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FACTORS IN CHILDHOOD AND ADULTHOOD INFLUENCING THE DEVELOPMENT AND TREATMENT OF LOW BACK PAIN

Ph.D. thesis

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ABBREVIATIONS

LBP- low back pain

CLBP- chronic low back pain

PRQ- patient reported questionnaire

PROM- patient reported outcome measure

ODI- Oswestry Disability Index

WHOQOL-BREF- brief version of the World Health Organization Quality of Life Questionnaire

TSK- Tampa Scale for Kinesiophobia

PCS- Pain Catastrophizing Scale

FABQ- Fear Avoidance Beliefs Questionnaire

ROC- Receiver Operating Characteristics

AUC- area under the curve

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1. INTRODUCTION

1.1. Adult low back pain

1.1.1. Definition and classification of low back pain

Low back pain (LBP) is one of the most common health problems and creates a substantial personal, community, and financial burden globally (Hoy, Brooks, Blyth, & Buchbinder, 2010). LBP is also referred to as a "western epidemic" that primarily affects the working age population (Waddell, 1987). In order to estimate the global burden of LBP it is necessary to predefine the anatomical definition of low back pain. In spinal research, LBP is mostly described as "activity-limiting LBP /pain referred into 1 or both lower limbs that lasts for at least 1 day" (Hoy et al., 2012; Hoy et al., 2010). Much of the methodological variation in research publications relates to the lack of or the variations in which the definition is described. Systematic reviews have demonstrated several case definition variations in relation to temporality and topography (Leboeuf-Yde & Lauritsen, 1995; Walker, 2000). Topographical definition of LBP is defined as pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without referred leg pain (Airaksinen et al., 2006). Definition of temporality relates to the duration of symptoms where two common approaches are recall period and episode duration. Cases might be characterized as acute (<6 weeks), subacute back pain (<12 weeks), chronic cases that have lasted for very long periods of time (>12 weeks), and cases of recurrent pain where the current episode has lasted for approximately 12 weeks. Patients suffering from LBP despite of the duration might continue to function well but also might be severely anticipated by back pain. Beside the two major definitions (topography and temporality) a simple and practical classification, which has gained international acceptance, is to divide low back pain into three categories – the so-called "diagnostic triage" (Waddell, 1987):

- Specific spinal pathology
- Nerve root pain/radicular pain
- Non- specific low back pain

1.1.2. Prevalence and incidence of adult low back pain

Estimating incidence of first ever episodes of LBP is highly difficult as these already often happen in early adulthood and the symptoms recur over time (Hestbaek, Leboeuf-Yde, Kyvik, & Manniche, 2006; Jeffries, Milanese, & Grimmer-Somers, 2007). Additionally, there are a lot of cross-sectional studies measuring prevalence, but not as

many longitudinal studies that measure incidence. However, reported 1 year incidence of people who have a first-ever episode of low back pain ranged from 6.3% to 15.4%, and the 1 year incidence of people who have any episode of low back pain (i.e., first-ever or recurrent) ranged from 1.5% to 36% (Hoy et al., 2010). Most of the studies investigating incidence do not take repeated episodes of low back pain into account so most likely the numbers above underestimate episode incidence. According to the European Guideline (Airaksinen et al., 2006; van Tulder et al., 2006) about 45% of the people suffer relapses of pain and 26-37% need sick leave after an initial episode of low back pain.

According to a review including 165 studies from 54 countries by Hoy et al. most adults will have low back pain at some point with the estimates of point prevalence of low back pain ranging from 1% to 58%, and 1-year prevalence is up to 84% (Airaksinen et al., 2006; Hoy et al., 2010). Horvath et al.(Horvath, Koroknai, Acs, Than, & Illes, 2010) conducted a Hungarian population wide epidemiology study and they found point prevalence rates about 44% and work absenteeism due to low back pain around 22%. LBP prevalence peaks in mid-life, is more common in female than in male and activity limitation linked to low back pain also increases with age (Hoy et al., 2010). The age-related prevalence of chronic low back pain (CLBP) may be related to a combination of occupational and domestic exposures and the age-related degenerative processes in the lumbar spine (Meucci, Fassa, & Faria, 2015; Meucci, Fassa, Paniz, Silva, & Wegman, 2013). Elderly individuals tend to suffer less from CLBP which may be due to reduced exposure to risk increasing job- or daily living activities. On the other hand, studies also suggest that older adults seem to be more resilient to pain mainly related to cognitive impairment and decreased pain perception (Hoy et al., 2012; Meucci et al., 2013). Best estimates suggest that CLBP prevalence is approximately 23% and about 10% of the population are disabled by CLBP (Airaksinen et al., 2006; Hoy et al., 2010). Furthermore, CLBP prevalence varied according to the age ranges in the literature and was around three to four times higher in patients aged above 50 compared to those aged 18 to 30 (Meucci et al., 2015; Meucci et al., 2013). According to Meucci et al. CLBP occurrence increased by double over an 8 year follow up period from about 4% to 9% in the investigated patient population. The growth of prevalence over time is worrisome as the disease has substantial social impact and is a major source of demand of health care services (Meucci et al., 2015; Meucci et al., 2013).

1.1.3. Etiology of low back pain

The source of LBP can be identified and differentiated based on the patient's history, physical examination, and the radiological imaging. Beside the fact that clinical tests are unable to accurately identify the tissue of source, any innervated structure in this topographical area can potentially cause symptoms in the lumbar spine and referred pain into the lower extremity. Tissue of potential origin include muscles, ligaments, dura mater and nerve roots, zygoapohyseal joints, annulus fibrosus, thoracolumbar fascia and vertebrae (Airaksinen et al., 2006; van Tulder et al., 2006). However, the somewhat complicated diagnostic procedure only reflects the complexity of the disease. Nevertheless, as mentioned in **Section 1.1.1** (**Definition and classification of low back pain)** in most of the cases the widely accepted diagnostic triage procedure makes a comprehensive and accurate diagnosis possible.

Specific LBP incidence is fairly low only 4% and 1% of the admitted cases caused in primary care are by compression fracture and neoplasm, respectively (Airaksinen et al., 2006). Kado et al. conducted an observational study in more than 7000 women aged over 65 years and they have found that 5% of the study population developed at least one vertebral fracture in a timeframe of 4 years (Kado et al., 2003). Infections involving the spine are rare and it should be hypothesized if the patient has fever, had previous surgery, a compromised immune system or drug abuse(Airaksinen et al., 2006). Specific and identified causes of LBP such as vertebral fractures, inflammatory diseases (e.g., spondylarthritis), malignancy, infections and intra-abdominal causes need specific therapeutic interventions (Hartvigsen et al., 2018).

Non-specific LBP is diagnosed if pain is not attributable to specific pathology or neurological encroachment and is found in about 85% of LBP patients (van Tulder et al., 2006; Waddell, 1987). Having said that, there are clinical patterns linked to specific structures at which the investigator's hypothesis are guided. Diffuse myofascial pain can be found often after trauma or repetitive motion injuries (Partanen, Ojala, & Arokoski, 2010) and is characterized by the presence of myofascial trigger points located in the fascia, tendons or muscle (Giamberardino, Affaitati, Fabrizio, & Costantini, 2011; Lucas, Macaskill, Irwig, Moran, & Bogduk, 2009; Simons, 2008; Urits et al., 2019). Facet joint originated pain is often linked to lumbar facet joint degeneration and the symptoms can be caused by osteoarthritis or stress within the joint capsule (Urits et al., 2019). Typically, the unilateral pain shows a deep and aching character, occasionally irradiating to the

gluteal area, groin and/or thigh above the knee (Urits et al., 2019). According to Hartvigsen et al. psychosocial stressors, increased or decreased physical activity, lumbar extension with or without rotation, and prolonged standing or sitting are factors that aggravate facet joint pain (Hartvigsen et al., 2018). Another common cause of LBP is discogenic pain. According to Comer, 39% of LBP can be linked to internal intervertebral disc disruption primarily caused by degradation of the disc and its nuclear components. Usually the patient suffers from a deep, dull, diffuse and central pain with minimal radiation (only to the buttock or thighs in some cases) (Park, Kim, & Kim, 2013). Pain often improves with standing, lying flat or with extension and usually aggravates with sitting, driving, bending, twisting, or coughing (Urits et al., 2019). The diagnosis of facet joint or discogenic low back pain can be carried out with radiologic imaging but results must always be interpreted with caution as many imaging (radiography, CT scan, and MRI) findings identified in people with low back pain are also common in people without such pain, and their importance in diagnosis is a source of much debate (Brinjikji et al., 2015). It is frequently reported that low back pain symptoms, pathology and radiological findings correlate poorly (Airaksinen et al., 2006).

Spondylolysis and spondylolisthesis are often classified as nonspecific low back pain because a considerable proportion of patients with such anatomic abnormalities are asymptomatic (Soler & Calderon, 2000).

According to a recently published review, lumbar radiculopathy is one of the most common complaints evaluated by a spine surgeon, with an estimated prevalence of 3%-5% of the population, affecting both men and women. Age is a primary risk factor, as it occurs secondary to the degenerative process within the spine. Symptoms typically begin in midlife, with men often affected in their 40s while women are affected in their 50s and 60s(Schoenfeld, Laughlin, Bader, & Bono, 2012; Tarulli & Raynor, 2007).

Clinicians must be aware of the key signs and symptoms associated with serious medical conditions that cause LBP and develop a system to continually screen for the presence of these conditions (Airaksinen et al., 2006; van Tulder et al., 2006).

Signs for possible serious pathology are labelled ‘red-flags’ which are risk factors detected in LBP patients’ past medical history and symptomatology and are associated with a higher risk of serious disorders causing low back. (van Tulder et al., 2006) LBP ‘red flags’ are:

- Age of onset less than 20 years or more than 55 years
- Recent history of violent trauma
- Constant progressive, non-mechanical pain
- Past medical history of malignant tumor
- Prolonged use of corticosteroids
- Drug abuse, immunosuppression, HIV
- Systemically unwell
- Unexplained weight loss
- Widespread neurological symptoms (including cauda equina syndrome)
- Structural deformity
- Fever

1.1.4. Clinical course and prognosis

Growing evidence shows that low back pain is a long-lasting disease with variable clinical course possibilities rather than episodes of unrelated occurrences (Dunn, Hestbaek, & Cassidy, 2013). Kongsted et al. investigated the trajectories of low back pain and they concluded that for most patients, LBP is not a condition from which they either experience a rapid recovery or develop chronic severe pain, but persistent or fluctuating pain of low or medium intensity is often found (Kongsted, Kent, Axen, Downie, & Dunn, 2016). Their publication highlights an important issue, that the classification of acute and chronic only based at trajectory of time is overly simplistic as many on the acute LBP cases are often a flare up in an ongoing (chronic) condition. The course of acute and chronic LBP is substantially distinct as often acute low pain patients completely recover within 4-6 weeks in contrast to its chronic form where the prognosis is rather poor (Maher, Underwood, & Buchbinder, 2017). Acute and persistent LBP patients also differ in their pain intensity profile. According to Costa et al. the reported mean pain score among acute LBP patients was 52 at baseline, 23 at 6 weeks, 12 at 26 weeks, and 6 at 52 weeks measured on a 0-100 scale (Costa Lda et al., 2009). In contrast, the pooled pain intensity in persistent LBP was 51, 33, 26, and 23 at the identical timepoints. Strong evidence suggests that most episodes of low back pain considerably improves within 6 weeks and low level of pain levels can be found at 12 months as well, but in two-thirds of the cases some pain will be reported at 3 months (Itz, Geurts, van Kleef, & Nelemans, 2013; Kongsted et al., 2016). Downie et al. conducted a large scale (1,585 acute LBP patients)

study where they were searching for clusters of trajectories that predicts positive or negative outcome (Downie et al., 2016). Five clusters of pain trajectories were identified during a 12-week period for acute LBP patients receiving first time medical care. Approximately 36% of the patients recovered rapidly, 34% recovered within 12-weeks, 14% partially recovered by 12-weeks, 11% had fluctuating pain and 5% had persistent high level of pain during the 12-week period. As for recurrence, research shows that 33% of the patients will have an episode in 1-year while recovering from a previous episode (da Silva et al., 2017). All the published evidence suggests that good prognosis for patients with acute low back pain might have been overestimated and the potential for improvement in people with persistent low back pain underestimated. Characterizing the clinical course of low back pain only by the duration (time trajectory) or the intensity of pain (pain trajectory) does not adequately reflect the complexity of the disease.

1.1.5. Risk and prognostic factors of low back pain

While research of risk factors for low back pain is challenging given the heterogeneity across research methods, it is clear that some environmental and individual factors affect the onset and course of LBP. These determinants can be aggregated into categories involving characteristics of individual, physical stress, poor general health and psychological stress (Hoy et al., 2010; Parreira, Maher, Steffens, Hancock, & Ferreira, 2018).

Although low back pain occurs in every age groups, evidence suggests that the highest incidence can be found in the third decade of life and prevalence increases until 60 years of age, gradually declining thereafter (Hoy et al., 2010; Parreira et al., 2018). According to Hartvigsen et al. (Hartvigsen et al., 2018) the global growth of burden caused by LBP is partly due to the increase of the aging population as opposed to the increase in prevalence rates itself.

Although most study results report no significant gender differences Hoy et al. (Hoy et al., 2012) described in their systematic review that the mean and median prevalence rates among woman was higher. Despite no definitive gender differences, older women are more prone to LBP compared to older men. Healthcare services utilization and work absence caused by LBP is also higher in older woman as this population group also has a greater risk of developing chronic low back pain.

