Musculoskeletal Science and Practice 44 (2019) 102066

Contents lists available at ScienceDirect

Musculoskeletal Science and Practice

journal homepage: www.elsevier.com/locate/msksp

Original article

Do sociodemographic features, pain sensitivity or pain catastrophizing relate to clinic-based adherence to physiotherapy in people suffering from chronic spinal pain? Secondary analysis of a randomized clinical trial

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ARTICLE INFO

Keywords:
Physical therapy modalities
Treatment adherence
Spine
Chronic pain

ABSTRACT

Purpose: Examining whether socio-demographic variables, pain or functionality are related to the degree of clinic-based therapy adherence in patients suffering from nonspecific chronic spinal pain (nCSP).
Design: Secondary analysis of a randomized clinical trial.
Setting: University hospital of Ghent and Brussels.
Methods: Dutch speakers, 18–65 years old, experiencing nCSP for at least 3 months. 120 participants were randomly allocated to two interventional groups, of which 94 completed all therapy sessions.
Main outcome measures: Degree of clinic-based adherence, defined as the amount of completed therapy sessions.
Results: Demographic data (sex, age or education) were not significantly associated with adherence in the total sample or the neuroscience group. For the traditional physiotherapy group, educational level was associated with attendance of at least 50% of the therapy sessions. Regarding pain-, belief- and function-related measures, only the association between change in kinesiophobia and adherence was significant for the traditional physiotherapy group.
Conclusions: Factors related to therapy adherence in the total group or the neuroscience group could not be found. Educational level and change in kinesiophobia were however related to therapy adherence in the traditional physiotherapy group.

1. Introduction

Spinal pain, more specifically neck and low back pain together, is the fourth most common cause of disability globally, and consequently has a significant impact on the quality of life (Vos et al., 2017). A diagnostic triage of these patients has been recommended for primary care management, for which 3 subdivisions have been made. Presence of a specific spinal pathology made up the first category, occurrence of a radicular syndrome was labelled as the second category and in case the condition did not correspond to either one of the previously mentioned categories, it was labelled as non-specific pain (Bardin et al., 2017). This last category is the most prevalent one of all 3.

Nonspecific chronic spinal pain (nCSP) is highly prevalent in the European population, with a point prevalence of 23%, and is associated with an important interaction with personal, social and socio-economic factors (Chronische lage rugpijn., 2006; Hoy et al., 2014; https://his.

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https://doi.org/10.1016/j.msksp.2019.102066
Received 14 May 2019; Received in revised form 9 July 2019; Accepted 25 September 2019
Available online 26 September 2019

wiv-isp.be/nl, 2008; Ma et al., 2014; Airaksinen et al., 2006; Pain Proposal Patient Sur, 2010; Vos et al., 2012). On the one hand, socially disadvantaged populations and people with lower education levels experience a larger impact of pain and disability but on the other hand, the presence of nCSP also impacts personal and socio-economic factors (Croft and Rigby, 1994; Leino-Arjas et al., 1998; Hagen et al., 2000; Latza et al., 2004; Dionne et al., 2001; Aggarwal et al., 2003). As a consequence, nCSP is related to an increased amount of years lived with disability and over the past 10 years, the prevalence of chronic low back pain increased by 17% (Hoy et al., 2014; Vos et al., 2012; Hurwitz et al., 2018).

Several conservative treatments (e.g. behavioural therapy, exercise therapy, manual therapy, non-steroidal anti-inflammatory drugs, etc.) have been proposed for the management of nCSP (Chronische lage rugpijn., 2006; [NG59] N guideline, 2016; Artus et al., 2010; Machado et al., 2009; Schroeder et al., 2013; van Middelkoop et al., 2011; van Tulder et al., 2006). However, in order to obtain high effectiveness of a treatment, the treatment modality is not the only important variable. Therapy adherence is another essential factor contributing to the effectiveness of an intervention, which is shown by the association between high therapy adherence and reduced reoccurrence of chronic musculoskeletal and low back pain (Linton et al., 1996; Friedrich et al., 1998; Mannion et al., 2009; Middleton, 2004). Adherence has been defined by the World Health Organization as "the extent to which a person's behaviour corresponds with agreed recommendations from a healthcare provider" (WHO, 2003). It can be measured by determining the extent to which a participant complies to the prescribed therapy program (Bassett, 2003a; Meichenbaum and Turk, 1987; Wilson et al., 1990). Clinic-based adherence is the part of adherence that focuses on the degree of attending appointments, whereas adherence in general evaluates both the attending of appointments and the compliance with advices, home exercises, or other elements of the therapy.

