"The influence of prescribed frequency, intensity, and type of homebased exercises on exercise adherence in patients with non-specific low back pain"

Masterthesis

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“ONDERGETEKENDE

Boo Moelands,

bevestigt hierbij dat de onderhavige verhandeling mag worden geraadpleegd en vrij mag worden gefotokopieerd. Bij het citeren moet steeds de titel en de auteur van de verhandeling worden vermeld.”

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ABSTRACT

Background Low back pain is a very common disorder worldwide with a prevalence of up to 39%. Non-specific low back pain is commonly treated with exercise therapy. However, exercise adherence is low, with non-adherence of fifty to seventy percent. Several factors seem to influence exercise adherence, but the influence of frequency, intensity, and type of exercises is unknown yet. An increase in exercise adherence results in a better therapeutic effect, better quality of life, and less costs for society.

Aim To determine the influence of prescribed frequency, intensity, and type of physiotherapeutic homebased exercises – separately or combined – on exercise adherence in patients with non-specific low back pain.

Methods This study had an observational longitudinal prospective cohort design. A secondary analysis of a randomized controlled trial was carried out on 185 patients with non-specific low back pain. The randomized controlled trial lasted from January 2018 to December 2019. Patients were recruited from 58 physiotherapy practices in the Netherlands and screened on eligibility. Baseline characteristics and descriptive statistics were quantified, and four linear mixed models were carried out to analyse the effect of prescribed frequency, intensity, and type of homebased exercises on exercise adherence, both separately and combined. Potential confounders were analysed as well.

Results The prescribed frequency and intensity have a significantly negative effect on the exercise adherence, both separately and combined. Frequency on itself has a coefficient of -0.31 with $p<0.0005$, while intensity on itself has a coefficient of -0.097 with $p<0.05$. The coefficients of frequency and intensity in a combined model are respectively -0.46 with $p<0.0005$ and -0.24 with $p<0.005$. Type of homebased exercise has no significantly influence on exercise adherence.

Conclusion and key findings A higher prescribed frequency and intensity of homebased exercises decrease the exercise adherence significantly in patients with non-specific low back pain, both separately and combined with other variables. However, the prescribed type of exercise has no influence on the exercise adherence in patients with non-specific low back pain. Physiotherapists should consider their prescriptions of frequency and intensity carefully when prescribing homebased exercises, if their goal is to improve exercise adherence.

Keywords: Low back pain, treatment adherence and compliance, frequency, intensity, type.

INTRODUCTION

Low back pain (LBP) is a very common musculoskeletal disorder worldwide (1). LBP is defined as 'pain, stiffness or muscle tension located between the lower rib and the inferior gluteus, with or without sciatica' (2). The life time prevalence varies widely, but is believed to be up to 39% (3). Although age-standardized prevalence worldwide has slightly decreased in the past two centuries, LBP remains the global leading cause of years lived with disability in 2019 (1). A distinction is made between specific and non-specific LBP (NLBP). Specific LBP has an identified cause, while NLBP does not have a specific pathology (4,5). About ninety percent of LPB is classified as non-specific (5). Besides disability and inconvenience for the patient, LBP results in work disability, and high social and economic costs (6). Multiple guidelines recommend the prescription of exercises to treat LBP, as exercises have a good effect on pain and function (7,8).

The exercise programs often involve homebased exercises (HBE) prescribed by a physiotherapist (9). However, the exercise adherence is low, with non-adherence in patients with LBP of fifty to seventy percent (9–12). Exercise adherence is defined as 'the extent to which a patient acts in accordance with the advised interval, exercise dose, and exercise dosing regimen' (13). Low exercise adherence results in a reduced therapeutic effect, increased pain, decreased function, and prolonged presence or recurrence of LBP, which has negative consequences for both the patient and society (9,13–16).

Several factors have already been identified that affect adherence in patients with LBP. Patients with higher age, higher ability to perform low-load activities, and higher degree of kinesiophobia adhere better to a multimodal rehabilitation program (17). However, lower levels of education and back pain unrelated to poor posture increased the odds for non-adherence to the same program (17). For physiotherapeutic HBE programs, patients report that low self-efficacy, depressions, fear, uncertainty, little social support, high number of therapeutic sessions, and misplaced insight in disease are reasons for their non-adherence (14,18). Besides that, HBE are easily forgotten or too pain provocative (18). At last, patients state that high frequency, high intensity, and complex or heavy type of prescribed exercises further explain their non-adherence (18). Frequency refers to how often an exercise is prescribed per time unit, while intensity is defined as the number of repetitions and series undertaken per performance of an exercise. Type is explained as the kind of exercise, such as mobilization or strength. HBE that meet the desires, abilities, and prior skills of the patients increase their exercise adherence (19).

