Clinical pain research

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The Standardised Mensendieck Test as a tool for evaluation of movement quality in patients with nonspecific chronic low back pain

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Abstract

Introduction: Nonspecific chronic low back pain is a multifactorial biopsychosocial health problem where accurate assessments of pain, function and movement are vital. There are few reliable and valid assessment tools evaluating movement quality, hence the aim was to investigate nonspecific chronic low back pain patients' movement patterns with the Standardised Mensendieck Test.
Methodology: Twenty patients (mean age = 41, SD = 9.02) with nonspecific chronic low back pain were examined with the Standardised Mensendieck Test whilst being videotaped and compared with 20 healthy controls. A physiotherapist, blinded to participant's group belonging, scored Standardised Mensendieck Test videos according to the standardised manual. Associations between movement quality, fear of movement and re(injury) i.e. kinesiophobia and pain intensity were also investigated.
Results: Patients scored significantly poorer than the controls in all 5 Standardised Mensendieck Test domains ($p < 0.001$). The biggest difference was observed with regard to movement pattern domain. In women we also found a difference in the respiration pattern domain.
Conclusions: The Standardised Mensendieck Test was able to detect significant differences in quality of movement between patients and healthy controls. These results indicate that the Standardised Mensendieck Test may be a valuable examination tool in assessment and treatment of nonspecific chronic low back pain patients. Further, longitudinal studies should investigate whether poor movement and respiration patterns are important factors in nonspecific chronic low back pain, e.g. as predictors and/or mediators of therapeutic effects.

Keywords: low back pain; movement quality; respiration; Standardised Mensendieck Test; kinesiophobia.

1 Introduction

Low back pain (LBP) is a highly prevalent [1] global health problem causing more years lived with disability than any other health condition [2]. The causes of LBP are multifactorial and associated with a complex interplay of biopsychosocial factors [3]. In about 85–90% of all LBP cases, the pathoanatomical aetiology is unknown and is defined as nonspecific [4]. Physical features such as maladaptive postures and movement patterns [5–7] and cognitive factors, like fear of movement and (re)injury [8] are merely some aspects associated with chronicity [9].

Treatment of nonspecific chronic LBP (NSCLBP) is challenging and no single method is shown to be superior to others. Recent update of clinical guidelines for LBP and *sciatica* recommends a combination of a physical and psychological programme, incorporating a cognitive behavioural approach for treatment of NSCLBP following a thorough patient examination [10]. Accurate assessment is recommended for targeted treatment of NSCLBP, however evaluation of psychosocial factors, pain, quality of movement and posture can be a challenging task, particularly in a daily clinical setting when time is limited and advanced equipment is rarely available. Consequently, in recent years, the development

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of assessment instruments that may help the clinicians to make informed decisions about back pain treatment and yet are easy to implement in daily practise has been strongly emphasised. One such instrument is a STarT Back tool [11], a short prognostic questionnaire, which can help to stratify patients into different types of treatments. Nevertheless, self-report questionnaires have limited value in evaluation of bodily characteristics and quality of movement, which constitutes a core of physiotherapists' focus when treating back pain. Maladaptive movement patterns (e.g. cautious tensed movements) [12] and maladaptive respiration patterns (e.g. shallow thoracic breathing, withholding breath during movements) are commonly observed [13, 14]. These maladaptive patterns can also potentially be targeted during treatment of NSCLBP, both through specific exercises and cognitive behavioural approaches [12]. Currently, there is no agreement, amongst health professionals, on how movement quality should be standardised in patients with nonspecific LBP [15]. We are thus in need for instruments that can provide us with a standardised evaluation of movement quality and breathing pattern, that are easy to perform and implement in clinical practise [7, 15].

