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Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

Fat content of the paraspinal muscles as a predictor of postoperative function in persons with a lumbar disc hernia

Iben Snijders
Lisa Vanderwegen

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

PROMOTOR :
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Research context

Master's thesis part two is an individual, prospective cohort study that is situated within an ongoing research project from our supervisor. Our supervisor had already gathered a significant portion of data for his own ongoing research. The students analysed and discussed these data with the supervisor in order to come to a research question that was interesting for the students. The students chose to draw up a research question for the current study that was as close as possible to last year's master's thesis subject.

In master's thesis part one, the comparison between the long-term effects of spinal surgery alone and the spinal surgery in combination with postoperative rehabilitation on functional outcomes and postoperative recovery on persons with lumbar disc herniation was examined. The current study investigates the predictive influence of the pre-operative fat content of the paraspinal muscles on postoperative function, in terms of pain and disability, in patients with a lumbar disc hernia who have undergone a discectomy.

This study topic is of great social relevance for two reasons. On the one hand, to prepare people for the possible pain and disabilities that may occur after surgery. On the other hand, to allow working proactively and to reduce the pre-operative fat content so that the patient's postoperative functioning improves. Reduced postoperative function can have a major impact on the individual and social level. Reducing postoperative pain and disability could influence the overall burden and cost that a lower postoperative function entails on a social level after a lumbar disc hernia surgery. Through this process, physiotherapists can contribute to minimizing postoperative pain and disabilities. Physiotherapists can offer a rehabilitation programme, after the operation or, if possible, before the operation.

The current study, being part of an ongoing research project and technical impossibility of monitoring the recruitment, interview and operation of all participants, resulted in the students only being involved in the data collecting process of two included participants. Nevertheless, the students considered important to follow some of the included participants to get an idea of the overall procedure. Our supervisor was involved in the data collection of all included participants. After collecting all data concerning the baseline characteristics, the pre-operative magnetic resonance imaging (MRI) images and the postoperative questionnaires of the included participants, those data were transmitted to the students by

the supervisor. In a meeting between the students and the supervisor, it was discussed how the MRI-images should be analysed. This analysis was carried out by the two students independently of each other. Further details on the processing of the data as well as agreements regarding the master's thesis part two were discussed during this meeting.

1. Abstract

Background: A discectomy is a surgical treatment option that can be applied to persons diagnosed with a lumbar disc hernia. After surgery, only a small number of patients (5-20%) remain with complaints. There are however several pre-operative factors that can predict the surgery outcome. Under normal circumstances, the paraspinal muscles ensure the stability and mobility of the spine. Low back pain (LBP), which can be associated with a lumbar disc hernia, can lead to structural changes in the paraspinal muscles, such as fat infiltration due to atrophy. So far, there are no recent studies supporting the assumption that the pre-operative fat content of the paraspinal muscles can have a predictive influence on postoperative function in persons with a lumbar disc hernia.

Objectives: The aim of this study is to gain a better understanding of the influence of a high pre-operative fat content of the paraspinal muscles on the course of pain and disability six weeks after lumbar disc surgery.

Participants: Twenty-five persons with symptoms of unilateral disc herniation, scheduled for minimally invasive surgery, were recruited between July 2018 and December 2019 at the Jessa Hospital, Hasselt, Belgium.

Measurements: Measurements such as the baseline characteristics and the fat content were carried out pre-operatively. Postoperative questionnaires (Oswestry Disability Index; ODI, Numeric Pain Rating Scale; NPRS) were taken six weeks after surgery.

Results: The pre-operative fat content of the multifidus muscle is positively correlated ($r=0.4640$) with postoperative pain. No correlation was seen between pre-operative fat content of the erector spinae muscle and postoperative pain ($p=0.5783$). The pre-operative fat content of the multifidus muscle or of the erector spinae muscle has no predictive influence on disability six weeks after surgery ($p>0.05$).

Conclusion: The pre-operative fat content of the multifidus muscle, at the level of the hernia, is correlated with pain six weeks after surgery.

Important keywords: Lumbar disc herniation, predictor, (pre-operative) fat content, postoperative pain, postoperative disability, MRI, ODI, NRPS

2. Introduction

Forty-nine to eighty percent of the general population experiences LBP at least once during their lifetime (Maniadakis & Gray 2000 in McGregor, Dore, Morris, Morris, & Jamrozik, 2010). Therefore, LBP can be considered as a common health problem that affects the quality of life of patients. This pain is situated on the posterior aspect of the body, from the lower edge of the twelfth rib to the lower gluteal folds (Adams, Bogduk, Burton, & Dolan, 2013). Within the population of lower back pain, lumbar disc hernia (LDH) is the most prevalent diagnosis (2-3%) (Vialle, Vialle, Henao, & Giraldo, 2010). The intervertebral discs, consisting of a central nucleus pulposus (NP) and an external membrane (annulus fibrosus), are located between the vertebrae of the spine. The NP consists of a hydrated gel substance, comprising a large quantity of proteoglycans, which retains water. The annulus fibrosus ensures, under normal circumstances, that the substance of the NP remains in the center of the disc. As a result, optimal mobility of the vertebral bodies and support of the compression loads on the vertebrae can be achieved (Adams et al.).

Surgery is one of the treatment methods that can be applied after the diagnosis of a LDH. Out of all patients diagnosed with LDH, 15% had to undergo surgery (Krämer, 1994; Zieger et al., 2011; Löbner et al., 2012 in Löbner et al., 2014). Among all surgical techniques performed in Europe, discectomy is the most widely used (Andrews & Lavyne, 1990; Atlas et al., 2005 in Ebenbichler et al., 2015). Eighty to ninety percent of patients who have undergone surgery, experiences success (Davis, 1994 in Ju, Park, & Kim, 2012). Only a small number of patients (5-20%) remains with complaints (Chatterjee, Foy, Findlay, 1995; Filiz, Cakmak, & Ozcan, 2005; Hides, Stokes, Saide, Jull, & Cooper, 1994; Kocyigit, Aydemir, Fisek, Olmez, & Mermis, 1999 in Ozkara et al., 2015). In addition to the uncertainty as to whether the operation will be successful, the surgery also involves considerable costs. For patients who remain with their symptoms, this is an additional burden (Wilson, Roffey, Chow, Alkherayf, & Wai, 2016). It is however possible to identify people who are likely to benefit from surgery as certain factors can predict the outcome of an operation. A possible influencing factor that should be considered is the importance of the paraspinal musculature in the function of the back. Paraspinal muscles, such as the multifidus muscle, play a role in providing segmental stability of the spine on the one hand and mobility of the spine on the other hand (Hildebrandt, Fankhauser, Meichtry, & Luomajoki, 2017). When the function of these muscles is less

valuable, this can be a factor contributing to LBP, as the support and control of the movements of the lumbar spine are provided by these muscles under normal circumstances (Ranger et al., 2017). In turn, LBP can lead to structural changes in these muscles, such as fat infiltration due to atrophy (Hides, Gilmore, Stanton, & Bohlscheid, 2008; Freeman, Woodham, & Woodham, 2010; D'hooge, Cagnie, Crombez, Vanderstraeten, Dolphens, & Danneels, 2012). In the study by Hildebrandt et al., fat infiltration in the multifidus was seen in 85% of patients with LBP. Especially with patients with chronic LBP, the risk of fat infiltration was higher than in patients with acute LBP. However, in the study by Ranger et al., there was conflicting evidence regarding the association between fat infiltration in the multifidus and LBP. There was insufficient evidence to establish the association between fat infiltration in the erector spinae and LBP. In addition to fat infiltration, the muscle cross-sectional area (CSA) was also examined as a predictor of LBP. No association was found for the relationship between erector spinae CSA and LBP, although a negative association was found between multifidus CSA and LBP (Ranger et al.).

The aim of this study is to gain a better understanding of the influence of the pre-operative fat content on postoperative function, established with pain and disability, in patients diagnosed with lumbar disc hernia who had a discectomy. Abnormalities in the paraspinal muscles can influence the surgery outcome of patients with a lumbar disc hernia. However, no recent studies have established proof supporting this assumption. For this reason, fat content is studied as a predictor. The study will therefore provide an answer to the following research question: “Does a high paraspinal fat content influence the course of pain and disability after lumbar disc surgery?”