Although patients state that high frequency, high intensity, and heavy type of exercises decrease their exercise adherence, this is not yet studied quantitatively. Currently, only one quantitative study reports predictive factors on frequency and duration adherence in patients with chronic NLBP (20). This study states that good self-efficacy, environmental factors (time and routines), previous use of physiotherapist, and satisfaction significantly increase the frequency adherence (20). Meanwhile, a high number of exercises (>6) seems to have a significantly negative effect on frequency adherence. However, the frequency itself does not have a significant influence on exercise adherence (20). Unfortunately, the influences of intensity and type of exercises are not studied quantitatively at all.

As no quantitative studies are available about the influence of frequency, intensity, and type of HBE on exercise adherence in patients with NLBP, this study aims to fill this gap of knowledge. Besides that, this study gives more insight in the prescriptions given by physiotherapists of frequency, intensity, and type of exercises in general. If more is known about the influence of frequency, intensity, and type of exercise, physiotherapists can adapt their HBE programs in order to increase the exercise adherence, and therefore the therapeutic effect (14–16). The aim of this study is to determine the influence of prescribed frequency, intensity, and type of physiotherapeutic HBE – separately or combined – on exercise adherence in patients with NLBP.

METHODS

Design

This study had an observational, longitudinal, prospective cohort design, reported according to the Strengthening The Reporting of Observational studies in Epidemiology (STROBE) checklist. As data was already gathered in a randomized controlled trial (RCT)(21,22), a secondary analysis of quantitative data was carried out. The protocol of the RCT was approved by the Medical Research Ethics Committee of the University Medical Center Utrecht in the Netherlands (21). The RCT had an intervention and control group, which were combined into one cohort group for this study in order to use all the data available. The intervention group received stratified blended physiotherapy, in which a smartphone app was blended in face-to-face physiotherapy treatment, while the control group only received face-to-face physiotherapy treatment (22). The RCT lasted from January 2018 to December 2019, but this study only focuses on the one to fourteen week treatment period of the patients. Eligible patients were recruited in 58 primary physiotherapy practices across the Netherlands in the period from June 2018 to December 2019 (22).

Setting

In order to recruit patients, the eligible primary physiotherapy practices were recruited first by sending out an invitational letter to the professional network of authors and physiotherapists who participated in a previous e-Exercise study (22,23). A practice was eligible if at least five patients with NLBP were applying for treatment each month. Patients were recruited within the participating physiotherapy practices, without there being a maximum limit for recruiting patients per practice. Patients were first orally informed about the study and invited to participate. If interested, patients received a patient information letter by email and had an informative phone call meeting with one of the researchers before the first appointment. Patients willing to participate after the phone call, attended a face-to-face appointment where informed consent was given and eligibility was verified (21,22).

Participants

Patients were eligible when: 1. Applying for physiotherapy for LBP; 2. Aged ≥18 years; 3. Having NLPB, defined as pain, stiffness or muscle tension located between the lower rib and the inferior gluteus (with or without sciatica), without a recognizable or specific pathology (2,4,5); 4. Possessing a smartphone or tablet with access to internet; and 5. Mastering the Dutch language (21). Patients were excluded if: 1. Having LBP due to a possible specific cause through medical imaging or a medical doctor (e.g. osteoporotic fractures, spinal nerve compromise, malignancy, ankylosing spondylitis, canal stenosis, or severe spondylolisthesis); 2. Serious comorbidities; and 3. Current pregnancy, due to the prevalence of pelvic girdle pain as a specific form of LBP (21,24). An additional inclusion criteria for this study was having

>1 physiotherapeutic session, in order to had enough datapoints to determine exercise adherence.