The Standardised Mensendieck Test (SMT) has previously been reliability tested and validated in women with chronic pelvic pain (CPP) [16], but not in NSCLBP-patients. In the present study, the aim was to apply the SMT to evaluate bodily characteristics and quality of movement in NSCLBP patients. Additionally, since fear avoidance beliefs play an important role in NSCLBP and has previously been shown to moderate changes in spinal movement control [17], we also wanted to investigate the associations between the SMT and the TAMPA scale of kinesiophobia (TSK) and pain measured by the numeric rating scale (NRS).

2 Methods

Twenty patients with NSCLBP and 20 healthy controls were included in the study. The patients were recruited from the Department of Pain Management and Research, Oslo University Hospital, a third line service receiving referrals nationwide from both primary and secondary care. The healthy controls (15 women and five men) were students and employees recruited from Oslo and Akershus University College. Patients eligible for the study were identified after assessment including extensive psychometric evaluation and examination by a physician specialised in assessment of pain patients. Patients, age 18–55 years, who had NSCLBP for at least 6 months, were eligible for inclusion in this study. Good Norwegian verbal and written skills were a further requirement. All eligible patients were contacted by a physiotherapist and were invited to participate in the study. The exclusion criteria are described in Table 1.

Table 1: Exclusion criteria.

1. Leg pain primary problem (e.g. nerve root compression or disc prolapse with true radicular pain/radiculopathy, spinal stenosis)
2. Less than 6 months after lumbar surgery, lower limb or abdominal surgery
3. Rheumatological/inflammatory disease (e.g. rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, lupus erythematosus, Scheuermann's disease)
4. Progressive neurological disease (e.g. MS, Parkinsons's disease)
5. Dependent on walking aids
6. Pregnancy
7. Red flags (such as cancer/malignancy, acute traumas, i.e. fracture, or infection, spinal cord compression/cauda equina)
8. Scoliosis, if primary source of pain

2.1 Data collection

Posture and movement pattern of all participants were evaluated with the SMT. The test was videotaped for later scoring. The subjects were tested once only by the same physiotherapist. Another physiotherapist, highly experienced with the SMT, scored the videotaped test according to a standardised protocol [16], having no prior information about the subjects' status and diagnoses. The pain intensity and kinesiophobia in NSCLBP patients were assessed with NRS and TSK, respectively. Further information was obtained about the patients' ages, duration and description of pain, aggravating and easing factors, activity levels and work and educational status. The study was granted ethical approval from the South-East Regional Committee for Medical and Health Research Ethics (2015/1907). All participants signed an informed consent.

2.2 Outcome measures

2.2.1 Standardised Mensendieck Test

The Standardised Mensendieck Test [16], was developed to analyse standing posture, movement, gait, sitting posture and respiration (Appendix A in Supplementary Material). It requires minimal equipment and takes about 10 min to perform. The subjects are observed in a number of positions and during functional movements that are used in everyday living. The scoring is based on the quality of the performance and the way the subjects use their bodies as a whole. Each element of the test is scored between 0 and 7 (0 = least optimal movement/posture, 7 = optimal performance). The five domains of SMT (body posture, movement pattern, gait, sitting posture and respiration pattern) are evaluated and scored separately.

One experienced physiotherapist well acquainted with the SMT performed the SMT assessments. This person demonstrated each subtest once, as a simple standardised verbal instruction was given. Patients were asked to immediately copy the movements whilst the physiotherapist videotaped their performance. The same physiotherapist made the video recordings of all the patients with NSCLBP in the same room and was not involved in the test performance rating. The evaluator did not know whether the person on the video was the patient or the healthy control and watched and rated the videos in a random order.

2.2.2 Measurement of pain intensity – Numeric Rating Scale

The 11-point Numerical Rating Scale (NRS), where score of zero represented no pain and 10 represented worst imaginable pain, was applied to assess pain intensity [18].

