Effectiveness of a Home Based Progressive Resistance Training Program in Reducing Pain and Disability in Patients with Osteoarthritis of Knee

ISHANKA PRANEETH MUNUGODA[1] and CHAMARI LOCHANA WEERARATHNE[2]
[1]Allied Health Sciences Unit; [2]Department of Pharmacology, Faculty of Medicine,
University of Colombo, Sri Lanka
ishankarc@gmail.com[1], chamariweera@gmail.com[2]

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Abstract – *This study aimed **t**o determine the effectiveness of a home-based progressive resistance training (PRT) program in reducing pain and disability in patients with Osteoarthritis of knee. This randomized controlled trial, conducted for 30 days, included 60 subjects, diagnosed with Osteoarthritis of a single knee, recruited from a clinical setting in Colombo. The subjects were randomized to experimental (EG) and control groups (CG) (n=30) and received their general treatments. The EG received a PRT program to be performed at home and regular telephone contacts. Data was collected using a self-administered questionnaire under four domains ; Perceived pain, Perceived stiffness, Level of Activities of Daily Living (ADL) and Quality Of Life (QOL). The results showed that 50 (83.33%) subjects completed the study. Pain was reduced by 7.18% for EG and 0.46% for CG. Stiffness for EG was decreased by 15%, but was increased by 2.6%, for CG. This trend was observed in levels of QOL and ADL for both these groups as well. Statistically significant improvements ($p < 0.05$) for four domains were present for EG, and the between group differences were statistically significant ($p < 0.05$). The introduced PRT program with the scientific approach and compliance strategy were effective in reducing pain and disability in patients with knee Osteoarthritis.*

Keywords : *Knee Osteoarthritis, Pain, Progressive resistance training exercises.*

INTRODUCTION

Osteoarthritis (OA) is a degenerative disease of joints resulting from wear of the articular cartilage, which may lead to secondary changes in the underlying bone [1]. It is a very common disease and may contribute largely to morbidity in the community [2]. Because of the high prevalence of the disease, it has become a major issue in the community. Usually, treatment for OA includes both pharmacological and non-pharmacological treatments. Due to the beneficial effects seen across the range of disease severities, conservative non-pharmacological management strategies became a topic of research interest across the past century. Recently, prescription of exercises by practitioners has become a first-line conservative intervention approach for OA. The objective of this study was to discover the effectiveness of a home-based progressive resistance training (PRT) program in reducing pain and disability in patients with osteoarthritis (OA) of knee. Furthermore, it was aimed to identify the general level of perceived pain, stiffness, level of activities of daily living and quality of life in OA patients before conducting the PRT program. The study was conducted at the Physiotherapy department of Department of Rheumatology and Rehabilitation of the National Hospital of Sri Lanka.

OBJECTIVES OF THE STUDY

The study aimed to discover the effectiveness of a home-based progressive resistance training (PRT) program in reducing pain and disability in patients with osteoarthritis (OA) of knee; specifically to identify the general level of perceived pain, stiffness, level of activities of daily living and quality of life in OA patients before conducting the PRT program; to identify the effectiveness of a home-based PRT program in reducing perceived pain and stiffness in patients with OA of knee; and to identify the effectiveness of a home-based PRT program in

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increasing level of activities of daily living and level of quality of life in patients with OA of knee.

REVIEW OF LITERATURE

Role of exercises in treatment of Osteoarthritis.

Exercise demonstrates the beneficial effects by improving the strength and endurance of the muscles of vital importance, thus enabling the degenerating joints to take assistance from surrounding musculature [3]. Furthermore, regular exercise helps enhance the flexibility and proprioception of the joints whilst improving cardiovascular fitness which is probably impaired in osteoarthritis, and are thought to cause significant impact on pain and related disability. In addition to this, exercise aims directly at reducing disability, for example, through correction of the walking pattern [4].