3. Methods

3.1 Participants

Twenty-five persons with symptoms of unilateral disc herniation, scheduled for minimally invasive surgery, were recruited between July 2018 and December 2019 at the Jessa Hospital, Hasselt, Belgium. Participants were invited to participate in the study by a neurosurgeon during their preoperative consultation if they met the following criteria: unilateral lumbar disc herniation diagnosed using medical imaging, age between 18 and 55 years old, and understand the Dutch language (both spoken and written). Participants were excluded when they had undergone surgery within the last year, had degenerative or other spinal pathologies, had contra-indications to undergo an MRI-investigation or had other known pathologies that could interfere with muscle biology. Once the participants agreed to be included in the study, the neurosurgeon further explained the procedure to be followed, including the possible disadvantages that could occur. After the consultation, the neurosurgeon informed the researcher at Hasselt University that the participant was willing to participate in the research. This allowed the investigator to contact the patient to provide more information about the study and the informed consent. The following information on patient characteristics was also collected: age, gender, side and level of discus hernia, type of hernia, MRI-data from one level below, the affected level and one level above the lesions (fat infiltration, cross-sectional area). This trial was registered on ClinicalTrials.gov under the identification number NCT03753711. Ethical approval was given by the Medical Ethics committee from the Jessa Hospital and Hasselt University (Belgium).

3.2 Procedure

Participants signing the informed consent were included in the study. Under normal circumstances, MRI of the spine was performed on each patient before the operation took place as this is the standard procedure in lumbar surgery.

These MRI-images were used to extract data in order to use fat content of the paraspinal muscles (m. multifidus, m. erector spinae) as a predictor. MRIs were obtained from the lumbar spinal column using T2-weighted images using a Tesla 3 turbo spin-echo (TSE). Images of the lumbar multifidus muscle and erector spinae muscle were evaluated using Image J 1.52a; Java 1.8,0_112 (64-bit) software according to the protocol of Fortin and Battié, 2012. CSA,

functional cross-sectional area (FCSA) and fat content of multifidus muscle and erector spinae muscle were measured at both the herniated and non-herniated side of the spinal level above, at, and below the herniated disc.

Postoperative function was measured six weeks after surgery. The back-pain intensity was evaluated with the Numeric Pain Rating Score (NPRS). NPRS is a reliable and valid scale to evaluate pain intensity (Childs, Piva, & Fritz, 2005). It consists of a line, indicating 11 consecutive scores with 'zero' representing no pain, and 'ten' representing worst imaginable pain. A clinically relevant difference is considered when the participant has a score improvement of two points. The Oswestry Disability Index (ODI) was used to evaluate disability. ODI is a reliable and valid questionnaire to evaluate constraints experienced by people in their daily activities due to back pain (van Hooff, Spruit, Fairbank, van Limbeek, & Jacobs, 2015). It consists of ten items addressing different aspects of daily function, each item having a score from zero to five, with higher values representing higher disability. The total score as a percentage represents the degree of functional limitation.

3.3 Data-analysis

Data were analysed using JMP ® Pro 14 from SAS, using linear regression. Baseline data were analysed for group characteristics. Since only one independent predictor, X-variable, was used, namely fat content, simple linear regression was applied. In addition, both pain and disability were considered dependent, the Y-variable. Since the response variable, pain and disability, as well as the covariate, fat content, are continuous data, linear regression is the most appropriate statistical model (Appendix Figure 1). The aim of linear regression is to study the linear relationship between continuous variables ($Y = \beta 0 + \beta 1X + \varepsilon$) (Kim, 2018). The first step is to examine whether there is a relationship between the response variable and the predictor variable, for which the Scatterplot was used. β1 determines what the straight line looks like, whether there is a positive or negative relationship between the Y and X variables. If β equals zero, there is no relation between Y and X variables. A value greater than zero indicates a positive relationship while a value less than zero indicates a negative relationship. In this first part of the data-analysis, the coefficient of determination (R-squared, r^2) was also interpreted. The strength of the linear relationship between the response and the covariate is determined by coefficient of determination, which is the square of the correlation coefficient (r), the Pearson correlation, for simple linear regression. R-squared can take a value from zero

to one, where a value of one means that all the variability of the Y-variable can be explained by the X-variable. As far as the value zero is concerned, the X-variable will explain nothing about the variability of Y, which also means that all predicted values are equal to the average of Y. From this, it can be concluded that the greater the coefficient of determination, the more the variability in Y is explained by X and is therefore an indication of the accuracy of prediction based on X (Portney, 2014).

Next, in the second part, the model and hypothesis tests were studied. There are four model assumptions that need to be checked (Kim, 2018). The first requirement is linearity, assessed based on residuals in relation to predicted values (Residual by Predicted Plot). An acceptable linearity means that a horizontal band is formed around the zero point, without a certain pattern (parabola, straight line...) being visible in the measurements. The second requirement is normality. Whether there is a normal distribution of residuals can be seen by means of a graphical model (Residual Normal Quantile Plot) or in a formal way (Goodness of Fit). Normality is achieved in the graph when measurements are as close as possible to the straight line or in the formal way when the p-value is not significant. The third requirement is homoscedasticity, which can be assessed, similar to linearity, on the basis of residuals relative to predicted values. The Residuals by Predicted Plot shows that with an acceptable homoscedasticity, there is an equal distribution of data. If this constant variance of errors across all data is maintained, no funnel shape will appear on the graphical representation. The last requirement is the independence of all measurements. This information is obtained from the trial design. The third part of the data-analysis looks at the correlation between the different variables using the multivariate function. The correlation is a measure of how closely two variables are related and therefore gives an idea of the extent to which the variation in one variable can be related to variation in a second variable. For the parametric variables Pearson correlation (r) was applied, while for the non-parametric variables Spearman's correlation (sr) was used. In order to interpret the correlation, the confidence interval must be observed. A significant effect can be determined if zero does not fall in the confidence interval. Only when there is a significant result the correlation may be interpreted.

In the current study, a significance level of five percent was used with a confidence interval of 95% over the entire data-analysis, as this is the standard for rejecting the null hypothesis (Portney, 2014).

4. Results

4.1 Baseline characteristics and outcome measures

A total of 25 patients participated (one lost to follow-up), of which 40% were females and 60% males. The mean age was 38.6 years (SD 8.34), an average height of 1.75 meters (SD 0.10), an average weight of 84.77kg (SD 19.65) and an average BMI of 27.05 (SD 5.04). An overview of the baseline characteristics is shown in Table 1.

The dependent outcomes are shown in Table 2. Pain at six weeks postoperatively, measured with NPRS, was low with an average of 2.60 (SD 2.96). The disability six weeks after surgery, measured with ODI, was on average 20% (SD 20.10).

Table 1
Baseline characteristics

Age (years)	38,6	[18 – 55]
Sex		
Female (%)	40 (n = 10)	
Male (%)	60 (n = 15)	
Height (m)	1,76	[1,58 – 1,93]
Body weight (kg)	84,77	[53 – 123,8]
BMI (kg/m²)	27,05	[18,8 – 35,8]
Working		
Yes (%)	80 (n = 20)	
No (%)	20 (n = 5)	

Table 2
Dependent outcomes

	NPRS	$\sqrt{\text{NPRS}}$	ODI	$\sqrt{\text{ODI}}$
LDH-01	8	2,8284	72	8,4853
LDH-02	/	/	/	0
LDH-03	9	3	8	2,8284
LDH-04	1,5	1,2247	22	4,6904
LDH-05	3	1,7321	20	4,4721
LDH-06	0	0	2	1,4142
LDH-07	0	0	16	4
LDH-08	6	2,4495	68	8,2462
LDH-09	0	0	18	4,2426
LDH-10	4	2	50	7,0710
LDH-11	1	1	26	5,0990
LDH-12	0	0	2	1,4142
LDH-13	2	1,4142	22	4,6904
LDH-14	7	2,6458	26	5,0990
LDH-15	0	0	22	4,6904
LDH-16	0	0	0	0
LDH-17	1	1	0	0
LDH-18	2,5	1,5811	12	3,4641
LDH-19	1	1	10	3,1623
LDH-20	0,5	0,7071	2	1,4142
LDH-21	7	2,6458	48	6,9282
LDH-22	7	2,6458	16	4
LDH-23	0	0	0	0
LDH-24	2	1,4142	18	4,2426
LDH-25	0	0	0	0
Mean	2,60	1,1716	20	3,5862

LDH Lumbar disc hernia; *NPRS* Numeric Pain Rating Score; *ODI* Oswestry Disability Index

4.2 Correlations of outcome measures

The predictive influence of the pre-operative fat content, of both the multifidus muscle and the erector spinae muscle, on postoperative pain and disability was investigated. The pre-operative fat content was based on the average value of the fat content of the uninvolved and involved sides of the defined muscle (Appendix Table 3,4). When analysing the data, it was found that models relating to the predictive influence of the fat content of both the multifidus and erector spinae on postoperative pain and on postoperative disability did not meet all model assumptions. For this reason, a square root transformation was performed on the data of both NPRS and ODI outcome measures.