Higher prevalence of low back pain, longer episode duration and poor outcome is linked to low educational level (Dionne et al., 2001). Hoy et al. also found an association between low back pain and social status (Hoy et al., 2012; Hoy et al., 2010). Low educational status and income often leads to poor living and labor conditions, in professions that might put them at higher risk of suffering from low back pain (Meucci et al., 2013). Jackson et al. have found that chronic low back pain (CLBP) was 2.5 times more prevalent in the working population than in the non-working population (Jackson et al., 2016).

Overweight or obesity leads to greater mechanical load on the lumbar spine and thus cause chronic pain in this area (Meucci et al., 2013). According to meta-analysis published by Shiri et al. compared with non-overweight people, overweight people had a higher prevalence of low back pain, but a lower prevalence of low back pain compared with obese people. Evidence shows that obesity or high body mass index (BMI >30) seems to be linked to increased occurrence of LBP (Vogt, Lauerman, Chirumbole, & Kuller, 2002; Webb et al., 2003).

Poor general health such as asthma, headache and diabetes increase the chance of LBP compared to healthy individuals (pooled ORs 1.6-4.2) (Walsh, Cruddas, & Coggon, 1992). The exact mechanism behind the relationship of low back pain and other chronic diseases is yet unknown, but evidence indicates that lifestyle factors such as smoking, obesity and low levels of physical activity are related to poor general health which is associated with a higher occurrence of low back pain episodes or chronic low back pain (Hartvigsen et al., 2018).

Hereditary of low back pain is a highly investigated area and there is ever growing evidence for a strong genetic component to low back pain both in youngsters and in adults (Leboeuf-Yde, 2004; Leboeuf-Yde & Lauritsen, 1995). According to a systematic review involving seven twin studies, the genetic impact of the probability to develop low back pain ranged from 21% to 67%, with the genetic component being higher for more chronic and disabling LBP than inconsequential LBP (Ferreira, Beckenkamp, Maher, Hopper, & Ferreira, 2013).

Excessive mechanical load on the spine is often linked to occupational physical demands. It is reported that LBP can be found in 39% and 18.3% of manual and sedentary workers, respectively (Hoy et al., 2012; Hoy et al., 2010). A systematic review has found that

manual handling, repeated bending, twisting and whole-body vibration can be considered as risk factors (Hoogendoorn, van Poppel, Bongers, Koes, & Bouter, 2000). Awkward postures, heavy manual tasks, feeling tired or being distracted all proved to be significant risk factors of a new episode of low back pain (Steffens et al., 2015).

In CLBP, the fear-avoidance model describes how individuals experiencing acute pain may become trapped into a vicious cycle of chronic disability and suffering, by fear leading to disability through activity avoidance (Lethem, Slade, Troup, & Bentley, 1983; Philips, 1987; Waddell, Newton, Henderson, Somerville, & Main, 1993). The model has been updated by Crombez et al. (Crombez, Eccleston, Van Damme, Vlaeyen, & Karoly, 2012) to capture the effect of maladaptive learning processes and disabling beliefs on pain perception and on behaviors. This suggests that pain cognitions have a central role in the development and maintenance of disability and more so than pain itself, therefore the treatment of chronic pain shifted from direct pain relief to changing the beliefs and behaviors linked to the condition as well.

People with poor mental health are also at increased risk of developing LBP, especially its chronic form (Hartvigsen et al., 2018). In a study conducted by Power et al. (Power, Frank, Hertzman, Schierhout, & Li, 2001) in the UK on patients aged 23, individuals in psychological distress were at increased risk of developing LBP in 10 years timeframe (OR 2.52, 95% CI 1·65–3·86). Similarly, a study performed with about 9,000 participants found that currently pain free individuals suffering from depression were more likely to develop LBP within 2 years compared to individuals without depression (OR 2.9, 95% CI 1.2-7.0) (Currie & Wang, 2005). The psychosocial risk factors are entered into a flag system (represented in Table 1.), where all the factors are identified that may lead to chronic disability or do not recover as expected for their condition. Psychosocial flags enable us to work from a biopsychosocial model and give a framework for assessment and planning. The flags only allow us to identify patients at risk of a poor outcome or prolonged recovery and as such are often viewed as obstacles to recovery.

Table 1. Flag system: Each flag color represents a different group of risk factors that increas the chance of chronicity (Leerar, Boissonnault, Domholdt, & Roddey, 2007):

Flag	Nature	Examples
Red	Signs of serious pathology	Cauda equina syndrome, fracture, tumor, unremitting night pain, sudden weight loss of 5 kg over 3 months, bladder and bowel incontinence, previous history of cancer, saddle anesthesia
Orange	Psychiatric symptoms	Clinical depression, personality disorder
	Beliefs, appraisals, and judgement	Unhelpful beliefs about pain: indication of injury as uncontrollable or likely to worsen. Expectations of poor treatment outcome, delayed return to work
Yellow	Emotional responses	Distress not meeting criteria for diagnosis of mental disorder. Worry, fears, anxiety
	Pain behavior (including pain and coping strategies)	Avoidance of activities due to expectations of pain and possible reinjury. Over-reliance on passive treatments.
Blue	Perceptions about the relationship between work and health	Belief that work is too onerous and likely to cause further injury. Belief that workplace supervisor and workmates are unsupportive.
Black	System or contextual obstacles	Legislation restricting options for return to work. Conflict with insurance staff over injury claim. Overly solicitous family and health care providers. Heavy work, with little opportunity to modify duties.

1.1.6. Yellow flags for chronic low back pain

Psychosocial factors that increase the risk of developing or perpetuating CLBP and long-lasting disability are labelled at ’yellow flags’, The identification of these factors is the ground base of appropriate management of LBP as cognitive and behavioral changes should be addressed as part of the interdisciplinary multimodal treatment approach. In the last decades, a number of psychological disorders were identified prognostic for CLBP and poor outcome including stress, anxiety, depression and certain types of behavior. However, it is unclear how exactly these raise the occurrence of CLBP (Airaksinen et al., 2006; Hartvigsen et al., 2018).

Although psychological factors are investigated separately, there is a substantial overlap and quite often patients suffer from a number of psychological factors at the same time.

Most measures investigating the psychological risk factors tap into the patient's emotional distress and its link to chronic disabling low back pain. A cohort study conducted in the UK by Campbell et al. (Campbell et al., 2013) with more than 500 participants found that pain-related distress explained about 35% and 50% of the variance in pain and disability, respectively. Acute low back pain is more likely to transition to its chronic form in the presence of these psychological disorders (Airaksinen et al., 2006). Job dissatisfaction, monotonous tasks, poor work relations, lack of social support, stress and perceived ability related to the work environment are also considered as yellow flags (Airaksinen et al., 2006). Furthermore, work related dissatisfaction also plays a role in turning acute low back pain into persistent chronic pain (Hoy et al., 2010).

The following are examples of 'yellow flags' in a patient interviews (Leerar et al., 2007):

- Inappropriate attitudes and beliefs about back pain (belief that back pain is harmful or potentially severely disabling or high expectation of passive treatments rather than a belief that active participation will help)
- Inappropriate pain behavior (fear-avoidance behavior and reduced activity levels)
- Work related problems or compensation issues (poor work satisfaction)
- Emotional problems (such as depression, anxiety, stress, tendency to low mood and withdrawal from social interaction).

Evidence suggests that the factors present in a patient interact with each other and the perceived pain by the patient is not merely a result of a nociceptive input. To understand the complexity of low back pain, the biopsychosocial model has been developed which represents a broader understanding of the disease compared to a purely biomedical approach. In the development of chronic disabling low back pain, numerous multifactorial contributors play an important role such as biophysical, psychological, social, comorbidities and genetic contributors (Hartvigsen et al., 2018).

1.2. Spinal pain in childhood

1.2.1. Prevalence of spinal pain in childhood

Adult prevalence rates of low back pain have been discussed in section 1.1.2 (**Prevalence and incidence of adult low back pain**) which clearly indicates the burden of the disease. Historically, spinal pain was primarily studied in the working age population, but it has been acknowledged and understood that the vulnerability to spinal pain starts and becomes perceptible already in the pediatric population (Aartun,

Hartvigsen, Wedderkopp, & Hestbaek, 2014; Dunn et al., 2013; Kamper, Yamato, & Williams, 2016). Swain et al. (Swain et al., 2014) analyzed data obtained from three consecutive waves of the 'Health Behaviour in School-aged Children: WHO Collaborative Cross-National Survey (HBSC)'. The research network of the HBSC is an international alliance among researchers that conduct four-yearly cross-national surveys where data about health, general well-being, health behaviors and social environment is collected from 11-, 13- and 15-year-olds. The prevalence rates in study participants were 55%, 37%, 50% and 74% for headache, backache, stomach-ache or at least one of the three pains, respectively. Girls and older aged adolescents were more likely to suffer from any of the pain in the investigated regions. Based on their results, it is evident that somatic pain is very common in this population, but their result also indicates that the occurrence of pain sites often coexist rather than found in isolation. On account of the study results, the long-held belief that childhood low back pain is rare has been challenged in the last decade. Low back pain is uncommon in the first decade of life, but prevalence increases steeply during the adolescent years as around 40% of 9–18-year olds in high-income, medium-income, and low-income countries report having had low back pain (Calvo-Munoz, Gomez-Conesa, & Sanchez-Meca, 2013; Hartvigsen et al., 2018). Recently published data show that the epidemiologic features of pediatric spinal pain are almost as high as in the adult population (Jeffries et al., 2007). Judging from these studies, it is clear that neck pain and LBP may well start in early childhood and at the end of adolescence their prevalence is likely to reach the prevalence rate in adulthood (Burton et al., 2006; Kjaer, Wedderkopp, Korsholm, & Leboeuf-Yde, 2011). Aartun et al. found that mild, infrequent neck, mid back and low back pain are common in children aged 11–15 and after a 2-year follow-up, regardless of location, a clear progression of the condition is apparent (Aartun et al., 2014). A Danish study showed that 8% of 13-year-olds sought treatment and this number rises to 34% by the age of 15 (Kjaer et al., 2011). Jones et al. (M. A. Jones, Stratton, Reilly, & Unnithan, 2004) interviewed 500 schoolchildren aged between 10 and 16 years and found that 13% of the investigated group experienced disabling recurrent low back pain, 23% needed medical care, 26% had been absent from school, and 30% experienced diminished physical activity. Typically, pain intensity is lower compared with adult LBP intensity and it also lasts for a shorter time (Wirth & Humphreys, 2015). Hestbaek et al. (Hestbaek et al., 2006) conducted a large population-

based study on twins and found a clear correlation between back pain in childhood, adolescence and low back pain in adulthood. Based on these findings, adult low back pain primary prevention measures should be advocated in childhood and/ or adolescence (Balague, Troussier, & Salminen, 1999; Hestbaek, Korsholm, Leboeuf-Yde, & Kyvik, 2008).

It has also been investigated whether low back pain in childhood predicts chronic low back pain in adulthood. Hestbaek et al. (Hestbaek et al., 2006) followed 9,600 twins over an 8 year period and their results leaves no doubt left that low back pain in early life is a strong predictor for having low back pain later in life with an odds ratio of 4, independently of both age and gender. Their study investigated the change of adolescence to adulthood in a predefined patient population for spinal pain occurrence and based on their findings, a strong recommendation is made to address any occurring spinal problems at a younger age and in order to avoid severe chronic pain later in life. They suggest that preventive actions should also target the young population. Joergensen et al. (Joergensen, Hestbaek, Andersen, & Nybo Andersen, 2019) conducted a large-scale study within the Danish National Birth Cohort where they have found that persistent pain has been associated with the co-occurrence of physical and psychological symptoms. Furthermore, in a Danish twin study, adolescents with tenacious low back pain were 3.5 times more likely to have persistent low back pain than adults (Hestbaek et al., 2006). Stahl et al. also found that the presence of other musculoskeletal symptoms can be viewed as risk indicators for a more persistent course such as multiple spinal pain (M. Stahl et al., 2008).

1.2.2. Risk factors of pediatric spinal pain

The identification of risk factors in the pediatric population is a significant research matter as the children suffering from spinal pain also experience increased healthcare utilization, absenteeism or impairment in school and restrictions on physical activity (Kamper et al., 2016; King et al., 2011; Roth-Isigkeit, Thyen, Stoven, Schwarzenberger, & Schmucker, 2005). Little is known about the etiology of pediatric spinal pain, early life predictors, and specific influence of timing and duration of spinal pain episodes (Aartun et al., 2014; Dunn et al., 2013; Hestbaek et al., 2006; Taylor, Goode, George, & Cook, 2014). Although the risk factors in adulthood are well investigated, they cannot automatically be applied to children. Moreover, there is also a lack of standardized, validated, patient-reported questionnaires (PRQ) that can be applied to pediatric spinal

conditions and their risk factors. Many studies on this issue use a self-developed questionnaire to investigate the risk factors of spinal pain development, but generally speaking the reliability or validity of such questionnaires is not reported and as such, from a methodological point of view, righteously questioned. This serves as a possible explanation for the inconsistency in previously published studies concerning the risk factors for spinal pain in children (Dockrell, Simms, & Blake, 2015; G. T. Jones, Watson, Silman, Symmons, & Macfarlane, 2003; Kovacs et al., 2003). Comparison of multicenter data is thus impossible, and the absence of a gold standard validated PRQ that reliably measures pediatric spinal pain also limits high-quality prospective studies to be carried out.

