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The efficacy of exercise intervention on knee osteoarthritis in older adults

Critical review of evidence

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Around 2.4% of people over 55 years are disabled by knee pain due to osteoarthritis (OA) knee and by the age of 65 years 30% of men and 40% of women have radiographic changes of knee osteoarthritis 3 which often limits the ability to rise from a chair, stand comfortably, walk, and use stairs (Deyle et al, 2000)

Many randomised controlled trials concluded that exercise reduces pain and improves function in patients with osteoarthritis of the knee, but the optimal exercise regimen has not been determined. Fitness walking, aerobic exercise, and strengthening training have all been reported to result in functional improvement in patients with osteoarthritis of the knee (Carter et al, 2002; McAlindon, et al, 1993).

The aim of this paper is to critically review the current literature in relation to knee osteoarthritis in older adults and evaluate the methodology of those studies, while assessing the robustness and benefits of their outcomes. Hence, the factors that determining the study's' results and implication of outcome for large population will be discussed.

In this study, different type of design, subjects of all age groups and of either gender were included. Studies were included if the subjects primary complaint was OA knee with or without disability. The exclusion criteria were joint replacement (total knee), infection, fracture, neoplasm and posture abnormality or biomechanics problems.

However, this study will not describe the different assessment tools that have been used in each study to measure different variables like health and disability of their subjects.

Method

Deyle et al, (2000) have carried out a RCT to evaluate the effectiveness of physical therapy for osteoarthritis of the knee, by combining the manual therapy and exercise.

In this RCT study, 83 patients with OA knee who were randomly assigned to receive treatment (*n* = 42; 15 men and 27 women [mean age, 60 ± 11 years]) or placebo (*n* = 41; 19 men and 22 women [mean age, 62 ± 10 years]).

The treatment group received manual therapy, applied to the knee as well as to the lumbar spine, hip, ankle and performed a standardized knee exercise program in the clinic and at home. The placebo group had sub-therapeutic ultrasound to the knee at an intensity of 0.1 W/cm2 with a 10% pulsed mode. Both groups were treated at the clinic twice weekly for 4 weeks.

Dependent variables measured consisted distance walking in 6 minutes and sum of the function, pain, stiffness, sub scores of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). A tester who was blinded to group assignment made group comparisons at the initial visit, 4 weeks, 8 weeks and 1 year. After controlling for potential confounding variables, the average distance walked in 6 minutes at 8 weeks among patients in the treatment group was 170 m (95% CI, 71 to 270 m) more than that in the placebo group and the average WOMAC scores were 599 mm higher (95% CI, 197 to 1002 mm).

At 1 year, patients in the treatment group had clinically and statistically significant gains over baseline WOMAC scores and walking distance. Interestingly Deyle et al,

(2000) proved that 20% of patients in the placebo group and only 5% of patients in the treatment group had undergone knee replacement (arthroplasty).

Deyle et al, (2000) conclude that a combination of manual physical therapy and exercise programme have functional benefits for patients with osteoarthritis of the knee and may delay or avoid the need for knee replacement. Although Deyle et al, (2000) have used reliable measurement tool like 6-minute walk distances and WOMAC scores, yet there is a significant weak points in their methodology, which they have not explained. Because the treatment group was receiving manual therapy and knee exercise, therefore it is not clear that the outcomes are linked to manual therapy or the knee exercise. Hence, a second treatment group, with performing only knee exercise could be a good alternative for this confounding variable.

In addition, Deyle et al, (2000) had relatively small sample size for RCTs, did not used regression module and they have not adequately measured the accuracy and intensity of home exercises, especially between the 8th sessions and 1-year. Although Deyle et al, (2000) have found sufficient evidence for their realistic hypothesis, yet the reliability of these outcomes needs to be clarified in future studies, before generalizing.

Jinks et al, (2007) carried out a cohort study, to determine the incidence of knee pain over a 3-yr period and to assess its impact on general health status and physical function, in people aged 50 and over.