Variables

Four primary study parameters were applicable to this study; the adherence score from the Exercise Adherence Scale (EXAS) as dependent variable, and prescribed frequency, intensity, and type of HBE as primary independent variables. The EXAS measures patient adherence to HBE prescribed by a physiotherapist based on intensity, frequency, and quality of performance (25). The EXAS is an interview-based questionnaire with an observational component and consists of three scores; the Adherence Rate (AR), the Adherence Score (AS), and the EXAS score (Appendix A). AR is the ratio of frequency and intensity reported by the patient divided by frequency and intensity prescribed by the physiotherapist (25). AS represents the exercise adherence per exercise per session by multiplying AR with the measured quality of performance (25). Quality of performance is rated by the physiotherapist and states how well a HBE is performed, with scores ranging from 0.2 (poor performance) to 1 (excellent performance) (25). The EXAS score represents the mean of the AS of all exercises per session (25). The AS was used in this study, as the effect of type of exercise on exercise adherence could also be analysed this way. As different types of exercises were combined into one EXAS score per session, the EXAS score was inadequate to analyse the effect of type of exercise on exercise adherence. All three scores ranges from zero to hundred with higher scores indicating better adherence. The convergent validities between lack of time and lack of motivation with the EXAS are significant with respectively 0.47 and 0.48. Cohen's kappa quadratic weights for intrarater reliability is significant with Kqw = 0.87. The interrater reliability has a significant Cohen's kappa of 0.36 (25).

Frequency referred to how often an exercise was prescribed per week. Intensity stood for the amount of repetitions and series that were undertaken per performance of an exercise. Type of exercise was categorized into mobilization, stabilization, and strength. These three categories were automatically merged out of ten types of exercises from the original RCT, as including all ten categories was inappropriate given the available sample size (21). These ten categories were; mobilizing, mobilizing/coordination, stabilizing, stabilizing/coordination, strength, strength/coordination, mobilizing/strength, mobilizing/stabilizing, strength/stabilizing, and stretching (21) (Appendix B).

Other known variables of having an association with exercise adherence were age, level of education, number of physiotherapeutic sessions, level of physical activity (LPA), kinesiophobia, self-efficacy, group allocation, risk profile, and duration of LBP (Table 1) (14,17,18). As these variables might had some influence on the relationships between frequency, intensity, type, and AS, they were analysed as well.

Level of education was categorized into higher (≥ bachelor degree) and lower education.

Low LPA was qualified as sitting, standing, and slow walking (26). LPA was measured with the Activ8, which is a small valid accelerometer that defines a set of body postures and movements. Hence it measured the time spent sitting, standing and slow walking (27). The Activ8 has a good to excellent sensitivity and positive predicted value (27).

Kinesiophobia was measured with the Fear-Avoidance Beliefs Questionnaire (FABQ), which measures fear of movement in relation to physical activity and work, with a total score ranging from zero to 96 (28,29). A higher score indicates greater fear and avoidance beliefs.

Table 1: Variables with corresponding type of parameter, parameter scale, instrument and, measurement moments

Variable	Type	Scale	Instrument	Measurement moment(s)
Exercise Adherence	Primary	Continuous	EXAS	Each PT session (except first one)
Frequency	Primary	Continuous	CRF, EXAS	Each PT session
Intensity	Primary	Continuous	CRF, EXAS	Each PT session
Type	Primary	Categorical (3)**	CRF, EXAS	Each PT session
Age	Other	Continuous	CRF	Baseline
Level of education	Other	Categorical*	CRF	Baseline
Number of sessions	Other	Continuous	CRF	After treatment period
Low LPA	Other	Continuous	Activ8	First week after baseline
Kinesiophobia	Other	Continuous	FABQ	Baseline
Self-efficacy	Other	Continuous	GSES	Baseline
Group allocation	Other	Categorical*	Dataset	-
Risk profile	Other	Continuous	SBT	Baseline
Duration	Other	Categorical (4)**	CRF	Baseline

**Categorical variable with two categories.*

***Categorical variable with more categories (number of categories).*

EXAS, Exercise Adherence Scale; CRF, Case Report Form; LPA, Level of Physical Activity; Activ8, Activ8 activity monitor; FABQ, Fear Avoidance Believes Questionnaire; GSES, General Self-Efficacy Scale; SBT, STarT Back Screening Tool.

Self-efficacy was measured with the General Self-Efficacy Scale (GSES), consisting of ten 4-point Likert scale items ranging from totally incorrect to totally correct (30). The score ranges from ten to forty, with a higher score indicating better self-efficacy (31).

Group allocation could be a confounding factor, as two treatment groups of the original RCT were merged into one cohort. It was therefore important to control the influence of group allocation (32). Moreover, group allocation had an (indirect) influence on the results, as the e-exercise intervention in the original RCT was not only designed to improve physical functioning, but also to support exercise adherence.