It could be established that the predictive influence of the pre-operative fat content on pain, six weeks after surgery, is different in the multifidus muscle compared to the erector spinae muscle. When the data concerning the relationship between multifidus and pain were analysed after transformation, it could be stated that all model assumptions have been fulfilled (Table 5). In addition, the Analysis of Variance of the relationship between the multifidus and pain showed that the model is significant (p=0.0224). From this it could be deduced that β1, which belongs to the X-variable (fat content), is different from zero and that consequently there is an effect of the fat content on pain. Table 6 shows a positive relationship (2.927); an increase in fat content pre-operatively results in an increase in pain postoperatively (Figure 2). The large variability of the data, as can be seen on Figure 2, results in a reasonably low R-squared (r^2=0.2153). However, this does not alter the fact that fat content is a significant predictor of postoperative pain (p=0.0224). Despite the low R-squared, which could be explained by the model, the variability in pain could be explained by the variability in fat content of the multifidus muscle. If this was linked to the Pearson correlation (Table 6), the variability of pain could be explained for 46.40% by fat content of the multifidus muscle. In assessing the relationship between the fat content of the erector spinae muscle and pain (Figure 3), it was found that, after the transformation, all model assumptions except normality were met, although this was a borderline case (p=0.0448). Due to the failure to meet the assumption of normal data distribution, the Pearson correlation could not be used, and the Spearman correlation was applied instead. The Spearman correlation was not significant (p=0.5783), so the corresponding null hypothesis could not be rejected; there is no relationship between pre-operative fat content of the erector spinae muscle and postoperative pain. The absence of a relationship between the two could also be observed when looking at the coefficient of determination (r^2=0.014638). Since this coefficient was almost equal to zero, it could be said that the fat content is only a minimal explanation for the variability in pain, given that coefficient of determination indicates how well the model describes the observations. A final confirmation that there was no linear relationship can be obtained using ANOVA (Table 6). The corresponding p-value (p=0.5733) was not significant in this case, suggesting that β1 is equal to zero. Consequently, any estimated value will be equal

to the group average, so that the average value of the Y-variable could simply be looked at and the model should not be used.

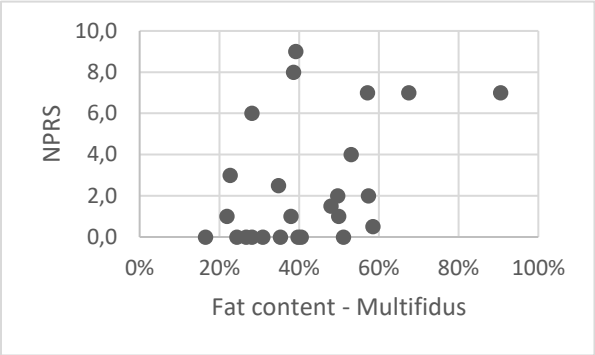

Figure 2. Fat content of multifidus compared with pain

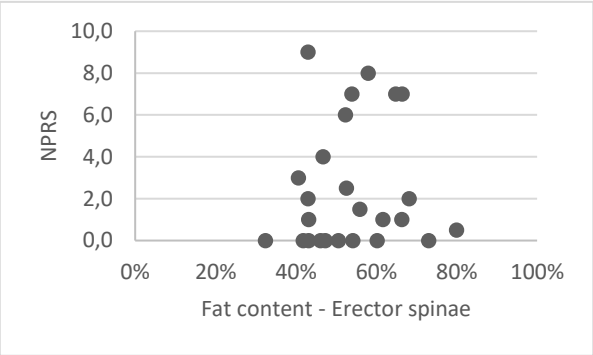

Figure 3. Fat content of erector spinae compared with pain

A second part of the study focused on the predictive influence of pre-operative fat content of both the multifidus muscle and the erector spinae muscle on postoperative disability. Both the data-analyses regarding the relationship between the fat content of the multifidus and disability (Figure 4), and the relationship between the fat content of the erector spinae and disability (Figure 5), after the square root transformation, met the four predefined model assumptions (Table 5). In both cases, the ANOVA table showed no significant effect (Table 6). This implies that both the pre-operative fat content of the multifidus and the erector spinae have no predictive influence on disability six weeks after surgery. The coefficient of determination in both muscle groups could also confirm this (Table 6).

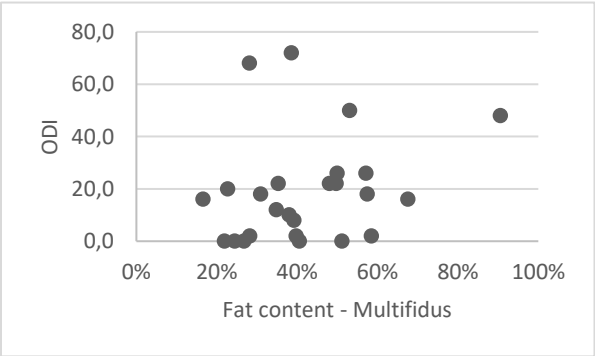

Figure 4. Fat content of multifidus compared with disability

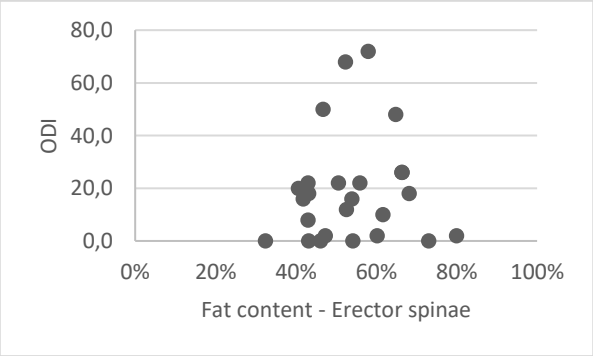

Figure 5. Fat content of erector spinae compared with disability

Table 5
Assumptions

	Pain		**Disability**	
	M. multifidus	M. erector spinae	M. multifidus	M. erector spinae
Linearity	X	X	X	X
Normality	X	/	X	X
Homoscedasticity	X	X	X	X
Independence	X	X	X	X

Table 6
Results

	Pain		**Disability**	
	M. multifidus	M. erector spinae	M. multifidus	M. erector spinae
COD (r^2)	0,2153	0,0146	0,0925	0,0062
ANOVA	p = 0,0224	p = 0,5733	p = 0,1394	p = 0,7075
Pearson correlation (r)	0,4640 p = 0,0224		0,3041 p = 0,1394	0,0790 p = 0,7075
Spearman's ρ		0,1194 p = 0,5783		
β1	2,9279	1,1027	4,6696	1,7518

COD Coefficient of determination (r^2); *ANOVA* Analysis of Variance; *β1* slope of the line

5. Discussion

5.1 Reflection of results

The aim of this study is to gain a better understanding of the influence of a high paraspinal fat content on the course of pain and disability six weeks after lumbar disc surgery. In this study the multifidus muscle and the erector spinae muscle were studied. However, a difference was observed between these two muscles in terms of the predictive influence of their fat content on postoperative pain, even though they belong to the same large muscle group. According to the data-analysis and results of this study, the fat content of the multifidus muscle, at the level of the hernia, is correlated with pain six weeks after surgery. This in contrast to the fat content of the erector spinae muscle, where no relationship was found between pre-operative fat content and postoperative pain. It can therefore be concluded that especially the pre-operative fat content of the multifidus muscle, independent of the erector spinae muscle, will allow to make a predictive statement about pain after surgery. When looking at the predictive influence of pre-operative fat content on postoperative disability, the results were similar for both muscles. The pre-operative fat content of neither the multifidus muscle nor of the erector spinae muscle has a predictive influence on disability six weeks after surgery.