Familial and social factors are assumed to be of importance for childhood health and pain experience (Groholt, Stigum, Nordhagen, & Kohler, 2003; Reinhardt Pedersen & Madsen, 2002). According to Groholt et al. (Groholt et al., 2003) societal factors that influence the occurrence of pain in childhood are children living in low income and low educated, worker families (OR 1.4). Their results also indicate a pain site-specific (headache, abdominal and back pain) association between parental and child pain. Reinhardt-Pedersen et al. (Reinhardt Pedersen & Madsen, 2002) investigated children's health and well-being in five Nordic countries and they concluded that children living in families where none of the parents are employed in the past six months had an increased risk of ill health and low well-being. In their study, they have applied three indicators to describe children's health status: recurrent psychosomatic symptoms, chronic illness, and level of wellbeing. One of the key elements of psychosomatic symptoms in their investigation was back pain. In spinal pain research, a relationship has been indicated for risk factors such as parental socioeconomic status (Hestbaek et al., 2008; Mustard, Kalcevich, Frank, & Boyle, 2005), biological vulnerability (Hestbaek, Iachine, Leboeuf-Yde, Kyvik, & Manniche, 2004; M. K. Stahl et al., 2013), and parental pain behavior (Chambers, Craig, & Bennett, 2002; Stone, Walker, Guest Editors: Cynthia A. Gerhardt, & Grayson, 2017).

Non-specific low back pain among parents and their children has been found to be significantly associated in several cross-sectional studies. This association evokes the possible role of genetic, environmental and/or psychosocial factors (Balague et al., 1999).

According to Wirth et al. (Wirth, Knecht, & Humphreys, 2013) spinal pain (regardless of area) is more common in girls and in children who use the computer for more than two hours a day. Specifically for low back pain, associations have been found between anxiety and depression, TV consumption, heavy smoking and parental low back pain (Roth-Isigkeit et al., 2005). Interestingly, being overweight and obese did not affect the occurrence of spinal pain and low back pain. Regular vigorous physical activity has also been identified as a risk factor for spinal pain (Beynon, Hebert, Lebouef-Yde, & Walker, 2019). Backpack weight and chair height at school have been linked to thoracic spine pain in children (Wirth & Humphreys, 2015; Wirth et al., 2013).

As in adult spinal pain, in its pediatric type, psychosocial factors play a significant role as well. A recent review by Beynon et al. (Beynon et al., 2019) identified that dysfunctional coping, anxiety sensitivity, somatosensory amplification, psychological distress and emotional or behavioral disorders influence the development of pediatric spinal pain.

Age can be interpreted as a potential predictor for back pain episodes as evidence shows that with aging the chance of back pain rises (Barke, Gassmann, & Kroner-Herwig, 2014; Burton et al., 2006; Burton, Clarke, McClune, & Tillotson, 1996; Mustard et al., 2005; Newcomer & Sinaki, 1996). All the evidence regarding childhood risk factor identification suggests that psychosocial factors might be more important than the mechanical factors for spinal pain. Results investigating risk factors in the young population are very controversial which can be explained by the lack of gold standard measurement tools or validated questionnaires. Most of the studies use a tool which has been developed for the adult population or apply their own developed questionnaire with no available psychometric data about it.

1.3. Outcome measures of low back pain

While outcome can refer to many aspects of a treatment such as operative metrics, radiographic parameters or physician assigned scales, the patients' perspective of their own clinical status is as or even more important as the objective measures mentioned above. The goals of surgical and non-surgical interventions for degenerative diseases of the lumbar spine are relieving pain, improving function and health-related quality of life (QOL) (DALYs et al., 2015; Stienen et al., 2019; van Tulder et al., 2006). Knowledge of

the source and natural history of the disease is required, as pain and even is some cases, motor deficit may respond adequately to conservative treatment. Besides radiologic imaging, assessment of pain intensity, lumbar spine related function and disability is essential since they form the basis for deciding upon the best therapeutic approach in the given patients' problems. On the other hand, the baseline objective assessment of the subjective symptoms can be used as a reference point in the later evaluation for failure or success of the applied treatment. Patient reported outcome measures (PROMs) aim to quantify treatment impact in three major categories: global health-related quality of life, pain and disease specific disability (Stienen et al., 2019). A paper-based or electronic instrument is defined as PROM if "any repost of the status of the patients' health condition that comes directly from the patient, without interpretation of the patient's response by clinician or anyone else." (Kyte et al., 2015).

The scientific focus of the development PROMs has also led toward a more patient-centered and shared decision-making medical approach. There are growing number of publications regarding PROMs which resulted in a wide variety of instruments applied in research but there is still a lack of a gold standard core set of instruments. Deyo et al. (Deyo et al., 1998) defined the advantages of standardized set of outcome measures from which spinal research can highly benefit. As such Deyo et al. as well as Bombardier et al. (Bombardier, 2000; Deyo et al., 1998) introduced the idea of a core set of measures including the following domains: (1) physical functioning domain, (2) pain intensity, (3) health-related quality of life.

1.3.1. Patient reported questionnaire in pediatric spinal pain

There is no gold standard for pediatric spinal pain measurement tools and generally all the published research articles use tools which have been developed by themselves. Therefore, we can see a great heterogeneity of study participants and differences in the reported results as well. However, there are a few tools which have been validated in the young population, all of which measure pain intensity. The numeric rating scale can be used from age eight, whereas the pictorial adaptation of the visual analogue scale, the Revised Faces Pain Scale, can be used as young as age three (Manworren & Stinson, 2016). Luridsen et al. (Lauridsen & Hestbaek, 2013) developed the questionnaire 'Young Spine Questionnaire' with the purpose of measuring prevalence, pain frequency as well

as intensity, and brief questions targeting activity restrictions, care seeking behavior and parental spine symptoms.

1.3.2. Patient reported outcome measures in adult lumbar spinal research

Despite the advances in research, work absenteeism and health-care costs are rising especially in its chronic form (Gore, Sadosky, Stacey, Tai, & Leslie, 2012; Martin et al., 2008). As evidence shows, chronic low back pain is a multifactorial disease where depression, anxiety, pain catastrophizing, fear avoidance beliefs and other possible factors play a role in the development and the prognosis as well (Airaksinen et al., 2006; Hoy et al., 2010). Next to clinicians, researchers have a great interest of predicting outcomes from an episode of LBP and for this purpose generic and specific questionnaires were developed. The detailed description of the core set PROMs follows in section 2.2.2.2 (**Questionnaire battery**).

1.4. Therapeutic management of LBP

Appropriate paths of treatment may include pharmacological interventions guided by evidence, psychological treatments, physical and rehabilitation treatments and minimally invasive approaches. Non-surgical therapeutic modalities and their evidence-based usage in treatment of acute and chronic low back pain are presented in Table 2. (Foster et al., 2018; Qaseem, Wilt, McLean, Forciea, & Clinical Guidelines Committee of the American College of, 2017; Stochkendahl et al., 2018).

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Table 2. Overview of interventions endorsed for non-specific low back pain in evidence-based clinical practice guidelines

	Acute low back pain	Chronic low back pain
Education and self-care		
Advice to remain active	First-line treatment, consider for routine use	First-line treatment, consider for routine use
Education	First-line treatment, consider for routine use	First-line treatment, consider for routine use
Non-pharmacological therapy		
Exercise therapy	Limited use in selected patients	First-line treatment, consider for routine use
Cognitive behavioral therapy	Limited use in selected patients	First-line treatment, consider for routine use
Spinal manipulation	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Massage, Acupuncture	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Yoga, mindfulness-based stress reduction	Insufficient evidence	Second-line or adjunctive treatment option
Interdisciplinary rehabilitation	Insufficient evidence	Second-line or adjunctive treatment option
Pharmacological therapy		
Paracetamol	Not recommended	Not recommended
Non-steroidal anti-inflammatory drugs	Second-line or adjunctive treatment option	Second-line or adjunctive treatment option
Skeletal muscle relaxants	Limited use in selected patients	Insufficient evidence
Selective norepinephrine reuptake inhibitors	Insufficient evidence	Second-line or adjunctive treatment option
Antiseizure medications	Insufficient evidence	Role uncertain
Opioids	Limited use in selected patients, use with caution	Limited use in selected patients, use with caution
Systemic glucocorticoids	Not recommended	Not recommended
Interventional therapies		
Epidural glucocorticoid injection (for herniated disc with radiculopathy)	Not recommended	Limited use in selected patients

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2. OBJECTIVES

2.1. Study aims

The aim of this thesis was to gain an understanding of the possible risk factors which increase the risk of pediatric spinal pain and to examine the risk profile and outcome of adult chronic low back pain. To attain these goals my, Ph.D work was built up by two structures.

In the first part of my Ph.D thesis we aimed to develop and validate a questionnaire which enables to measure pediatric spinal pain prevalence and to identify possible familiar, lifestyle and environmental factors leading to this condition. Followingly, with the previously determined risk factors our goal was to build a risk scoring model which allows us to identify the children at risk. Afterwards, a large-scale prospective study was conducted with the intent to validate the new risk assessment system.

For this purpose, I specifically addressed the following questions:

1. How reliable is the newly developed pediatric spinal pain questionnaire?
2. What are the possible specific risk factors that might play a role in the development of spinal pain in childhood?
3. Can the probabilistic risk scoring system model be validated?

If the aims are achieved, this risk estimation questionnaire can be a standardized tool for primary prevention actions of pediatric spinal pain by being a feasible method for the identification of the at-risk group of children and to follow the change in their condition.

The aim of the second part of the thesis was firstly the cross-cultural adaptation and validation of the STarT Back Tool into the Hungarian language (STarT-H) and secondly to measure the predictive ability of the STarT-H on global treatment outcome and psychological distress in a typical outpatient secondary setting - group physical therapy for adult non-specific LBP patients. For this, the following specific questions have been asked:

4. Does the Hungarian version of the STarT Back Tool have acceptable psychometric properties?
5. Can the STarT-H discriminate between patients with good and poor outcome?
6. Can the STarT-H predict 3 months global treatment outcome in LBP patients treated with group physical therapy?

2.2. Research methodology applied in the studies

2.2.1. Development of the pediatric spinal pain questionnaire

The three-stage method for questionnaire development published by Wilson and Cleary was followed (Wilson & Cleary, 1995); (1) conceptualization; (2) development, (3) testing. An expert group was formed to select the possible risk factors based on a careful literature review with the participation of physiotherapists, school- teachers, rheumatologist, prevention expert and spine surgeons. The items of the questionnaire were drafted and finalized after several iteration cycles among the group members.

Considering the age and reading comprehension of the target group, the parents were advised to supervise or help the children during the completion of the PRQ. No missing item was accepted for the questionnaire. The research protocol was designed and implemented regarding the Helsinki Declaration on human subjects testing and the study was approved by the Scientific and Research Ethics Committee of the Medical Research Council (431/PI/2007).

2.2.1.1. Study population for the pediatric spinal pain questionnaire

Elementary and high schools participating in the validity and the reliability study were selected from three different geographic regions of the country representing a general population sample. After collecting required parental informed consents, children from the 5th to 6th graders were included into the reliability study. All subjects were healthy volunteers without any known disabling musculoskeletal or other chronic disease or functional limitation. We recruited 146 schoolchildren into the reliability study from two elementary schools. The children filled out the paper-based questionnaire at home two times with a one-week interval in-between. All statistical analyses were performed with IBM SPSS 20.0 software and $p>0.05$ were considered significant.

For the validity analysis schoolchildren were enrolled into a 5 year-long prospective study from six elementary schools throughout the country. Second to eights graders filled out newly developed questionnaire. The test (N=952) and the validity dataset (N=897) were generated by the random selection of the participant school-classes. Sample size for the reliability and validity analyses was determined based on recommendations in the literature (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996; Terwee et al., 2007).

2.2.1.2. Assessing the reliability of the developed pediatric spinal pain questionnaire

The methodological quality of the new questionnaire was measured by investigating the reliability. The test-retest method was used where, the measurement tool is applied within a short period of time making sure that no clinically significant change could occur between the two examination timepoints. Particularly, in this study we reapplied the questionnaire within a week, so that the children and parents, could not remember the questions, but at the same time no clinically meaningful change could happen. High reliability is important for discriminative purposes, to differentiate between a disease or in our case a painful condition, or to measure how severe a disease or painful condition is. The newly developed PRQ data type was nominal so Kappa statistic was chosen for the analysis (Terwee et al., 2007). As a measure of reliability, Kappa value should be statistically significant and as proposed by Landis and Koch (Landis & Koch, 1977) values below 0.4 were interpreted as poor, 0.41-0.75 as fair to good, and 0.75-1 as excellent agreement.

2.2.1.3. Pediatric spinal pain risk factor analysis and model validation

In order to identify significant factors that increase the risk of spinal pain in childhood, the prospective study data was explored by uni- and multivariate logistic regression models. All the variables with $p<0.1$ in the univariate analysis performed on the test cohort data were then entered into a stepwise multivariate logistic regression model. Multicollinearity was assessed with Pearson's rank correlation ($r>0.8$). The predictive performance of the final multivariate model was calculated and validated using the receiver operating characteristics (ROC) method. The software uses a nonparametric method to estimate the area under the ROC curve (AUC) and calculate p-values. Predictive ability was considered adequate in case AUC being ≥ 0.7. Chi-square test was performed to investigate the probability regarding the risk scoring system and pediatric spinal prevalence.

2.2.2. Cross-cultural adaptation and translation procedure for STarT-H

The formal translation and the cross-cultural adaptation of the STarT Back Tool into Hungarian language was based on the multistep approach suggested by Beaton et. al (Beaton, Bombardier, Guillemin, & Ferraz, 2000). The semantic, idiomatic, experimental, and conceptual equivalence between the source and the target questionnaire can maximally be attained through the structured adaptation process. The study was

approved by Scientific and Research Ethics Committee of the Medical Research Council Hungary (ad.0213/15. ad.29970-3/2015/EKU).

First, the developers were contacted and informed about the translation plan of the original questionnaire. After receiving the formal permission, an expert committee was formed with participating bilingual English and Hungarian language experts, spine surgeons, a physiotherapist, and a methodologist.