Previous studies have shown that obtaining clinic-based adherence to exercise therapy is a serious challenge, as non-adherence can occur in up to 70% of the participants (Vasey, 1990; Sluijs et al., 1993; Reilly et al., 1989; Nelson et al., 1995). This poor adherence has a negative impact on both treatment cost and effectiveness (Jack et al., 2010).

Knowing which variables influence clinic-based therapy adherence would help therapists to identify patients at risk of non-adherence. This would enable therapists to exert techniques to increase the motivation of these patients to enhance therapy effects. Previous research has shown that (non-)adherence to therapy can for example depend on personal factors such as the degree of helplessness of the patient, situational factors including the administered therapy, and therapeutic alliance (Friedrich et al., 1998; Bassett, 2003a; Sluijs et al., 1993; Alexandre et al., 2002). Concerning personal characteristics, conflicting evidence exists about the role of socio-demographic variables (e.g. age, gender or educational level) in clinic-based therapy adherence for people suffering from (chronic) low back pain, as well as in a more general population of patients visiting a physiotherapist (Bassett, 2003a; Sluijs et al., 1993; Hartigan et al., 2000). Similarly, contradicting results can still be found for the role of baseline pain, functionality, and pain beliefs in people with chronic low back pain (Mannion et al., 2009; Sluijs et al., 1993; Nava-Bringas et al., 2016; Al-Eisa, 2010).

As most of this research is limited by small sample sizes (ranging between 30 and 60 participants) and consensus is lacking, research including a large sample size is needed to determine the importance of socio-demographic and pain-related variables in clinic-based therapy adherence to exercise therapy based on the current best evidence physiotherapy for patients having nCSP. Therefore, the aim of this research is to examine the link between clinic-based physiotherapy adherence and demographic variables, pain, function and pain beliefs in people suffering from nCSP.

2. Methods

2.1. Study design and setting

This study was carried out as a secondary analysis in a multi-centred randomized controlled trial (RCT), which took place at the University Hospitals of Ghent and Brussels. Both local ethical committees rendered study approval (University Hospital Ghent, registration number: 2013/1133; University Hospital Brussels registration number: 2013/385). The protocol of this RCT was registered at clinicaltrials.gov (NCT02098005).

2.2. Study participants

Recruitment of participants was done through distribution of flyers at the University Hospitals of Brussels and Ghent, at occupational health services and primary care practices, and through social media and adverts.

For inclusion, participants had to be native Dutch speakers, aged between 18 and 65 years, experiencing nCSP at least 3 days/week for at least 3 months since the first symptoms. nCSP followed the definition as stated in the introduction, indicating the absence of a specific spinal pathology or a radicular syndrome. In this study, patients suffering from chronic low back pain without a clear causal mechanism, as well as due to failed back surgery syndrome (e.g. more than 3 year ago, anatomically successful operation without symptom disappearance) were included, along with patients suffering from chronic whiplash associated disorders, and chronic idiopathic non-traumatic neck pain.

Participants had to be available and willing to participate in physiotherapy sessions and were not allowed to continue any other therapies (i.e. other physiotherapy treatments, acupuncture, osteopathy, etc.), with the exception of usual medication. 6 weeks prior to and during the course of the therapy administration, all participants were asked not to initiate new types of therapy or medication to obtain a steady-state condition.

Participants were excluded from the study when a specific medical condition was diagnosed, which was possibly related to their pain (e.g., neuropathic pain, history of neck/back surgery in the past 3 years, osteoporotic vertebral fractures, rheumatologic diseases), or if they had a chronic widespread pain syndrome diagnosis (fibromyalgia or chronic fatigue syndrome). People living more than 50 km away from either one of the treatment locations were also excluded to prevent dropout. Patients with interest for participation were screened for these in- and exclusion criteria by 3 researchers with a background in physiotherapy. In case of doubt, the case was discussed among the research consortium existing of researchers with a broad expertise in chronic spinal pain, both on a scientific and clinical level.

All participants signed an informed consent prior to study participation.

2.3. Randomization

Participants that met the inclusion criteria and provided informed consent for participation, were allocated to a traditional physiotherapy or a modern neuroscience approach. Group allocation was based on a randomization scheme, provided by an independent researcher from the Biostatistics Unit of Ghent University. For this purpose, SAS 9.4 was used with a stratified permuted block allocation (block size of 4). The treatment centre (Ghent or Brussels), dominant pain location (low back or neck) and sex were included as stratification factors (Kernan et al., 1999; Kang and Park, 2008). Treatment allocation of included participants was performed by an independent researcher that did not participate in patient recruitment, therapy administration or data analysis.