Risk profile probably had an influence on the exercise adherence, as a higher risk profile resulted in lower attendance rates at LBP treatments (33). It was therefore plausible that risk profile influenced the exercise adherence as well. The risk profile was measured with the STarT Back-Screening Tool (SBT), which is a brief questionnaire that screens physical and psychosocial risk factors for the prognosis of persistent, disabling LBP (34). Scores range from 0-9, with a higher score indicating a higher risk profile.

Duration of LBP after onset of symptoms was ought to have an impact on exercise adherence based on clinical experience (35). Duration was categorized into four categories; 0-6 weeks, 6-12 weeks, 12 weeks – 12 months, and > 12 months.

Data measurement

Table 1 shows the measurement moments per variable. Baseline assessments took place in the patient's home environment, or in the physiotherapy practice if preferred. Baseline assessment was measured after informed consent was given and took approximately 45 minutes. Age, level of education, FABQ, GSES, SBT, and duration was questioned at baseline. Frequency, intensity, type of exercise, and AS were retrieved with the EXAS after each physiotherapeutic session, which took approximately five minutes. Frequency, intensity, and type of exercise were also reported in case report forms. Low LPA was measured five weeks after onset of baseline with the Activ8 activity monitor, except when sleeping, showering, bathing, and swimming (21). Only the first week was used for analysis due to feasibility reasons. The number of physiotherapeutic sessions was recorded after the treatment period.

Bias

Frequency and intensity were used to calculate the AS (and EXAS), which might indicate that there was a relationship between frequency, intensity and the AS in any case. However, the AS was a ratio of the performed with the prescribed exercises, which were both measured with frequency and intensity. This study investigated if a certain pattern was present in frequency and intensity that could influence the AS. Such pattern could be that a higher frequency mostly resulted in a lower AS for example. In identifying such pattern, it did not matter that frequency and intensity were used to calculate the AS.

Sample size

Unfortunately, a precise sample size calculation was not possible, as no adequate formulas for the particular analysis of this study were available in literature. Known formulas for longitudinal mixed model analyses involved two groups (control vs. intervention), while this study had one group (36–38). Besides, information to fill in sample size formulas was missing, such as correlation coefficient, variance, and effect size of the EXAS. A rule of thumb was used instead, stating that each independent parameter in the equation results in a minimum of ten participants added to the sample size (39). As there were seventeen independent parameters (Table 1), the total sample size had to be at least 170 participants.

Analysis

Descriptive statistics were used to describe the characteristics of the study population. Continuous variables were presented with measures of central tendency (mean or median) and measures of variability (standard deviation or interquartile range), categorical variables with frequencies. Variables were checked for normality and outliers. IBM Statistical Package for Social Sciences (SPSS) version 27 was used to prepare the data, while the software program R was used for imputing missing data and further analyses (40). Data was checked for missing data and missing data was imputed using Multivariate Imputations by Chained Equations (MICE)(41–43). The number of imputed datasets was equal to the percentage of incomplete cases, which was 56 (44).

A total of four linear mixed models (LMM's) were executed, since the data were dependent and longitudinal due to repeated measurements (45–47). Including a random effect in the LMM's was therefore necessary to control for the correlation within patients (45). The first three LMM's analysed the influence of prescribed frequency, intensity, or type of exercises separately on the AS. The fourth model was the best fitted model of frequency, intensity, and type of exercise on the AS, controlled for all other variables stated in Table 1. The backward stepwise method was used to exclude the variable with the lowest p-value one by one, until only variables with $p < 0.05$ were in the model. Exceptions were made for the primary variables frequency, intensity, and type of exercise, which ended up in the model independent of their p-value. Group allocation was also included regardless of its significance to control for the possibility of confounding by merging two treatment groups into one cohort (32). Interactions between primary study parameters were analysed as well and included in the model if significant. Before LMM analyses were executed, multicollinearity between independent variables was checked with correlation matrices and VIF scores (VIF>10 indicates high multicollinearity) (48,49). Although LMM is quite robust to distributional violations, LMM assumptions of normality of residuals and homoscedasticity were checked afterwards with respectively histograms and residual plots (49,50). Results from the LMM analyses were displayed with the unstandardized partial coefficients (estimates), Standard Errors (SE), p-values, and 95% Confidence Intervals (CI) (50,51).

