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Faculteit Geneeskunde en Levenswetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

The effect of High Intensity Training on Activity Level, Pain and Disability in Chronic , Nonspecific Low Back Pain Patients

Don Lamers
Laura Moonen

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen

PROMOTOR :
Prof. dr. Frank VANDENABEELE

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Gastel (NL), 5 june 2018 D.L.

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Research context

This thesis study is situated in the musculoskeletal context of people with chronic low back pain. To date low back pain is a very common physical disorder with a broad spectrum of influencing factors. These factors are part of the biopsychosocial model. In this study the biophysiological part was more pronounced than the psychosocial aspect. A part of treatment in chronic low back pain is exercise treatment. There are many variations to prescribe an exercise program. Rehabilitation can consist of aerobic training, strength training, stabilization training, flexibility training and sometimes training can be following the principle of graded activity. Aerobic training can be divided into moderate intensity and high intensity training. In this last training modality people strive to train close to their maximal capabilities. These high intensity training programs are called High Intensity Training (HIT). In the world of musculoskeletal disorders these HIT programs are an interesting upcoming therapy. Still, for chronic low back pain there are only a few articles available that investigate these HIT programs.

We conducted our thesis as a smaller part of a broader doctoral study where Drs. Jonas Verbrugghe is part of. This doctoral study is titled by 'structural and functional effects of high-intensity interval training in patients with a non-specific chronic low back pain (study 15.142/reva15.14)' supervised by Prof. dr. Frank Vandenabeele, dr. Monique van Erum, Prof. dr. Bert Op 't Eijnde and Prof. Dr. Annick Timmermans. Our thesis used parts of data provided by Drs. Jonas Verbrugghe. All these data were original from tests conducted in REVAL research center for rehabilitations research of Hasselt University fundamental research and service in the domain of rehabilitation and physiotherapy in Diepenbeek, Belgium.

This master thesis is performed by two master students musculoskeletal rehabilitation sciences and physiotherapy from Hasselt University. The thesis research question was set up by this two master students and Drs. Jonas Verbrugghe. Participants were recruited by brochure work and social media. The included participants were guided during rehabilitation by Drs. Jonas Verbrugghe, Drs. Sjoerd Stevens and, if extra support was needed, by master students.

1. Abstract

Background: Chronic low back pain has a big influence on disability in Western countries. To date research has concluded that exercise therapy has a great effect on this population. These exercise programs consist mostly out of core stabilization and an aerobic training program with moderate intensities.

Objectives: This Master Thesis investigates the effect of different High Intensity Training (HIT) programs compared with a Moderate Intensity Training (MIT) program in patients with non-specific chronic low back pain (NSCLBP).

Participants: Fifty-two participants were included in this study. Every participant was randomized in a treatment group. Four different HIT treatment groups were available and one MIT group as control group. The additional training modalities in the groups are stabilization, strength, mobilization or combination. During intervention each group started with a cardiovascular training program followed by additional training.

Measurement: Primary outcomes were Numeric Pain Rating Score (NPRS) and activity level measured by Actigraph accelerometer. Secondary outcomes were subjective activity level measured by Physical Activity Scale for Individuals with Physical disabilities (PASIPD) questionnaire and Modified Oswestry Disability Index (MODI) questionnaire.

Results: During follow-up there was one drop-out in the HIT mobilization group. Every group significantly improved in the in NPRS and MODI scores after intervention. Activity level measured by accelerometer and PASIPD questionnaire didn't change after 12 weeks of training. Between -group comparison didn't show any differences in NPRS, activity level and MODI.

Conclusion: Pain and disability improve after 12 weeks of HIT or MIT training. Future research could focus on the different effects of HIT and MIT training intensities. There is no significant improvement in activity level, both objective and subjective.

2. Introduction

In Western countries low back pain is a major health problem, associated with medical costs and absence from work activities. (Ricci et al., 2006; van Tulder, Malmivaara, Esmail, & Koes, 2000). Low back pain has a lifetime prevalence of 85%, of these percentage 23% tend to progress to a chronic condition. 11%-12% of the low back pain patients are disabled from work.(Balague, Mannion, Pellise, & Cedraschi, 2012)

Low back pain can be divided in specific and non-specific low back pain. Specific low back pain is defined by the KNGF Guideline as low back pain with a specific cause that can be diagnosed by supplementary diagnostic tests. Lumbosacral radicular syndrome, osteoporosis or spondylolysis are specific forms of low back pain. Non-specific low back pain is defined by the KNGF Guideline as low back pain without a known cause and that presents between the lowest ribs and anal cleft. Besides the specificity of low back pain, duration is an important component. This component can be divided into acute, subacute and chronic. This paper investigates the chronic population of non-specific low back pain. Chronic low back pain can be defined as pain that is felt for more than 12 weeks. (Wells, Kolt, Marshall, & Bialocerkowski, 2014). There is an increased risk of 40% to develop a chronic condition after an acute onset of low back pain (Reme et al., 2012).

There is a suspected physical deconditioning present in NSCLBP in terms of cardiovascular and muscular fitness due to inactivity of this population. The inactivity could arise from a fear of movement perception because of perceived pain level resulted in a decrease in physical activity. (Verbunt, Seelen, et al., 2003a; Verbunt, Seelen, Vlaeyen, van der Heijden, & Knottnerus, 2003). This is seen in the avoidance behavior model from Vlaeyen et al. (1995) (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995).

To date reviews and meta-analysis explored the effectiveness of physical activity and exercise as treatment for patients with non-specific chronic low back pain. These authors conclude that physical activity and exercise is an effective treatment (Gordon & Bloxham, 2016; Hayden, van Tulder, Malmivaara, & Koes, 2005; Meng & Yue, 2015; van Middelkoop et al., 2010). Even though physical exercise therapy seems to be effective, there was no specific kind of exercise that was superior.