However, in addition to fat content, there are other factors that may play a role in the prediction of postoperative pain and disability that have not been included in this study. A first factor to consider that possibly play a role in the prediction of postoperative function is age. According to the systematic review by Wilson et al., 2016, age was not a significant factor. It could however be established that young people obtained better postoperative results (Carragee, Han, Suen, & Kim, 2003; Fisher et al., 2004; Fujii, Henmi, Kanematsu, Mishiro, & Sakai, 2003; Halldin, Zoëga, Lind, & Cederlund, 2005; Ohtori et al., 2010; Silverplats et al., 2010 in Wilson et al., 2016). A second factor that can play an important role in the prediction of postoperative function is gender. Conflicting evidence has been found regarding the gender (Dewing, Provencher, Riffenburgh, Kerr, & Manos, 2008; Johansson, Linton, Rosenblad, Bergkvist, & Nilsson, 2010; Olson et al., 2010; Peul, van den Hout, Brand, Thomeer, Koes, & Leiden-The Hague Spine Intervention Prognostic Study Group, 2008; Silverplats et al., 2011 in Wilson et al., 2016). Unlike Wilson et al., 2016, where gender in general turns out to be slightly significant, Cook et al. (2015) states that gender is not a significant predictor of the outcome

of an operation. The type of work (sedentary or physically demanding) can also be a factor influencing the postoperative prognosis, for which it is not yet clear whether this has a positive or negative impact. One study showed that physically demanding work is a negative predictor (Loupasis, Stamos, Katonis, Sapkas, Korres, Hartofilakidis 1999 in Mannion, & Elfering, 2006), while two other studies showed no influence on postoperative results (Carragee et al., 2003; Woertgen, Rothoerl, Breme, Altmeppen, Holzschuh, Brawanski, 1999 in Mannion et al., 2006).

In this current study only the fat content of the paraspinal muscles has been considered as a possible predictor since there are no studies available showing that the fat content of the paraspinal muscles can be a factor contributing to postoperative function. The study by Biltz et al. (2020) shows that fat infiltration has an effect on muscle function, namely on the contractile elements of the muscles involved. Defects in muscle function could be a possible cause of pain and dysfunction. Being able to predict the postoperative function, seen in terms of pain and disability, could be of social importance. Postoperative pain and disability are often a major burden on the socio-economic level and prediction and anticipation of the postoperative function could therefore offer a social contribution (Puolakka, Ylinen, Neva, Kautiainen, & Häkkinen, 2008).

As discussed earlier, there is a positive correlation between the pre-operative fat content of the multifidus muscle and postoperative pain, which means that the pre-operative fat content could predict postoperative pain. A high level of postoperative pain and/or a large postoperative disability can have a huge impact on the individual, the environment as well as on society. It is important to detect patients with an increased risk of postoperative pain based on the predictive influence of the pre-operative fat content in the paraspinal muscle. The ability to detect patients in time can influence this relationship by applying a rehabilitation programme, which has the potential to reduce postoperative pain and improve the corresponding postoperative function. The study by Hakkinen et al. (2003) shows that early identification of patients with postoperative disabilities is essential to start rehabilitation on time. A rehabilitation programme can be applied pre-operatively as well as postoperatively. However, pre-operative rehabilitation is only possible if the patient can be contacted sufficiently in advance to be able to complete the entire rehabilitation programme before surgery. Pre-operative rehabilitation will mainly focus on lowering the pre-operative fat

content in the paraspinal muscles, so that the positive correlation with postoperative pain can be influenced. A lower pre-operative fat content could lead to a lower postoperative pain level. On the other hand, rehabilitation can also be initiated after the operation. The results in the article by Choi et al. (2005) show that in patients with a lumbar disc hernia lumbar extension exercises after a discectomy the postoperative function of the spine improved and the postoperative pain decreased. From all the above it can be concluded that there is still a great deal of uncertainty about the most optimal treatment that can be applied to persons diagnosed with a lumbar disc hernia. When considering which treatment option should be performed on the individual patient, measuring the amount of fat could contribute to that decision. After the first consultation with the patient, a surgeon can measure the fat content of the muscles, obtained by MRI-images. This allows the surgeon to decide, based on the fat content, whether it is better to first refer the patient to pre-operative physiotherapy for weight reduction. Or the surgeon can decide to immediately perform the operation and then send the patient to the physiotherapist or not. Based on the amount of fat, it can be decided which treatment is most suitable for the patient. The inclusion of fat content as a decision factor in treatment options should be further investigated.

5.2 Reflection about the strengths and limitations of the study

This individual, prospective cohort study has a few strengths, including the use of clear in- and exclusion criteria. By using clear in-and exclusion criteria, an influence can be exerted on the extrapolation of the study results to the patient population in question. Another strength is that the MRI-images have been analysed by two independent researchers. The average fat content used in the study is the average of the values obtained independently by the two researchers.

The study also has several limitations. Initially, a few biases are present in this study. A first bias that can be determined is a selection bias, since all participants included in the study were recruited from the Jessa Hospital in Hasselt. A selection bias ensures that the generalisation to the general population is reduced. In addition, a performance bias can also be established. The participants have not been checked or questioned about the interventions they undertook themselves in the period after their operation. As a result, patients in the same group may have received other treatments in addition to the treatment to be examined, which were therefore not the same for everyone in the group. No guidelines on this had established

in advance and communicated to the participants. The last bias that can be identified is a confounding bias. Confounding variables such as gender or age have not been taken into account. A confounding variable can cause a distortion in the relationship between the dependent and independent variable and should therefore be considered in the study design. A second weakness is the number of participants, only 25 patients participated in the study, of which one lost to follow-up at six weeks postoperatively. Due to the small sample size, there is a high probability that the statistical power of this study has been reduced (Portney, 2014). Another weakness of the study is that the questionnaires (ODI, NPRS) used to evaluate postoperative function, six weeks after surgery, are subjective. The subjective questionnaires together with the small sample size can distort the results. A final limitation is that the Spearman correlation was applied since the data-analysis, that related to the relationship between the pre-operative fat content of the erector spinae muscle and postoperative pain, was not normally distributed. Using the Spearman correlation, in contrast to the Pearson correlation, will lead to a reduced power of the results.

5.3 Recommendations for future studies

Our recommendations for future studies are primarily to conduct further research with a larger sample size to confirm the results of the current research. Furthermore, future studies on this topic should also consider the confounding variables such as gender and age and whether these variables influence the results. The preservation of these results in the long term should also be further investigated. In this study only the level of the hernia itself has been considered, although the underlying segment as well as the segment above should be considered.

6. Conclusion

In general, it can be concluded that the pre-operative fat content of the multifidus muscle, and not of the erector spinae muscle, could be able to predict pain six weeks after surgery on persons with a lumbar disc hernia. Disabilities six weeks postoperative could not be predicted from the pre-operative fat content of the paraspinal muscles. Furthermore, the current study does not consider other potentially influential variables that may distort the results.