An informed (T1-medical background, informed) and an uninformed (T2-no medical background, blinded to the concept) native Hungarian translator adapted the questionnaire into Hungarian.). The translators were asked to report of any issues throughout the adaptation process. During an expert committee meeting involving both T1 and T2 the two Hungarian versions were synthetized, the reports from T1 and T2 were thoroughly discussed and a first Hungarian version was agreed on (T12). The questionnaire (T12) then was back- translated into English by two independent native English-speaking (BT1-British and BT2-US) translators who were blinded to the original English version and none of them had medical backgrounds. The aim at this point was to highlight gross conceptual inconsistencies or errors. An expert committee meeting was held after the backtranslation process involving the translators and consensus was achieved on a prefinal Hungarian version (V1). Thereafter, a pilot study was conducted including 30 LBP patients in the orthopedic inpatient clinic to test the acceptability and comprehensibility of the V1 version. The patients were interviewed about ambiguity and difficulty of the translated prefinal Hungarian V1 version. The primary goal of the pilot study was to assess how the prefinal version (V1) works in the target setting and therefore no data was collected regarding validity or reliability. A final expert committee meeting was convened and based on the recommendations and remarks of the patients a final consensus version (V2) was agreed on.

2.2.2.1. Study population for the psychometric analysis of the STarT Back Tool

We carried out a prospective cohort study recruiting 150 LBP patients with or without pain irradiating to the leg. Before entering the study, all patients were screened for eligibility by a spinal surgeon. Participants were enrolled by physiotherapists as they were attending their first-time group physiotherapy at the outpatient clinic of the National Center for Spinal Disorders. Inclusion criteria were a) adult age; b) low back pain with or

without referred pain; c) normal cognitive function, voluntary participation; d) able to read and answer the questionnaire in Hungarian. Exclusion criteria were a) spinal surgery in the last 12 months; b) metabolic bone disease; c) active malignant disease; d) severe osteoporosis; e) fracture; f) spinal infection, neuromuscular disease; g) autoimmune disease; h) spondylarthrosis; i) myelopathy; k) congenital spinal deformity; l) mental disorders; m) pregnancy. Participants were treated with group physical therapy once or twice a week and were completing strengthening and stretching exercises with the main goal of pain reduction. Spinal stabilization exercises aimed to strengthen the core muscles and flexibility exercises targeted the elasticity of spinal and hip joints. Sample size calculations were made based on the recommendations of the literature (Terwee et al., 2007). As suggested the study sample size consisted of at least 50 patients and 100 for reliability and internal consistency, respectively. As for the prognostic discriminative validity analysis a subgroup was generated including 70 patients.

2.2.2.2. Questionnaire battery

The booklet contained questions about basic demographic characteristics, the target questionnaire (STarT-H), the reference questionnaires; brief version of the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF), Tampa Scale for Kinesiophobia (TSK), Oswestry Disability Index (ODI), Pain Catastrophizing Scale (PCS), the Fear Avoidance Beliefs Questionnaire (FABQ) and average pain intensity (over the last week) in the lower back and leg measured by the Numeric Rating Scale. Global treatment outcome was measured on a five-point Likert scale (13). Patients participating in the study were informed and their written consent was collected.

2.2.2.2.1. STarT Back Screening Tool

There was a demand on a simple, easy to use tool in the triage of patients in routine clinical care, thus an English research group developed the STarT Back Screening Tool in a primary care setting for patients suffering from non-specific LBP (Hill et al., 2008). The nine-item self-administered, multidimensional PRQ aims to classify the patients into prognostic groups according to the individual risk status and to identify the individual's overall risk for persistent disabling pain (Hill et al., 2008). The questionnaire items are related to physical and psychosocial factors predicting future persistent disabling LBP. The physical predictive domains screened for in the tool include referred leg pain, neck or shoulder pain, difficulties in walking and in dressing. Psychological factors that are screened within the psychosocial domain are fear of movement, anxiety, pain

catastrophizing, depressive mood, and overall impact from back pain. Item 1 to 4 relate to physical aspects of LBP whereas questions 5 to 9 forms a psychosocial subscale. The first 8 questions have an "agree" and "disagree" dichotomous answer whereas the 9th item response is a 5-item Likert scale, where higher scores indicate worse status. The overall score for the STarT Back Tool is the sum of the positive answers, whereas the psychosocial subscale is the sum of questions 5 to 9. A total score of ≤3 and ≥4 points in combination with <4 points on the psychosocial subscale (item 5-9) indicates low and medium risk group, respectively. Points ≥4 on the psychosocial subscale classifies to high risk. Based on the overall and subscale scores the patients are then stratified into *low*, *medium* and *high-risk* groups which are linked to matching treatment recommendations. Patients in low and medium risk groups mainly are advised physical therapeutic treatment, whereas the patients allocated into the high-risk group are recommended to participate in psychologically informed physical therapy interventions (Hill et al., 2011).

2.2.2.2.2. Oswestry Disability Index

The ODI is a patient-reported, validated back-specific questionnaire assessing disability associated with low backpain (J. C. Fairbank & Pynsent, 2000). The 10-item questionnaire assesses pain severity, self-management, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling. The ODI has officially been cross- culturally adapted and validated into Hungarian language (Valasek et al., 2013).

2.2.2.2.3. WHOQOL- BREF

The WHO defines quality of life (QOL) as 'an individual's perception of their situation in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns' (Skevington, Lotfy, O'Connell, & Group, 2004). As a generic questionnaire developed to measure QOL the WHOQOL-BREF is a valid assessment tool containing 26 items about different aspects of life constituting four domains: physical, psychological, social relationships, and environmental (Skevington et al., 2004).

2.2.2.2.4. Tampa Scale for Kinesiophobia

The TSK is a 17 item PROM developed to assess fear of movement related pain in patients with musculoskeletal pain. The TSK is a reliable and valid measurement tool that provides valuable data on activity avoidance and pathological somatic focus in patients with musculoskeletal pain (Weermeijer & Meulders, 2018). A cut off score of 37 was developed by Vlaeyen (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995), where a

score over 37 is associated with high level of kinesiophobia. The TSK has been officially translated and validated into Hungarian language but has not been published yet.

2.2.2.2.5. Fear Avoidance Beliefs Questionnaire

FABQ was developed by Waddell et al. (Waddell et al., 1993) and it is based on the fear avoidance model focusing on the patient's beliefs about how physical activity and work affect their low back pain. The Fear Avoidance Beliefs Questionnaire has been officially translated and validated into Hungarian language (Simoncsics & Stauder, 2017).

2.2.2.2.6. Pain Catastrophizing Scale

The PCS is a 13 item self-report measurement tool which assesses three dimensions of individuals who catastrophize in the context of actual or anticipated about their pain; rumination, magnification and helplessness in relation to their ability manage their pain (Darnall et al., 2017; Osman et al., 1997). The PCS has been officially translated and validated into Hungarian language but has not been published yet.

2.2.2.3. Evaluating the psychometric properties of the Hungarian version STarT Back Tool

The participant's baseline characteristics, drop-out rate and missing data were explored with descriptive statistics. Recommendations by Terwee at al. were followed for the psychometric analysis (Terwee et al., 2007). Missing items were handled in consonance with the instructions of the original questionnaire developers. Floor or ceiling effects are considered to be present if more than 15% of respondents achieved the lowest or highest possible score, respectively (Terwee et al., 2007).

2.2.2.3.1. Internal consistency

Internal consistency was tested by factor analysis and calculating the Cronbach's alpha value, considering the factor structure of the questionnaire. Poor internal consistency was defined as $\alpha < 0.70$, and item redundancy was defined as $\alpha > 0.90$. Kaiser-Meyer-Olkin's measure of sample adequacy and Bartlett's test of sphericity were applied to test the appropriateness of the factor analysis. Principal component analysis was applied with varimax rotation with the eigenvalues more than 1 and items with factor loading >0.40 were included.

2.2.2.3.2. Construct validity

Construct validity of the instrument was evaluated by Spearman's rank correlation coefficient where $r > 0.4$ was considered satisfactory ($r > 0.80$ as excellent, 0.61–0.80 very

good, 0.41–0.60 good, 0.21–0.40 fair, 0–0.20 poor). Our primary hypothesis were significant baseline and posttreatment differences between the risk groups relating the STarT baseline scores and the reference questionnaires. These were evaluated with the non-parametric Kruskal-Wallis test. The applied therapy targeted the physical aspect of LBP and we expected significant changes to be found in the outcome measures targeting physical health at 3 months follow up compared to baseline. Posttreatment change for each investigated measurement tool was calculated and the mean scores were compared between risk groups depending on the distribution of the data by one-way ANOVA with Bonferroni correction or Kruskal-Wallis test. To explore the relationship between the risk groups at baseline and the outcome at 3 months Fisher's exact test was applied.

2.2.2.3.3. Reliability and agreement analysis

A test-retest study was carried out as described in section 2.2.1.2. **(Assessing the reliability of the developed pediatric spinal pain questionnaire)** and intraclass correlation coefficient for absolute agreement derived from a two-way random effects' ANOVA model was calculated. Patients filled out the booklet containing the target and the reference questionnaires at baseline before receiving any therapy and a week later. Kappa test and 95% confidence interval were used to evaluate the item-by-item reliability. ICC and kappa values between 0.60 and 0.80 were considered as good reliability, whereas values higher than 0.80 indicated excellent reliability. Agreement was demonstrated by determining the standard error measurements for the repeated measurements. Minimal detectable change at 95% confidence level was calculated using the formula 2.77x standard error measurements.

2.2.2.3.4. Prognostic discriminative validity

Discriminative ability is the capacity of a questionnaire to detect clinically important changes over time. Patients received the questionnaire booklet at 3 months follow up through a prepaid envelope and returned after self-completion by postal mail. This was measured with the ROC method which is displayed by the AUC. Discriminative ability was considered adequate in case AUC being ≥0.7. To distinguish good and poor outcome, the global treatment question was collapsed, and a dichotomous variable was generated. Good outcome was considered if the patient replied 'very good' or 'good' and poor outcome was identified in case the answers 'satisfactory', 'bad' or 'worse than before' were marked.

Besides global treatment outcome, the patients psychological well-being is an important aspect so a dichotomous variable was also generated representing psychological distress based on the publication of Karstens et al. (Karstens et al., 2015) To determine discriminative ability of the given change score relative of the patient's perception of being in distress, a dichotomous composite reference standard was generated based on the original study and the publication by Karstens et al (Hill et al., 2008; Karstens et al., 2015). The cut-off scores for the composite reference standard are shown in Table 3. The patients who scored above the cut off score in all the reference standard questionnaires were identified as being in distress, whereas in case of scoring below meant they were classified as non-distress.

Table 3. Cut off values for the reference standard questionnaires

Questionnaire	Set cut off value
TSK	≥41[a]
PCS	≥20[a]
ODI	≥20[b]
VAS	≥2,5[b]

[a] No cut off value for Hungarian population available

[b] median utilized as cut off

3. RESULTS

3.1. Development and item identification of the possible risk factors for pediatric spinal pain

Within the framework of the Genodisc project, we have conducted a careful, systematic literature review in order to identify the possible risk factors which might play a role in the development of pediatric spinal pain. The published systematic review was the basic foundation of the newly developed questionnaire in which we have determined the risk factors of interest. The final consensus version of the PRQ consisted of 22 items divided into three sections:

- Section 1: items targeting physical activity and mechanical load in terms of lifestyle factors (sports activity level, time spent in front of TV and computer, type and perceived weight of the school bag, comfort of the school environment, sleeping disturbances)
- Section 2: covering the child's health care seeking behavior and general well-being
- Section 3: questions addressed to the parents about familial history of spinal problems

3.2. Pediatric spinal pain reliability

Prior to investigating reliability, a pilot study was carried out involving 30 children their answers and remarks were discussed before a final version of the questionnaire was agreed on. (Supplementary Material 1.). Within a one-week interval, a total of 146 children fully completed the PRQ twice. Looking at the baseline characteristics, the mean age was 10.73 ± 0.8 years, and the gender distribution was 53% boys (n = 78) and 47% girls (n = 68). Table 4. summarizes the results of the reliability analysis. In section 1, the item "transportation to school" achieved the highest kappa value ($\kappa = 0.95$), while the question about "how tiring is it to carry the school bag" showed the least reliability ($\kappa = 0.39$). "Missing days' from school because of any health problem" ($\kappa = 0.75$) and "spinal pain for days" ($\kappa = 0.8$) in Section 2 proved to be highly reliable. All the items about symptom location performed poorly. The analysis of Section 3, the item about family spinal pain history achieved a good to excellent agreement ($\kappa = 0.74$ and 0.84).

Table 4. Results of the reliability analysis

Item	Content	Kappa value
1	Transportation type to school (car, bus or by foot)	0.95
1.	Hours spent studying/day	0.61
3	Hours spent watching TV weekday/weekend	0.65/ 0.76
4	Hours spent using the computer weekday/weekend	0.76/ 0.81
2.	Type of gym class	0.6
3.	Regular sport activities	0.82
4.	Type of school bag	1
5.	Weight of school bag perceived	0.63
6.	How tiring is it to carry the school bag	0.39
7.	How comfortable is the school desk	0.74
8.	How well does the child sleep	0.74
9.	General well being	0.52
10.	Missing days from school because of any health problem	0.75
11.	Low back pain in the last month	0.23
12.	Back pain in the last month	0.39
13.	Neck pain in the last month	0.43
14.	Spinal pain for days	0.8
15.	Missed school because of spinal pain	insuff. number
16.	Doctor visit because of spinal pain	0
17.	Spinal pain among first degree relatives	0.74
18.	Spinal pain among second degree relatives	0.84

3.3. Prevalence of pediatric spinal pain

Age and gender distribution were similar in the test and the validation dataset (11.8 ± 1.8 vs. 11.0 ± 1.8 years old and 48 vs. 45% boys). The highly reliable item 'spinal pain for days' was dichotomized for prevalence analysis purposes and we found an occurrence of 12.9% in the total study population. Analyzing the full cohort 19.4%, 24.9% and 25% had LBP, back and neck pain, respectively. About 4% had already visited a doctor because of spinal pain. Prevalence rates of the test and validity cohort are represented in Table 5.

