

Predictors of long-term effect from education and exercise in patients with knee and hip pain

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ABSTRACT

INTRODUCTION: Education and exercise are poorly implemented in osteoarthritis care. The purpose of the present study was to identify predictors of effectiveness at one year from education and exercise in patients with knee or hip pain in clinical practice.

MATERIAL AND METHODS: Good Life with Arthritis in Denmark is an implementation initiative consisting of education and 12 sessions of neuromuscular exercise delivered by trained physiotherapists. Pain (visual analogue scale 0-100) and quality of life (EQ-5D) were assessed at baseline and after three and 12 months. Changes in outcome from baseline to one year were dependent variables in regression analyses, while changes from baseline to 3 months and absolute results at three months in physical performance (30-second chair stand test) and self-efficacy were predictor variables.

RESULTS: A total of 79/82 patients completed the one-year follow-up. Improvements in pain and EQ-5D at three months were maintained at one year ($p < 0.006$). Change in self-efficacy from baseline to three months (Beta = -0.369) and 30-second chair stand test (Beta = -0.251) and self-efficacy at three months (Beta = -0.492) were predictors of one-year improvement in pain ($p < 0.05$). Furthermore, self-efficacy at three months (Beta = 0.304) was a predictor of one-year improvement in EQ-5D ($p = 0.01$).

CONCLUSION: The identified predictors highlight the importance of combining education and exercise. This study indicates that good long-term treatment results are achievable in clinical practice.

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The burden of symptomatic osteoarthritis (OA) is expected to increase rapidly in the future [1], which highlights the need for a paradigm shift towards early-stage treatment [2].

Individualised treatment consisting of exercise, patient education and weight loss is recommended as the core treatment of knee and hip OA [3]. However, the current quality of care is suboptimal and does not reflect treatment guidelines [4]. A comprehensive approach tailored to the specific settings and population is needed to successfully implement guidelines [5].

Good Life with Arthritis in Denmark (GLA:D) represents such an initiative. It teaches physiotherapists to deliver an evidence-based combined treatment of education and neuromuscular exercise [6]. GLA:D is feasible and effective in reducing pain and improving function and quality of life [6]. Furthermore, patient data are entered into a registry which gives a unique possibility to evaluate the quality of non-surgical care given in Denmark [6].

Long-term effectiveness after exercise represents a challenge, since short-term improvements in pain and function have been reported to decline over time [7]. To improve long-term effectiveness, potential predictors of treatment response should be explored. However, most previous studies have investigated predictors of short-term effectiveness or of non-modifiable patient characteristics instead of evaluating variables more closely related to the effect from various interventions.

The purpose of this study was to determine if improvements in physical performance and self-efficacy (a person's belief in his or her ability to succeed in a given situation) from baseline to three months (as measures of treatment effect and compliance) and physical performance and self-efficacy at three months (as measures of patient status after the intervention) were predictors of long-term effectiveness in patients with knee and/or hip pain.

MATERIAL AND METHODS

Study design

This was a prospective uncontrolled pilot study undertaken in clinical practice with 12-month follow-up.

Participants

The study included a total of 82 consecutive patients initiating GLA:D at a physiotherapy clinic between 12 September 2011 and 17 December 2012 with non-acute knee (63 patients), hip (13 patients) or knee and hip (6 patients) pain (Table 1). The exclusion criteria were symptoms more pronounced than the knee/hip pain, comorbidities influencing physical activity, and not understanding Danish. The short-term results for 36 of the 82 patients have been reported [6]. The study was approved by the Danish Data Protection Agency and conducted in accordance with the Helsinki Declaration.

ORIGINAL ARTICLE

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 TABLE 1

Baseline characteristics (N = 82).

Characteristic	Baseline
Women, n (%)	68 (83)
Age, yrs, mean (\pm SD)	62.5 (\pm 7.2)
Duration of symptoms, months, mean (\pm SD)	53.1 (\pm 62.8)
Body mass index, mean (\pm SD)	28.2 (\pm 7.7)
Pain, VAS ^a , mean (\pm SD)	42.0 (\pm 18.4)
Pain in more than one knee/hip joint, n (%)	58 (70)
Self-efficacy ^b , mean (\pm SD)	68.9 (\pm 17.9)
30-second chair stand test, mean (\pm SD)	12.6 (\pm 3.3)

SD = standard deviation.

a) Visual analogue scale 0-100^o.

b) Self-efficacy was assessed using the Arthritis Self-Efficacy Scale (Mean of the Pain and Other Symptoms subscales).