A very popular training form today is High Intensity Training (HIT). This training is performed at minimal intensity of 80% of a person's maximum capability. Until now this modality has not been investigated extensively. Some authors have published studies about HIT training in patients with NSCLBP. They compared HIT to passive treatment and concluded that aerobic HIT training significantly decreases pain level, disability level and psychological strain in patients with NSCLBP (Chatzitheodorou, Kabitsis, Malliou, & Mougios, 2007; Murtezani, Hundozi, Orovcanec, Sllamniku, & Osmani, 2011). Still more research needs to be done to compare HIT training with usual exercise therapy.

This study investigates the effect of different HIT protocols and compares it with usual moderate intensity exercise therapy. These protocols contain aerobic training, strength training, trunk stabilization training, mobilization exercises or a combination. This Randomized Controlled Trail (RCT) investigates whether a HIT protocol is more effective on physical activity level, pain and disability scores compared to a MIT protocol in patients with chronic non-specific low back pain.

3. Methods

3.1. Participants

During this study participants with NSCLBP were recruited. The recruitment was conducted by giving information through social media and informative brochures. Potential participants were able to contact the researchers by e-mail and telephone. During first contact participants were included if they met the inclusion criteria.

3.1.1. Inclusion criteria

Included NSCLBP participants must meet the following criteria. Back pain was located between the last ribs and the gluteal line; current episode of back pain during >12 weeks; 25-65 years old; able to understand Dutch language.

3.1.2. Exclusion criteria

Participants were excluded if they met the following exclusion criteria. Experienced invasive neurosurgery in the last 18 months (exception of minimally invasive neurosurgery); uni- or bilateral radiculopathy; other comorbidities (diabetes mellitus, paresis and sensory abnormalities with another underlying neurological source, rheumatoid arthritis); ongoing work absence >6 months and/or ongoing compensations; conduction of any rehabilitation or exercise therapy involving low back pain in the last 6 months; have a pain increase of >3/10 VAS and >8/10 VAS during the last 48h.

3.2. Study design

Context of this investigation was the REVAL research center for rehabilitation research of Hasselt University fundamental research and service in the domain of rehabilitation and physiotherapy, located in Diepenbeek, Belgium.

There was a total of three assessments for participants with NSCLBP after their initial screening process. The baseline assessment (T0) was performed before the start of the participant rehabilitation program. After six weeks (T1) and 12 weeks (T2) the other assessments were conducted. This study only uses baseline measurement and the post-intervention measurement. Progression was made after physical assessment executed on

T1. This assessment consists of muscular strength testing using Biodex and cardiovascular capacity testing using ergospirometry. Figure 1 shows a timeline of this study design.

Every participant with NSCLBP was randomized in a treatment group by block randomization. Participants could be placed in one of the five different treatment groups: 1) HIT strength, 2) HIT stabilization, 3) HIT combined, 4) HIT mobilization or 5) MIT combined. The MIT combined group is a control group in which there will not be any progression during their rehabilitation program.

Each session was performed twice a week for two hours each, with experienced supervision. All participants were instructed to continue their normal diet and physical activities until the end of this study.

3.3. Intervention

For every participant, the first two weeks were familiarization sessions. The purpose of these sessions was to teach correct movement patterns for executing the exercises and to get used to the new training input. During these sessions there was no progression in training load. Extrinsic feedback was given about the movement quality.

After every session, each participant scored the level of exertion. These were measured by the Borg Rating of Perceived Exertion Scale (RPE scale), which quantifies the level of exertion during every session. Exertion was rated on a 6 to 20 scale.

The HIT strength program consists of a cardiovascular high intensity interval training (HIIT) conducted on a cycle ergometer combined with a strength training at a high intensity. The supervisor controlled the exercise execution of each participants. Progression was made when the participant could reach 12 RM with proper technique and reduced when 8RM could not be reached with proper technique. The strength training was performed in a circuit of 6 exercises on different machines and performed two times. A detailed description of High Intensity Interval Training protocols and additional training protocol is explained in Table 1.

The HIT stabilization program consisted of the same cardiovascular HIT training, combined with a stabilization training protocol. This protocol consists of 6 different trunk muscle exercises, which are performed at high intensity. The focus of the stabilization program is

core stability. Progression was made if participants could perform exercise with correct control and execution. These exercises were performed in a circuit and executed two times.

The HIT mobilization program consists of a HIIT training combined with static stretching exercises. These exercises were supervised and corrected during execution. Six different stretch exercises were used in this protocol, these exercises are described in Table 1.

The HIT combined program consists of a HIIT training combined with a strength circuit and a stabilization circuit. This group completed one strength circuit and one stabilization circuit. Progression was made using same protocol as other programs. Continuous supervision was provided for the correct execution.

The MIT combined program is a control group containing aerobic, strength and trunk stabilization exercises at moderate intensity. This program does not progress. The trunk stabilization exercises do not have a high maximum voluntary contraction to be called high intensive. Participants are supervised for correct execution of these exercises.

3.4. Measurement

3.4.1. Primary outcome measures

The main measurement outcomes are pain scores measured by a questionnaire and physical activity level which is measured by an accelerometer and a questionnaire.

Numeric Pain Rating Scale

This is an 11-numeric questionnaire where people need to fulfil the amount of pain they are experiencing. The scale goes from left to right and numbered from 0 to 10, where 0 is no pain and 10 is the worst pain imaginable. People circle their pain score. If two numbers are circled the mean is taken.

Physical activity

Measured by an accelerometer during 7 consecutive days. Actigraph accelerometers have been used. Participants wore these on their waist during the whole day except during sleeping time. Outcome was expressed in seconds that an individual was active in a certain activity level. These levels are divided in sedentary, light, lifestyle, moderate, vigorous and very vigorous. This study used sedentary, moderate and vigorous activity level for analysis. This accelerometer is uniaxial that measures accelerations ranging from 0,05 to 2G and the

band has a frequency movement from 0,25 to 2,5Hz. Because of this, normal body motion can be registered and vibrations will be filtered out. Signals from the accelerometer are summed over a time interval or epoch. After every epoch the activity count is stored, and the accumulator is reset for next registration (Freedson, Melanson, & Sirard, 1998).

3.4.2. Secondary outcome measures

The Modified Oswestry Disability Index (MODI) and the Physical Activity Scale for Individuals with physical disabilities (PASIPD) were used as secondary outcomes.