2.2.3 Tampa Scale for Kinesiophobia (TSK 13)

In this study, kinesiophobia, i.e. fear of movement and re/injury, was evaluated with the TSK 13, translated and validated into Norwegian [19]. This version contains 13 items from the original TSK-17 and uses a 4-point Likert scale with responses ranging from 1 = "strongly disagree" to 4 = "strongly agree". The scale ranges from 13, a low level of kinesiophobia, to 52, with higher scores indicating greater fear of movement. The total score is calculated by adding the scores of the individual items.

2.3 Statistical methods

Mean and standard deviation (SD) were calculated for all SMT items. Distribution of scores regarding age and mean values of all SMT domains were evaluated by histograms in both groups. Statistical differences between the groups were calculated by the Independent-samples *t*-test. A *p*-value of <0.05 was considered significant. The effect of age on SMT scores was checked for using linear regression with age as a covariate and group belonging as a fixed factor, due to significant difference in mean age between the groups. Mean and standard deviation for pain intensity (NRS) and kinesiophobia (TSK) were calculated in NSCLBP group. The Pearson's correlation test was used for estimating the associations between SMT, TSK, and pain scores.

3 Results

3.1 Sociodemographic and clinical characteristics

Twelve women and eight men with NSCLBP were included. The mean age was 41.00 (SD = 9.02) years. Thirteen out of 20 patients were on 100% sick leave or were receiving disability pension. Only three out of 20 were in full-time work. The mean duration of pain was 6.98 (SD = 6.76) years lasting from 1 year up to 30 years at the most. In the control group 15 out of 20 participants were females. The average age of the controls was 31.00 (SD = 7.23) years. All controls were either studying or working full-time. There was a significant age difference between NSCLBP and controls, $\Delta\mu = 10.00$, $t = 3.70$, $p < 0.001$.

3.2 Pain intensity and pain descriptors

The most common pain descriptors were aching, sharp and stabbing pains. Patients were given a list of 10 pain descriptors whereby a minimal of two pain descriptors were chosen. Most patients used 3–4 words to describe their back and leg pain. Twelve subjects had LBP as well as pain below the gluteal fold, on one side only. Results showed an average pain intensity score of 6.05 (SD = 1.88), measured with the NRS, prior to the assessment with the SMT.

3.2.1 Fear of movement and re(injury)

The mean kinesiophobia score was 29.25 (SD = 6.89), measured with TSK 13. Out of 20 patients, four displayed subclinical levels of kinesiophobia (TSK < 22), nine mild levels (TSK = 23–32), six moderate levels (TSK = 33–42) and one severe level of kinesiophobia (TSK > 42) based on severity levels suggested by Neblett et al. [20].

3.3 Standardised Mensendieck Test

Patients with NSCLBP scored significantly lower than the controls on all of the 24 items of the SMT (Table 2).

Since there was a significant difference in age between the groups, a linear regression with the group belonging as independent variable and age as a covariate was performed. The results showed that age had no significant impact on the difference between the groups on any of the SMT domains.

Additional analyses of between-group differences in the SMT scores were performed for female subjects. Males were not tested separately due to the low number of participants, five in the control group and eight in the NSCLBP group. The results for females were very close to those for the whole group with regard to all the SMT domains apart from the respiration pattern domain, where a much larger difference in mean scores between the groups was observed; control group 5.63 (0.88) vs. NSCLBP group 3.41 (0.91), $\Delta\mu = 2.22$, $t = 6.31$, $p < 0.001$.

3.4 Associations between bodily findings, kinesiophobia and pain

There were no significant correlations found between the SMT and the TSK scores. In the case of pain and the SMT, the strongest, but non-significant association, was

Table 2: Standardised Mensendieck Test (SMT) scores (means and SD) for patients with non-specific chronic low back pain (NSCLBP) and healthy controls.