Table 5. Prevalence of pediatric spinal pain symptoms

	Test cohort (N=952)	Validity cohort (N=897)
Low back pain (last month)	190 (20.1%)	164 (18.5%)
Back pain (last month)	228(24.1%)	227 (25.6%)
Neck pain (last month)	233 (24.6%)	224 (25.3%)
Spinal pain (for days)	127 (13.4%)	109 (12.4%)
Missing school because of spinal pain	23 (2.4 %)	13 (1.5%)
Doctor's visit because of spinal pain	40 (4.3%)	34 3.8%)

3.4. Risk factors leading to pediatric spinal pain and risk scoring system validation

Spinal pain was used in the further analysis as a dependent variable as it proved to be the most reliable item feature. To develop a simplified risk estimation model, the categorical variables of the PRQ were dichotomized based on the deeper analysis of the results of the first run of univariate logistic regression models. The dichotomized variables were analyzed again in univariate models and variables with $p < 0.1$ entered into the multivariate model. Results of the uni- and multivariate logistic regression analysis are represented in Table 6.

The final multivariate predictive model ($\chi 2 = 101.07$; $df = 8$; $p < 0.001$) achieved by logistic regression analysis was built up by seven risk factors.

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Table 6. Results of univariate and multivariate logistic regression analyses on pediatric spinal pain for days[a]

	Univariate regression				Multivariate logistic regression			
Variables	**B**	**Wald**	**OR (95% CI)**	**p**	**B**	**Wald**	**OR (95% CI)**	**p**
Older age than 12 years	***0.43***	***4.95***	***1.54 (1.05-2.26)***	***0.026***	***0.49***	***4.74***	***1.63 (1.05-2.53)***	***0.03***
Sex	0.21	1.46	1.23 (0.84-1.79)	0.283				
Transportation by vehicle	-0.04	0.03	0.97 (0.65-1.44)	0.864				
Afternoon learning more than 2 hours/day	***0.65***	***7.52***	***1.91 (1.20-3.02)***	***0.008***	***0.60***	***4.62***	***1.82 (1.05-3.22)***	***0.032***
Watching TV more than 2 hours on weekdays	*0.63*	*5.53*	*1.87 (1.11-3.17)*	*0.025*				
Watching TV more than 2 hours/day on the weekend	***0.69***	***12.53***	***1.99 (1.36-2.91)***	***<0.001***	***0.95***	***17.01***	***2.59 (1.65-4.05)***	***<0.001***
Computer use more than 2 hours on weekdays	0.30	0.71	1.36 (0.67-2.76)	0.415				
Computer use more than 2 hours*/day on the weekend*	-0.10	0.20	0.91 (0.59-1.39)	0.657				
Excused from gym class	0.54	2.16	1.72 (0.84-3.53)	0.161				
No sport activity	*0.51*	*6.63*	*1.66 (1.13-2.44)*	*0.011*				
Asymmetric school bag	*0.51*	*5.03*	*1.67 (1.07-2.61)*	*0.03*				
Heavy school bag	0.25	0.79	1.28 (0.74-2.20)	0.364				
Carrying school bag is tiring	*0.78*	*10.79*	*2.18 (1.37-3.48)*	*0.002*				
Uncomfortable school desk	***1.79***	***52.14***	***5.96 (3.67-9.68)***	***<0.001***	***1.66***	***34.27***	***5.27 (3.03-9.18)***	***<0.001***
Frequent sleeping problems	***0.79***	***16.68***	***2.20 (1.51-3.20)***	***<0.001***	***1.33***	***7.62***	***3.79 (1.33-2.83)***	***0.006***
General discomfort	***0.95***	***22.14***	***2.58 (1.74-3.83)***	***<0.001***	***0.57***	***5.33***	***1.76 (1.09-2.85)***	***<0.001***
Frequent missing from school	*0.68*	*4.23*	*1.97 (1.03-3.77)*	*0.0502*				
Spinal disorder among relatives	***0.724***	***13.14***	***2.06 (1.40-3.05)***	***<0.001***	***0.641***	***8.108***	***1.898 (1.33-2.83)***	***0.004***

[a]Risk factors identified in univariate regression in italic and the risk factors in bold were entered in the multivariate regression model; beta coefficients (B), Wald statistics, odds ratios (OR) and its 95% confidence intervals (CI) as well as p-values are represented

A good prediction power of the multivariate probabilistic model was confirmed on the test and validation cohort for 'spinal pain for days' with the AUC value of 0.76 and 0.71, respectively (Figure. 1a, b).

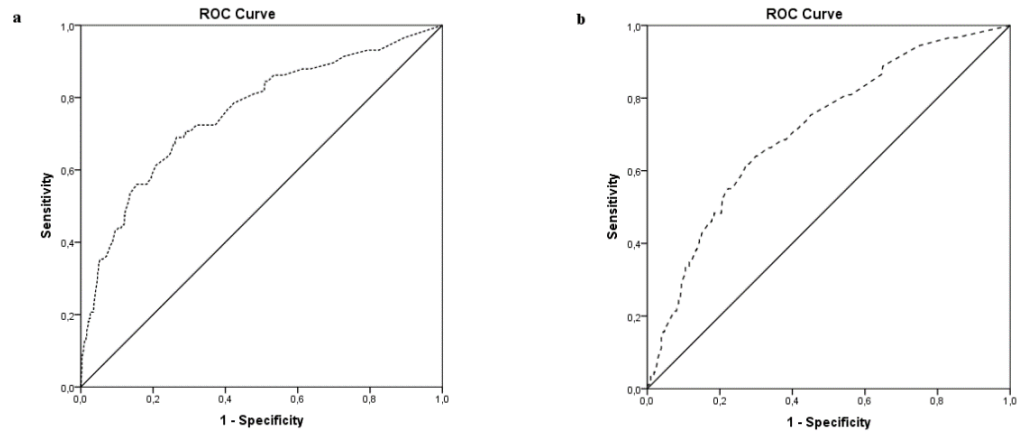

Figure 1 ROC analysis for 'spinal pain for days' in the test (a) and validity cohort (b)

As a next step, a simplified risk scoring system was developed based on the seven previously identified risk factors. Based on the risk scoring system, children's probability to suffer from spinal pain was of 8.5% with one risk factor compared to 50% with four or more risk factors. ($\chi 2 = 65.0$; df = 4; $p < 0.001$) (Fig. 2).

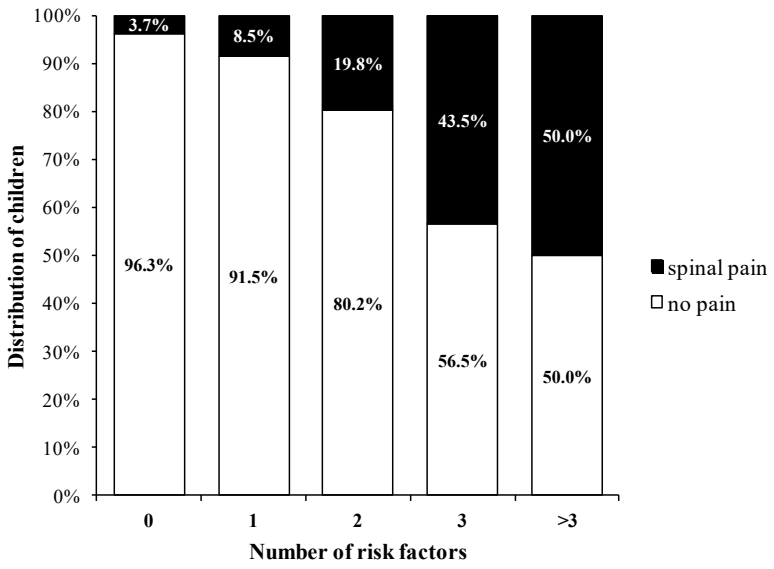

Figure 2 Frequency of children in pain according to the number of risk factor

3.5. Psychometric properties of the Hungarian STarT Back Tool

3.5.1. Pilot study results

At the orthopedic inpatient department, a pilot study was carried out involving 30 LBP patients. Afterwards, the STarT-H was reviewed, and final consensus version was agreed on at an expert group discussion based on the answers and remarks of the pilot phase (Supplementary Material 2).

3.5.2. Patient population and baseline characteristics

The psychometric analysis was performed on a patient cohort including 150 LBP patients, who had been previously diagnosed by a spine surgeon with lumbar degenerative disease and were referred to conservative group physiotherapy. We have excluded patients from the study in case they have missed the retest date, left unacceptable number of missing answers or failed to give back the questionnaire booklet. Thus, the final cohort was built up by 133 (male 42/female 91) patients. As a quality standard, we have accepted the 12% drop out rate. When investigating the distribution of the risk groups 4 (3%), 30 (23%) and 99 (74%) patients were classified to the high, medium and low risk group, respectively. Although the prevalence of the high-risk group cases is low, we wanted to demonstrate the frequency of the cases in our cohort by calculating the percentages for each group. The basic demographic features of the cohort are shown Table 7.

Table 7. Baseline characteristics of the study population

	Mean (SD)
Age	55.9 (±15.7)
Female	91 (68.4 %)
BMI	25.92 (±0.33)
Duration	
<4 weeks	33 (24.8%)
4-12 weeks	52 (39.1%)
>12 weeks	48 (36.1%)
Low Back Pain	3.45 (±0.20)
Leg Pain	2.39 (±0.28)
STarT-H total	2.55 (±0.17)
High	7 (±1.10)
Medium	4.74 (±0.98)
Low	1.58 (±1.07)
ODI	21.75 (±1.10)
TSK	34.49 (±0.47)
PCS	17.88 (±1.00)
FABQ	31.48 (±1.87)
WHOQOL-physical health	13.79 (±1.70)
WHOQOL-psychological	14.48 (±2.22)
WHOQOL-social relationships	14.71 (±2.56)
WHOQOL-environmental	14.46 (±1.93)

SD= standard deviation

3.5.3. Internal consistency

No floor and ceiling effects were present at baseline, with 14% and 1% of the cases responding the highest and lowest values, respectively. Assumptions were met for the factor analysis with the Kaiser-Meyer-Olkin's measure of sample adequacy value being adequate (0.77) and the Bartlett's test of sphericity being significant (Chi^2= 211.6, df= 36, p<0.001). Inspecting the scree plot and the eigenvalues a 2-factor solution resulted in the best fit and 44.16% of the total variance was explained. The calculated Cronbach's alpha was 0.89 and 0.62 for the overall and psychosocial subscale, respectively.

3.5.4. Reliability and agreement

The calculated Intraclass Correlation Coefficient was 0.93 (95% CI_{ICC} 0.9-0.95) and 0.91 (95% CI_{ICC} 0.87-.096) for the STarT-H total and psychosocial subscale, respectively. Standard error measurement was 0.49 and 0.29, thus the minimal detectable change at 95% confidence level was calculated to be 1.37 and 0.81 points for the STarT-H total and subscale, respectively.

3.5.5. Construct validity

Good to excellent correlation was found between the STarT-H and reference questionnaires except for pain catastrophizing and WHOQOL-BREF psychological, social and environmental dimension. Table 8 demonstrates the correlation between the STarT-H and the reference questionnaires.

Table 8. Correlation between the STarT-H and the reference standard questionnaires

Instrument	STarT-H	
	Total	**Subscale (Q5-9)**
ODI	0.65**	0.49**
TSK	0.47**	0.43**
PCS	0.27*	0.42**
LBP	0.57**	0.51**
Leg pain	0.50**	0.32**
FABQ	0.45**	0.43**
WHOQOL- physical	-0.56**	-0.49**
WHOQOL- psychological	-0.34**	-0.46**
WHOQOL-social	-0.17	-0.23*
WHOQOL- environmental	-0.23*	-0.32**

Spearman's rank correlation coefficients (rho) are represented; *p <0.05; **p <0.01

Risk group's overall STarT scores significantly differed at baseline (p<0.001). Significant differences between the risk groups were also discovered (p<0.05) in pain intensity for LBP and leg pain, and FABQ physical activity subscale. A more detailed analysis showed significant differences between the high and low risk groups in their means score of the ODI, TSK, PCS, FABQ work subscale, WHOQOL-BREF psychological, environmental and social domain as well. Results of the outcome measures before and after are shown in Table 9.