Intervention

GLA:D is a combined education and exercise treatment programme for patients with knee and/or hip pain. The educational part consists of three 1.5-hour sessions, two led by a physiotherapist and one led by a previous GLA:D participant.

The education aims at improving the knowledge of the participants regarding OA and its treatment. The educational part is followed by 12 sessions of individualised exercise supervised by a physiotherapist or at home according to the NeuroMuscular Exercise Program (NEMEX) [8]. For further details on GLA:D, see [6].

In this study, all assessments and interventions were performed by one of two physiotherapists trained in delivering and evaluating GLA:D.

Outcome measures

Average pain during the past month (primary outcome; visual analogue scale (VAS) 0-100) and Euro-Quality-of-Life – 5 dimensional form (EQ-5D) were assessed at baseline and at the three- and 12-month follow-ups.

Predictor variables

An average score for the subscales Pain and Other symptoms of the Arthritis Self-Efficacy Scale (ASES) [9] was used as a measure of self-efficacy (10-100 with terminal descriptors “very uncertain” and “certain”), and the number of rises from a chair during 30 seconds [10] was used as a measure of physical performance.

Changes from baseline to three months in self-efficacy and physical performance were regarded as measures of effect from patient education and exercise, respectively.

Absolute results after three months in self-efficacy and physical performance were regarded as measures of psychological and functional status after the intervention, respectively.

Statistical analysis

Data were confirmed to be normally distributed by visual inspection of Q-Q plots.

A repeated measures (RM) ANOVA was used to evaluate short-term and long-term effectiveness with time (baseline, three months, 12 months) as the within-subject factor. Bonferroni was used as post hoc test (by multiplying the p values by the number of tests).

Regression analyses were applied to investigate whether the a priori hypothesised predictor variables were associated with long-term effectiveness. The construction of the model followed the construction proposed by Bursac et al [11]. Any variable with a p-value < 0.10 in the univariable analysis was included in the multivariable analysis [11]. Any variable included in the first model was removed if non-significant ($p \geq 0.10$) and not a confounder (i.e. changed the estimate of the other variables > 20%). Variables not selected for the first model were re-entered into the model to identify variables that contributed to the model in the presence of the other variables ($p < 0.10$). The assumptions of normality and constant variance were verified using a normal probability plot of residuals and a plot of standardised residuals against standardised predicted value. Tolerance level was used to test for collinearity (< 0.01 resulted in exclusion of variable). Beta-values were used as a measure of how much each independent variable affected the dependent variable.

The significance level of the RM ANOVA and the final regression model was set at $p < 0.05$, and all analyses were performed in IBM SPSS Statistics (Version 20, IBM Corporation, Armonk, NY, USA).

Trial registration: not relevant.

RESULTS

Outcome measures

A total of 79 (96%) patients completed the 12-month follow-up. One of the three participants not completing the follow-up was terminally ill, whereas the other two were unavailable for follow-up. Compared with baseline, pain ($p < 0.001$) and EQ-5D ($p < 0.006$) were significantly improved at the three-month and 12-month follow-ups, with similar pain and EQ-5D scores at both follow-up time points ($p > 0.85$; **Table 2**).

Predictors of pain

Univariable regression analysis showed that change in self-efficacy (Beta = -0.369) from baseline to three months, 30-second chair stand test (Beta = -0.251) and the self-efficacy score at the three-month follow-up (Beta = -0.492) were significant predictors of 12-month improvement in pain ($p < 0.05$) (**Table 3**).

A multiple regression model consisting of change in



TABLE 2

Outcome measures	Baseline, mean (\pm SD)	3-month follow-up, mean (\pm SD)	12-month follow-up, mean (\pm SD)	Difference 3-month baseline, mean (95% CI)	Difference 12-month baseline, mean (95% CI)	Difference 12-month 3-month, mean (95% CI)	p-value ^a
Pain, VAS	42.0 (C 18.4)	29.3 (\pm 19.8)	31.5 (\pm 21.9)	-12.7 (-18.9-6.5)	-10.5 (-16.4-4.6)	2.2 (-2.8-7.2)	< 0.001
EQ-5D	0.763 (\pm 0.080)	0.810 (\pm 0.103)	0.804 (\pm 0.115)	0.047 (0.015-0.079)	0.041 (0.010-0.073)	-0.006 (-0.042-0.029)	< 0.006

Absolute value and change from baseline to 3- and 12-month follow-ups of pain and quality of life.