2.4. Intervention

Through randomization participants were allocated to the traditional physiotherapy or modern neuroscience approach. Both interventions had a total duration of 12 weeks in which 3 education sessions were given followed by 15 exercise sessions linked to home exercises.

Whereas the construct of both therapy groups was the same, the content did differ. The modern neuroscience approach included pain neuroscience education which aimed at reconceptualising beliefs about pain, decreasing pain-related fear and increasing knowledge of pain (Nijs et al., 2014; Van Oosterwijck et al., 2013; Van Oosterwijck et al., 2011; Lorimer M, 2004). This education was followed by cognition-targeted exercise therapy, in which all exercises were based on functional goals and given in a time-contingent way and aimed at altering incorrect pain beliefs.

The traditional physiotherapy approach combined traditional biomedically-focussed back and neck education with general exercises (Glomsrod B Soukup et al., 2001; Soukup et al., 2001). The exercise program comprised of exercises that focused on the treatment of biomedical dysfunctions of the spine (including training of mobility, muscle strength, muscle endurance, and general fitness), and exercises were given in a pain-contingent way.

Full description of the interventions and their modalities can be consulted in the published protocol article and publication of the results from primary analyses (Malfliet et al., 2017, 2018).

2.5. Outcome measures

2.5.1. Clinic-based adherence

The degree of clinic-based adherence was defined as the amount of therapy sessions (out of 18) completed by the participants. No cut-offs were used to determine levels of adherence.

2.5.2. Treatment

Participants were randomized to either a modern neuroscience approach treatment or a traditional physiotherapy approach intervention.

2.5.3. Demographic data

Demographic data were collected at baseline, and included sex, age, height, weight, and educational level.

2.5.4. Pain, beliefs and functionality

Pain, beliefs and functionality of the participants were assessed at baseline.

Pain was evaluated using the numeric rating scale (NRS) and pressure pain thresholds (PPT) (Farrar et al., 2008). Participants were asked to rate their mean pain intensity during the last 3 days using an 11-point NRS from 0 to 10. PPTs (i.e. the point of minimal pressure at which a person indicates an unpleasant sensation) were administered using a digital pressure algometer with a 1 cm^2 tip (Wagner Instruments). PPTs were evaluated by gradually increasing the pressure at a rate of 1kgf/s at the most painful side or at the dominant side in case of bilateral pain. This was performed both at the trapezius muscle midway between the spinous process of vertebra C7 and the acromion tip, and at 5 cm lateral of the spinous process of vertebra L3. The order of the measurements was randomized. The average of 2 consecutive PPT assessments (30 s between consecutive assessments) was used in the analysis. Pressure algometry has been shown to be an efficient and reliable technique to determine PPTs and consequently, to examine hyperalgesia (Vanderweeen et al., 1996; Kosek et al., 1999; Fabio Antonaci, 1998).

The 36-Item Short Form Health Survey (SF-36) was used to evaluate the function of the participants, which evaluates health-related quality of life (Aaronson et al., 1998). This questionnaire contains 8 scales that are summarized into 2 main domains, i.e. a mental and a physical health component (Ware et al., 1993). Each item is scored between 0 and 100, which then leads to 2 summary scores between 0 and 100 where higher scores represent better health status. Both its convergent and discriminant validity are generally rated high across different populations and its test-retest reliability as good (Kuzmanić et al., 2017; Steffen and Seney, 2008; Andresen and Meyers, 2000). Pain catastrophizing was evaluated using the Pain Catastrophizing Scale (PCS), a valid questionnaire with moderate test-retest reliability that assesses the presence of catastrophic thoughts and feelings towards pain in 13 statements rated on a 5-point Likert scale (McWilliams and Asmundson, 2007; Sullivan and Pivik SRB, 1995; Vlaeyen, 1996; SA, 2009; Lamé et al., 2008).

The fear of movement or (re)injury was assessed with the Tampa Scale for Kinesiophobia (TSK), which is a reliable instrument with an adequate predictive validity and an internal consistency ranging from a = 0.68 to 0.80, and a moderate test-retest reliability (Crombez et al., 1999; Moseley, 2002; Dolphens et al., 2014; Lamé et al., 2008). The TSK was developed to assess pain-related fear or fear-avoidance beliefs based on 17 items that are scored on a four-point Likert scale.

2.5.5. Therapy effect

Pain, beliefs and functionality of the participants were assessed a second time directly after termination of therapy (at three months).

Based on the difference between evaluation at follow-up and evaluation at baseline, delta (δ)-values were calculated for the scores on the NRS, PPT, SF-36 (separately for the mental and physical health subscale), PCS and TSK. These δ-values represent the change in these respective parameters in response to the intervention.