Table 9. Mean scores of outcome measures in the STarT risk groups before and after treatment

Outcome	STarT Risk group	Before treatment Mean (SD)	After treatment Mean (SD)
ODI[##]	Low	16.21 (10.94)	13.67 (10.21)
	Medium	29.92 (11.67)	24.33 (16.45)
	High	*35.42 (15.69*	*47.50 (10.61)**
LBP[#]	Low	2.77 (2.13)	2.07 (1.56)
	Medium	3.94 (2.04)	3.00 (4.24)
	High	*7.37 (1.97)*	*3.67 (2.69)**
Leg pain[#]	Low	1.78 (2,31)	1.41 (2.14)
	Medium	3.57 (2.67)	3.00 (2.78)
	High	6.33 (2.50)	5.50 (3.54)
TSK[##]	Low	33.27 (4.79)	32.08 (5.50)
	Medium	35.63 (5.48)	33.83 (6.08)
	High	*39.89 (3.51)*	*46.50 (0.71)**
PCS[##]	Low	15.69 (9.68)	11.10 (7.63)
	Medium	21.31 (11.88)	19.00 (14.34)
	High	24.62 (6.03)	32.00 (14.45)
FABQ physical activity subscale[#]	Low	10.98 (5.34)	10.52 (5.87)
	Medium	14.00 (5.52)	13.33 (5.39)
	High	20.75 (2.50)	18.00 (8.49)
FABQ work subscale[##]	Low	11.21 (10.36)	8.97 (8.88)
	Medium	17.80 (11.56)	16.89 (14.04)
	High	25.40 (12.78)	23.50 (19.09)
WHOQOL-BREF physical health	Low	*14.16 (1.61)*	*15.87 (1.82)***
	Medium	12.71 (1.41)	13.92 (2.35)
	High	12.17 (2.89)	12.29 (2.02)
WHOQOL-BREF psychological[##]	Low	14.85 (2.07)	15.25 (1.67)
	Medium	13.69 (2.28)	14.67 (1.99)
	High	11.50 (3.04)	12.33 (0.67)
WHOQOL-BREF environment[##]	Low	14.77 (1.82)	15.34 (2.16)
	Medium	13.63 (2.08)	15.54 (2.68)
	High	12.63 (1.32)	13.04 (1.89)
WHOQOL-BREF social[##]	Low	14.87 (2.34)	15.74 (2.25)
	Medium	14.29 (3.10)	15.33 (2.56)
	High	13.33 (4.22)	14.44 (1.39)

[#]*p<0.05* between STarT risk groups, [##]*p<0.05* between low and high STarT risk groups

**p<0.05*; ***p<0.001* before and after treatment

Patients being in distress had significantly (p<0.05) higher STarT baseline scores (4.44; SD=1.70) than the individuals not being in distress (2.24; SD= 2.37). Figure 3. represents the baseline STarT score differences between patients in distress and non-distress.

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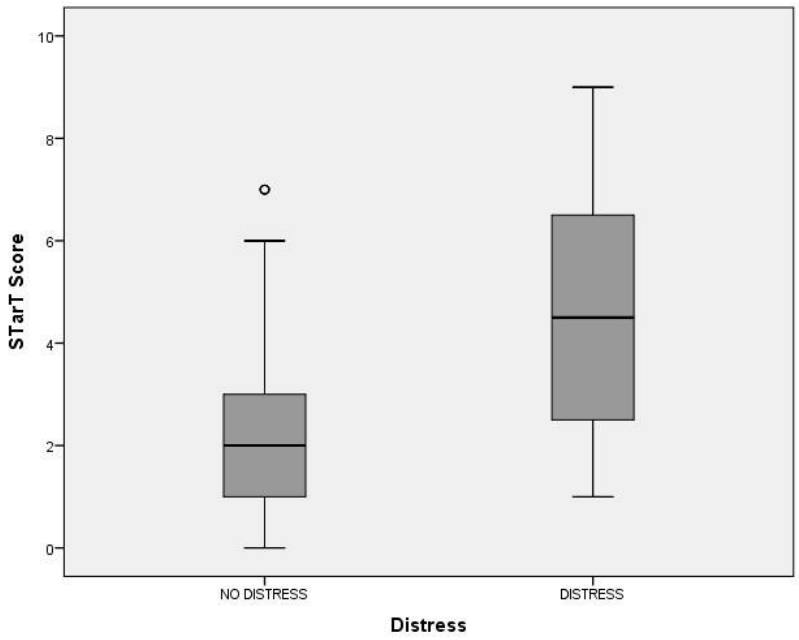

Figure 3. STarT-H score in distress and no distress group at baseline

We also found significant improvement in the physical health domain of WHOQOL-BREF in the low-risk group. On the contrary, we have found that the high-risk group significantly worsened in their functional impairment and fear of movement scores although their LBP pain intensity improved. We have also found a mild worsening in pain catastrophizing, but this change did not prove to be significant.

Investigating the risk group global treatment outcome, we have found that 50 (94%) and 12 (92%) patients had good outcome in the low and medium risk groups after 3 months, respectively. As shown in Table 10., we can see that all patients allocated to the high-risk groups had poor outcome as did 3 and 1 patients from the low and medium risk groups, respectively.

Table 10. STarT risk groups and distribution of global treatment outcome and distress

	STarT Risk Groups		
	Low n=53 (%)	**Medium** n =13 (%)	**High** n =4 (%)
Good outcome	50 (94)	12 (92)	0 (0)
Poor outcome	3 (6)	1 (8)	4 (100)
No distress	49 (92)	11 (92)	0 (0)
Distress	4 (8)	2 (8)	4 (100)

Chi^2=17,47; p<0.001 for good vs poor outcome

Chi^2=19,09; p<0.001 for distress vs no distress outcome

We found significant differences between the STarT risk groups and global treatment outcome at 3 months (Chi^2=17,47; p<0.001) and for the patients experiencing distress and no distress (Chi^2=19,09; p<0.001).

3.5.6. Prognostic discriminative validity

The distribution of patient global improvement at a 3-month follow up was as follows: 91% good, 9% for poor outcome and 86% were experiencing no distress, 14% were in distress. Discriminative ability of the STarT Back Tool was determined by the ROC method and an analysis was performed for global treatment outcome and distress. For patients being in distress, the AUC was 0.8 for baseline STarT scores, thus representing a good discriminative ability (Figure 4a). The predictive ability for global treatment outcome vs STarT risk groups proved to be adequate as well with an AUC of 0.76. For the baseline STarT scores an AUC of 0.7 was found regarding global treatment outcome (Figure 4b).

Fig.4a

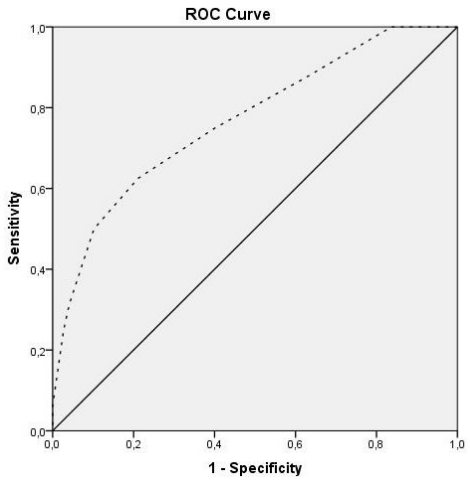

Fig.4b

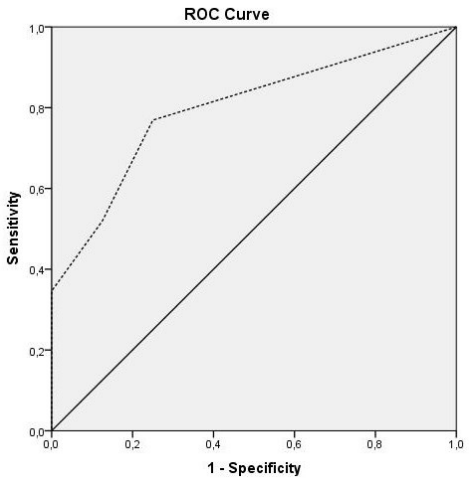

Figure 4a. and 4b. Receiver operating characteristic curve for the STarT-H total score for patients being in distress and for the STarT-H total score for global treatment outcome

4. DISCUSSION

4.1. Pediatric spinal pain prevalence and risk factors

Pediatric spinal pain prevalence found in our cohort resembles the previously published occurrence rates (M. A. Jones et al., 2004; Kjaer et al., 2011). About 13% of children with the mean age of 11 years had experienced spinal pain in the last month. Low back pain was found in 19.4%, back pain in 24.9% and neck pain in 25% of the cases. According to the existing evidence, it can be expected that this number will rise with age as the reported prevalence reaches almost the adult rates by adolescence. Opposing to Jones et. al, who reported that about 23% needed medical care and 26% had been absent from school, in our cohort we that only found 4% needed to visit a doctor and even less were absent from school because of spinal pain. This can be most likely explained by the different age groups investigated as our cohort represents a younger group, whereas Jones investigated a group of children 10-16 years.

Through a large-scale prospective study seven risk factors were identified and validated that play a role in spinal pain development in childhood. Age older than 12 years, spending longer time learning or watching TV, perceiving the school desk as uncomfortable, frequent sleeping problems, poor general well-being and positive familiar medical history regarding spinal disorders are associated with spinal pain in schoolchildren.

Consistent with the evidence, we found that the occurrence of spinal pain and health care seeking behavior increases with age (Dissing et al., 2017; Kjaer et al., 2011; Lazary et al., 2014). Our findings support the results published by Trevelyan et al. (Trevelyan & Legg, 2006) that children older than 12 years had an increased risk for the development of spinal pain. Gender is a plausible biological risk factor for adult spinal pain, but there has been conflicting evidence regarding pediatric spinal pain. In our analysis, gender was not significantly associated with spinal pain, which corresponds with the findings of several publications investigating the relationship between prevalence rates of spinal pain and gender (Calvo-Munoz et al., 2013; Dissing et al., 2017; Olsen et al., 1992). Kovacs et al. (Kovacs et al., 2003) conducted a population based study investigating adolescent and adult LBP and one of their key findings was that gender related risks increase with age, other authors found female gender to be a predictor for spinal pain but only in the cases of more severe and frequent LBP or having pain in more than one spinal area

(Harreby et al., 1999; Wirth & Humphreys, 2015). As highlighted in section 1.2.2. (**Risk factors for pediatric spinal pain**), we must be careful in making comparisons and drawing conclusions in pediatric spinal research as extensive heterogeneity can be found in research methodology and the investigated study population.

Sedentary lifestyle is linked to back pain (Lazary et al., 2014; Skoffer & Foldspang, 2008) as it is assumed that the structural changes of the intervertebral disc are the underlying mechanism of the development of chronic low back pain (Billy, Lemieux, & Chow, 2014). Technical developments have led to increased sedentary lifestyle causing growing physical inactivity. The tendency of sedentary lifestyle increases with age and in our investigation children over 12 years of age spend significantly longer times seated ($\chi 2 = 32.1$; $df = 5$; $p < 0.001$) compared to the younger population. Our study confirmed that watching TV or studying for more than 2 hours a day increases the risk of spinal pain in children. However, computer usage of more than 2 hours a day did not increase the occurrence of spinal pain in our risk assessment model. The most plausible explanation how computer usage did not raise the chance of spinal pain is that the ergonomic environment is much favorable compared to watching TV and studying from a book.

Sitting position at school can be also associated with the development of spinal pain according to our and others' findings, that uncomfortable school desks increase the risk for back pain or health care seeking behavior (Limon, Valinsky, & Ben-Shalom, 2004; Trigueiro, Massada, & Garganta, 2013). However, from an ergonomic point of view, the Hungarian educational setting is the most favorable as the sitting direction of the children in relation of the teacher is faced frontal (Limon et al., 2004).

Studies report a link between spinal pain and carrying heavy objects, carrying school backpacks and transportation to and/from school by car (Lazary et al., 2014; Limon et al., 2004). Watson et al. (Watson et al., 2002) found that 94% of the children who were suffering from back pain experienced some disability, with the most common reports being difficulty carrying schoolbags. In our analysis, the question about how heavy the school bag was perceived, scored very poorly in the reliability analysis and therefore so we could not make any conclusions in this matter. However, we have found that asymmetric types of schoolbags and "carrying schoolbag is tiring" were significantly associated with spinal pain in our univariate models but were not entered into the final multivariate regression model. In a secondary subsequent analysis, the weight of the

backpack played a significant role for LBP ($\chi2 = 21.84$; df = 2; $p < 0.001$), BP ($\chi2 = 23.69$; df = 2; $p < 0.001$) and for neck pain ($\chi2 = 16.83$; df = 2; $p < 0.001$) which can be explained by the type of mechanical load the spine likely suffers from while carrying a backpack. Regarding the transportation to and/from school played a role in LBP as the children who were taken by car (increased time seated per day) were more likely to have LBP ($\chi2 = 21.77$; df = 2; $p < 0.001$).

Poor general well-being and frequent sleeping problems, as in so many other diseases, proved to increase the risk of pediatric spinal pain as well. Wirth et al. investigated more than 400 adolescents and found that sleep disorder is a significant predictor for pain in more than one spinal area and also a trend for frequent pain (Wirth & Humphreys, 2015). Adverse psychological factors such as distress or dissatisfaction caused by the educational system and pre-existing somatic pain can also can increases the risk of musculoskeletal symptoms, especially LBP in children who initially were pain free (Erne & Elfering, 2011; G. T. Jones et al., 2003).

Parental spinal pain in our analysis was identified as a risk factor representing a consecutive biological vulnerability and possible adverse effect of parental pain behavior. Children whose first- and second-grade relatives had suffered from LBP were more likely to experience neck, back or low back pain. Our results reinforce the results of Wirth et al. in which they report that LBP pain in one or both parents may lead to spinal pain in childhood (Wirth et al., 2013). Although the rate of children who needed medical attention and sequential absence from school was low in our cohort, a deeper analysis revealed that children suffering from spinal pain were at higher risk to take sick leave and showed a greater extent of health care seeking behavior ($\chi2 = 190.35$; df = 2; $p < 0.001$; $\chi2 = 281.73$; df = 2; $p < 0.001$). The exact roles of the possible genetic and behavioral factors as well as the effective mitigation strategies of these familiar risks need further investigations.

Pediatric spinal pain risk factors are connected in their effects. It has been investigated that there is an association between screen-time and poor psychological well-being (Twenge & Campbell, 2018). Longer screen times, which are more frequent with older age, also have a negative effect on physical and cognitive abilities and are linked to sleep problems (Domingues-Montanari, 2017). Lifestyle is an important aspect of every musculoskeletal disease and school children (which could be seen as sedentary lifestyle)

are also linked to after school screen-based sedentary behavior hence low level of daily physical activity. As we can see, the complexity in which spinal pain can develop is entangled, but on the other hand it has elements which can be changed and by that the vicious cycle can be broken.