CI = confidence interval; EQ-5D = Euro-Quality-of-Life – 5 dimensional form; SD = standard deviation; VAS = visual analogue scale 0-100.

a) Reflects the difference from baseline to both the 3- and 12-month follow-ups, while similar pain and quality of life scores were found at the 3- and 12-month follow-ups ($p > 0.85$).



TABLE 3

Predictor variables	Mean (\pm SD)	Univariable analysis		Multivariable analysis	
		Beta	p-value	Beta	p-value
Change in self-efficacy	5.1 (\pm 16.9)	-0.369 ^b	0.002	-0.216 ^b	0.06
Change in 30-second chair stand test	1.9 (\pm 3.1)	-0.170	0.17	–	–
Self-efficacy ^a after 3 months	74.9 (\pm 16.2)	-0.492 ^b	< 0.001	-0.411 ^b	< 0.001
30-second chair stand test after 3 months	14.7 (\pm 3.2)	-0.251 ^b	0.04	–	–

Predictors of improvement in pain from baseline to 12 months.

SD = standard deviation.

a) Self-efficacy was assessed using the Arthritis Self-Efficacy Scale (Mean of the Pain and Other Symptoms subscales); changes in self-efficacy and in 30-second chair stand test represent the differences between the baseline and 3-month results.

b) Significance: $p < 0.10$ was considered to be significant.

self-efficacy and self-efficacy at the three-month follow-up ($p < 0.001$) accounted for 26% of the variance in change in pain from baseline to the 12-month follow-up (Table 3).

Predictors of quality of life

Univariable regression analysis showed that self-efficacy at the three-month follow-up (Beta = 0.304) was a significant predictor of 12-month improvement in quality of life ($p = 0.01$) (Table 4).

Self-efficacy at the three-month follow-up ($p = 0.01$) accounted for 8% of the variance in change in quality of life from baseline to the 12-month follow-up (Table 4).

DISCUSSION

Self-efficacy after the intervention was a significant predictor of improvements in pain and quality of life from baseline to 12 months. Furthermore, physical performance after the intervention and change in self-efficacy from baseline to three months were significant predictors of improvements in pain.

A systematic review from 2007 failed to demonstrate long-term effects following short-term exercise therapy for hip and knee OA [7]. However, a more recent high-quality, cluster-randomised controlled trial (RCT) investigating the effectiveness from exercise and patient education in 418 patients with chronic knee pain found short-term effects to be maintained at 2.5 years [12]. The authors suggested that the maintained effects could be due to the contents and design of their inter-

vention considering physiological, psychological, behavioural and socioeconomic aspects [12]. Integrating these aspects into the education combined with an individualised exercise programme may be instrumental in improving long-term adherence and effectiveness by changing the patients' beliefs in the importance of exercise as a method to control and improve pain in OA [13]. The educational part of GLA:D focuses on these aspects and encourages and supports the participants to continue exercising after the supervised 12-session treatment programme. This empowerment of the participants may improve their ability to deal with symptoms, also following the treatment programme using exercise and other self-help tools.

Another important aspect of GLA:D is the supervised 12-session evidence-based exercise programme [8]. While it is possible to exercise at home, the participants are encouraged to participate in the supervised exercise, as a meta-analysis showed that 12 or more supervised sessions (as in this study) are twice as effective as less than 12 supervised sessions [14]. Since some of the participants in this study exercised at home, the effects would be expected to be, if anything, even higher if everybody participated in the supervised exercise.

Greater improvement or better self-efficacy and physical performance at three months were found to be predictors of a better long-term outcome. This indicates that the physiotherapist should give extra attention and support to patients with small improvement or low self-efficacy and/or physical performance after the interven-

TABLE 4

Predictors of improvement in quality of life from baseline to 12 months.