With increasing interest in evaluating effectiveness of various forms of exercises, researches sought to compare the efficacy between a wide range of therapeutic exercises modalities such as strengthening, aerobics, hydrotherapy and Tai-chi [5]. In literature, trials have used different modes of delivering of these exercises. In some, hospital based regimens individually, or class based with machinery, have been performed whilst in others home based regimens which were partly supervised were used where the exercises were carried out exclusively in the living environment of the subject [5].

Effectiveness of strengthening exercises in reducing pain and disability associated with knee Osteoarthritis.

Literature reveals that dynamic stability of the knee joint depends on the appropriate strength ratio of quadriceps and hamstring muscles. Hence, strengthening the weakened muscles has been increasingly considered in treating patients with osteoarthritis [4].

Certain literature reveal that strengthening improves pain and physical function even though the effects on quality of life and depression levels of the patients are yet to be confirmed. A variety of modalities in strengthening were used even though there appears to be no evidence that the type influences [6].

A systematic review done in 2002 showed that quadriceps and hamstring muscles have been reported to have strength at the rate of nearly 60/40 for knee stabilization and they emphasized that exercises related to quadriceps and hamstring muscles played a role in treatment of knee OA patients [7].

In a similar study in 2007, the authors studied the effects of strengthening exercises on 28 subjects with mild to moderate pain. Compared to the previously mentioned studies, the exercise regimen comprised the strengthening exercises of quadriceps and hamstrings with a Medx knee machine. Moreover, the subjects have performed home based isometric exercises for muscles. Improvements were observed three months from the beginning and were sustained up to 1-3 years. Thus, the authors concluded that strengthening is beneficial for patients with mild to moderate severity [8].

Consistent results were observed in a randomized clinical trial of 201 participants, where the authors also sought to determine the effectiveness of exercise in osteoarthritis. In addition to strength training exercises of knee extensors and flexors, stretching quadriceps and hamstrings, coordination, mobility, and exercises for elementary movement as well as locomotion abilities have been included. At the end of the 12 weeks of study period, authors have examined the pain, drug use and observed disability. According to results obtained, reduction of pain and disability was observed, but with no visible change in the level of NSAIDs usage. Also effects sizes for pain (0.58) and for observed disability (0.28) were medium and moderate respectively [4].

Effectiveness of home based exercises in reducing OA related symptoms.

Home based exercises are prescribed for patients with OA of knee, but the effectiveness of these home based exercise regimes is an area that needs further studies to be done.

Another study which employed a randomized sample of 191 men and women with knee pain aimed to improve strength of quadriceps muscle and outcome data were abstracted for the change in pain and disability. The exercise group was subjected to a graded exercise programme which consisted of isometric quadriceps contractions in full extension, isotonic quadriceps contractions held in mid flexion, isotonic hamstring contractions, isotonic quadriceps contractions with resistance band and dynamic stepping exercises (walking up and down one step/stair). At the end of the study the subjects gained quadriceps strength whilst in the control group, the strength was reduced. Pain was measured using Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain scores and Visual Analogue

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Scale (VAS) assessments and the obtained results showed a significant reduction in pain for exercise group which was consistent for both measures. The results showed that, for pain, reduction was by 22.5% in the exercise group and by 6.2% in the control group [9].

The findings of another study, are consistent with the previous study in terms of pain and functional status associated with osteoarthritis. Out of 75 participants, 52 have performed regular exercises for eight months. The exercise programme was designed with active Range of Motion (ROM) exercises, isometric and isokinetic exercises for quadriceps and hamstrings over the study period. Upon completion of the exercise program of eight months, researchers have evaluated the severity of pain and the functional status of the subjects using VAS, WOMAC and 36-Item Short-Form Health Survey (SF-36) scores. A significant improvement was presented and authors also mention that even after the treatment, improvements were maintained at 12th week with a slight decline. Furthermore the authors state that cost-effective and easily applicable home-based exercise programs can improve the levels of functionality, pain and quality of life [7].