The study has got some possible limitations. Firstly, we did not predefine an age limit for the questionnaire. According to educational experts Hungarian children are capable to read and write alone at the age of 8-9 years, but to fill out a questionnaire alone is another cognitive developmental level. Studies applying questionnaire targeting children need to consider different schooling systems and as such each country must examine this matter on a national scale. We generally advised the children to fill out the questionnaire themselves with the supervision of their parents; therefore, there is a chance of possible bias in terms of parental influence on the given answers. In our study we did not include the investigation of pain intensity as our primary aim was to identify possible risk factors leading to pediatric spinal pain. We have investigated sitting as a risk for spinal pain, but we did not deeply explore the quality in which the children sit, therefore we cannot make conclusion in regard of possible postural disturbances. Another limitation of our study is that the risk assessment scoring system has not yet been externally validated.

4.2. STarT Back Tool cross-cultural adaptation and validation

Cross-cultural adaptations and validation studies of diverse PROMs add valuable information about the psychometric properties of the questionnaires in various cultural environments and thus enhances a broader usage of this particular measurement tool (Al Zoubi, Eilayyan, Mayo, & Bussieres, 2017). The STarT questionnaire has already been cross-culturally adapted and validated into 10 languages. We have aimed to conduct the study with highest quality standard thus, the procedure which was followed for the cross-cultural adaptation and translation process was the recommendations by Beaton et al. and previous Hungarian translation validation studies (Beaton et al., 2000; Klemencsics et al., 2016; Valasek et al., 2015; Valasek et al., 2013). The original English version was referred to as an easily administered, reliable and valid tool for stratifying low back pain patients into prognostic risk groups of CLBP(Al Zoubi et al., 2017; Hill et al., 2011). The Hungarian version of the STarT Back Tool, along with its 10 translated versions, proved to be an easily implemented tool in everyday clinical practice (Al Zoubi et al., 2017). Our results demonstrate that the Hungarian version of the StarT Back Tool (STarT-H) has

high test-retest reliability, acceptable internal consistency, good construct validity and adequate prognostic discriminative ability for LBP patients with and without referred leg pain in a Hungarian secondary care setting.

Originally, the instrument was developed for primary care LBP screening, as often the proportion of acute or subacute cases in this setting is higher compared to secondary care settings. To enroll to secondary care is usually somewhat time consuming and in many cases the patient already recovers or enters into a subacute or chronic stage of LBP. Differences in study participant enrolment can be explained by the diverse national healthcare systems and the Hungarian health-care system enabled us to conduct a study in a secondary care hospital environment.

When comparing results of various psychometric properties of language adaptations detailed elaboration on the patient participants is needed. Looking at the demographics of our study population compared to the original article patients, participants in our cohort were older, had less pain intensity and lower STarT-H scores. The mean age in the published translated versions ranges between 43.03 and 58.6 years, both studies conducted by Iranian and Persian research groups (Abedi et al., 2015; Azimi, Shahzadi, Azhari, & Montazeri, 2014a). Our study participants mean age (55.9 SD ± 15.7) places our cohort at the end of this range. Although LBP prevalence peaks in midlife and it would indicate a greater proportion of younger patients in our cohort, but general observation suggest that these patients prefer individual therapy opposed to group therapy. We hypothesize that this can be due to easier scheduling with office hours.

It is important to mention that in the original publication, about 60% of the cases included LBP for less than 3 months, in our study this rate was 24.8% showing similarities with other publications (Bruyere et al., 2014; Hill et al., 2008; Morso et al., 2013). Again, study results must be carefully interpreted as a great majority of the published articles do not describe their study population's proportion of chronicity. We advocate a clear description of the study population for future research projects as it adds a great value to the existing study results and lack of it can make further analysis biased.

Regarding construct validity, the STarT-H the strongest association was found between ODI, TSK, LBP, LP, FABQ and WHOQOL-BREF physical health subscale which corresponds published language adaptations (Azimi, Shahzadi, Azhari, & Montazeri, 2014b; Matsudaira et al., 2017). Pain catastrophizing showed the weakest connection with

the target questionnaire similarly as the published German validation studies (Aebischer, Hill, Hilfiker, & Karstens, 2015; Karstens et al., 2015), although the psychosocial subscale showed a somewhat stronger correlation. Clinically, this could be explained by inspecting our patient population in more detail, as the participants were treated with group physiotherapy and a great proportion of them were already suffering from CLBP. Reliability of the STarT-H proved to be excellent, supporting previously published language adaptations (Abedi et al., 2015; Luan et al., 2014).

4.3. Predicting outcome of group physical therapy with the STarT Back Tool

STarT-H has proved to be predictive for global treatment outcome after 3 months of group physical therapy treatment for low-back pain. The AUC represents the ability of the screening questionnaire to discriminate between patients with and without the symptom or sign being assessed. In our analysis, we have investigated two major aspects in relation to the applied therapy, whether the tool can discriminate between patients of good and poor outcome and patients being in distress and not being in distress. In consonance with the original publication results, we have found that the STarT-H can successfully discriminate between patients in distress because of their condition and the ones that are not in distress (Hill et al., 2008). The instrument was also capable to differentiate between patients with better or worse global treatment outcome. Discriminative ability was seldom considered, as only 2 publications investigated the ability of the instrument to measure change over time. Our results add another important value to the already assembled psychometric features (Al Zoubi et al., 2017; Medeiros, Costa, Oliveira, & Costa, 2019). Some studies analyzed the predictive ability of the STarT Back Tool in primary and secondary care settings (Beneciuk et al., 2013; Forsbrand et al., 2018; Hill et al., 2008; Matsudaira et al., 2016; Suri, Delaney, Rundell, & Cherkin, 2018). The recently published Israeli version was carried out in a secondary setting but on a subgroup of patients of acute and subacute low back pain patients (Ben Ami et al., 2020). We decided to analyze the total group and not only its' subgroups as this represent the whole patient population in secondary care for the treatment for low back pain.

Yellow flags increase the possibility of chronicity thus, they are interpreted as prognostic factors and as such they are primary targets of treatment strategies aimed to improve

outcome. Certain modifiable psychological factors, such as depression, fear avoidance beliefs, anxiety, fear of movement, pain catastrophizing, are linked to the development and poor prognosis of chronic low back pain (Airaksinen et al., 2006; Hoy et al., 2010). In the National Center for Spinal Disorders a psychological screening system was implemented in routine care using standardized questionnaires targeting the above-mentioned yellow flags to identify patients in need of psychotherapy. However, the results of our study prove, that even the most widely accepted and precise tool is unable to screen perfectly, resulting patients considered by the STarT-H as high risk participating in treatment focusing on improving physical health and functional capacity. Consequently, the patients who were classified as high risk but fell through the standard screening process and participated in group physical therapy focusing highly on the physical aspects of LBP, did not improve from the applied therapy. The STarT Back Tool provides us with the opportunity to relatively quickly identify those patients at risk of poor outcomes and offer alternative treatment approaches that include broader biopsychosocial management of their LBP.

Despite that in some cases the screening process seems to fail, in most of the cases the patients were allocated correctly to the adequate treatment. Most of the patients' psychosocial risk factors were below the cut off scores for high risk of chronicity, consequently preferred main therapeutic approach for these patients targets the musculoskeletal aspects of the disease. If we compare the outcome measures after 3 months of treatment, we found significant improvement in the physical activity domain of the quality of life in the low-risk group, which can be expected if the patient is stratified to the right therapeutic modality. Interestingly, this improvement could only be found in the low-risk group, but not in the medium or high-risk group.

Although, the patients did improve in their clinical features but the change we have found was not significant, which can be explained by the relative low level of impairment in these specific parameters and looking at the values of minimal important change in these specific patient reported outcome measures (Ostelo & de Vet, 2005). Assessing the baseline clinical status of the study participants compared to other publications, and mostly surgically treated LBP patients, the level of functional disability is relatively low (Brox et al., 2003; J. Fairbank et al., 2005).

Even though statistically considered to be stable, the high-risk group patients did aggravate on their quality of life, functional impairment, pain catastrophizing and fear avoidance beliefs which only reinforces the evidence that the high-risk patients need a psychologically informed physical therapy or psychotherapy, and in some cases additional musculoskeletal focused treatment.

Based on our findings, the STarT Back Tool proved to be an excellent instrument to stratify the patients to risk groups of persistent disabling LBP, but its purpose to allocate the patients to the best possible therapy according to their clinical status can only be achieved if the matching treatment modalities can be provided to them. We advise primary and secondary care settings involved in spinal care to establish a psychosocial screening system to identify the patients at risk of CLBP, where the patients can participate in highly individualized treatment as earliest possible. The treatment options which should be provided for the patient cover psychologically informed physiotherapy or psychotherapy to musculoskeletal focused physiotherapy. As patient education is gaining more evidence in the successful therapy of LBP, treatment centers (hospitals, institutions, or practices as well) should try to incorporate high value and clear information about spinal disorders into their treatment protocols. Looking at the number of patients globally suffering from chronic LBP, it is at upmost priority to prevent the development of persistent symptoms for which in my opinion the STarT Back Tool could be an excellent choice.

However, there are some limitations to this current study. Firstly, in our analysis we have measured LBP generated disability with the Hungarian validated Oswestry Disability Index (Valasek et al., 2013) opposed to the Roland Morris Disability Questionnaire applied in the original publication, thus comparison of baseline functional disability caused by low back pain is obstructed. This can also be found with the Finnish and Iranian publications (Azimi et al., 2014b; Piironen et al., 2016), and such observations can generally be recognized in several language adaptations for different instruments. Secondly, albeit as mentioned, earlier the instrument was primarily developed for the primary care setting, the patient recruitment was carried out in a secondary setting. As a result, majority of the patients recruited to our study were considered chronic low back pain patients at the time of enrollment. Conclusions and comparisons with other studies must carefully be interpreted as the number of patients in the high-risk group in our study

was fairly low, thus further research with larger number patients allocated to the group of having high risk of chronicity are therefore recommended.

5. CONCLUSIONS

In the first part of this Ph.D. thesis, risk factors were identified which increase the possibility of developing pediatric spinal pain.

1. *The newly developed pediatric spinal questionnaire proved to be reliable, except for the spinal pain localizations.* In our analysis regarding of lifestyle and environmental domains, we have found that except the question about how heavy the school bag is perceived, all items had fair to excellent reliability. We hypothesize, that in the Hungarian school system the weight of the schoolbag strongly varies daily depending on the classes the children must attend, which explains why the question about the weight of the schoolbag scored so poorly. As for the symptom localization specific questions, we have identified that the question if the child has had experienced spinal pain for days proved to be the most trustworthy variable. Several studies have investigated and reported about possible risk factors but opposed to their findings a great value of our findings is that we have applied a highly reliable dependent variable as the center of our analysis. Most of the scientific inquiries neglect to question their methodological quality regarding their reliability of the developed questionnaires targeting childhood spinal pain prevalence and their risk factors.
2. *Furthermore, our study allowed us to determine and validate seven risk factors that can lead to the development of pediatric spinal pain*. We have identified age older than 12 years, spending more than 2 hours a day learning or watching TV, perceiving the school desk as uncomfortable, frequent sleeping problems, poor general well-being and positive familiar medical history regarding spinal disorders as risk factors.
3. *Subsequently, we have developed and successfully validated, on a large sample size prospective cohort study, a risk scoring system which is capable of identifying the children who are at risk of suffering from spinal pain*. Accordingly, children having one risk factor had a possibility of 8.5% to suffer from spinal pain while the 50% in the case of four or more risk factors. The risk scoring system is a reliable and easily applied tool for everyday preventative actions and we highly suggest the use of it in school healthcare systems. If we look at the identified risks, only age is classified as a non-modifiable risk factor, but all the others can be targeted, and hence pediatric spinal pain can successfully be avoided. Previous studies have proven that experiencing spinal pain in childhood is predictive for adult low back pain and as such

the developed questionnaire not only prevents pediatric spinal pain but can also be perceived as a tool for primary prevention actions for adult low back pain.

However, our main purpose was the development of a risk scoring system applicable in school-based health systems or pediatric clinical care settings, to initiate primary prevention actions for spinal pain in childhood. The new instrument fills a gap by providing an easy to use tool which can be administered and analyzed quite easily. Recent technological innovations open up possibilities to follow the children's health and intervene if needed. The tool could be applied paper-based, online, or even as an application developed for different technological devices.

In the second part of the Ph.D thesis we cross-culturally adapted and validated the STarT Back Tool questionnaire into Hungarian language thus also reporting firsthand information of the risk profile of LBP patients in a secondary care setting in Hungary.

4. *According to our results, the STarT-H has satisfactory psychometric properties.* The tool has high test-retest reliability, acceptable internal consistency, good construct validity and adequate prognostic discriminative ability for LBP patients with and without referred leg pain in a Hungarian secondary care setting. We aimed and accomplished to provide the Hungarian spine care professionals with an easy to use and reliable tool which can assess and classify the patients into prognostic risk groups of persistent disabling LBP based on their individual risk profile.
5. *Furthermore, our study results allow us to conclude, that the STarT-H is capable of differentiating patients who have good or poor outcome*. The instrument also successfully discriminates between patients who are at psychological distress and patients who are not in distress. LBP is considered as a multifactorial disease and the STarT-H is reliable tool which can flag the patients who need psychologically informed therapy or psychotherapy. The tool is able to identify patients who are more likely to benefit from therapies focusing more on the physical aspect of LBP such as group physical therapy.
6. Based on our analysis, the tool can be also used to predict global treatment outcome in LBP patients treated with group physical therapy. Beside stratifying patients for risk of disabling persistent pain, we wanted to examine previously unexplored possibilities of the STarT-H questionnaire. According to our findings, the tool can not only predict global treatment outcome, but it also successfully discriminates patients

in psychological distress and not in distress. Even though, the tool was initially developed as a screening instrument, our findings indicate the possibility to use it to predict outcome, which seems to be worthwhile. Nevertheless, further research can broaden the spectrum in which the instrument can be applied.