In this study, four groups of responders were defined according to change in knee pain over the 3 yrs by using knee pain question (KNEST) and SF-36 scores: (i) no knee pain group, (ii) new knee pain group, (iii) resolved knee pain group, (iv)

continuing knee pain group. At baseline, 8995 subjects were sent a questionnaire to which 6792 responded. Finally 3907, (91%) responded to the follow-up questionnaire by answering the KNEST knee pain question at both baseline and follow-up. In total, 43% of the original population sent the baseline questionnaire (53% adjusted for deaths and departures from the GP list) and were followed up at 3 yrs.

They (Jinks et al, 2007) carried out all adjusted analyses by using multiple linear regression unlike Deyle et al, (2000), with all independent variables entered simultaneously and checks performed on the residuals for departure from normality, homogeneity of variance and multicollinearity between the independent variables.

After controlling the data, overall, mean SF-36 scores in their study are similar to the UK norm-based SF-36 data (Jinks et al, 2007). However, using the SF-36 scores and KNEST as main assessment tools without any practical examination of the knee joint, reduce the robustness of methodology in this study.

Nevertheless, SF-36 scores in 3-yr showed the no knee pain, resolved and continuing groups remained relatively stable in SF-36 scores at follow up, with generally only small falls in the no knee pain and continuing groups. In contrast, the new knee pain group (i.e. those who developed knee pain between baseline and follow-up) showed a mean fall of more than 10 points for Physical Functioning.

The main weak point of this cohort study is that they have not measured other variables related to general health and physical function decline like psychological aspects, illness perceptions, health beliefs and optimism and pessimism. In addition, this study could not explain why the resolved group did not return to full function.

Their results emphasize the importance of knee pain as a likely risk factor of physical decline in aged persons. Almost a quarter of adults over 50 yrs who suffer from knee pain will experience resolution of pain at 3 yrs however; their general health status and physical functioning will not gain full recovery. Because there were no any obvious methodological weak point in this study, hence, their results are likely to be generalized to the wider population. However, the results (Jinks et al, 2007) are not useful to apply in physiotherapy practice directly. These results are more suitable for NHS and other government bodies to manage and prevent the elderly disabilities on time.

The purpose of McAlindon, et al (1993) research was to assess the influences of radiographic severity, quadriceps strength, knee pain, age, and gender on functional ability in patients with osteoarthritis of the knee.

Equal numbers of knee pain positive and negative respondents to a survey of registrants aged more than 55 years at a general practice were invited to attend for knee radiographs and quadriceps femoris isometric strength estimations. Disability was measured using the Stanford Health Assessment Questionnaire (SHAQ).

Respondents with knee pain and an equal number of controls were contacted in random order by telephone and invited to participate in the study. Cases and controls were matched by gender and were born within 12 months of each other.

Full data were obtained on the first 159 from 513 subjects who attended. These 159 patients were younger (mean age 70-2 years v 72-4; p<005) and less disabled (X2=l 1-2; one degree of freedom; p<005) than the remainder.

They used the following methods to measure the studied variables: knee pain, was assessed verbatim by Health and Nutrition Examination Survey, disability was

measured by SHAQ, quadriceps isometric strength was tested by Edwards test and radiography was assessed with weight bearing in anteroposterior position and standardised technique. However, early research using the Kellgren and Lawrence (1957) radiographic osteoarthritis score showed relatively poor reproducibility.

The relations between variables were investigated first using simple linear regression for continuous variables (age and quadriceps strength) and Spearman rank correlation for discontinuous measures McAlindon, et al (1993).

In this study logistic regression was undertaken because of the non-normal distribution of the Health Assessment Questionnaire score, while Jinks (2007) used linear regression which might favour a continuous dependent variable in favour of a discontinuous measure like (McAlindon, et al (1993) quadriceps strength may favour radiographic score.