Modified Oswestry Disability Index

This questionnaire consists of ten items that are scored from 0 to 5, where a higher score indicates greater disability level. After score is counted it will be multiplied by two. This will result in a percentage 0 to 100%.

Interpretation of scores (Ramasamy et al., 2017; Vianin, 2008):

- 20-40% = moderately disabled
- 40-60% = seriously disabled
- 60-80% = very seriously disabled
- 80-100% = bedridden and dramatically disabled

Physical Activity Scale for Individuals with Physical Disabilities

This questionnaire investigates the participants' physical activity of the last seven days. The 7-day recall question records number of days/week and hours/day participated in household, leisure time and occupational activities.

3.5. Medical ethics

This study has been approved by the medical ethical committee of Hasselt University and of Jessa Hospital (Hasselt, Belgium) under protocol name 14.87/REVA14.12. The clinical trial has been registered at clinicaltrials.gov as NCT02786316.

3.6. Statistic analysis

Statistical analysis was performed with SPSS version 25.0.

For all data we calculated mean and standard deviation. Mean values are used during the statistical analysis.

Baseline characteristics of all treatment groups were compared to each other with a Oneway Anova to see if there were any significant differences between groups before attempting their treatment protocol. All data were checked for assumptions and were corrected when necessary.

Pre-intervention and post-intervention data was analyzed using a repeated measurement Anova with a Bonferonni test to reduce the chance for a type I error. This study was interested in the within-group and between-group differences of the pre-intervention data and the post-intervention data in time. If any significance was found, a pairwise comparison was performed.

4. Results

Subjects

After baseline assessment, fifty-two subjects participated in this study and started rehabilitation. All of them were randomly allocated in five different treatment groups. Allocation of participants can be found in Figure 2. After completion of 12 weeks of treatment, one drop-out was reported in the HIT combined group, due to illness not related to low back pain. All data from different questionnaires pre- and post-rehabilitation were collected. However, some data from accelerometers was lacking due to technical issues.

Baseline characteristics

Baseline characteristics of the different treatment groups can be found in Table 2. No significant differences were found between all treatment groups for age, working hours, sedentary activity, moderate activity, MODI, NPRS and PASIPD.

NRPS

In all different treatment groups is a significant decrease in pain score, p-values can be found in Table 3. However, there is no significant pre-post difference between groups in NRPS (p=0.228). Figure 3E shows a graphic presentation.

MODI

Results of MODI show a significant post-intervention improvement within all treatment groups. The between group difference is not significant (p=0.538). Data can be found in Table 3. Graphic presentation of these data shown in Figure 3F.

PASIPD

A global overview shows a different evolution between groups over the treatment period. In some groups the PASIPD score increases while in some groups this score decreases. No significant data was found between groups (p=0.334). Within-group comparison didn't show any significant difference in time (see Table 3). Figure 3F show a graphic presentation of the PASIPD outcome scores.

Sedentary activity

All HIT treatment groups decreased in sedentary activity level, but without any significance within- and between-groups (p=0.310). MIT treatment group had an increase in sedentary activity level. All data is presented in Table 3. Figure 3A shows a graphic presentation of this outcome.

Moderate activity

MIT and HIT mobilization had a small increase, but not significant, in moderate activity level. Other treatment groups had a small decrease, but not significant, in moderate activity level. No between-group difference was noticeable (p=0.769). HIT stabilization within-group difference was close to significant (p=0.065). Figure 3B show a graphic presentation of this outcome.

Vigorous activity

Most HIT groups had a decrease in vigorous activity level except the HIT mobilization and MIT group, these had an increase in activity level. The HIT strength group was close to a significant decrease in vigorous activity time. Further, no significance was found between-groups and within-groups over time. Figure 3C show a graphic presentation of this outcome.

5. Discussion

The purpose of this study was to investigate the effect of different HIT protocols in combination with a strength, stabilization or mobilization program on patients with CLBP. Besides the HIT protocol, this study compared these groups with a MIT protocol to examine the effect of different intensities during training. Before and after treatment of 12 weeks there was a measurement of the activity level, pain level and disability level. This is the first RCT that compares different HIT programs with a MIT program in combination with additional training modalities, and also the first RCT that assesses the physical activity level after training.

The results of this research show no differences between groups after 12 weeks of training for all outcomes. No training protocol is superior to another, even the MIT protocol shows no difference with other groups. Within-groups there is a difference between pre- and post-measurement in pain (NPRS) and disability level (MODI) that is significant. There was no difference in activity level within the treatment groups.

Primary outcomes of this study were changes of activity level after intervention. Until now there is no study that investigated physical activity level before and after an exercise treatment intervention. This study showed no differences in physical activity level after 12 weeks intervention between groups. The PASIPD questionnaire increased in some groups and decreased in others. This corresponds with the objective physical activity level measured with the Actigraph. The decrease in activity level after intervention was not expected by the authors. Before starting this investigation, the authors hypothesized that participants would increase in physical activity level when decreasing in pain score, as investigated by Verbunt et al. (2003) (Verbunt, Seelen, et al., 2003b). This reduction in activity level could be explained by the possibility that participants reduce their activities after finishing training of the HIT treatment which is performed at very high intensities. To be sure of this, there could be a follow-up measurement to see if participants increase their activity level again. If so, this could be explained by the fact that participants had experienced more back pain after inactivity, so that they initiate physical activity or exercise on their own. Whether the participants in this study have lowered activity level compared with healthy controls is questionable. A systematic review from Griffin et al. investigated the level of activity in chronic low back pain patients compared with healthy controls and didn't find any difference

in physical activity in the adult population, there was significantly lower physical activity in older adults (Griffin, Harmon, & Kennedy, 2012).

This study did not assess correlations between activity level and pain or disability index before and after treatment. Other results in activity level could be suspected when participants have a higher pain and disability level. In the meta-analysis of Lin et al. (2011) was concluded that higher disabled chronic low back pain patients show lower levels of physical activity (Lin et al., 2011).