The instrument was initially developed to be applied in primary care settings but according to our results it has a rightful place in a secondary care setting as well. However, our primary advice remains to use the questionnaire in primary care settings as the patient population might be more diverse in terms of LBP staging (acute, subacute, chronic) and as steps to avoid chronicity must be taken at the earliest timepoint possible. It must also be acknowledged that the tool was also well accepted by the patients, which is highly valuable in research but also in clinical spinal care as in our experience the patient compliance towards long questionnaire booklets is rather low.

In general, we can recommend the usage of the STarT-H in primary and secondary care clinical settings with predefined treatment or referral options for each risk group. In terms of generalizability, cross-cultural adaptations and psychometric analysis with high methodological quality can add a great value to the original questionnaire and opens possibilities to augment international collaboration in multicenter studies targeting low back pain research.

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6. SUMMARY

The general aim of my Ph.D work was to develop, cross-culturally adapt and validate measurement tools in Hungarian language which aim to identify the risk that leads to LBP in childhood or increase the risk of adult CLBP in the Hungarian population.

In the first part of my Ph.D thesis after a careful literature review (Lazary et al. 2014) involving experts in pediatric spinal pain, a new self-report questionnaire was developed (Szita et al. 2018) with the goal to measure pediatric spinal pain prevalence and to identify possible risk factors leading to this condition. To maintain the highest research methodological quality, firstly we analyzed the newly developed questionnaire's reliability through a test-retest study involving 150 children. Subsequently, we have placed the highly reliable 'spinal pain' as the center of the risk factor analysis. Through a large-scale study, we have identified seven risk factors that increase the occurrence of spinal pain in childhood. We have built a risk assessment system which we have validated on a large sample size prospective cohort study and based on our results, if a child carries four or more of the identified factors, the chance of suffering from spinal pain raises to 50%.

In the second part of the thesis (Szita et al. 2020), firstly the cross-cultural adaptation of the STarT Back Tool was conducted into Hungarian language and the following analysis proved adequate psychometric properties. Secondly, the predictive ability of the STarT-H on global treatment outcome and psychological distress was proven in a typical outpatient secondary setting - group physical therapy for adult non-specific LBP patients. Evidence shows that spinal pain in childhood is a common complaint which is also predictive for adult chronic low back pain. Preventive actions aiming to avoid chronicity therefore not only should target adult acute and subacute low back pain, but also to avoid the initial development of spinal pain in childhood. In our study, we have identified risk factors which are almost all modifiable, therefore successful interventions are advocated in form of primary prevention programs to address these issues. This risk estimation questionnaire can be a standardized tool for primary prevention actions of pediatric spinal pain by being a feasible method for the identification of the at-risk group of children. With the STarT-H, we provide Hungarian speaking spine care professionals with an easy to use tool which enables the identification of patients who are at high risk of persisting disabling pain and if treated with psychologically informed therapy a poor prognosis can be avoided.

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8. LIST OF OWN PUBLICATIONS

8.1. Publications that formed the basis of the dissertation

Szita Julia; Kiss Laszlo; Biczo Adam; Feher Katalin; Varga Peter P.; Lazary Aron Outcome of group physical therapy treatment for non-specific low back pain patients can be predicted with the cross-culturally adapted and validated Hungarian version STarT back screening tool. DISABILITY AND REHABILITATION in press p. in press (2020)

Szita J, Boja S, Szilagyi A, Somhegyi A, Varga PP, Lazary A. Risk factors of non-specific spinal pain in childhood. Eur Spine J. 2018 Feb 15. doi: 10.1007/s00586-018-5516-1.

Lazary, A; Szoverfi, Z; **Szita, J**; Somhegyi, A; Kumin, M; Varga, PP Primary prevention of disc degeneration-related symptoms. EUROPEAN SPINE JOURNAL 23 Suppl 3 pp. S385-S393. (2014)

8.2. Publication in the field of spinal care as first and co-author

Biczo, Adam; **Szita, Julia**; McCall, Iain; Varga, Peter Pal; Lazary, Aron**; Genodisc Consortium**. Association of vitamin D receptor gene polymorphisms with disc degeneration. EUROPEAN SPINE JOURNAL 29: 3 pp. 596-604., 9 p. (2020)

Lazary, Aron; Klemencsics, Istvan; Szoverfi, Zsolt; Kiss, Laszlo; Biczo, Adam; **Szita, Julia**; Varga, Peter Pal. Global Treatment Outcome after Surgical Site Infection in Elective Degenerative Lumbar Spinal Operations. SURGICAL INFECTIONS Paper: Online ahead of print (2020)

Szita Júlia, Nem-specifikus, krónikus generalizált gerincfájdalom kezelése Gerincgyógyászati Szemle, július pp. 21-24., 4 p. (2020)

Szita Júlia; Fehér Katalin; Bereczki Ferenc; Varga Péter Pál; Lazáry Áron. Sacroiliacalis ízület differenciál diagnosztikai tesztek megbízhatósága és validálása GERINCGYÓGYÁSZATI SZEMLE (2064-8324): 5 1 pp 58-65 (2018)

Szita Júlia, Magyar Orsolya. A nem specifikus nyak fájdalom fizioterápiás vizsgálatának áttekintése. Fizioterápia: Magyar Gyógytornászok Társaságának lapja, 2015.

Szita Júlia, Fehér Katalin, Varga Péter Pál, Lazáry Áron. A STarT Back Screening Tool magyar nyelvű verziójának kulturális adaptációja és validálása (STarT-H). Gerincgyógyászati Szemle, 2017

Magyar Orsolya, **Szita Júlia**, Lazáry Áron. Online mozgásprogram alkalmazásának lehetőségei derékfájdalom kezelésében. Gerincgyógyászati Szemle, 2017

Szita Júlia, Bors István, Lazáry Áron, Varga Péter Pál. A törzs izometriás izomereje degeneratív lumbális gerincbetegségben. Gerincgyógyászati Szemle, 2015

Szita Júlia, Lövei-Pólik Dorottya. A carpal tunnel szindróma és a double crush szindróma kapcsolata. FIZIOTERÁPIA 22: 1 pp. 18-21. (2013)

Szita Júlia, Shenker Benjámin. Cervicogen fejfájás terápiája. FIZIOTERÁPIA 21: 1 pp. 10-11. (2012)

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SUPPLEMENTARY MATERIALS

Supplementary Material 1.

EGÉSZSÉGFELMÉRŐ KÉRDŐÍV

Tisztelt Szülők!

A tartásjavító program hosszú távú hatékonyságát illetve a gerincpanaszok gyakoriságát szeretnénk az alábbi kérdőívvel felmérni. Kérjük, a kérdőívet a gyermekével közösen töltsék ki! A kérdőív kitöltése rövid, de komoly feladat. Figyeljenek oda, hogy őszinte válaszokat adjanak, ne vicceljék el a kérdőív kitöltését. Magyarázzák el gyermeküknek, hogy nincsen pontozás, nincsen jó vagy rossz válasz és, hogy az őszinte, igaz válaszok nagyon fontosak. ***Kérjük, hogy a kérdőívet a gyermekükkel a mai napon töltsék ki és írják alá (ezzel igazolják, hogy gyermekük az Önök felügyelete mellett töltötték ki a kérdőívet) és holnap gyermekükkel küldjék vissza az iskolába!***

A GYERMEK NEVE: _____ SZÜLETÉSI DÁTUM:_____/____/____

NEM: O fiú **O** lány

ISKOLA: _____ OSZTÁLY: _____

I. A következő kérdések a mindennapjaidra vonatkoznak:

1. Hogyan jársz iskolába?

□ gyalog

□ autóval

□ busszal/vonattal

2. Hány órát tanulsz délután átlagosan?

□ kevesebb, mint napi 1 órát

□ napi 1-2 órát

□ több, mint napi 2 órát

3. Mennyi időt töltesz tévézéssel?

	Hétköznap	Hétvégén
kevesebb, mint napi fél órát	□	□
napi fél-1 órát	□	□
napi 1-2 órát	□	□
több, mint napi 2 órát	□	□

4. Mennyit számítógépezel, videójátékozol naponta?

	Hétköznap	Hétvégén
kevesebb, mint napi fél órát	□	□
napi fél-1 órát	□	□
napi 1-2 órát	□	□
több, mint napi 2 órát	□	□

5. Milyen testnevelésre jársz az iskolában?

□ testnevelés óra

□ gyógytestnevelés óra

□ gyógytornára járok

6. Sportolsz valamit rendszeresen? (az iskolai testnevelésórán kívül)

□ nem

□ igen, hetente 1-2 alkalommal (sportág:_____)

□ igen, majdnem minden nap (sportág: _____)

□ igen, versenyszerűen sportolok (sportág: _____)

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7. Milyen típusú az iskolatáskád?

□ kétpántos és két vállon hordom

□ kétpántos, de egy vállon hordom

□ egypántos

8. Milyen nehéz az iskolatáskád?

□ nagyon nehéz

□ néha nehéznek érzem

□ nem nehéz

9. Elfáradsz az iskolatáska cipelésében?

□ igen, minden nap fárasztó cipelni

□ néha elfáradok a táska miatt

□ nem fárasztó vinnem a táskát

10. Mennyire érzed kényelmesnek az iskolapadot, a széked?

□ egész tanóra alatt gond nélkül tudok ülni

□ néha kényelmetlen az iskolapadban ülni

□ előfordul, hogy tanóra végére fájnak a tagjaim

11. Hogyan alszol?

□ jól alszom

□ néha felébredek éjjel

□ gyakran felriadok álmomból

12. Ha választanod lehetne, mivel töltenéd a szombat délutánt? (írd le!)

_____

II. A következő kérdések az egészségi állapotodra vonatkoznak:

13. Hogy érzed magad a bőrödben?

□ jól érzem magam

□ néha nem vagyok jól

□ gyakran rosszul érzem magam

14. Milyen gyakran hiányzol az iskolából, mert beteg vagy?

□ szinte soha

□ évente egyszer, kétszer

□ gyakran

15. Előfordult-e az <u>utóbbi hónapban</u>, hogy fájt a derekad?

□ nem

□ igen, egyszer-kétszer

□ igen, gyakran

16. Előfordult-e az <u>utóbbi hónapban</u>, hogy fájt a hátad?

□ nem

□ igen, egyszer-kétszer

□ igen, gyakran

17. Előfordult-e az <u>utóbbi hónapban</u>, hogy fájt a nyakad?

□ nem

□ igen, egyszer-kétszer

□ igen, gyakran

18. Volt-e már olyan, hogy <u>napokig</u> fájt a derekad, a hátad, vagy a nyakad?

□ nem

□ igen, egyszer már volt

□ igen, többször volt

19. Volt-e már olyan, hogy annyira fájt a derekad, hátad vagy a nyakad, hogy nem tudtál iskolába jönni?

□ nem

□ igen, egyszer már volt

□ igen, többször volt

20. Volt-e már olyan, hogy annyira fájt a derekad, hátad vagy a nyakad, hogy doktorhoz kellet menni, vagy gyógyszert kaptál a fájdalomra?

□ nem

□ igen, egyszer már volt

□ igen, többször volt

FORDÍTS!

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III. A következő kérdésekre Anyukád, vagy Apukád válaszoljon!

21. A közeli rokonok között fordult-e elő gerincbetegség a családban?(több választ is jelölhet)

□ nem

□ igen, a gyermek elsőfokú rokonainál (szülő, testvér)

□ igen, a gyermek másodfokú rokonainál (nagyszülő, nagybácsi, nagynéni, unokatestvér)

22. Szülőként/gondviselőként, hogyan látja gyermeke gerincének egészségét?

□ kiváló („A gyermek gerincének egészsége biztonságban van.”)

□ közepes („Lehetne jobb a gyerek tartása!”)

□ nem jó („Valamit sürgősen tenni kell…)

Szülő/gondviselő aláírása: _____ KITÖLTÉS DÁTUMA: _____/___/___

SEGÍTSÉGÉT KÖSZÖNJÜK!

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Supplementary Material 2. Hungarian version of the STarT Back Screening Tool

The Keele STarT Back Screening Tool

Beteg neve: Dátum:

Az utolsó 2 hetet figyelembe véve válaszoljon a következő kérdésekre:

		nem értek egyet 0	egyetértek 1
1.	Volt olyan, hogy a **lábamba/lábaimba lesugárzott** a derékfájdalmam az utóbbi 2 hétben	□	□
2.	Volt olyan, hogy a **nyakamban** vagy a **vállamban** fájdalmat éreztem az utóbbi 2 hétben	□	□
3.	A derékfájdalmam miatt csak **rövid távokat sétáltam**	□	□
4.	Az utóbbi 2 hétben a szokásosnál **lassabban öltöztem** a derékfájdalmam miatt	□	□
5.	Egy hozzám hasonló állapotban lévő személynek, nem igazán biztonságos, hogy fizikailag aktív legyen	□	□
6.	Sokszor **aggasztó gondolatok** járnak a fejemben	□	□
7.	Úgy érzem a **derékfájdalmam szörnyű** és **soha nem lesz jobb**	□	□
8.	Általában nem élvezem azokat a dolgokat, amiket korábban élveztem	□	□

9. Az **utóbbi 2 hétben** összességében mennyire volt **zavaró** a derékfájdalma?

egyáltalán nem	enyhén	közepesen	nagyon	rendkívüli módon
□	□	□	□	□
0	0	0	1	1

Összpontszám: **Alpontszám (5-9 kérdés):**

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A STarT Back Tool pontérték rendszer