2.6. Power calculation

The needed sample size was calculated in the original study using G*Power software (Universität Düsseldorf), based on the therapy effects on pain resulting from a pilot study performed by Moseley at al. (partial $\eta 2 = 0.02$, $\alpha = 0.05$, power = 0.80) and accounting for 30% loss to follow-up (Moseley, 2002; Dolphens et al., 2014). Following from this power calculation, the needed sample size to obtain a power of 80% equalled 117 participants.

Based on this existing sample size, the resulting power for the analyses performed in this research was determined with SAS power and sample size. For the evaluations of differences in clinic-based therapy adherence between sex, age and education categories, power was determined based on a hypothesized medium effect size of 0.5 and a sample size of 114 (SA, 2009). This resulted in a power of .754. For the correlation analyses, a medium effect size of 0.3 was hypothesized, with $\alpha = 0.05$ and a sample size of 114, resulting in a power of .906 (Jacob, 1988)' (J C, 1992).

2.7. Statistical analyses

All analyses were performed with the use of SPSS, version 24.0, and included analysis of the total group, and separate ones for the traditional physiotherapy and modern neuroscience approach groups.

2.7.1. Treatment and demographic data

Using a Mann-Whitney *U* test, differences in clinic-based therapy adherence between the two intervention groups, and between male and female participants were evaluated. Similar analyses were performed with a Kruskal-Wallis test to investigate if the number of completed therapy sessions differed between the 5 age categories and between the 3 educational levels, both measured at baseline. Age categories were constructed based on research by Smith et al. in chronic pain patients (Smith et al., 2001): the 5 categories had a range of respectively 18–24, 25–34, 35–44, 45–54, and 55–65 years old.

2.7.2. Pain, beliefs, functionality and therapy effect

Baseline scores of NRS, PPT, SF-36 mental and physical health, PCS and TSK, as well as calculated δ-values were correlated with the number of completed sessions using Spearman correlation coefficients.

As the analyses were performed for both the total group and for both treatment arms separately, the level of significance was corrected by dividing the significance level of .05 by 3. Therefore, results were evaluated based on a significance level of 0.016.

2.7.3. Logistic regression model

Due to an absence of consensus on a cut-off to determine (a lack of) therapy adherence and to check the robustness of the findings, three different logistic regression models were built, based on respectively attendance to 50%, 75% or 100% of the therapy sessions (Munneke et al., 2003; O'Donnell et al., 2003; Gram et al., 2014; Peterson et al., 2015). Each model determined if a patient were or were not to complete the predefined minimum amount of sessions. To determine the variables of interest for inclusion in these logistic regression models, a significance level lower than 0.1 had to be obtained in a *t*-test or chi square test (Freedman and Freedman, 1983). These tests were performed on total group level, as well as on separate intervention group level. These variables of interest were then introduced into a binary logistic regression function to determine whether patients did or did not attain the predefined percentage of therapy sessions.

3. Results

After considering the in- and exclusion criteria, 120 participants were included in this study. Of these, 60 were randomly allocated to the traditional physiotherapy and 60 to the modern neuroscience approach. The baseline characteristics of the included participants are shown in Table 1.

There was a loss to follow-up of 11 participants in the modern neuroscience group and of 15 participants in the traditional physiotherapy group. Only baseline data was collected and analysed from these participants. An additional 2 participants from the modern neuroscience group and an additional 5 from the traditional physiotherapy group filled out the questionnaires but did not allow measurement of the PPTs during the follow-up assessment. The study flowchart and details on dropout can be found in Fig. 1. These numbers differ from the flowchart described within the published RCT as loss to follow-up was evaluated 12 months after treatment in the published RCT, whereas is was examined at the end of the treatment in this paper. The number of completed therapy sessions did not differ significantly between both intervention groups (p = .12).

3.1. Demographic variables and clinic-based therapy adherence

For the total group, the number of completed sessions did not differ between sex (p = .93), age categories (p = .39), and educational levels (p = .21). When examining both intervention groups separately, no differences were found in the number of completed sessions, depending on the demographic variables, in the traditional physiotherapy group (sex: p = 1.00; age: p = .34; education: p = .24) or the modern neuroscience group (sex: p = .86; age: p = .19; education: p = .52).

3.2. Associations between clinic-based therapy adherence and pain, beliefs and functionality

Due to the correction for multiple comparisons, none of the

Table 1
Baseline characteristics of the population.