Predictor variables	Mean (\pm SD)	Univariable analysis		Multivariable analysis	
		Beta	p-value	Beta	p-value
Change in self-efficacy	5.1 (\pm 16.9)	0.071	0.56	–	–
Change in 30-second chair stand test	1.9 (\pm 3.1)	0.181	0.14	–	–
Self-efficacy ^a after 3 months	74.9 (\pm 16.2)	0.304 ^b	0.01	–	–
30s chair stand test after 3 months	14.7 (\pm 3.2)	0.153	0.22	–	–

SD = standard deviation.

a) Self-efficacy was assessed using the Arthritis Self-Efficacy Scale (Mean of the Pain and Other Symptoms subscales); Changes in self-efficacy and in 30-second chair stand test represent the differences between the baseline and 3-month results.

b) Significance: $p < 0.10$ was considered to be significant.

tion since they may not achieve good long-term results. This can be implemented directly in clinical practice, giving the physiotherapist a further possibility to guide treatment after the treatment period.

Consisting of change in self-efficacy and self-efficacy after the treatment programme, our model predicted 26% of the variance in change in pain from baseline to 12 months, which is comparable to findings from attempts to explain variation in outcomes following total knee replacement [15].

However, a large proportion of the variation in the outcome remains unexplained. Several other factors, such as depression, knee alignment, signs of inflammation and pain intensity, have been shown to predict non-surgical treatment outcome in knee and hip OA [16, 17]. Including these and other predictors in future analyses from the GLA:D registry when greater sample sizes are available could improve the predictive capacity of the model.

By the end of April 2014, GLA:D was offered by more than 200 physiotherapists across all five health-care regions in Denmark in both primary and secondary care, and data from more than 1,500 patients have been entered into the registry. Owing to a huge interest among health-care providers, patients and the media, the numbers of physiotherapists offering the intervention and patients undergoing the intervention are rising rapidly. In Sweden, data are available from more than 14,000 patients with hip or knee OA who have received education similar to the GLA:D education. Using a simple equation (cost/EQ-5D improvement), the cost per quality-adjusted life year for the Swedish OA school is 50,000 SEK for hip patients and 37,500 SEK for knee patients [18]. Using the same equation, total hip arthroplasty costs 194,000 SEK per quality-adjusted life year [18]. Future analyses from the GLAD-registry will show if a combined intervention including education and exercise has the potential to impact the number of health-care visits and the social costs associated with hip and knee OA in Denmark.

Study limitations

Since no X-rays were obtained, the effects of the treatment programme in relation to radiographic OA severity remain unknown. However, a recent meta-regression analysis found similar pain reduction from exercise when comparing studies including patients with mild/moderate to severe radiographic OA grade [19], which indicates that a similar treatment response may be expected, regardless of radiographic OA severity.

Although the observed improvements in pain and quality of life were statistically significant, the clinical significance can be discussed. At a group level, a decrease in pain of 10.5 mm or 30% was found. Whereas a minimum 15 mm decrease in pain is considered clinically important, so is a 15% decrease following exercise [8]. There are a number of definitions of concepts of minimally important change, and the more recent ones include not only patient perception but also the significance of changes in patient's management, meaning greater changes needed for treatments of greater risk or cost than for treatments with few adverse events and/or of low cost [20]. Education and exercise are low cost treatments with few minor adverse events and thus a smaller improvement can be considered clinically significant than for pharmacological pain relief or surgery, supporting the clinical relevance of the pain reduction of 30% seen in this study from education and exercise.

Furthermore, the clinical relevance of the effects on pain and quality of life from a one-unit change in self-efficacy and physical performance can be discussed. However, the results are significant and they highlight the predictive capacity and importance of the variables.

Another limitation is the lack of control group and the fact that neither gender, exercise adherence after the three months of follow-up, nor affected joint (knee/hip) was controlled for. However, this is an implementation study building upon solid evidence from several RCTs showing that education and exercise are superior to a control treatment [3, 19]. Therefore, the purpose of the study was not to establish evidence for the effective-

ness of the treatment or the effects in different subgroups, but rather to investigate the effects when translating evidence into clinical practice.

CONCLUSION

We demonstrated that higher self-efficacy and physical performance predict better long-term effects in knee and hip pain. Long-term improvements seem achievable following an eight-week intervention performed in clinical practice.

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