McAlindon, et al (1993) conclude that of the variables studied, quadriceps strength, knee pain, and age are essential determinant of functional disability in older people than the severity of knee osteoarthritis as assessed radiographically. Therefore, an adequate intervention can optimise muscle strength that has the potential to reduce a vast burden of disability, dependency, and cost. However, they did not explain, what is the optimise muscle strength for older adults.

The critiques to this study are the reliability of the measurement tools and examine many variables at same time. Selection of relatively young patient with less disability is another issue, which may increases biases and reduce the validity of their outcomes. However, the result of this study seems be more realistic and rigorous than Jinks et al, (2007).

McAlindon, et al (1993) have acknowledged their limitation and biases that may affect the applicability of the outcomes while (Jinks, 2007 and Deyle et al, 2000) have not considered any possible biases. Generally, the methodology of this study seems to be rigorous and therefore the outcomes of this study could be generalised to wider population.

Penninx et al (2001) have studied the relation between an exercise programme and prevention of disability in activities of daily living (ADL) in patients with OA knee.

Their method consisted of a 2-center, randomized, single blind, controlled trial, in which participants were assigned to an aerobic exercise program, a resistance exercise program, or an attention control group.

Of the 439 person aged 60 years or older with OA knee, the 250 participants free of ADL disability were used for this study. They defined ADL disability, as difficulty in transferring from a bed to a chair, eating, dressing, using the toilet, or bathing, and they assessed ADL disability, quarterly during 18 months of follow-up.

Although they had a long list of inclusion/ exclusion criteria, nevertheless it is not clear on what ground they have set up these criteria list. In addition, there are some contraindication in their exclusion criteria and their conclusion. For instance, subjects with heart condition, lung disease and inflammatory arthritis were excluded, though they acknowledged, “Many of the older participants with knee osteoarthritis in our study (41%) had other disabling comorbid conditions, such as cardiovascular disease, diabetes mellitus, lung disease, or cancer” (Penninx et al, 2001, P2315).

Interestingly, Penninx et al (2001) had monthly group sessions for control group, including time for discussions and social gathering, to educate participants and give them adequate study attention, while other studies (McAlindon et al, 1993; Deyle et al, 2000) had not such educational meetings. Hence, the benefits of these monthly group sessions have not been explained or measured by Penninx et al (2001).

The aerobic group and resistance group exercise programme was scheduled as 3 times per week for 1 hour. They do not explain the grounds for this hypothesis, which may be intensive training for this group of patient.

Their results have showed that the cumulative incidence of ADL disability was lower in the exercise *groups (37.1%) than in the attention control group (52.5%) (P=.02).* After adjustment for demographics and baseline physical function, the relative risk of incident ADL disability for assignment to exercise was 0.57 (95% confidence interval, 0.38-0.85; *P*=.006). Both exercise programs prevented ADL disability; the relative risks were 0.60 (95% confidence interval, 0.38-0.97; *P*=.04) for resistance exercise and 0.53 (95% confidence interval, 0.33-0.85; *P*=.009) for aerobic exercise. The lowest ADL disability risks were found for participants with the highest compliance to exercise.

Penninx et al (2001) have proven that persons participating in either a resistance or an aerobic exercise program had a significantly higher probability of remaining free of ADL disability for 18 months.

In addition, Penninx et al (2001) relayed on subjects self-reporting assessment method and Cox proportional hazards analyses, to measure disability and pain, while in similar situation Deyle et al, (2000) used WOMAC health questionnaire

assessment tool and Jinks et al, (2007) used Short Form-36 and knee pain screening tool (KNEST). Therefore, it is obvious that different studies come up with different results even if they research the same topic.

However, it appears that the differential study loss due to unavailability might have biased (Penninx et al, 2001) results. Overall, 129 (8.6%) of the total 1500 ADL disability assessments were missing.

Penninx et al (2001) concluded that aerobic and resistance exercise may be an effective strategy for preventing ADL disability and consequently, may prolong older persons' autonomy. Although the methodology of this study have few weak points as mentioned above, since, their results are not contradicting any of the above studies, therefore, their outcome can be generalised to a large population of OA knee.