Another primary outcome was a change in pain scores. In all groups, participants showed a significant decrease in pain rating after following the 12-weeks training program. This corresponds to the conclusion of the systematic review of Gordon & Bloxham (2016) that states exercise intervention programs are beneficial for nonspecific chronic low back pain using Visual Analogue Scale for rating back pain. This review also states that there is no difference in strength, flexibility or aerobic fitness exercise treatment when they were given separately (Gordon & Bloxham, 2016). Results in this investigation also show no significant difference in pain decrease between all treatment groups. This means that combining two of the three modalities is not superior. Even HIT and MIT treatments don't show different results. This could mean that only performing an exercise program, even in lower intensities, is enough to decrease low back pain. Yet, in this investigation we didn't combine all three treatment modalities – strength exercises, flexibility training and aerobic fitness. It could be interesting to compare one HIT combined training modality with the same modality using moderate intensities (MIT) to investigate the effect of higher training intensities. Until now no studies investigated these training modalities.

The secondary outcome of this study was change in MODI scores after intervention. Like the results in NPRS, participants show a significant improvement in disability index (MODI) in every single treatment group but no significant difference between any groups. Chatzitheodorou et al. (2007) concluded that there is a significant decrease in disability after following HIT training that was significantly different with the control group. Yet this control group did not use any form of active training which can explain why the authors of this study didn't find a difference between groups (HIT and MIT) (Chatzitheodorou et al., 2007). This also corresponds with the article of Murtezani et al. (2011) which concludes that HIT training has a superior effect on disability level when compared to passive modalities (Murtezani et

al., 2011). Again, this could mean that only participating in an exercise program in patients with low back pain is sufficient to decrease disability. Although all groups significantly improved in MODI scores this doesn't necessarily mean that these values are clinically important. Fritz et al. (2001) concluded that the minimum clinically important difference is six points in patients with acute low back pain (Fritz & Irrgang, 2001). Denteneer et al. (2018) researched this Dutch version of the MODI in patients with NCLBP. They found a minimal detectable change of 8.80 (Denteneer et al., 2018). In this study some treatment groups didn't meet these detectable changes so whether this is clinically significant is questionable. This could be explained by the relative small baseline values in this study. There is a probability that more disabled persons experienced a greater effect.

One of the strengths of this study is its research design. All participants were randomly assigned to a treatment group using block randomization, so that treatment groups were equally divided. Another strength was the usage of different additional treatment programs between all the groups to investigate if an additional program is superior in comparison with others. First two weeks of each treatment protocol was a learning phase to make all participants familiar with their program. Each HIT group had an equal volume and intensity. Progression during the HIT program was standardized each week with an increase of 10 sec during high intensity workload. Because of this, the treatment groups are comparable. All participants had a measurement of their physical activity level for one week before and after intervention. This was measured subjectively by using a questionnaire and objectively using an accelerometer. The Actigraph accelerometers used in this study have a good reliability and acceptable step count during moderate-to-high walking speeds in daily life situations and laboratory context (Lee, Williams, Brown, & Laurson, 2015; Santos-Lozano et al., 2012). The MIT program was used as a control group, this group didn't progress in intensity during their program.

This study had some limitations. Each group had a relatively small number of participants because of the use of five different treatment groups. It may be more valuable if this study used only two different treatment groups with same additional training but differ in HIT or MIT protocol so there could be a better understanding of the effect of different training intensities. Although a blocked randomization was used, the treatment groups were not equally divided because not all participants started the 12-weeks program during writing of

this article. Only one participant was noted as dropout because of illness not related to low back pain.

Another limitation was the loss of data because of incorrect usage of the accelerometer. In some participants the accelerometers failed during their registration week, so data was not available. This limited the amount of data to be used. Blinding of research personnel and participants was not possible, and participants were sometimes assisted by different research staff which could affect the treatment. People attracted for this study were probably more active people who had some experience with sports or exercise. The study protocol merely focused on physical aspects of the participants, so there was no intervention addressing yellow flags like catastrophizing, fear avoidance and pain education.

6. Conclusion

After 12 weeks of training in different HIT and one MIT modalities, we can conclude that there is a significant, positive effect on pain and disability in NSCLBP patients. This effect could be found in all of the treatment groups. There was no significant difference between any of the groups, which could mean that physical exercise with no preference for a specific training protocol is sufficient to decrease pain and disability.

On the other hand, there is no significant difference in activity level, both the objective and subjective measurement, after rehabilitation. Also, there is no significant difference between any of the groups.

Future research should use only two different treatment groups with a high and moderate intensity aerobic training program combined with the same additional training program to investigate the effect of different training intensities in NCLBP patients. Also, physical activity should be measured as follow-up to see if participants will increase physical activity on their own. This should be measured by an accelerometer to objectify the outcome.

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8. Appendix

Figure 1: Research timeline

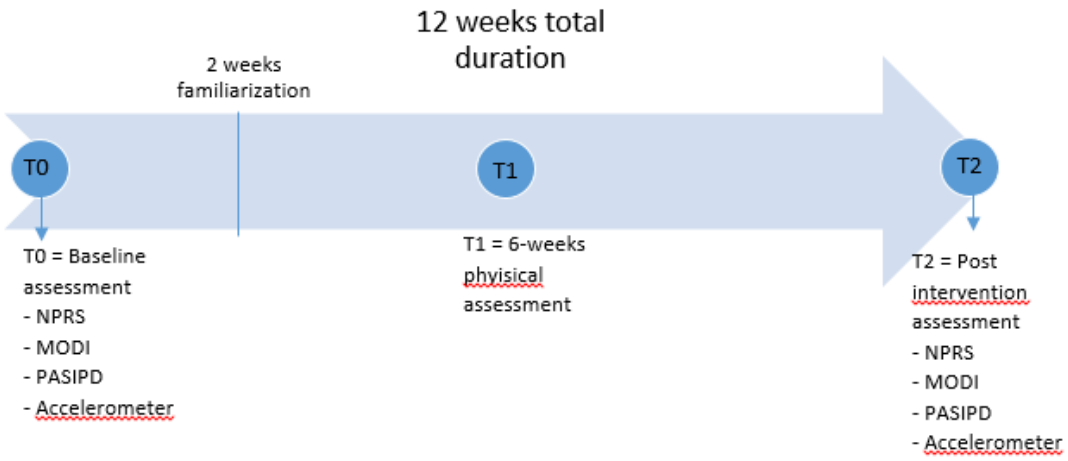


Table 1: intervention specification including volume and intensities.