	Control	NSCLBP	Mean difference
Standing posture			
Standing posture-global impression	5.75 (0.88)	3.95 (0.89)	1.80
Ankle	6.00 (0.84)	4.70 (0.86)	1.30
Knee	5.88 (1.00)	4.60 (1.47)	1.28
Pelvis	5.65 (1.03)	4.15 (0.88)	1.50
Back	5.50 (0.84)	3.65 (0.81)	1.85
Shoulder	5.65 (0.92)	3.85 (0.75)	1.80
Neck	5.33 (1.48)	4.10 (0.97)	1.23
Total mean score	**5.68 (0.75)**	**4.14 (0.63)**	**1.54**
Movement pattern			
Movement pattern – global impression	5.92 (0.86)	3.45 (0.89)	2.48
Horizontal arm lift	5.85 (1,14)	2.60 (1.39)	3.25
Vertical arm lift	6.08 (1.08)	2.70 (1.45)	3.38
Parallel arm swing	6.03 (0.94)	4.00 (1.34)	2.03
Diagonal arm swing	6.00 (0.81)	4.00 (1.45)	2.00
One leg raise	6.38 (0.69)	5.05 (1.32)	1.33
Total mean score	**6.06 (0.76)**	**3.63 (0.90)**	**2.43**
Gait pattern			
Gait pattern – global impression	5.82 (0.69)	3.85 (1.27)	1.97
Foot rolling	5.68 (0.77)	4.40 (1.19)	1.28
Hip extension	5.58 (0.63)	3.90 (1.45)	1.68
Rotation of the pelvis	5.39 (0.76)	3.65 (1.35)	1.74
Total mean score	**5.62 (0.61)**	**3.95 (1.24)**	**1.67**
Sitting posture			
Sitting posture – global impression	5.68 (0.92)	4.30 (1.69)	1.38
Support area	5.83 (0.91)	4.15 (1.79)	1.68
Pelvis position	6.03 (0.85)	3.95 (1.82)	2.08
Back position	5.82 (0.91)	4.25 (1.62)	1.58
Total mean score	**5.84 (0.79)**	**4.16 (1.67)**	**1.68**
Respiration pattern			
Respiration pattern – global impression	5.68 (0.83)	3.90 (1.07)	1.78
Arm lift	5.45 (1.05)	3.85 (1.35)	1.60
Pelvic lift	5.45 (1.05)	3.90 (1.29)	1.55
Total mean score	**5.53 (0.84)**	**3.88 (1.19)**	**1.64**

There is a significant difference ($p < 0.001$) between the groups for all items, apart from knee, neck and sitting posture – global impression and support area were ($p < 0.01$), tested with the independent sample *t*-test.

observed in relation to the mean score for sitting posture ($r=0.40$, $p=0.08$); i.e. a tendency towards poorer sitting position was observed in patients reporting higher pain intensity. Association between pain and TSK showed a tendency towards higher pain scores in patients with higher levels of kinesiophobia, although the results did not reach a significant level ($r=0.42$, $p=0.07$).

4 Discussion

To our best knowledge, this is the first study investigating quality of movement and respiration pattern with the SMT in NSCLBP patients. The main findings showed that patients with NSCLBP had significantly poorer scores than controls on every item in all domains of the SMT. The differences were most pronounced in the movement pattern domain (mean difference 2.4). This represents in clinical and practical terms a clear and easily observed difference in movement quality. The two items of movement pattern domain with the largest difference between the groups were the horizontal and vertical arm lift (mean difference of 3.25 and 3.38, respectively). In these two tests, participants are asked to lift their arms into a horizontal and a vertical position, respectively and then let them "*go*" in a relaxed manner. The ability to let the arms "*go*" is scored. The large difference between the groups indicates that NSCLBP patients had significant problems with releasing muscle tension, displaying a tensed movement pattern. A possible explanation of this finding might be reduced body awareness and a reduced ability to recognise the level of tension in the muscles during the performance of functional movements among the patients. Such patterns have been previously registered in other groups of chronic pain patients as chronic pelvic and vulvar pain [21, 22]. Movement aberrations and hampered respiration have also been observed in musculoskeletal pain conditions and psychiatric disorders [23] and CPP [16]. From a patient perspective, the meaning of having body awareness can be expressed as being embodied; being in contact with and living in one's body, furthermore living in relation to others and in society [24]. Quality of movement is represented by an interactive process between biomechanical, physiological, psycho-socio-cultural and existential themes [25]. Similarly, Sundén et al. [26] state that movements and the quality of movements signify cognitive, emotional, intentional and sociocultural features of the individual. Another possibility is that NSCLBP patients might have been afraid that letting their arms "*go*" will provoke their back pain. However, the fact that the items of movement pattern domain did not significantly correlate with the TSK scores suggested that the general level of kinesiophobia had no influence on the movement scores. The reduced ability to relax and coordinate the arms and legs may have been a somewhat unexpected finding amongst LBP patients.