Carter et al (2002) conducted a randomized controlled trial of specific exercise programs designed specifically for women with OA to prevent falls.

Their RCT's methods consisted of 93 women 65 to 75 years diagnosed with OA knee by dual-energy X-ray absorptiometry in Vancouver and BC Women's hospital between 1996 and 2000. The subjects were selected if they had not engaged in regular weekly programs of moderate or hard exercise. The subjects were randomly assigned to participate in a twice-weekly exercise class or to not participate in the class. Whereas Penninx et al (2001) exercise programme was scheduled as 3 times per week for 1 hour for similar age group.

Carter et al (2002) had emphasised on improving posture and balance, which differentiate their program from other exercise programs (Penninx et al, 2001 and Deyle et al, (2000)) of which include an aerobic exercise and strengthening

component. Carter et al (2002) have used static and dynamic balance to measure risk factors for falls and strength. They used the Equitest computerized posturography platform (Neurocom International, Clackamas) for static balance and speed traversing a 10-m figure-eight circuit for dynamic balance.

In this study both the experimental and control subjects were invited to bimonthly social seminars to encourage the control group to stay involved in the study, similar to Penninx et al (2001). They assessed general health of the subjects by Canadian Multicentre Osteoporosis questionnaire, evaluated total physical activity by questionnaire of Blair and colleagues and measured quality of life by questionnaire of the European Foundation. Although the assessment tools of variables in this study are different from above studies, yet they are reliable tools.

Before adjustment for covariates, the intervention group tended to have greater, although non-significant, improvements in static balance (mean difference 4.8%, 95% confidence interval [CI] –1.3% to 11.0%), dynamic balance (mean difference 3.3%, 95% CI –1.7% to 8.4%) and knee extension strength (mean difference 7.8%, 95% CI –5.4% to 21.0%). The intervention group also had a 6.3% greater improvement in static balance after adjustment for rheumatoid arthritis and osteoarthritis, but this difference was not significant ($p = 0.06$). Compared with the control group, the intervention group experienced no improvement in quality of life.

This study had few limitations for instance, their participants were more healthy and motivated individuals and the subjects' age was limited to 65-70 years, which limits the generalizability of their findings.

However, Carter et al (2002) indicated that participants in the exercise program experienced improvements in dynamic balance and strength, both important determinants of risk for falls, particularly in older women with osteoarthritis. This focused review has highlighted the benefits of exercise and physical activity for older adults. It was part of the study guide on geriatric rehabilitation in the Self-Directed Physiatric Education Program for practitioners and trainees in physical medicine and rehabilitation. This article specifically focused on the benefits of physical activity and exercise for older adults with regard to morbidity, mortality, and disability.

Campbell et al, (2001) carried out a mixed method design to understand reasons for compliance and non-compliance with a physiotherapy home based exercise intervention by patients with osteoarthritis of the knee.

This qualitative study was nested within a RCT, to investigate the effectiveness of physiotherapy intervention in reducing knee pain and mobility restriction associated with OA knee. In total, they have recruited 87 people, of whom 43 were randomised to the treatment arm. In the intervention arm, patients undertook nine half hour exercises sessions over eight weeks to strengthen the quadriceps muscle and taping of the patella. In depth, interviews were conducted with 20 patients in the intervention arm using open ended questions, guided by a topic schedule, to encourage patients to describe their experiences and reflect on why they did or did not comply with the physiotherapy exercises. Interviews were audio taped, fully transcribed and analyzed thematically according to the method of constant comparison.

Those in the control group received only general advice about weight reduction and exercise at a single baseline visit. However, the control group in this study may have been affected by external variables such as age and lack of radiographic result, and the advices, while the authors have not mentioned these issues.

The trial results showed that five months after the start of treatment there was a small decrease in pain and a significant increase in the strength of the quadriceps muscle of the knee. After one year, however, there were no significant differences in the outcome measures, most of which had returned to pre-treatment levels.

