)	16.44 ± 4.23	15.86 ± 4.76 (−0.23 ± 3.71)	.344	15.03 ± 5.53	14.77 ± 5.46 (−0.21 ± 4.07)	.399	.001* (0.964)	.371†
Barthel ADL (Change)	18.20 ± 3.10	17.99 ± 4.93 (0.02 ± 4.26)	.928	16.94 ± 4.66	16.50 ± 4.71 (−0.17 ± 3.14)	.248	.000* (.565)	.186†
Range of motion								
Neck rotation								
Left	50.92 ± 15.57	64.01 ± 15.99	.000*	-	-	-	-	-
Right	52.22 ± 16.16	63.95 ± 17.76	.000*	-	-	-	-	-
Shoulder flexion								
Left	139.53 ± 27.22	152.08 ± 22.99	.000*	-	-	-	-	-
Right	138.09 ± 31.66	152.37 ± 25.50	.000*	-	-	-	-	-
Shoulder abduction								
Left	131.39 ± 31.44	148.57 ± 26.07	.000*	-	-	-	-	-
Right	125.50 ± 32.98	143.63 ± 27.60	.000*	-	-	-	-	-
Lumbar flexion	14.80 ± 13.35	20.07 ± 15.12	.000*	-	-	-	-	-
Lumbar rotation								
Left	46.76 ± 17.34	59 89 ± 19.15	.000*	-	-	-	-	-
Right	48.41 ± 17.72	62.22 ± 21.26	.000*	-	-	-	-	-
Hip flexion								
Left	54.58 ± 34.60	64.31 ± 39.81	.000*	-	-	-	-	-
Right	54.67 ± 36.16	63.90 ± 39.82	.000*	-	-	-	-	-
Knee flexion								
Left	51.87 ± 36.14	64.19 ± 42.42	.000*	-	-	-	-	-
Right	52.97 ± 35.94	64.39 ± 41.23	.000*	-	-	-	-	-
Quality of life								
SF-12 Physical (Change)	36.67 ± 10.74	34.65 ± 11.11 (−1.07 ± 11.43)	.276	37.07 ± 10.55	35.47 ± 10.75 (−1.37 ± 10.63)	.025*	.728 (0.817)	.496
SF-12 Mental (Change)	57.39 ± 7.47	56.98 ± 7.80 (0.59 ± 7.37)	.352	58.05 ± 7.02	56. 94 ± 7.31 (−1.05 ± 8.30)	.043*	.406 (0.076)	.973
Psychological								
Happiness (Change)	18.22 ± 6.06	19.32 ± 5.54 (1.86 ± 5.52)	.000*	18.67 ± 5.80	18.35 ± 6.12 (−0.32 ± 6.01)	.256	.393 (0.000*)	0.069

Loneliness (Change)	40.98 ± 11.77	39.49 ± 10.52 (−3.35 ± 10.90)	.000*	40.17 ± 11.80	40.41 ± 12.60 (0.24 ± 11.61)	.711	.429 (0.000*)	.383
Life satisfaction (Change)	9.78 ± 4.37	10.14 ± 4.22 (1.07 ± 4.01)	.000*	9.77 ± 4.08	9.56 ± 4.13 (−0.21 ± 3.50)	.057	.979 (0.000*)	.129
Depression (Change)	6.14 ± 3.92	5.93 ± 3.79 (−0.77 ± 3.53)	.001*	6.04 ± 3.99	6.00 ± 4.13 (−0.05 ± 3.33)	.590	.771 (0.021*)	.856

β^1: Baseline VS Post: Experimental pain group (Paired Sample T-test); β^2: Baseline VS Post: Control pain group (Paired Sample T-test); α^1: Baseline Experimental pain group VS Control pain group (Independent Sample T-test); α^2: Post: Experimental pain group VS Control pain group (Independent Sample T- test).

*$p \leq .05$ was considered statistically significant

†Adjusted p-value by adding pre-test value as covariance

is a feasible intervention, which is easy to replicate and is applicable to other residents. Physical activity is an important non-pharmacological strategy in the management of chronic pain, and it is important to encourage older adults with chronic pain to remain active (Griffin, Harmon, & Kennedy, 2012; Stubbs et al, 2013). The physical exercise in this study is beneficial to older adults. The authors suggest that the physical exercise program should be implemented in nursing homes as a routine activity. Moreover, older residents should perform this exercise in their free time to relieve pain and maintain their functions.

The score change in the Barthel index indicated a statistically significant improvement in the participant's physical capacity and no significant group difference in the Elderly Mobility Scale. This was possibly due to the high physical functional capacity among the enrolled residents (especially the PEP group) at baseline. This might have caused a ceiling effect that hindered satisfactory improvements in physical mobility of the participants.

The authors suggest that instruments such as the Timed Up and Go test, the Timed Chair Stand test, and the Gait Velocity test could be other effective outcome measures used for further studies in the evaluation of physical mobility (Csuka & McCarty, 1985; Hayes & Johnson, 2003; Shumway-Cook, Brauer, & Woollacott, 2000).

There were significant improvements in the psychological measures regarding the change in happiness, life satisfaction, loneliness, depression, and two pain beliefs in permanence and self-blame in the PEP group. Yet, the control group did not show any significant improvement, even tending to deteriorate in those variables. The favorable improvements experienced by the PEP group were significant in enhancing psychological well-being for older adults.

Indeed, the design of the PEP was an eight-week program given by the research team, and the authors could only deliver it once a week for eight weeks in each nursing home. In future studies, it would be interesting to explore the effectiveness of a four- or six-week dose. To focus developing exercise as a habit, older adults were encouraged to perform exercises on their own time. The study did not have a particular measure on resident activity and exercise outside of class, which would be a limitation of the present study, and further study should include recording exercise activities beyond the PEP class.

The fact is that personal attention given to nursing home residents during the PEP was not controlled for among the experimental groups, and this constituted a limitation of the present study. In the future study,

a nursing student could be assigned to sit with and visit nursing home residents for the same period that the PEP group gets their exercise program.

CONCLUSION

In conclusion, the eight-week PEP is effective in relieving pain and improving certain psychological functions for older residents of nursing homes. The authors compared the physical mobility between the two groups after the PEP and found that the PEP group had a significant improvement in the range of motion of common painful joints.

By learning and self-practicing the physical exercises learned in the PEP, older residents persons are more likely to have their pain reduced, their psychological well-being enhanced, and their joint mobility improved to perform daily activities as well as a better quality of life in the long run.

Acknowledgments

The authors would like to thank all the study participants. Special thanks to CADENZA: A Jockey Club Initiative for Seniors, The Hong Kong Jockey Club Charities Trust, for providing financial support for this study.

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