RESULTS

The 58 physiotherapy practices asked 434 eligible patients for participation, of which 208 patients were included. Loss to follow-up was 23, resulting in a sample size of 185 participants (22). Baseline characteristics of the study participants before MICE are displayed in Table 2. Sex, education level, and group allocation are almost balanced. The 0-6 weeks (41.6%) and >12 months (35.1%) periods in duration of symptoms have the highest frequency.

Table 2: Baseline characteristics

Variables	Overall (N=185)	
Age (years)		
Mean (SD)	48.1	(14.4)
Sex		
Male (%)	95	(51.4)
Education level		
Low (%)	94	(50.8)
High (%)	91	(49.2)
Duration of symptoms		
0-6 weeks (%)	77	(41.6)
6-12 weeks (%)	27	(14.6)
12 weeks – 12 months (%)	16	(8.6)
> 12 months (%)	65	(35.1)
Group allocation		
Control (%)	91	(49.2)
Low level of physical activity		
Median (IQR)	298.0	(44)
Missing (%)	27	(14.6)
Self-efficacy		
Mean (SD)	32.6	(3.99)
Missing (%)	3	(1.6)
Kinesiophobia		
Median (IQR)	23.5	(19)
Missing (%)	3	(1.6)
Risk profile		
Mean (SD)	3.2	(2.1)

SD, standard deviation; IQR, Interquartile Range.

Table 3: Descriptive statistics of the imputed dataset

Variables	Outcomes	
Number of sessions		
Median (IQR)	4.00	(3)
Average number of exercises		
Mean (SD)	3.98	(1.27)
Frequency		
Median (IQR)	7.00	(7)
Intensity		
Mean (SD)	20.65	(14.88)
Type	2872	
Mobilization (%)	1850	(64.4)
Strength (%)	679	(23.6)
Stabilization (%)	343	(11.9)
Quality of exercise		
Mean (SD)	0.82	(0.17)
Exercise adherence		
Median (IQR)	80.00	(60)

IQR, Interquartile Range; SD, Standard Deviation

The descriptive statistics of the variables of interest after MICE are displayed in Table 3. Frequency, intensity, quality percentage, and exercise adherence are calculated per exercise per treatment session. The average number of exercises per treatment session has a mean of 3.98. A total of 2872 HBE are prescribed, of which 64.4% are classified as mobilization. The performed quality of exercise has a mean of 0.82, while exercise adherence has a median of 80.00.

The results of the LMM analyses are displayed in Table 4, 5, 6, and 7. Table 4 shows a significantly negative effect of frequency on the AS with an estimate of -0.31 and $p < 0.0005$. Table 5 displays a significantly negative effect of intensity on the AS with an estimate of -0.097 and $p = 0.031$. The type of exercise does not have a significant association with the AS (Table 6).

Table 4: Association between adherence score and frequency.

Variable	Estimate	SE	P-value	95% CI low	95% CI high
Intercept	66.99	1.73	0.000*	63.59	70.38
Frequency	- 0.31	0.066	0.000*	- 0.44	- 0.18

**Significant with p < 0.0005*
SE, Standard Error; CI, Confidence Interval.

Table 5: Association between adherence score and intensity.

Variable	Estimate	SE	P-value	95% CI low	95% CI high
Intercept	65.32	1.82	0.000*	61.75	68.90
Intensity	- 0.097	0.045	0.031**	- 0.18	- 0.0089

**Significant at p < 0.0005*
***Significant at p < 0.05*
SE, Standard Error; CI, Confidence Interval.

Table 6: Association between adherence score and type of exercise.

Variable	Estimate	SE	P-value	95% CI low	95% CI high
Intercept	63.02	1.60	0.000*	59.89	66.16
Type					
Mobilization	0	0	0	0	0
Stabilization	0.14	1.88	0.94	- 3.54	3.83
Strength	1.60	1.53	0.30	- 1.40	4.60

**Significant at p < 0.0005*
SE, Standard Error; CI, Confidence Interval.

Table 7 shows the best fitted model of the effect of frequency, intensity, and type of exercise on the AS, corrected for by all other variables (Table 1). The best fitted model includes frequency, intensity, type, group allocation, kinesiophobia, and the interaction between frequency and intensity. Frequency, intensity, and kinesiophobia have a significantly negative effect on the AS. The interaction of frequency and intensity has a significantly positive effect on the AS. The type of exercise is not significantly associated with the AS. The estimate of group allocation indicates that exercise adherence of the treatment group increases with 2.61, although not significant. The interactions containing type of exercise are not included in the model, as these interactions result in very high VIF scores and correlations with other variables.