Initial compliance was high because of loyalty to the physiotherapist. A necessary precondition for continued compliance was the perception that the physiotherapy was effective in ameliorating unpleasant symptoms.

Campbell et al, (2001) study have few weak points like (1) recruiting young participants (age 45 and over), (2) three quarters of participants had previously Knee treatment and (3) a single session exercise with some advice to control group. In addition, their methodology have no sufficient measurement tool for RCT design and they have not explained for instance how they measured the strength of quadriceps muscles and the reason of taping patella.

However, Campbell et al, (2001) mixed methods provided us with relevant and rigorous evidence, from the patient's perspective which may help practitioners to make adequate decision about home exercise and whether we should judge effectiveness according to whether an intervention works when compliance is optimal or taking into account variable levels of compliance.

Dawson et al (2003) have carried out a matched case-control study to explore the risk factors for knee osteoarthritis in women, which included wearing high heeled shoes. Their methodology, in which exposure information was obtained by interview in women, aged 50 to 70 included occupational activities, past shoe wearing, participation in competitive sports, height, body weight, smoking and use of contraceptive pills at three different stages of life.

In total, 111 eligible women were interviewed (29 cases, 82 controls) and the information was entered on a life grid. Dawson et al (2003) measured past exposure by focusing on specific risk factors in their interviews and unlike Campbell et al, (2001) they did not used only, open ended question.

For instance, they showed the pictures of 38 different styles of shoes, with both front and side view to the participants to find out the heights of their shoes in the past.

In addition, Dawson et al (2003) used few self-developed assessment tools like life-grid, which may not meet the standard criteria for such study.

Hence, for the statistical analysis, Dawson et al (2003) used conditional logistic regression to compare cases and controls in relation to the frequency of risk factors, while Campbell et al, (2001) did not used any regression models in for analysing their interview results.

One of the studied variables in this research was socioeconomic status. While their results suggested that control subjects were generally of higher socioeconomic, than cases, interestingly, Dawson et al (2003) found no significant differences in any of the measures of socioeconomic status between cases and controls; nevertheless, socioeconomic was not the main objective of this pilot study.

However, several variables showed a significant relation with OA Knee, in particular occupational activities like lifting and bending. All respondents reported wearing shoes with heels at least one inch high at some time in their lives, while 8 of 111 (7%) said that they had never worn heels as high as two inches and 40 of 111 (36%) reported never wearing three inch heels.

Interestingly, none of the measures of high heel wearing was significantly associated with OA Knee and in most cases the odds ratios indicated a protective effect rather than the hypothesised increase in risk. Dawson et al (2003) concluded that it is very unlikely that prolonged wearing of high heeled shoes represents a risk factor for symptomatic osteoarthritis of the knee in women. Furthermore, they confirmed that being overweight before the age of 40 considerably increases the risk of subsequent OA in women. Hence, small sample size in this research (Dawson et al, 2003) coupled with a large number of risk factors is the main weak point of this study that may increases the risk of obtaining false positive results and the findings should therefore be treated with due caution. However, based on the topic of this study, RCT would be an appropriate design to obtain accurate outcomes.

CONCLUSION

Reviewing the above studies has revealed that most of them have a few weak points in their methodology in producing clinical evidence and recommendations. Based on the current literature, especially the above reviewed studies, exercise intervention generally have been proven to reduce the symptoms and disability in patients with

OA knee. Based on different methodology and different measurement tools that have been used in each of the above study, it is not possible to compare the outcomes.

In addition, most of the above studies have not produced robust and valid evidence. Therefore, the results of this paper cannot be applied to a large group of OA patient. However, the result of individual study (Campbell et al, 2001; Penninx et al 2001; McAlindon, et al, 1993) revealed, that applying exercise interventions are effective approaches in reducing pain and disability in patients with OA knee therefore their outcomes could be generalised to large population of osteoarthritis. Based on the above facts, the future studies have to be more accurate in their methods and measurement tools to produce robust outcomes for large population of OA knee.

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