Training	Cardiovascular	Maximal strength	Trunk stabilization	Stretching	Cardiovascular MIT
Group	HIT strength HIT stabilization HIT mobilization HIT combined	HIT strength (2 rounds) HIT combined (1 round)	HIT stabilization (2 rounds) HIT combined (1 round)	HIT mobilization (2 rounds)	MIT combined
Protocol	5 high-intensity intervals: • Week 1: 1'00'' • Week 2: 1'00'' • Week 3: 1'10'' • Week 4: 1'20'' • Week 5: 1'30'' • Week 6: 1'30'' • Week 7: 1'00'' • Week 8: 1'10'' • Week 9: 1'20'' • Week 10 1'30'' • Week 11: 1'40'' • Week 12: 1'50'' 5 active recovery cycles • Week 1-12: 1'00''	Six machine exercises: 1. Vertical traction 2. Leg extension 3. Chest press 4. Leg press 5. Arm curl 6. Leg curl Week 1-2: quality control and 1RM testing[s] Week 3-12: 80% 1RM (8-12reps)*	Week 1-2: muscle setting and quality control 1. Transversus abdominis 2. Multifidus 3. Gluteal 4. Thoracic 5. Posture Week 3-12: stabilization training [A] 1. Bridging 2. Clam exercise 3. Bird dog 4. Planking 5. Side planking 6. Rowing	Stretching exercises:[B] 1. Gluteus maximus 2. Gluteus medius 3. Lumbar spine 4. Thoracic spine 5. Frontal abdominals 6. Side abdominals	Moderate intensity cycle program: • Week 1-12: 20' Stabilization exercises Strength exercises
Frequency/duration	2 sessions/week	2 sessions/week[s]	2 sessions /week	2 sessions/week	2 sessions/week
Workload	High intensity : 100% of maximal wattage Active recovery: 50% of maximal wattage	80% of 1Repetition Max			Aerobic training at 50-60% VO_2max Strength training at 60% 1RM

First 6 weeks are based on the baseline assessment (T0) of maximal wattage (Wmax): after week 7 the maximal wattage is based on assessment of T1 after 6 weeks
*Resistance was increased when on 2 consecutive sessions >12 correct repetitions could be performed
[s]The protocol was executed twice / session starting from the third week
[A]10x10sec per exercise
[B]30sec passive static self-stretching twice per side, spine: 2x10 repetitions

Table 2: baseline characteristics

	HIT strength	HIT stabilization	HIT combined	HIT mobilization	MIT combined	p-value (between-group)
Gender						0.614
- **Male**	6	5	3	4	4	
- **Female**	5	6	8	6	5	
Age	46,00 (7,94)	47,27 (9,23)	44,18 (9,01)	47,00 (8,11)	46,00 (11,29)	0.941
Working hours	38,14 (19,42)	34,82 (11,44)	37,86 (18,18)	36,80 (17,29)	36,00 (7,68)	0.987
Sedentary activity (sec)	557268 (42317)	552832 (37108)	560452 (62565)	575043 (38563)	535171 (31207)	0.498
Moderate activity (sec)	22799 (9295)	28198 (15194)	23819 (7193)	22694 (9604)	22563 (5096)	0.683
Vigorous activity (sec)	3718 (7078)	3065 (2614)	1874 (937)	1628 (1166)	1354 (876)	0.577
MODI	19,27 (10,44)	18,91 (11,04)	18,36 (11,13)	21,00 (7,38)	16,22 (9,40)	0.890
NPRS	4,34 (1,64)	5,64 (1,29)	5,41 (1,63)	6,20 (1,57)	5,06 (1,99)	0.123
PASIPD	10,11 (6,61)	15,58 (9,85)	16,96 (10,03)	19,60 (12,61)	11,20 (8,16)	0.157