Table 7: Best fitted model using backward stepwise selection with dependent variables explaining the adherence score.

Variable	Estimate	SE	P-value	95% CI low	95% CI high
Intercept	77.41	3.76	0.000*	70.03	84.79
Frequency	- 0.46	0.081	0.000*	- 0.62	- 0.30
Intensity	- 0.24	0.072	0.001**	- 0.39	- 0.10
Type					
Mobilization	0	0	0	0	0
Stabilization	- 0.71	1.87	0.70	- 4.38	0.30
Strength	0.60	1.57	0.70	- 0.25	3.68
Group allocation	2.61	3.27	0.43	- 3.81	9.02
Kinesiophobia	- 0.26	0.10	0.013***	- 0.46	- 0.055
Frequency:intensity	0.0081	0.0038	0.033***	0.00067	0.016

**Significant at $p < 0.0005$*
***Significant at $p < 0.005$*
****Significant at $p < 0.05$*
SE, Standard Error; CI, Confidence Interval.

DISCUSSION

This is the first study to examine the influence of prescribed frequency, intensity, and type of HBE on exercise adherence in patients with NLPB. The study results show that the prescribed frequency and intensity of physiotherapeutic HBE have a significantly negative influence on exercise adherence, both separately as combined. Thus, an increase in prescribed frequency and intensity of HBE results in lower exercise adherence. The type of HBE does not significantly influence the exercise adherence in patients with NLBP. Kinesiophobia is the only other variable with a significant effect on exercise adherence.

The results partially agree with a qualitative study of Palazzo et al (18), as patients with LBP state that a higher frequency and intensity are reasons for their non-adherence. However, the result that there is no relationship between type of HBE and exercise adherence does not correspond with Palazzo et al (18), as patients also state that heavy or complex exercises influenced their adherence. Quantitatively, there are currently no studies available studying the same association on patients with NLBP as this study. Yet, there is one study by Medina-Mirapeix et al (20) stating that a high number of exercises have a significantly negative effect on frequency adherence in patients with chronic LBP. However, Medina-Mirapeix et al (20) focus solely on the number of exercises and frequency adherence, not on the influence of frequency, intensity, and type of exercise on the exercise adherence. Another study is available investigating the influence of frequency, intensity, and type of exercises on exercise adherence, but its study population is not patients with NLBP (52). Instead, the study population consists of healthy adults and patients with chronic diseases. This meta-analysis states that only intensity has a significantly moderate negative effect on exercise adherence in a combined population of healthy adults and adults with chronic diseases (52).

This study has some important strengths. One of the strengths is the use of the MICE procedure to impute missing data. MICE is a form of multiple imputation (MI). MI creates unbiased estimates and produce more reasonable SE's compared with single imputations (53). Moreover, the MICE procedure is very flexible, can handle variables of varying types, and accounts for the statistical uncertainty in imputations (43).

Another strength is the use of four LMM analyses to analyse the data. Hence, frequency, intensity, and type are analysed separately in the first three models, and combined as well in the fourth model. Moreover, the fourth model takes the interaction between frequency and intensity into account, as well as group allocation and the significant variable kinesiophobia. The fourth model is therefore corrected for by other relevant variables, and gives a broader perspective on the clinical relationship between exercise adherence and frequency, intensity, and type combined.

Nevertheless, this study also has some limitations. First of all, the sample size could not be estimated in advance due to insufficient formulas and missing values, and is therefore based on a rule of thumb (39). Sample sizes based on rule of thumbs are rarely congruent with power analysis, and results mostly in under- or overpowered study samples (54). Consequently, results may be missed, biased or totally incorrect. A known 'solution' is to do a post-hoc power analysis, but that only seems to be flawed and misleading, and is therefore not done in this study (55,56). Another limitation regards the merging of the ten categories from the type of exercise. The merging process was easily done automatically for seven of the categories, which were mobilizing, mobilizing/coordination, stretching, stabilizing, stabilizing/coordination, strength, and strength/coordination. However, the three remaining categories (mobilizing/strength, mobilizing/stabilizing, strength/stabilizing) were a combination of the three types and could therefore belong to both of them. After checking the automatic assignment of these combined categories in some random variables, it seemed that the assignment was up to seventy percent accurate when assigning the combined categories to the first one stated in the merged name. Consequently, the combined categories were also assigned automatically to the main types mobilization or strength. However, results have to be interpreted with some caution due to the limitations.