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8. Appendix

Table 3

Independent outcome, m. multifidus

	Side	CSA	FCSA	Fat%	Mean fat%
LDH-01	involved	998,083	615,353	40,40%	38,55%
LDH-01	uninvolved	1003,134	645,704	36,70%	
LDH-02	involved	899,211	543,515	41,60%	40,50%
LDH-02	uninvolved	872,373	540,403	39,40%	
LDH-03	involved	1758,668	1320,167	26,60%	39,15%
LDH-03	uninvolved	1778,378	1003,759	51,70%	
LDH-04	involved	994,502	538,317	39,40%	47,95%
LDH-04	uninvolved	1049,546	464,187	56,50%	
LDH-05	involved	1470,561	1141,509	18,70%	22,70%
LDH-05	uninvolved	1271,319	922,933	26,70%	
LDH-06	involved	1049,038	749,423	30,00%	39,70%
LDH-06	uninvolved	954,327	570,456	49,40%	
LDH-07	involved	921,388	721,629	19,70%	16,50%
LDH-07	uninvolved	996,149	844,015	13,30%	
LDH-08	involved	1334,343	1056,483	23,60%	28,10%
LDH-08	uninvolved	1355,894	1036,83	32,60%	
LDH-09	involved	1343,016	963,062	25,10%	30,90%
LDH-09	uninvolved	1346,211	945,366	36,70%	
LDH-10	involved	1361,647	737,857	50,80%	53,00%
LDH-10	uninvolved	1446,183	792,998	55,20%	
LDH-11	involved	1576,051	735,335	57,90%	49,90%
LDH-11	uninvolved	1639,469	983,141	41,90%	
LDH-12	involved	716,687	513,758	26,50%	28,15%
LDH-12	uninvolved	799,242	530,619	29,80%	
LDH-13	involved	1183,888	624,076	49,90%	49,65%
LDH-13	uninvolved	942,354	500,098	49,40%	
LDH-14	involved	1600,249	666,372	59,60%	57,10%
LDH-14	uninvolved	1492,761	701,817	54,60%	
LDH-15	involved	1364,623	941,502	31,60%	35,25%
LDH-15	uninvolved	1293,513	814,538	38,90%	
LDH-16	involved	1384,143	951,607	34,10%	26,70%
LDH-16	uninvolved	1505,633	1052,697	19,30%	
LDH-17	involved	1261,756	972,053	22,20%	21,90%
LDH-17	uninvolved	1284,191	966,316	21,60%	
LDH-18	involved	748,016	508,641	32,20%	34,80%
LDH-18	uninvolved	740,462	488,868	37,40%	
LDH-19	involved	1041,258	642,487	35,50%	37,95%
LDH-19	uninvolved	1074,212	616,902	40,40%	
LDH-20	involved	1133,945	799,655	76,20%	58,45%
LDH-20	uninvolved	1048,523	223,446	40,70%	
LDH-21	involved	1047,927	118,948	89,10%	90,55%
LDH-21	uninvolved	1144,284	108,81	92,00%	
LDH-22	involved	949,969	318,011	72,10%	67,50%
LDH-22	uninvolved	1232,911	522,462	62,90%	
LDH-23	involved	1458,186	719,138	51,30%	51,10%
LDH-23	uninvolved	1469,156	769,292	50,90%	
LDH-24	involved	1350,289	740,969	49,00%	57,35%
LDH-24	uninvolved	1237,74	500,221	65,70%	
LDH-25	involved	1160,578	862,786	25,10%	24,40%
LDH-25	uninvolved	1290,459	985,013	23,70%	

LDH Lumbar disc hernia; *CSA* Cross-sectional area; *FCSA* Functional cross-sectional area

Table 4

Independent outcome, m. erector spinae

	Side	CSA	FCSA	Fat%	Mean fat%
LDH-01	involved	1590,439	780,812	55,70%	57,95%
LDH-01	uninvolved	1649,069	764,878	60,20%	
LDH-02	involved	688,021	238,869	54,00%	54,15%
LDH-02	uninvolved	638,218	250,278	54,30%	
LDH-03	involved	840,735	455,122	41,50%	43,05%
LDH-03	uninvolved	945,285	441,952	44,60%	
LDH-04	involved	953,705	492,238	45,10%	55,90%
LDH-04	uninvolved	742,006	198,029	66,70%	
LDH-05	involved	1409,017	811,162	41,00%	40,60%
LDH-05	uninvolved	1598,695	990,771	40,20%	
LDH-06	involved	632,228	331,311	51,30%	60,25%
LDH-06	uninvolved	987,531	350,439	69,20%	
LDH-07	involved	1465,853	870,041	37,90%	41,80%
LDH-07	uninvolved	1309,462	690,633	45,70%	
LDH-08	involved	705,197	354,719	59,90%	52,30%
LDH-08	uninvolved	770,114	490,394	44,70%	
LDH-09	involved	1396,427	836,588	41,20%	43,15%
LDH-09	uninvolved	1017,585	524,06	45,10%	
LDH-10	involved	2306,18	1260,793	52,10%	46,75%
LDH-10	uninvolved	1893,997	1187,914	41,40%	
LDH-11	involved	1351,675	525,53	69,60%	66,35%
LDH-11	uninvolved	1321,464	509,981	63,10%	
LDH-12	involved	1761,435	990,087	48,40%	47,35%
LDH-12	uninvolved	1786,505	1052,369	46,30%	
LDH-13	involved	1619,755	1021,553	40,20%	43,05%
LDH-13	uninvolved	1603,969	880,78	45,90%	
LDH-14	involved	1323,462	411,449	68,40%	66,45%
LDH-14	uninvolved	1203,915	364,408	64,50%	
LDH-15	involved	1460,888	747,669	47,40%	50,55%
LDH-15	uninvolved	2085,52	931,883	53,70%	
LDH-16	involved	3370,664	2493,083	23,40%	32,45%
LDH-16	uninvolved	2745,757	1464,643	41,50%	
LDH-17	involved	1639,026	841,393	41,50%	43,15%
LDH-17	uninvolved	1693,754	883,318	44,80%	
LDH-18	involved	1084,461	574,544	46,60%	52,60%
LDH-18	uninvolved	1173,643	497,376	58,60%	
LDH-19	involved	1541,149	563,853	60,10%	61,65%
LDH-19	uninvolved	1454,587	520,21	63,20%	
LDH-20	involved	786,091	244,508	76,10%	79,95%
LDH-20	uninvolved	925,213	223,446	83,80%	
LDH-21	involved	614,191	222,695	63,70%	64,80%
LDH-21	uninvolved	785,862	268,11	65,90%	
LDH-22	involved	1673,206	776,841	55,40%	53,90%
LDH-22	uninvolved	1570,872	790,403	52,40%	
LDH-23	involved	570,342	212,132	65,80%	73,05%
LDH-23	uninvolved	588,608	180,067	80,30%	
LDH-24	involved	889,718	381,94	65,50%	68,20%
LDH-24	uninvolved	1039,747	350,067	70,90%	
LDH-25	involved	966,624	521,095	45,20%	46,15%
LDH-25	uninvolved	973,323	504,19	47,10%	

LDH Lumbar disc hernia; *CSA* Cross-sectional area; *FCSA* Functional cross-sectional area