A randomized trial done by the participation of 48 volunteers with knee OA, conducted over a period of 4 weeks, shows that there was no difference in reduction of pain for home-based strength training and home-based balance training. Using the Knee Injury and Osteoarthritis Outcome Score, the pain as the primary outcome measure and function in daily living, function in sports and recreation and knee related quality of life, as secondary outcome measures were taken. They also conclude that the strength training group improved in knee related quality of life than the balance training group. No other outcome measures showed between group difference in these groups [10].

A study done on knee pain reveals that a simple home based exercise program which includes strengthening and mobilizing exercises to knee, can significantly reduce the pain related to OA. The authors state that psychosocial effect given by the contact of a therapist alone cannot deliver the improvements as no significant reduction in pain was observed in telephone contact groups. The study employed WOMAC index and SF-36 questionnaire as outcome measures in which 786 men and women over the age of 45 were recruited, out of which 600 participants completed the study. Even though there are methodological flaws in the study, the effect size is considerably higher and measures were also taken to control the possible confounders [11].

Another randomized control trial reveals that the patients with knee osteoarthritis, can be helped most economically by functional home based exercises given with a session of advices. The study had employed 27 subjects who had been undergoing physiotherapy treatments. The outcome measures were pain, range of motion, quadriceps strength, knee joint swelling and exercise tolerance and no significant difference had been found among the groups [12].

MATERIALS AND METHODS

Subjects

Sixty patients with already confirmed OA of a single knee were recruited for the study. The diagnosis of study participants were confirmed by physicians based on clinical features and radiological evidence. The subjects were being treated at the Physiotherapy department and were in between 40 – 65 years of age [4]. Subjects were excluded if they had undergone surgeries on lower limbs [4], had recent lower limb fractures during past 12 months or had intra-articular steroidal injections within last 3 months [4]. In addition to that, subjects who were diagnosed to have OA in both knees or any other inflammatory arthropathy such as rheumatoid arthritis were excluded from the study. Furthermore, subjects who had medical conditions other than OA, which may interrupt with the exercise program [4], and subjects diagnosed to have psychological illnesses according to medical records were also excluded. Once the volunteer subjects who fulfilled inclusion and exclusion criteria were recruited, written consent was obtained after providing information regarding the study. Then the subjects were randomized to the Experimental Group (EG) and Control Group (CG) using Simple random sampling.

Outcome Measures

Data collection was done using a self-administered questionnaire which took about 15 to 20 minutes to complete. The self-administered questionnaires were provided to all the subjects in both groups at the beginning, and baseline measures were established. The self-administered questionnaire was designed by the investigators with the aim of collecting subjective data under four main domains; perceived pain, perceived stiffness of the joint, level of activities of daily living and level of quality of life.

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In the questionnaire, there were 22 questions, divided under the 4 main domains. Each question consisted of 5 answers from 1 to 5 and a score was given to each answer according to the ascending order, hence a higher score indicated an increased severity and vice-versa. In addition to this, socio-demographic data of the subject was also needed to be filled. The questionnaire was validated and pre-tested before being used as the data collection tool. The questionnaire was validated by two rheumatologists and 3 physiotherapists. In order to test the comprehensibility, clarity and credibility of the questionnaire, it was pre-tested among 10 knee osteoarthritis patients at another clinical setting in Sri Lanka. A diary was also distributed among subjects of the experimental group which was designed by the investigators. This was required to be filled on a daily basis for the duration of the exercise program in which the number of exercises performed, total time taken to complete all the exercises and reasons for not being able to perform any exercise, if any, was required to be filled. This was given as a measure of increasing adherence to the exercise program.

Interventional program

Once the baseline data collection was completed, an exercise program was introduced to the subjects of the experimental group and no exercise or intervention was introduced to the control group. The exercise program consisted of 3 exercises which were required to be performed once a day, on a daily basis for 30 days.