Baseline characteristic	Group	Mean	SD	Median	Range (min-max)	Q1 – Q2 – Q3
Age (years)	Total (n = 120)	40.06	12.58	39.00	46 (19–65)	29.00 – 39.00 – 52.00
	Modern neuroscience (n = 60)	38.92	11.99	37.50	45 (20–65)	27.25 – 37.50 – 52.00
	Traditional physiotherapy (n = 60)	41.12	13.07	41.50	46 (19–65)	30.25 – 41.50 – 52.75
Height (cm)	Total (n = 120)	172.18	9.79	171.00	48 (153–201)	165.00 – 171.00 – 180.00
	Modern neuroscience (n = 60)	172.86	8.86	172.00	44 (157–201)	167.00 – 172.00 – 179.00
	Traditional physiotherapy (n = 60)	171.52	10.65	170.00	44 (153–197)	164.00 – 170.00 – 180.75
Weight (kg)	Total (n = 120)	70.41	13.93	68.50	64 (46–110)	62.00 – 68.50 – 80.00
	Modern neuroscience (n = 60)	69.72	14.16	66.00	61 (49–110)	59.25 – 66.00 – 77.50
	Traditional physiotherapy (n = 60)	71.11	13.78	69.50	62 (46–108)	62.25 – 69.50 – 81.00
BMI (kg/cm^2)	Total (n = 120)	23.63	3.58	23.46	19.45 (16.65–36.11)	20.90 – 23.46 – 25.69
	Modern neuroscience (n = 60)	23.15	3.30	23.31	15.75 (16.65–32.41)	20.42 – 23.31 – 25.15
	Traditional physiotherapy (n = 60)	24.09	3.81	23.65	17.66 (18.44–36.11)	21.41 – 23.65 – 26.10
Number of completed therapy sessions	Total (n = 120)	13.73	5.35	16.00	18 (0–18)	13.00 – 16.00 – 17.00
	Modern neuroscience (n = 60)	14.40	5.18	16.00	18 (0–18)	15.00 – 16.00–17.00
	Traditional physiotherapy (n = 60)	13.07	5.47	15.00	18 (0–18)	10.25 – 15.00 -17.00
Duration of pain (months)	Total (n = 116)	112.48	92.31	79.00	414 (6–420)	36.00 – 79.00 – 168.00
	Modern neuroscience (n = 58)	121.55	100.77	97	414 (6–420)	36.00 – 97.00 – 190.50
	Traditional physiotherapy (n = 58)	103.41	82.88	68.75	341 (7–348)	36.00 – 68.75 – 141.00

		Frequencies: N (%)
Sex	Total (n = 120)	Male: N = 47 (39.2%); Female: N = 73 (60.8%)
	Modern neuroscience (n = 60)	Male: N = 22 (36.7%); Female: N = 38 (63.3%)
	Traditional physiotherapy (n = 60)	Male: N = 25 (41.7%); Female: N = 35 (58.3%)
Educational level (no edu – lower sec – higher sec – higher)	Total (n = 120)	No edu: N = 0 (0%); Lower sec: N = 12 (10%); Higher sec: N = 24 (20%); Higher: N = 84 (70%)
	Modern neuroscience (n = 60)	No edu: N = 0 (0%); Lower sec: N = 4 (6.7%); Higher sec: N = 11 (18.3%); Higher: N = 45 (75%)
	Traditional physiotherapy (n = 60)	No edu: N = 0 (0%); Lower sec: N = 8 (13.3%); Higher sec: N = 13 (21.7%); Higher: N = 39 (65.0%)

SD: standard deviation; Min.: minimum; Max.: maximum; N: number; Q: quartile; BMI: Body mass index; edu: education; sec: secondary.