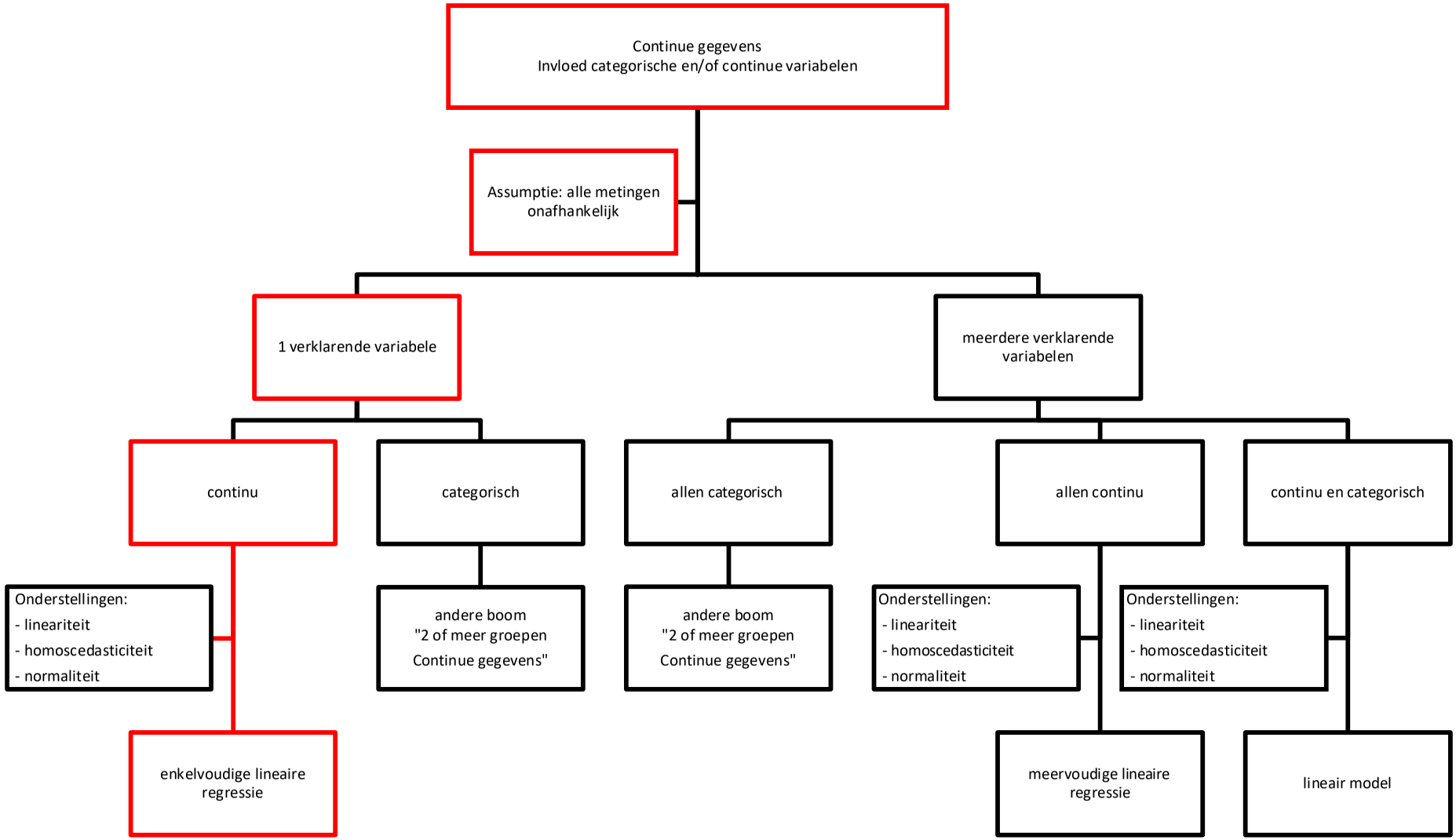

Figure 1. Statistical roadmap

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UHASSELT
KNOWLEDGE IN ACTION

INVENTARISATIEFORMULIER WETENSCHAPPELIJKE STAGE DEEL 2

DATUM	INHOUD OVERLEG	HANDTEKENINGEN
21/11/2019	Introductie bespreken	Promotor: Copromotor/Begeleider: Student(e): Student(e): 
20/12/2020	Volgen + bespreken van de procedure bij 2 geïncludeerde patiënten in Jessa ziekenhuis	Promotor: Copromotor/Begeleider: Student(e): Student(e): 
31/03/2020	Bespreking studie-opzet en methode (Google meet)	Promotor: Copromotor/Begeleider: Student(e): Student(e): 
15/04/2020	Bespreking resultaten (Google meet)	Promotor: Copromotor/Begeleider: Student(e): Student(e): 
04/05/2020	Voorlopige versie	Promotor: Copromotor/Begeleider: Student(e): Student(e): 
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):
		Promotor: Copromotor/Begeleider: Student(e): Student(e):

In te vullen door de promotor(en) en eventuele copromotor aan het einde van MP2:

Naam Student(e): Snijders Iben **Datum:** 25/05/2020

Titel Masterproef: Fat content of the paraspinal muscles as a predictor of postoperative function in persons with a lumbar disc hernia.

1) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:
   - NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
   - 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
   - 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
   - 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
   - 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
   - 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

Competenties	**NVT**	**1**	**2**	**3**	**4**	**5**
Opstelling onderzoeksvraag	O	O	O	O	O	O
Methodologische uitwerking	O	O	O	O	O	O
Data acquisitie	O	O	O	O	O	O
Data management	O	O	O	O	O	O
Dataverwerking/Statistiek	O	O	O	O	O	O
Rapportage	O	O	O	O	O	O

2) Niet-bindend advies: Student(e) krijgt toelating/geen toelating (schrappen wat niet past) om bovenvermelde Wetenschappelijke stage/masterproef deel 2 te verdedigen in bovenvermelde periode. Deze eventuele toelating houdt geen garantie in dat de student geslaagd is voor dit opleidingsonderdeel.

3) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) openbaar verdedigd worden.

4) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) opgenomen worden in de bibliotheek en docserver van de UHasselt.

Datum en handtekening Student(e)	Datum en handtekening promotor(en)	Datum en handtekening Co-promotor(en)
		

Verklaring op Eer

Ondergetekende, student aan de Universiteit Hasselt (UHasselt), faculteit Revalidatiewetenschappen aanvaardt de volgende voorwaarden en bepalingen van deze verklaring:

1. Ik ben ingeschreven als student aan de UHasselt in de opleiding Revalidatiewetenschappen en kinesitherapie, waarbij ik de kans krijg om in het kader van mijn opleiding mee te werken aan onderzoek van de faculteit Revalidatiewetenschappen aan de UHasselt. Dit onderzoek wordt beleid door Prof. Dr. F. Vandenabeele en kadert binnen het opleidingsonderdeel Wetenschappelijke stage/masterproef deel 2. Ik zal in het kader van dit onderzoek creaties, schetsen, ontwerpen, prototypes en/of onderzoeksresultaten tot stand brengen in het domein van Musculoskeletale aandoeningen (hierna: "De Onderzoeksresultaten").

2. Bij de creatie van De Onderzoeksresultaten doe ik beroep op de achtergrondkennis, vertrouwelijke informatie[1], universitaire middelen en faciliteiten van UHasselt (hierna: de "Expertise").

3. Ik zal de Expertise, met inbegrip van vertrouwelijke informatie, uitsluitend aanwenden voor het uitvoeren van hogergenoemd onderzoek binnen UHasselt. Ik zal hierbij steeds de toepasselijke regelgeving, in het bijzonder de Algemene Verordening Gegevensbescherming (EU 2016-679), in acht nemen.

4. Ik zal de Expertise (i) voor geen enkele andere doelstelling gebruiken, en (ii) niet zonder voorafgaande schriftelijke toestemming van UHasselt op directe of indirecte wijze publiek maken.

5. Aangezien ik in het kader van mijn onderzoek beroep doe op de Expertise van de UHasselt, draag ik hierbij alle bestaande en toekomstige intellectuele eigendomsrechten op De Onderzoeksresultaten over aan de UHasselt. Deze overdracht omvat alle vormen van intellectuele eigendomsrechten, zoals onder meer – zonder daartoe beperkt te zijn – het auteursrecht, octrooirecht, merkenrecht, modellenrecht en knowhow. De overdracht geschiedt in de meest volledige omvang, voor de gehele wereld en voor de gehele beschermingsduur van de betrokken rechten.

6. In zoverre De Onderzoeksresultaten auteursrechtelijk beschermd zijn, omvat bovenstaande overdracht onder meer de volgende exploitatiewijzen, en dit steeds voor de hele beschermingsduur, voor de gehele wereld en zonder vergoeding:

   - Het recht om De Onderzoeksresultaten vast te (laten) leggen door alle technieken en op alle dragers;
   - Het recht om De Onderzoeksresultaten geheel of gedeeltelijk te (laten) reproduceren, openbaar te (laten) maken, uit te (laten) geven, te (laten) exploiteren en te (laten) verspreiden in eender welke vorm, in een onbeperkt aantal exemplaren;

[1] Vertrouwelijke informatie betekent alle informatie en data door de UHasselt meegedeeld aan de student voor de uitvoering van deze overeenkomst, inclusief alle persoonsgegevens in de zin van de Algemene Verordening Gegevensbescherming (EU 2016/679), met uitzondering van de informatie die (a) reeds algemeen bekend is; (b) reeds in het bezit was van de student voor de mededeling ervan door de UHasselt; (c) de student verkregen heeft van een derde zonder enige geheimhoudingsplicht; (d) de student onafhankelijk heeft ontwikkeld zonder gebruik te maken van de vertrouwelijke informatie van de UHasselt; (e) wettelijk of als gevolg van een rechterlijke beslissing moet worden bekendgemaakt, op voorwaarde dat de student de UHasselt hiervan schriftelijk en zo snel mogelijk op de hoogte brengt.

- Het recht om De Onderzoeksresultaten te (laten) verspreiden en mee te (laten) delen aan het publiek door alle technieken met inbegrip van de kabel, de satelliet, het internet en alle vormen van computernetwerken;
- Het recht De Onderzoeksresultaten geheel of gedeeltelijk te (laten) bewerken of te (laten) vertalen en het (laten) reproduceren van die bewerkingen of vertalingen;
- Het recht De Onderzoeksresultaten te (laten) bewerken of (laten) wijzigen, onder meer door het reproduceren van bepaalde elementen door alle technieken en/of door het wijzigen van bepaalde parameters (zoals de kleuren en de afmetingen).

De overdracht van rechten voor deze exploitatiewijzen heeft ook betrekking op toekomstige onderzoeksresultaten tot stand gekomen tijdens het onderzoek aan UHasselt, eveneens voor de hele beschermingsduur, voor de gehele wereld en zonder vergoeding.