*significant outcome with P<0.05
() standard deviation

Figure 2: flow chart with recruitment of participants

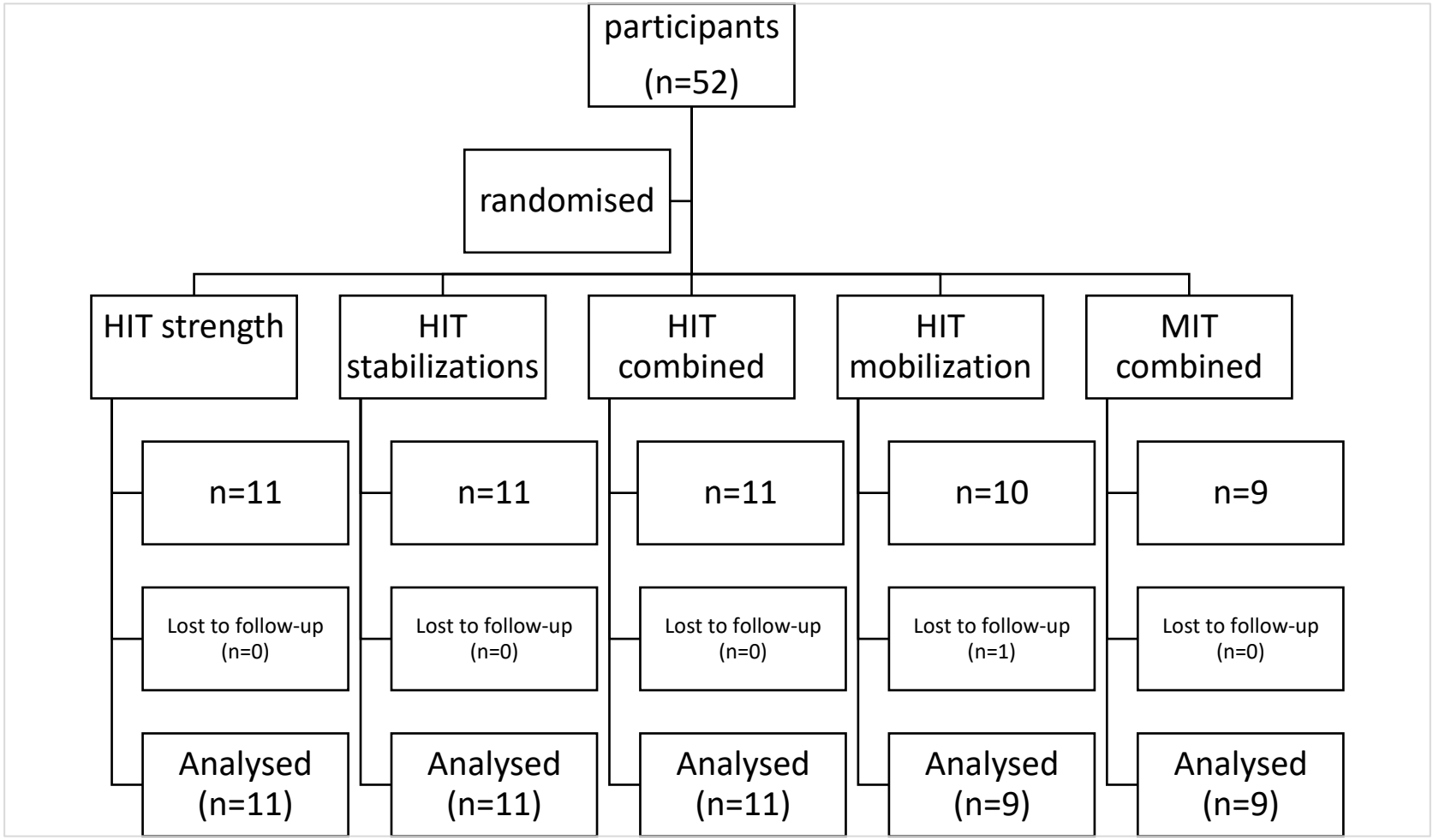


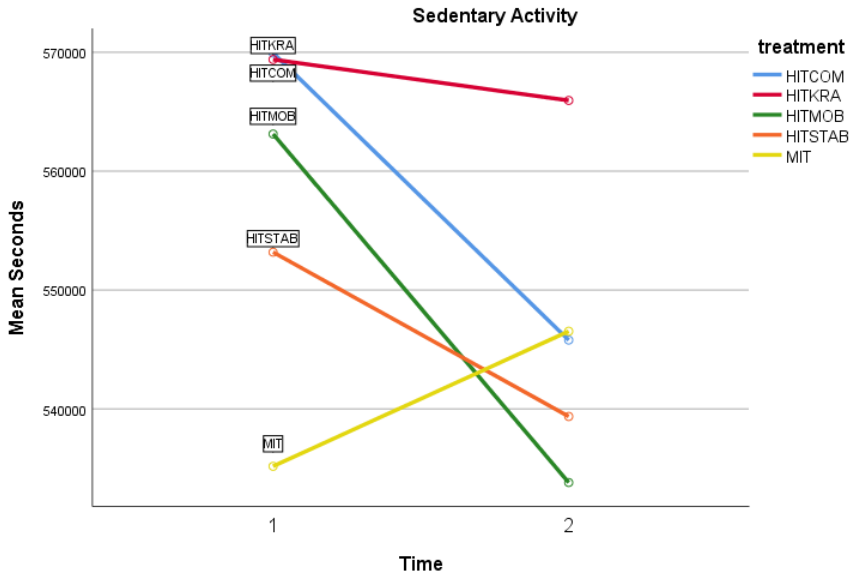
Table 3: between-group and within-group differences

	HIT strength	HIT stabilization	HIT combined	HIT mobilization	MIT	p-value (between group)
NRPS						
Pre measure	4,34 (0,49)	5,64 (0,493)	5,41 (0,49)	6,11 (0,55)	5,06 (0,55)	0.228
Post-measure	2,64 (0,52)	2,36 (0,52)	4,00 (0,52)	2,72 (0,58)	2,50 (0,58)	
p-value (within-group)	0.010*	<0.001*	0.031*	<0.001*	0.001*	
MODI						
Pre-measure	19,27 (3,03)	18,91 (3,03)	18,36 (3,03)	20,00 (3,35)	16,22 (3,35)	0.538
Post-measure	13,27 (1,87)	11,64 (1,87)	8,00 (1,87)	11,11 (2,07)	6,89 (2,07)	
p-value (within-group)	0.043*	0.015*	0.001*	0.008*	0.005*	
PASIPD						
Pre-measure	10,11 (2,82)	15,58 (2,82)	16,96 (2,82)	17,63 (3,12)	11,20 (3,12)	0.334
Post-measure	11,30 (2,58)	11,86 (2,58)	14,89 (2,58)	15,27 (2,85)	12,97 (2,85)	
P-value (within-group)	0.713	0.252	0.521	0.509	0.621	
Sedentary activity (sec)						
Pre-measure	569392 (14089)	553179 (14943)	569942 (14089)	563124 (17255)	535171 (14943)	
Post-measure	565947 (10200)	539363 (10819)	545786 (10200)	533804 (12492)	546529 (10819)	0.310
p-value (within-group)	0.834	0.429	0.147	0.150	0.515	
Moderate activity (sec)						
Pre-measure	21133 (3436)	29625 (3644)	23964 (3436)	25100 (4208)	22563 (3644)	
Post-measure	18050 (3388)	23342 (3593)	21900 (3388)	27279 (4149)	25009 (3593)	0.769
p-value (within-group)	0.328	0.065	0.511	0.570	0.463	
Vigorous activity (sec)						
Pre – measure	4343 (1320)	2704 (1400)	1727 (1320)	1873 (1616)	1354 (1400)	0.864
Post – measure	1602 (850)	1731 (901)	1554 (850)	2423 (1041)	3798 (901)	
P-value (within-group)	0.052	0.506	0.899	0.744	0.100	