Isotonic quadriceps contractions at terminal extension: The subject is required to sit on the bed with back supported against the head end of the bed. Legs are kept extended, with a rolled up towel kept under one knee. The subject contracts quadriceps muscle, lifting the ankle up, clearing the bed, and holds for five seconds [13]. This exercise was required to be performed 3 sets of 8 repetitions everyday [14].

Isotonic quadriceps contractions : The subject is required to sit on a chair and to lift the lower leg to partially extended position and to hold for five seconds [9].This exercise was required to be performed 3 sets of 8 repetitions everyday [14].

Isotonic hamstring contractions: The subject is required to lie prone on the bed and to bend the knee bringing the foot towards the body [9]. This exercise was to be performed 3 sets of 8 repetitions everyday [14].

The exercise program was designed in such a way that the exercises were easy to be performed at home with minimum economic cost and side effects. The subjects were asked to perform these exercises without using any resistance for first 15 days and then to increase the resistance during next 15 days by using cuff weights bound around the ankle joint of the exercising leg which were provided. The cuff weight weighed 400g [13]. The towel which was to be a bath towel, was needed to be rolled up in such a way that the height should be 10 cm once kept on a flat surface [9]. The subjects of the experimental group were contacted over the telephone for several times. Problems pertaining to the program were clarified. This strategy of contacting over the telephone was carried out as a measure of increasing the compliance as it has been shown to improve adherence to exercise programs and to improve patient outcomes [15]. The subjects of both groups were contacted on the 30th day and an appointment was set for the reassessment. The self-administered questionnaire was again given to the subjects of both groups and data collection was carried out. In addition to this, the diary was also collected. The subjects of both groups were allowed to continue their general treatment for OA including exercises given by Physiotherapists.

Statistical Analysis and Ethical clearance

Ethical clearance was obtained from Ethics Review Committee (ERC) of the Faculty of Medicine, University of Colombo, Sri Lanka. Furthermore, permission was obtained from the director of the hospital and Consultant Rheumatologists of the department. Informed written consent was obtained from all the subjects after explaining the study, prior to being recruited to the study.

It was analyzed using Statistical Package for Social Sciences (SPSS) version 17.0, and was stored in a household personal computer. The level of significance was determined to be at a p value of less than 0.05. Socio-demographic characteristics of the study sample and the two groups were established by the usage of descriptive statistics. Independent sample t-test was used to analyse the relationship between these characteristics of the two groups. Moreover, Independent sample t-test was used to establish the relationship between the baseline characteristics, post scores of the variables at completion and the difference of improvement levels. Paired sample t-test was utilized to analyze the pre and post scores of the variables to obtain the improvement levels.

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RESULTS

The response rate was 83.33% as only 50 subjects out of 60, completed the study. 26 (86.67%) subjects out of 30, of the control group (CG) completed the study and only 24 (80%) subjects out of 30, completed from the Experimental group (EG). Furthermore, all the subjects (n=60;100%) recruited were females. No male subjects were recruited as nobody fulfilled the inclusion and exclusion criteria. Table 1 shows the demographical characteristics of the subjects.

Table 2 below shows the general levels of perceived pain, stiffness, quality of life and activities of daily living at the beginning of the study showing the baseline measurements of the study sample. No statistically significant difference was observed between the control and experimental groups. As evident from Table 3, statistical significance was found throughout the four variables with regard to the difference of pre and post scores.