Ik behoud daarbij steeds het recht op naamvermelding als (mede)auteur van de betreffende Onderzoeksresultaten.

7. Ik zal alle onderzoeksdata, ideeën en uitvoeringen neerschrijven in een "laboratory notebook" en deze gegevens niet vrijgeven, tenzij met uitdrukkelijke toestemming van mijn UHasseltbegeleider Prof. Dr. F. Vandenabeele.

8. Na de eindevaluatie van mijn onderzoek aan de UHasselt zal ik alle verkregen vertrouwelijke informatie, materialen, en kopieën daarvan, die nog in mijn bezit zouden zijn, aan UHasselt terugbezorgen.

Gelezen voor akkoord en goedgekeurd,

Naam: Snijders Iben

Adres: Diamantstraat 30, 3960 Bree

Geboortedatum en –plaats: 08/10/1997 te Brussel

Datum: 25/05/2020

Handtekening:

AFSPRAKENNOTA

1. Organisatie

Naam	Universiteit Hasselt/transnationale Universiteit Limburg (Hierna: UHasselt/tUL)
Adres	Martelarenlaan 42 3500 Hasselt
Sociale doelstelling	De UHasselt/tUL is een dynamisch kenniscentrum van onderwijs, onderzoek en dienstverlening.
Werking van de organisatie	**Faculteiten** De UHasselt telt zes faculteiten die het onderwijs en onderzoek aansturen: o faculteit Architectuur en kunst o faculteit Bedrijfseconomische wetenschappen o faculteit Geneeskunde en levenswetenschappen o faculteit Industriële ingenieurswetenschappen o faculteit Rechten o faculteit Wetenschappen Elke faculteit stelt per opleiding een onderwijsmanagementteam (OMT) en een examencommissie samen. **Vakgroepen** Binnen de faculteiten opereren diverse vakgroepen. Zij groeperen alle personeelsleden die onderzoek en onderwijs verrichten binnen eenzelfde discipline. Elke vakgroep bestaat vervolgens uit een of meerdere onderzoeksgroepen. Zij staan in voor de organisatie van het gespecialiseerd onderzoek. Deze klassieke boomstructuur van faculteiten, onderzoeksgroepen en vakgroepen wordt doorkruist door de onderzoeksinstituten. De instituten groeperen onderzoekers uit verschillende onderzoeksgroepen die in bepaalde speerpuntdomeinen onderzoek uitvoeren. Daarbij wordt het volledige onderzoekspectrum afgedekt, van fundamenteel over toegepast onderzoek tot concrete valorisatietoepassingen.
Juridisch statuut	Autonome openbare instelling

Verantwoordelijke van de organisatie, die moet verwittigd worden bij ongevallen.

Naam	…
Functie	…
Tel. - GSM	…

2. De vrijwilliger: student-onderzoeker

Naam	Snijders Iben
Correspondentieadres	Diamantstraat 30, 3960
Tel. - GSM	0476/07.00.51

3. Verzekeringen

Waarborgen	De burgerlijke aansprakelijkheid van de organisatie.
Maatschappij	Ethias
Polisnummer	45009018

Waarborgen	Lichamelijke schade die geleden is door vrijwilligers bij ongevallen tijdens de uitvoering van het vrijwilligerswerk of op weg naar- en van de activiteiten.
Maatschappij	Ethias
Polisnummer	45055074

4. Vergoedingen

De organisatie betaalt geen vergoeding aan de vrijwilliger.

5. Aansprakelijkheid

De organisatie is burgerrechtelijk aansprakelijk voor de schade die de vrijwilliger aan derden veroorzaakt bij het verrichten van vrijwilligerswerk.

Ingeval de vrijwilliger bij het verrichten van het vrijwilligerswerk de organisatie of derden schade berokkent, is hij enkel aansprakelijk voor zijn bedrog en zijn zware schuld.

Voor lichte schuld is hij enkel aansprakelijk als die bij hem eerder gewoonlijk dan toevallig voorkomt.

Opgelet: voor het materiaal dat de vrijwilliger zelf meebrengt, is hij/zij zelf verantwoordelijk.

6. Geheimhoudingsplicht – verwerking persoonsgegevens

De vrijwilliger verleent de UHasselt toestemming om de gegevens die in het kader van zijn/haar inschrijving aan UHasselt werden verzameld, ook te gebruiken voor de uitvoering van deze afsprakennota (de evaluatie van de vrijwilliger alsook het aanmaken van een certificaat). UHasselt zal deze informatie vertrouwelijk behandelen en zal deze vertrouwelijkheid ook bewaken na de beëindiging van het statuut student-onderzoeker. De UHasselt neemt hiertoe alle passende maatregelen en waarborgen om de persoonsgegevens van de vrijwilliger conform de Algemene Verordening Gegevensbescherming (EU 2016/679) te verwerken.

De vrijwilliger verbindt zich ertoe om alle gegevens, documenten, kennis en materiaal, zowel schriftelijk als mondeling ontvangen in de hoedanigheid van student-onderzoeker aan de UHasselt als strikt vertrouwelijk te behandelen, ook indien deze niet als strikt vertrouwelijk werd geïdentificeerd. Indien de vertrouwelijke gegevens van de UHasselt ook persoonsgegevens bevatten dient de stagiair hiertoe steeds de Algemene Verordening Gegevensbescherming (EU 2016/679) na te leven en bij elke verwerking het advies van het intern privacycollege van de UHasselt in te winnen. Hij/zij verbindt zich ertoe om in geen geval deze vertrouwelijke informatie mee te delen aan derden of anderszins openbaar te maken, ook niet na de beëindiging van het statuut student-onderzoeker.

7. Concrete afspraken

Functie van de vrijwilliger

De vrijwilliger zal volgende taak vervullen: …
Deze taak omvat volgende activiteiten: …
De vrijwilliger voert zijn taak uit onder verantwoordelijkheid van de faculteit …
De vrijwilliger wordt binnen de faculteit begeleid door…
Zijn vaste werkplek voor het uitvoeren van de taak is …

De vrijwilliger zal deze taak op volgende tijdstippen uitvoeren:

- op de volgende dag(en):
    - maandag
    - dinsdag
    - woensdag
    - donderdag
    - vrijdag
    - zaterdag
    - zondag
- het engagement wordt aangegaan voor de periode van … tot … (deze periode kan maximaal 1 kalenderjaar zijn en moet liggen tussen 1 januari en 31 december).

Begeleiding

De organisatie engageert zich ertoe de vrijwilliger tijdens deze proefperiode degelijk te begeleiden en te ondersteunen en hem/haar van alle informatie te voorzien opdat de activiteit naar best vermogen kan worden uitgevoerd.
De vrijwilliger voert de taken en activiteiten uit volgens de voorschriften vastgelegd door de faculteit. Hij/zij neemt voldoende voorzorgsmaatregelen in acht, en kan voor bijkomende informatie over de uit te voeren activiteit steeds terecht bij volgende contactpersoon: …

De vrijwilliger krijgt waar nodig vooraf een vorming. Het volgen van de vorming indien aangeboden door de organisatie, is verplicht voor de vrijwilliger.

De vrijwilliger heeft kennis genomen van het ‘reglement statuut student-onderzoeker’ dat als bijlage aan deze afsprakennota wordt toegevoegd en integraal van toepassing is op de vrijwilliger.

Certificaat

Indien de vrijwilliger zijn opdracht succesvol afrondt, ontvangt hij/zij een certificaat van de UHasselt ondertekend door de decaan van de faculteit waaraan de vrijwilliger zijn opdracht voltooide.

8. Einde van het vrijwilligerswerk.

Zowel de organisatie als de vrijwilliger kunnen afzien van een verdere samenwerking. Dat kan gebeuren:

- bij onderlinge overeenstemming;
- op vraag van de vrijwilliger zelf;
- op verzoek van de organisatie.

Indien de samenwerking op initiatief van de vrijwilliger of de organisatie wordt beëindigd, gebeurt dit bij voorkeur minstens 2 weken op voorhand. Bij ernstige tekortkomingen kan de samenwerking, door de organisatie, onmiddellijk worden beëindigd.

Datum: 25/05/2020

Naam en Handtekening decaan

Naam en Handtekening vrijwilliger

_____ _____

Opgemaakt in 2 exemplaren waarvan 1 voor de faculteit en 1 voor de vrijwilliger.