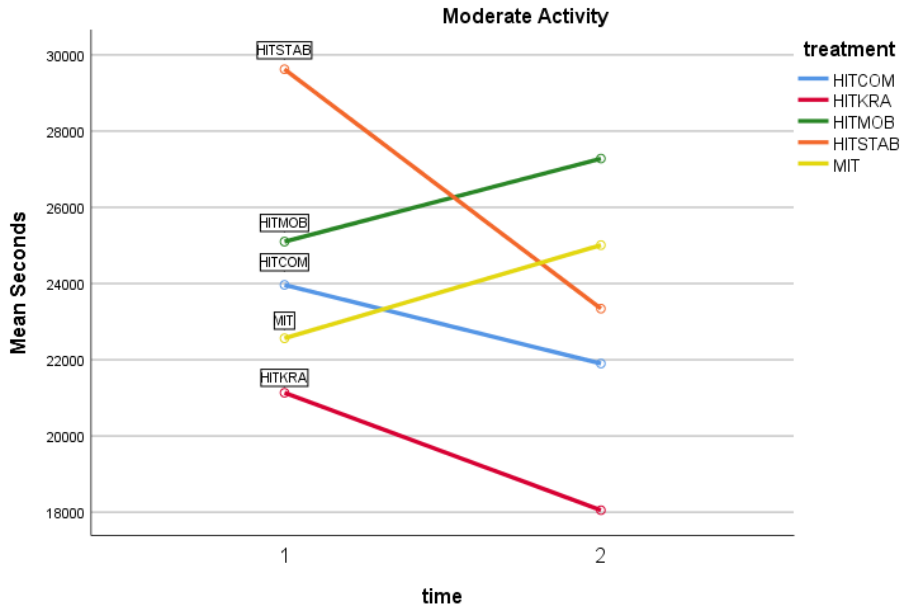
*significant outcome with p<0.05
() standard deviation

Figure 3: graphic view of the baseline outcomes (Time 1) with post-intervention outcomes (Time 2) after 12 weeks.