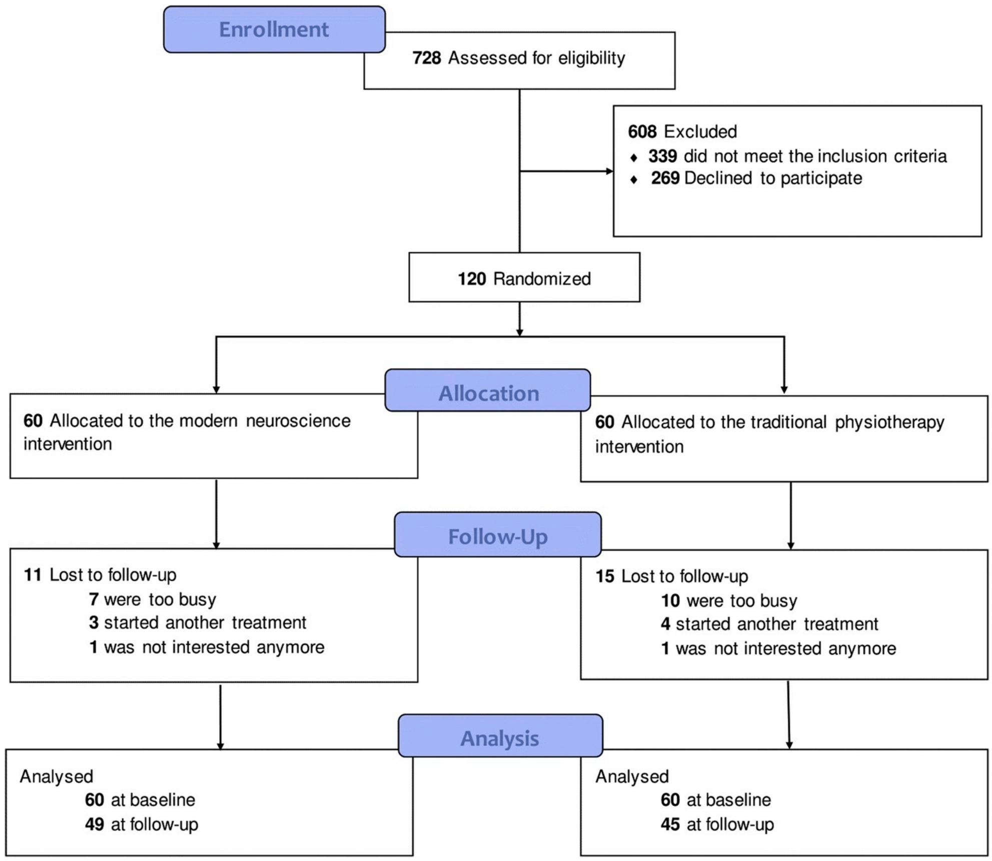

Fig. 1. Study flowchart.
Follow-up indicates the loss to follow-up during treatment and was assessed immediately at the end of the treatment.

investigated associations reached significance in the total group (all p-values >.01).

In the traditional physiotherapy group, a significant association was found between the δ-TSK and the number of completed sessions. This indicates that a larger change in score on the TSK, which represents a greater reduction of kinesiophobia, was related to a larger clinic-based adherence. However, none of the other investigated associations reached significance.

For the modern neuroscience approach group, similar results were obtained as for the total group, meaning that no significant associations were obtained. Detailed results can be found in Table 2.

3.3. *Logistic regression model*

Three models were built to investigate the relationship between the baseline variables of interest and completion of respectively at least 50%, 75%, or 100% of the therapy sessions. These models were built for both the total group of patients, and for each treatment group separately.

When defining the variables of interest for inclusion in the first

Table 2
Correlations between clinical measures and completed sessions.

Variable	Total group			Modern neuroscience group			Traditional physiotherapy group		
	r^s	Sign (p-value)	N	r^s	Sign (p-value)	N	r^s	Sign (p-value)	N
PPT	.087	.53	115	.062	.65	56	.107	.42	59
PCS	.092	.32	120	-.054	.68	60	.192	.14	60
SF36: Physical health	.120	.19	120	-.004	.97	60	.201	.12	60
SF36: Mental health	.075	.42	120	.201	.12	60	-.036	.78	60
NRS	.032	.73	120	.168	.20	60	-.069	.60	60
TSK	-.031	.74	120	-.107	.42	60	.069	.60	60
δ- PPT	-.228	.03	87	-.162	.28	47	-.318	.05	40
δ- PCS	-.095	.36	94	.242	.09	49	-.334	.03	45
δ- SF36: Physical health	-.071	.50	94	-.092	.53	49	-.019	.90	45
δ-SF36: Mental health	.016	.88	94	-.170	.24	49	.051	.74	45
δ- NRS	-.060	.57	94	.040	.80	49	-.104	.50	45
δ- TSK	-.213	.04	94	.035	.81	49	-.416	**.004**	45

Interpretation correlation coefficients: A correlation coefficient of 0.00 to .10 represents a negligible correlation, 0.10 to 0.39 represents a weak correlation, 0.40 to 0.69 represents a moderate correlation, 0.70 to 0.89 represents a strong correlation, and 0.90 to 1.00 represents a very strong correlation (J C, 1992).
Abbreviations: r^s: Spearman correlation coefficient; p-value: significance level; N: number; PPT: pressure pain threshold; PCS: pain catastrophizing scale; SF36: short form 36; NRS: numeric rating scale.
Significant correlations are represented in bold (p<.01).

logistic regression model, 4 variables attained a significance level below 0.1 on a *t*-test or chi (Bardin et al., 2017) test for defining at least 50% therapy adherence in the total group. These variables were physical health (SF36), mental health (SF36), TSK and educational level, measured at baseline. When performing these same analyses for 75% (i.e. model 2) and 100% (i.e. model 3) of adherence, only baseline physical health (SF36), mental health (SF36) and TSK remained significant.