An implication for physiotherapists is to consider the prescriptions of frequency and intensity carefully when giving HBE. Higher prescriptions of frequency and intensity results in lower exercise adherence, and consequently in lesser therapeutic effects (14–16). However, prescribing HBE with too low frequencies and intensities may result in undertraining, and hence also in lesser therapeutic effects (57). Finding a good balance in prescriptions of frequency and intensity is necessary in maintaining good exercise adherence on the one hand, and obtaining an adequate therapeutic effect on the other hand. An implication for future research is to study the effect of frequency and intensity on both exercise adherence and effect of treatment simultaneously. Consequently, more specific advice in best prescriptions of frequency and intensity can be given to physiotherapists to improve both exercise adherence and effect of treatment.

CONCLUSION

A higher prescribed frequency and intensity of HBE decrease the exercise adherence significantly in patients with NLBP, both separately and combined with other variables. However, the prescribed type of HBE has no influence on the exercise adherence in patients with NLBP. Physiotherapists should consider their prescriptions of frequency and intensity carefully when prescribing HBE, if their goal is to improve exercise adherence. Future research should simultaneously focus on the effects of frequency and intensity on both the exercise adherence and the effect of treatment.

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APPENDICES

Appendix A: Adherence rate, adherence score and EXAS score

The adherence rate is the ratio between the frequency and intensity reported by the patient and prescribed by the physiotherapist (Figure 1). For the adherence score, the quality of performance score is added to the adherence rate by multiplying the adherence with the performance score (Figure 2). This performance score is based on a five point scale, ranging from 0.2 (poor performance) to 1.0 (excellent performance)(Figure 3). The adherence rate and score is calculated for each exercise. At last, the actual EXAS score is obtained by calculating the mean of the adherence scores for all individual exercises (Figure 4).

$$\text{Adherencerate} = \frac{\textit{Number of days} * \textit{number of times perday} * \textit{sets} * \textit{repetitions reported by the patient}}{\textit{Number of days} * \textit{number of times perday} * \textit{sets} * \textit{repetitions recommended by the therapist}}$$

Figure 1: Adherence rate formula of the EXAS

Excellent	Good	Reasonable	Moderate	Poor
Score 1 All parts of the home-based exercise are performed perfectly according to the recommendations by the therapist. There is no room for improvement. It is certain the desired effect of the exercise has been achieved.	Score 0.8	Score 0.6 Most parts of the exercise are performed well according to the recommendations by the therapist. Important parts of the exercise can be improved. The desired effect of the exercise is likely to have been achieved.	Score 0.4	Score 0.2 The majority or all of the parts of the exercise are not performed according to the recommendations by the therapist. It is very unlikely that the desired effect of the exercise has been achieved.

Figure 2: Five point scale performance score of the EXAS

$$\text{Adherence score} = \text{Adherence rate} * \textit{quality of performance score}$$

Figure 3: Adherence score formula of the EXAS

$$\text{EXAS score} = \frac{\text{Adherence score exercise } 1 + \ldots + \text{Adherence score exercise} n}{n}$$

Figure 4: EXAS formula

Appendix B: Merging of categories process

In the category ‘mobilization’ belong the types ‘mobilizing’, ‘mobilizing/coordination’, and ‘stretching’. The category ‘stabilization’ consists of the types ‘stabilizing’ and ‘stabilizing/coordination’. Among the category ‘strength’ belong the types ‘strength’ and ‘strength/coordination’. The remaining three types (‘mobilizing/strength’, ‘mobilizing/stabilizing’, and ‘strength/stabilizing’) were also automatically assigned to a category, in which the exercises were assigned to the first category in the combination. So mobilizing/strength and mobilizing/stabilizing were both assigned to ‘mobilization’ and strength/stabilizing to ‘strength’. This seemed reasonable after checking this method in advance on a random set of variables of the data. As each exercise was stated with a purpose and an exercise description, the description was used to manually assign an exercise to a category. If the type of exercise was not stated, the type was manually corrected with the name of the exercise. The assignment process was documented in detail in a Word document.