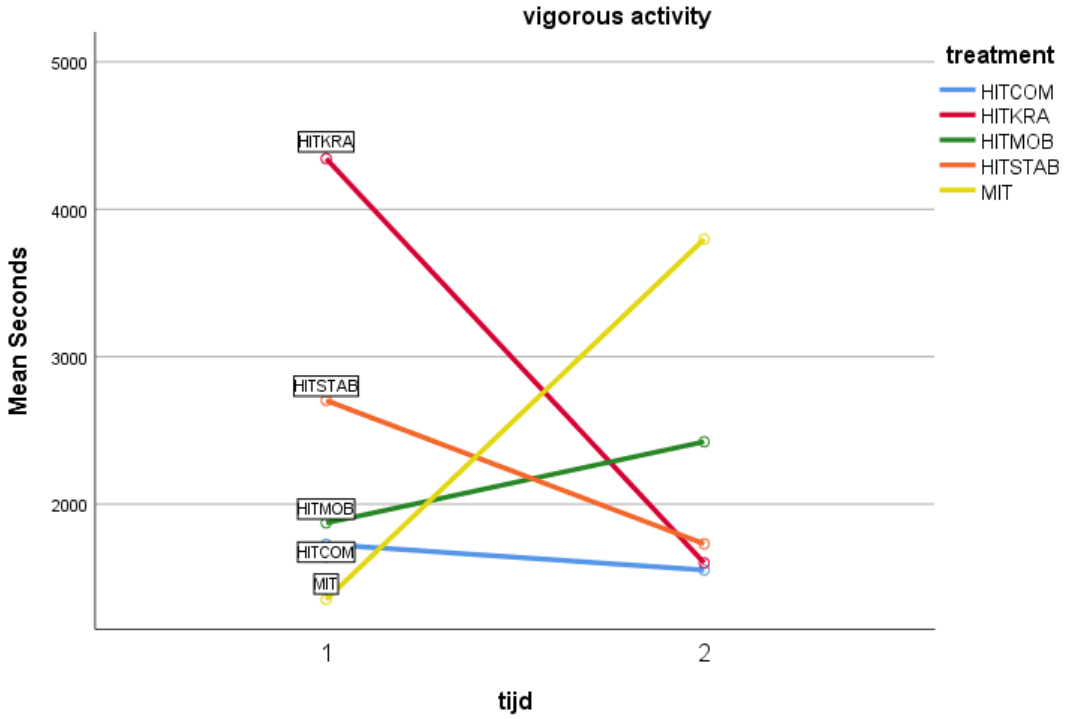
A. Sedentary activity



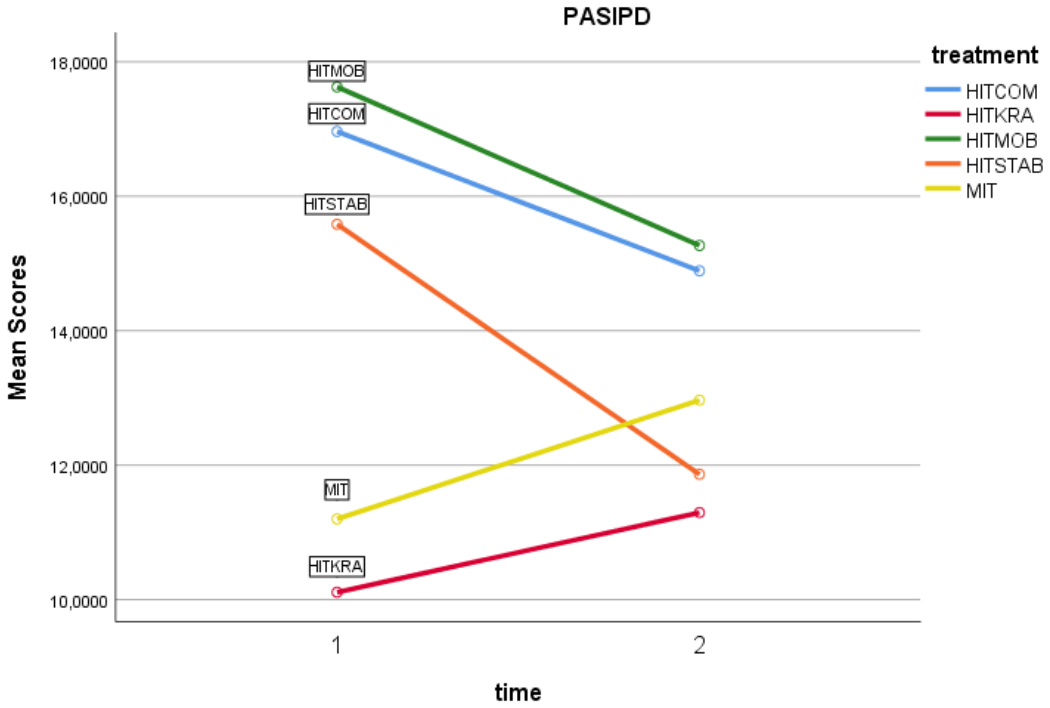
B. Moderate activity



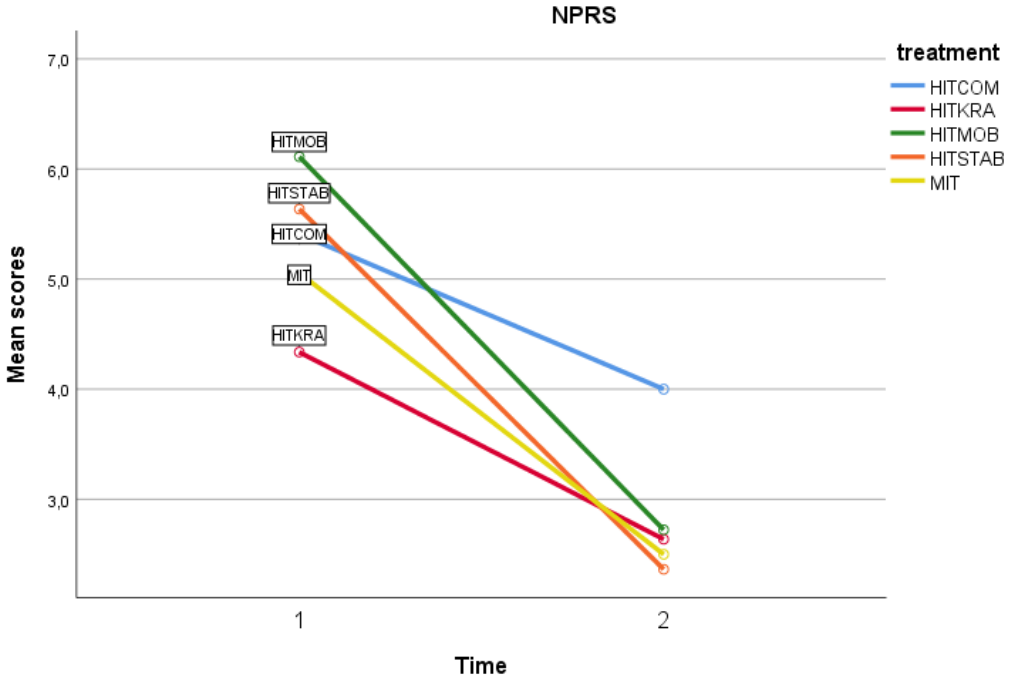
C. Vigorous activity



D. PASIPD



E. NPRS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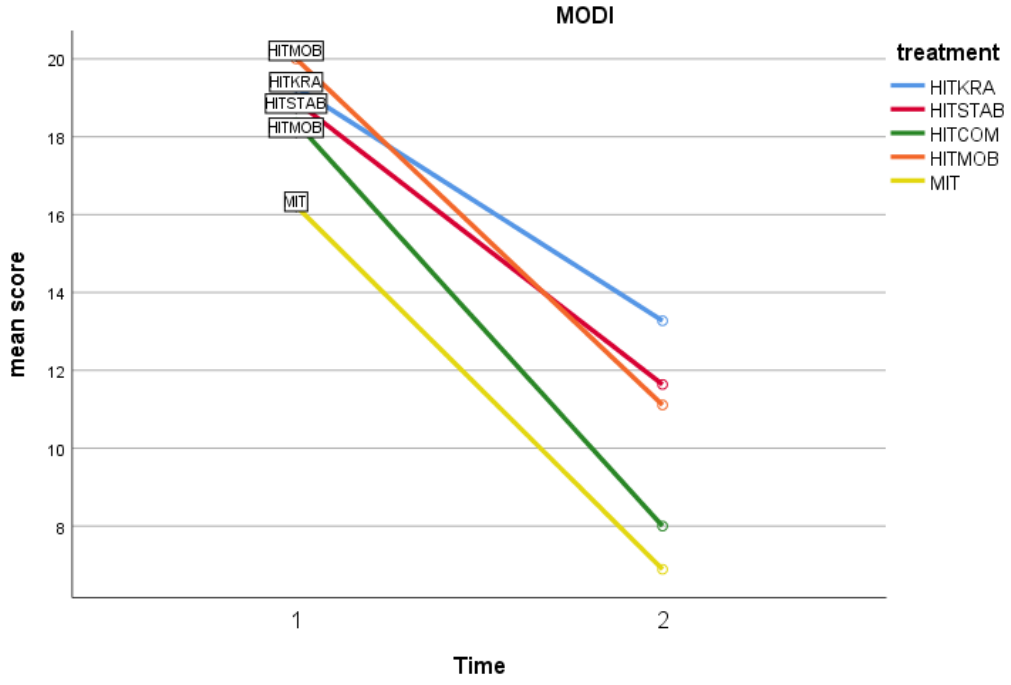
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5/2/18	overleg master thesis deel 2: methode + resultaten/data	Promotor: Copromotor: Student(e): Student(e):
11/4/18	overleg master thesis deel 2: data analyse + discussie	Promotor: Copromotor: Student(e): Student(e):
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Richting: **master in de revalidatiewetenschappen en de kinesitherapie-revalidatiewetenschappen en kinesitherapie bij musculoskeletale aandoeningen**
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