Table 1. Demographic data of participants

	Control Group	Experimental Group
1. Age	53.77 (SD=4.812)	54.57 (SD=5.469)
2. Marital Status		
Married	26 (86.7%)	28 (93.3%)
Single	4 (13.3%)	2 (6.7%)
3. Occupation		
Housewife	20 (66.7%)	19 (63.3%)
Self-employed	6 (20%)	5 (16.7%)
Other	4 (13.3%)	6 (20%)
4. Analgesic usage		
Only when pain exacerbates.	9 (30%)	7 (23.3%)
Once a day	9 (30%)	6 (20%)
Twice a day	12 (40%)	17 (56.7%)
5. Involvement of the OA leg.		
Right	18 (60%)	19 (63.3%)
Left	12 (40%)	11 (36.7%)

Table 2. Baseline measurements of the sample

	Control Group		Experimental Group	
	Mean	SD	Mean	SD
1. Perceived pain	16.90	3.960	15.77	3.775
2. Perceived stiffness	5.33	1.422	4.93	1.388
3. Activities of daily living	25.80	7.402	27.03	6.970
4. Quality of life	8.63	2.512	8.80	2.455

Table 3. Relationship of differences in scores of variables

	Mean difference	t	Significance (p value)
1. Pain	1.339	2.035	0.046*
2. Stiffness	0.904	2.110	0.039*
3. ADL	3.654	2.141	0.040*
4. QOL	1.584	2.060	0.042*

* $P<0.05$

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DISCUSSION

The dropout rate for experimental group (20%) was higher than for the control group (13.33%) despite regular telephone contacts. However, the reasons given for the dropouts were unrelated to the exercise program or the study. This inequality in dropouts could be observed in several studies.[7, 16]. Furthermore, all the subjects recruited in the study sample were females (100% ; n=60), as male subjects did not fulfill the inclusion and exclusion criteria. The number of male patients attending the clinics at study settings was low when compared to the number of female patients. This finding is however, inconsistent with most of the studies, as certain research employed 20% of male subjects in the studies [7].

It was evident that 100 % (n=60) of the subjects in the current study were under analgesics prescribed by the General Practitioner (GP) showing high prevalence of analgesic usage in this patient group. This is in accordance with the findings of Deyle et al. [16], but contradicts the findings of Baar et al.[4], in which analgesic usage was reported to be around 50 % at the beginning of the study. This difference in analgesic usage may be attributed to the study designs, methods of recruitment and study settings, as the current study was solely based on hospital settings where the patients were recruited to the study from the physiotherapy clinics to which the patients are referred after being treated with medication by the GP. This usage of analgesics may have caused a self-reporting bias in data collection. Furthermore, the current study shows that the majority were having OA of right knee (60%) which is inconsistent with findings of Chaipinyo and Karoonsupcharoen [10] in which the involvement of OA of left knee was greater than that of right knee.

Hence, the socio-demographic data of the two groups (i.e. control & experimental), were similar showing no significant difference ($p > 0.05$) in any of the socio-demographic characteristic in the current study. Since the conditions are more or less the same for both groups, these factors can be thought to have cancelled out each other in each group. This is consistent with many of the findings of research including the work done by Deyle et al. [16], Doherty et al. [11] and Foley et al. [5].

Most of the studies have sought to find the general level of pain and the effects of exercise on pain as these are found to be the chief complaints of this patient group. The current study found that the general level of pain among the subjects at the beginning was 54.4%. The mean levels of control and experimental groups showed no statistical significance ($p > 0.05$). This is in accordance with the findings of Baar et al. [4] and Foley et al. [5]. But these are not equivalent with findings of (Sheila, Muir and Doherty [9] and Doherty et al. [11], in which the general levels of pain at the beginning was markedly lower. Also, in the study done by Chaipinyo and Karoonsupcharoen [10], the pain levels have been markedly increased and there was no significant difference between the groups. These differences may be attributed to the differences in study settings and methods of recruitment adopted by different research. Majority of research have employed stiffness as an outcome measure even though some studies, have not sought to find the stiffness levels [3]. Current study found that the general level for stiffness was 51.3%. Furthermore, there was no significant difference ($p > 0.05$) between the control and experimental groups and this finding is similar with studies done by Baar et al. [4] and Foley et al. [5].