A binary logistic regression analysis was performed for each of these three models, but none of these models contained variables that related significantly to the outcome (i.e. respectively 50%, 75% or 100% therapy adherence).

When examining the traditional physiotherapy group alone, the baseline educational level was the only variable of interest for the first model (i.e. 50% adherence), no variable was of interest for the second model (i.e. 75%) and only the baseline physical health (SF36) was of interest for the third model (i.e. 100%).

Performing a binary logistic regression for each model resulted only in a significant result for the relationship between 50% adherence and baseline educational level. From this, we could conclude that both people with lower secondary education and higher secondary education were more likely to attend to minimally 50% of the sessions than people with higher education.

Analyses based on the outcomes of the modern neuroscience group alone, resulted in a significant relationship between the baseline mental health (SF36) and 50% adherence on one hand (i.e. model 1), and between age and 100% adherence on the other hand (i.e. model 3). Again, no variables of interest could be found for model 2 (i.e. 75% adherence).

Entering these variables in two different binary logistic regression did not deliver any significant models.

4. Discussion

The aim of this study was to determine sociodemographic or clinical characteristics that are related to (non-)adherence to physiotherapy. Although the format of both interventions was the same, fundamental differences still existed between both. Moreover, results from the published RCT showed that the modern neuroscience approach was more effective than the traditional physiotherapy approach for improving pain, beliefs and functioning (Malfliet et al., 2018). Therefore, analyses were performed for both the total sample and for each intervention group separately.

This research focused on clinic-based adherence to exercise therapy as both the modern neuroscience approach and traditional physiotherapy intervention were mainly based on exercise therapy. Although this research focuses on a specific treatment, it is still clinically relevant as the importance of exercise therapy in spinal pain and of consistent practice has been proven multiple times (Friedrich et al., 1998; Hansen et al., 1993; Philadelphia Panel eviden, 2001; Stankovic and Johnell, 1990). The identification of determinants for therapy adherence is especially important for exercise-based therapy, as its benefits are typically not attained immediately, which can diminish the motivation of the patients (Friedrich et al., 1998; Belza et al., 2002). Informing patients about the importance of clinic-based therapy adherence can improve their participation and consequently their outcomes (Proctor et al., 2005; Hayden et al., 2005). Therefore, physiotherapists should obtain knowledge about which factors are related to adherence, so that their increased alertness to these factors can provide therapists the opportunity to give the necessary additional information to the patient before a decrease of attendance to therapy sessions occurs.

As the published RCT indicated a larger effect of the modern pain neuroscience approach, differences in outcomes between the end of therapy and baseline were computed (δ-values), and relationships between these changes and clinic-based therapy adherence were investigated (Malfliet et al., 2018). We included these δ-values to investigate whether the effect of therapy has an influence on the adherence and hypothesized that a larger therapy effect would result in a larger adherence. A significant association was found in the traditional physiotherapy group between the level of improvement on the TSK (δ-value) and the number of completed sessions. No other significant correlations between any of the clinical measures and the number of completed sessions could be found. However, perceived therapy effect has already been shown to influence adherence but does not necessarily equal the actual therapy effect (Woodard and Berry, 2001; Grant et al., 2003). Therefore, future research should take both actual and perceived therapy effect into account.

Our research could only indicate a limited amount of factors that were related to a decreased participation. The absence of associations between clinic-based therapy adherence and sex and age is in line with previous research performed in people with chronic low back pain or in a more diverse population of patients visiting a physiotherapist (Sluijs et al., 1993; Nava-Bringas et al., 2016; Hartigan et al., 2000). One of these did however find that middle aged people showed higher adherence levels (Sluijs et al., 1993). Concerning education level, this same research showed that less educated patients were slightly more adherent, which is in line with the association between lower education and an adherence of at least 50%, which is still rather limited, in our traditional physiotherapy group. The fact that this result and agreement with other literature cannot be found in the modern neuroscience group, can be a consequence of the difference in therapy construct. Participants in both groups received education as a part of the therapy but the content differed between both groups. Although not intended, it could be that the complexity of this education was not the same in both groups, resulting in a possibly larger influence of education status in one of both groups.

A relationship between levels of pain and psychological outcomes was found in previous research, whereas this research only found a relationship between the δ-TSK and adherence to traditional physiotherapy (Mannion et al., 2009; Sluijs et al., 1993; Nava-Bringas et al., 2016). This can be a result of a difference in methodology, as adherence was defined as attendance to the therapy sessions in our research, whereas it was defined as a combination of attending sessions and performing home exercises, or even only the assessment of home exercises in other research. Moreover, the content of the therapy differs between all studies, which can also influence the outcomes and resulting findings.