Bijlage 1

Reglement betreffende het statuut van student-onderzoeker[1]

Artikel 1. Definities

Voor de toepassing van dit reglement wordt verstaan onder:
student-onderzoeker: een regelmatig ingeschreven bachelor- of masterstudent van de UHasselt/tUL die als vrijwilliger wordt ingeschakeld in onderzoeksprojecten. De opdrachten uitgevoerd als student-onderzoeker kunnen op geen enkele wijze deel uitmaken van het studietraject van de student. De opdrachten kunnen geen ECTS-credits opleveren en zij kunnen geen deel uitmaken van een evaluatie van de student in ket kader van een opleidingsonderdeel. De onderzoeksopdrachten kunnen wel in het verlengde liggen van een opleidingsonderdeel, de bachelor- of masterproef.

Artikel 2. Toepassingsgebied

Enkel bachelor- en masterstudenten van de UHasselt/tUL die voor minstens 90 studiepunten credits hebben behaald in een academische bacheloropleiding komen in aanmerking voor het statuut van student-onderzoeker.

Artikel 3. Selectie en administratieve opvolging

§1 De faculteiten staan in voor de selectie van de student-onderzoekers en schrijven hiervoor een transparante selectieprocedure uit die vooraf aan de studenten kenbaar wordt gemaakt.
§2 De administratieve opvolging van de dossiers gebeurt door de faculteiten.

Artikel 4. Preventieve maatregelen en verzekeringen

§1 De faculteiten voorzien waar nodig in de noodzakelijke voorafgaande vorming van student-onderzoekers. De student is verplicht deze vorming te volgen vooraleer hij/zij kan starten als student-onderzoeker.
§2 Er moet voor de betrokken opdrachten een risicopostenanalyse opgemaakt worden door de faculteiten, analoog aan de risicopostenanalyse voor een stagiair van de UHasselt/tUL. De faculteiten zien er op toe dat de nodige veiligheidsmaatregelen getroffen worden voor aanvang van de opdracht.
§3 De student-onderzoekers worden door de UHasselt verzekerd tegen:
- Burgerlijke aansprakelijkheid
- Lichamelijke ongevallen

en dit ongeacht de plaats waar zij hun opdrachten in het kader van het statuut uitoefenen.

Artikel 5. Vergoeding van geleverde prestaties

§1 De student-onderzoeker kan maximaal 40 kalenderdagen, gerekend binnen één kalenderjaar, worden ingeschakeld binnen dit statuut. De dagen waarop de student-onderzoeker een vorming moet volgen, worden niet meegerekend als gepresteerde dagen.

§2 De student-onderzoeker ontvangt geen vrijwilligersvergoeding voor zijn prestaties. De student kan wel een vergoeding krijgen van de faculteit voor bewezen onkosten. De faculteit en de student maken hier aangaande schriftelijke afspraken.

Artikel 6. Dienstverplaatsingen

De student-onderzoeker mag dienstverplaatsingen maken. De faculteit en de student maken schriftelijke afspraken over deal dan niet vergoeding voor dienstverplaatsingen. De student wordt tijdens de dienstverplaatsingen en op weg van en naar de stageplaats uitsluitend verzekerd door de UHasselt voor lichamelijke ongevallen.

[1] Zoals goedgekeurd door de Raad van Bestuur van de Universiteit Hasselt op 15 juni 2017.

Artikel 7. Afsprakennota

§1 Er wordt een afsprakennota opgesteld die vooraf wordt ondertekend door de decaan en de student-onderzoeker. Hierin worden de taken van de student-onderzoeker alsook de momenten waarop hij/zij de taken moet uitvoeren zo nauwkeurig mogelijk omschreven.
§2 Aan de afsprakennota wordt een kopie van dit reglement toegevoegd als bijlage.

Artikel 8. Certificaat

Na succesvolle beëindiging van de opdracht van de student-onderzoeker, te beoordelen door de decaan, ontvangt hij een certificaat van de studentenadministratie. De faculteit bezorgt de nodige gegevens aan de studentenadministratie. Het certificaat wordt ondertekend door de decaan van de faculteit waaraan de student-onderzoeker zijn opdracht voltooide.

Artikel 9. Geheimhoudingsplicht

De student-onderzoeker verbindt zich ertoe om alle gegevens, documenten, kennis en materiaal, zowel schriftelijk (inbegrepen elektronisch) als mondeling ontvangen in de hoedanigheid van student-onderzoeker aan de UHasselt, als strikt vertrouwelijk te behandelen, ook indien deze niet als strikt vertrouwelijk werd geïdentificeerd. Hij/zij verbindt zich ertoe om in geen geval deze vertrouwelijke informatie mee te delen aan derden of anderszins openbaar te maken, ook niet na de beëindiging van zijn/haar opdracht binnen dit statuut.

Artikel 10. Intellectuele eigendomsrechten

Indien de student-onderzoeker tijdens de uitvoering van zijn/haar opdrachten creaties tot stand brengt die (kunnen) worden beschermd door intellectuele rechten, deelt hij/zij dit onmiddellijk mee aan de faculteit. Deze intellectuele rechten, met uitzondering van auteursrechten, komen steeds toe aan de UHasselt.

Artikel 11. Geschillenregeling

Indien zich een geschil voordoet tussen de faculteit en de student-onderzoeker met betrekking tot de interpretatie van dit reglement of de uitoefening van de taken, dan kan de ombudspersoon van de opleiding waarbinnen de student-onderzoeker zijn taken uitoefent, bemiddelen. Indien noodzakelijk, beslecht de vicerector Onderwijs het geschil.

Artikel 12. Inwerkingtreding

Dit reglement treedt in werking met ingang van het academiejaar 2017-2018.

COVID-19 Addendum - Masterproef 2

Gelieve dit document in te laten vullen door de promotor en ingevuld toe te voegen aan je masterproef.

Naam promotor(en): Prof. Frank Vandenabeele (promotor), dr. Anouk Agten (co-promotor)

Naam studenten: Iben Snijders, Lisa Vanderwegen

1) Duid aan welk type scenario is gekozen voor deze masterproef:

☐ scenario 1: masterproef bestaat uit een meta-analyse - masterproef liep door zoals voorzien
☒ scenario 2: masterproef bestaat uit een experiment - masterproef liep door zoals voorzien
☐ scenario 3: masterproef bestaat uit een experiment - maar een deel van de voorziene data is verzameld
    ☐ 3A: er is voldoende data, maar met aangepaste statische procedures verder gewerkt
    ☐ 3B: er is onvoldoende data, dus gewerkt met een descriptieve analyse van de aanwezige data
☐ scenario 4: masterproef bestaat uit een experiment - maar er kon geen data verzameld worden
    ☐ 4A: er is gewerkt met reeds beschikbare data
    ☐ 4B: er is gewerkt met fictieve data

2) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:

- NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
- 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
- 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
- 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
- 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
- 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

Competenties	NVT	1	2	3	4	5
Opstelling onderzoeksvraag	☐	☐	☐	☒	☐	☐
Methodologische uitwerking	☐	☐	☐	☐	☒	☐
Data acquisitie	☐	☐	☐	☐	☒	☐
Data management	☐	☐	☐	☒	☐	☐
Dataverwerking/Statistiek	☐	☐	☐	☐	☒	☐
Rapportage	☐	☐	☐	☐	☐	☒

Datum: 22/05/2020

Anouk AGTEN
aan Iben, Frank, Vicky, mij, Sjoerd

Beste Iben en Lisa,
cc: Vicky

Bij deze gaan wij akkoord met de ingevulde formulieren in bijlage van jullie mail (incl. het inventarisatieformulier).
Wij geven jullie dan ook GUNSTIG advies voor indiening eerste zittijd.

De documenten (bijlagen) mogen als dusdanig ingediend bij het studentensecretariaat.
Wij hebben mevr. Vanhille reeds in cc gezet.

Met vriendelijke groeten,
Prof. dr. Frank Vandenabeele (promotor)
dr. Anouk Agten (copromotor)
drs. Sjoerd Stevens (Begeleider)

dr. Anouk Agten
Doctor-Assistent - Post-doctoral researcher

REVAL- Rehabilitation Research Center
BIOMED - Biomedical Research Center
Faculteit Geneeskunde & Levenswetenschappen
Faculty of Medicine & Life sciences

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Kantoor BMO-A101

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