Most of the studies done earlier, have sought to find the effects of exercise on physical activity as OA has been shown to have direct impact on functionality of patients [3]. The current study shows that the level of ADL for the study sample was 48.04%. These findings are consistent with Foley et al. [5] and Chaipinyo and Karoonsupcharoen [10] but are inconsistent with the findings of Sheila, Muir & Doherty [9], and Halim et al. [7] as the physical function has shown to be smaller comparatively. Out of a plethora of studies, some have sought to find the QOL in terms of health perception, anxiety levels and etc Sheila, Muir and Doherty [9]. Our study found that the level of QOL was 58.13%. This finding is similar to that of the study done by Halim et al. [7] and shows inequalities with the study done by Chaipinyo & Karoonsupcharoen [10].

We found that a statistically significant improvement ($p < 0.05$) was present with regard to pain, for experimental group, when pre and post scores were compared, where the mean pain score was reduced by 7.18%. But, no statistically significant improvement ($p > 0.05$) was observed for the control group, even though the mean pain score was reduced by 0.46%. This reduction of pain in both groups could be attributed to the usage of analgesics and other means of treatments given at the settings. But, the greater improvement in experimental group could be directly related to the effects of exercises and the improved psychosocial contact. Also, this finding is consistent with the findings by Sheila, Muir & Doherty [9], Deyle et al. [16], Baar et al. [4] and

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Doherty et al. [11] in which they found that even though the pain scores were reduced in both groups, statistical significance was observed in experimental group, which was clinically important. In Deyle et al. [16], the pain reduction for experimental group was 60% where as it was 20% for the control group. But, the authors also used manual therapy treatments with the exercises for the experimental group which might describe the larger percentage improvement in the perception of pain. The between group difference was statistically significant ($p < 0.05$) in the current study with regard to pain, and this is in good accordance with Sheila, Muir and Doherty [9] and Deyle et al.[16].

It was found that the stiffness was also significantly different ($p < 0.05$) for experimental group. The findings reveal that the reduction for experimental group was 15%, where as it was -2.6% for control group, illustrating that the stiffness deteriorated slightly. No statistically significant difference ($p > 0.05$) was observed for the control group. This improvement in experimental group can be attributed to the effects of exercise program and telephone contact sessions, but the decrease in the level of stiffness in control group cannot be explained clinically, though this may be due to recall bias. The improvement of stiffness in experimental group is in accordance with the findings of Deyle et al. [16] and Doherty et al. [11],. In the study by Deyle et al. [16], the improvement in stiffness for experimental group was 54% and was 25% in control group. But, our findings contradicts the findings of Foley et al. [5] in which no difference was observed in the two groups. The between group difference was statistically significant ($p < 0.05$) in the current study with regard to stiffness, and this is in good accordance with Deyle et al. [16] and Doherty et al. [11].

A statistically significant difference ($p < 0.05$) was again seen with regard to the level of ADL, in the experimental group with pre and post score comparison. The improvement for experimental group was marked to be 6.31%, where it was -2.41% for control group where no statistically significant difference ($p > 0.05$) was observed. This deterioration of control group, again cannot be explained clinically, but may be attributed to recall bias. The improvement in experimental group is in good accordance with Deyle et al. [16] and Doherty et al. [11]. It is shown in the study by Sheila, Muir & Doherty [9], that the level of physical function was reduced in control group which is a similar finding with the current study. The between group difference was statistically significant ($p < 0.05$) in the current study with regard to ADL, and this finding is consistent with Sheila, Muir & Doherty [9].