This variability in results, depending on methodology and therapy construct, is reflected in the fact that an absence of relationships between clinic-based therapy adherence and pain or psychology has also been found in other previous research (on smaller scale) (Linton et al., 1996; Nava-Bringas et al., 2016).

In contrast to previous research, the present study did not use a cut-off to determine the presence of non-adherence as doing this would oversimplify the study results (and hence would decrease statistical power), which can again declare the differences in results between different studies.

Nevertheless, our results need to be interpreted in the context of several limitations and strengths. For one, due to the construct of our research, only the attending of appointments was evaluated, which is a measure of clinic-based adherence (Bassett, 2003b; Di Fabio et al., 1996). Home exercises were performed by both groups but adherence to these exercises was not monitored and could therefore not be evaluated. In most previous research, clinic-based therapy adherence was evaluated based on both attendance and execution of home exercises (Mannion et al., 2009; Escolar-Reina et al., 2010; Behlau et al., 2013).

Secondly, this study is the result of secondary analyses within a larger study design. Therefore, the methodology of this clinical trial was not extended to maximally answer the posed research question. For example, this research did not aim at investigating every personal characteristic that could possibly influence therapy adherence. Research in other patient populations have for example shown an influence of the economic and social context, whereas these elements have not been evaluated in this study due to the unavailability of such data (Vermeire et al., 2001; Levy et al., 2009).

Thirdly, 3 regression models were built to address the problem of the unavailability of a cut-off and to check to robustness of the findings. From these analyses, we could conclude that patients from the traditional physiotherapy group with a lower education level were more likely to attend minimally 50% of the sessions. However, this finding could not be obtained in the 75% or 100% model, which points out that this finding should be interpreted with a critical view.

Lastly, obtaining non-significant results brings along difficulties towards interpretation (Dienes, 2014). A false interpretation of these results can lead to an inappropriate refutation of certain theories, or it can lead to the ignorance of information that is in fact informative (Things, 1990; R. R, 1993; Rouder et al., 2007; Greenwald A, 1975; Pashler and Harris, 2012). One way to figure out which decision should be made based on the data, is to investigate the power (Cohen, 1977). Therefore, a post hoc power calculation was performed based on the available sample size, which resulted in a power of 75.4% for the group comparisons, and 91% for the correlations.

Although we were limited by the above mentioned factors, several strengths should be mentioned. For example, a high power was obtained by including a large sample size and sound methodology was pursued by applying a correction for multiple comparisons (Stacey et al., 2012; Vasilopoulos et al., 2016). As we wanted to be able to detect clinical relevant differences, medium effect sizes were used to determine the obtained power based on our sample size (Excellence N institute for clinical, 2004; Jacob, 1988).

Recruiting and enrolling subjects at two locations, Ghent and Brussels, decreases a possible influence of selection bias and makes the results more generalizable.

Moreover, balanced treatment arms were compared in this study, while relying on a published trial and treatment protocol and applying blinded outcomes assessments (Malfliet et al., 2017; Dolphens et al., 2014).

Another aspect that distinguishes this research from previous ones, is the choice not to make a category of non-adherent participants, but to look at the relationships between patient characteristics and the number of completed therapy sessions instead. This choice was made as there is still no consensus on a specific cut-off, and choosing a random cut-off would over-simplify the study results (Munneke et al., 2003; O'Donnell et al., 2003; Gram et al., 2014; Peterson et al., 2015).

From these limitations and strengths, two main recommendations for future research can be made. First, a clear cut-off for therapy (non-) adherence should be decided upon as this would create uniformity across different studies and facilitate interpretation and comparison.

Second, future research should focus on factors that were not included in our analyses such as working status, occupation, marital status, income level, living environment (urban vs rural), etc. and investigate the influence of these factors on clinic-based therapy adherence on a large scale. Moreover, to evaluate whether the effect of the therapy influences the adherence, future studies should include a measure for perceived therapy effect, along with the actual therapy effect and evaluate this at different time points throughout the therapy instead of only at the end of the therapy.

5. Conclusion

Based on our study, we could not find factors that related significantly with therapy adherence in the total group or in the group of patients that received a modern neuroscience approach; whereas we could only find a relationship between therapy adherence on one hand and the TSK and educational level on the other hand in the traditional physiotherapy group.

Declaration of competing interest

The authors report no conflicts of interest.

Acknowledgements

D. Lenoir, I. Coppieters and W. Willaert were funded by the Flemish Research Foundation (FWO), whereas A. Malfliet and J. Kregel were funded by the Agency for Innovation by Science and Technology (IWT) – Applied Biomedical Research (TBM), Belgium.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.msksp.2019.102066.

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