Our study observed that a significant relationship ($p < 0.05$) was present with regard to levels of QOL in the experimental group, when pre and post scores were compared. The improvement for experimental group was 12.3% where as it was -4.73% for control group. No statistically significant difference ($p > 0.05$) was observed for the control group. This improvement in experimental group and deterioration in control group is difficult to be explained in clinical norms. But, it may be largely due to recall bias. These findings are similar with the findings of Sheila, Muir and Doherty [9] where reduction of QOL was observed for control group in which it increased in experimental group. In Foley et al. [5], and Halim et al. [7], the QOL levels improved for experimental group and was not changed in the control group. Also, some research have completely omitted to assess QOL levels of subjects and has not considered QOL as an outcome measure [12]. The between group difference was statistically significant ($p < 0.05$) in the current study, and this finding is consistent with Sheila, Muir & Doherty [9] and Halim et al. [7].

In the current research, continuous contact with a health care professional may also have influenced the improvements other than the effects of exercise program and the scientific approach in experimental group as the perception has been shown to differ with the contact of a health-care professional [17]. Furthermore, Rene et al. [17] revealed that telephone contact alone was strong enough to create significant benefits in treatments in OA patients. Therefore, this may have caused self-reporting bias in the experimental group.

In the meantime, perceived reduction in knee pain and stiffness may have led to the improvements in ADL and QOL as there could be psychological effects involved with this. Similar effects have been shown in the study by Halim et al. [7]. The exercises used in the current study, strengthen the muscles concentrically as well as eccentrically. But, strength of the muscles was not taken as a measure of outcomes which is similar to the studies done by Deyle et al. [16], Doherty et al. [11], and Halim et al. [7]. But, in studies done by Callaghan, Oldham and Hunt [12] and Sheila, Muir & Doherty [9], the muscle strength was measured and used as an outcome measure. Analgesics were allowed to be used in this study which is consistent with studies by Callaghan, Oldham & Hunt [12], Sheila, Muir and Doherty [9] and Foley et al. [5], and in some

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studies, analgesic usage has been used as an outcome measure [4].

CONCLUSION AND RECOMMENDATIONS

The main aim of the study was to assess the effectiveness of a home-based progressive resistance training (PRT) program with a compliance strategy, in reducing pain, stiffness, level of activities of daily living and level of quality of life, in patients with Osteoarthritis of the knee. Furthermore, it was focused on assessing the general level of perceived pain, and other factors with regard to knee OA. The findings suggest that, the general level of perceived pain, stiffness, ADL and QOL are 54.4%, 51.3%, 48.04% and 58.13% respectively as percentages, prior to the intervention. Furthermore, it reveals that there is statistical significance with regard to all 4 domains between the experimental and control groups.

Hence, the combination of exercises in this PRT program with the scientific approach and compliance strategy, can be utilized for female patients. Furthermore, the sample size of this study is not sufficient to arrive at a definitive conclusion with regard to clinical significance.

Further research is needed to assess the effectiveness of exercises and this PRT program with a compliance strategy and with a larger sample size covering a larger geographical area, including knee OA patients of both legs and male subjects. This may increase the applicability of the study findings to the general population. Further research is recommended for assessment of the relationship between severity of condition with effects of exercises and PRT programs as it may be beneficial in application of findings in hospitals and clinical settings.

LIMITATIONS

In this pilot study, comparatively a smaller sample size was used and hence, generalization of the study findings should be done cautiously. It is not sufficiently powered to arrive at definitive conclusions but gives a direction for further research.

Only female subjects were present in the study sample as male subjects did not fulfil the inclusion and exclusion criteria. Hence, the gender effect on exercises and perception levels were not studied. This may hinder the applicability of the findings to general population.

Blinding of assessor or subjects was not done as it was not possible in this study. This may have led to performance bias.

The subjects are under analgesics prescribed by the GP, which may have affected the perception of pain leading to self-reporting bias. This variation in perception of pain may have also affected the level of activities of daily living and quality of life.

Other diseases which the subjects were having other than knee OA, may have also affected the perception of pain, ADL and QOL levels leading to self-reporting bias.

There may have been other confounding factors, that are impossible to be controlled in a clinical setting, which may have affected the study without being noticed. These confounders may also have led to biases in the study.

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