The differences between the groups on other items of the movement pattern domain were clearly smaller, ranging from 1.33 (one leg raise) to 2.00/2.03 (parallel/diagonal arm swing). In practical terms, differences of less than two points might be difficult to discern reliably and its clinical significance is uncertain. In this respect, the one leg raise test-item seems to be of less value when evaluating quality of movement in NSCLBP patients. The between groups differences on all other domains of the SMT, including the respiration pattern, were approximately 1.6 points. Although significant, in practical terms the difference of 1.6 is relatively minor and might be difficult to observe reliably. This puts in question the ability of the SMT to assess the quality of the respiration pattern in NSCLBP. Interestingly, following further statistical analysis, where only females were compared to each other, the difference in the respiration pattern domain increased to 2.22, similar to that of the movement pattern domain. No major changes in mean scores on any other domains of the SMT were seen after removing males from the statistical analysis. This suggests that the respiration pattern in females suffering from NSCLBP is clearly less functional than in healthy controls. We found the diaphragmatic and low costal movements were decreased and replaced by an exaggerated upper costae contraction. These results are in line with several studies [16, 27, 28], investigating women with chronic pelvic pain and musculoskeletal pain, respectively. Overall little is known about the breathing pattern in CLBP patients. According to Jafari et al. [29], the influence of long-term pain on respiration continues to be unclear thus warrants attention in future studies. In one case-control study, a significantly more altered breathing pattern was found in NSCLBP patients observed during motor control tests compared to healthy controls [30]. The sample was small ($n=10$), and considering the 13-year pain history, the VAS score was contrastingly low (mean = 24.4 mm), hence the results should be interpreted with some caution. According to Chaitow et al. [31], tense accessory respiratory muscles together with loss of thoracic cage compliance, can hamper normal chest movement, and exacerbate poor diaphragmatic descent. Furthermore, causes of breathing dysfunction can also have a psychosocial aetiology such as anxiety and depression [31], which is also highly comorbid with chronic pain [32].

4.1 Associations between SMT, pain and kinesiophobia

In our study, we found no significant associations between the SMT scores and pain intensity and kinesiophobia. The lack of associations suggests that findings regarding movement and respiration patterns are not directly related to the pain intensity or to the level of kinesiophobia. At the same time, it is important to note that 13 out of 20 patients displayed subclinical or mild levels of kinesiophobia and only one of the participants had severe kinesiophobia. This result category was somewhat surprising considering patients were recruited from a specialist service with a long history of LBP. In one study, the patients with CLBP had the highest TSK score studied across various pain diagnoses and in different countries [33]. Interestingly, the one patient in our study with severe kinesiophobia displayed a score of 1 on both horizontal and vertical lift items in the SMT, representing the lowest scores on those items among all participants. It is therefore possible that higher levels of kinesiophobia might be directly associated with poor scores on the movement pattern domain in the SMT. We found no other studies investigating the relationship between quality of movement and kinesiophobia. Nonetheless several studies have investigated the relationship between TSK scores and physical performance in the CLBP population, albeit with conflicting results. Reneman et al. [34] and Demoulin et al. [35] found weak or non-existent associations between pain and pain-related fear and physical performance such as lifting, bending, and lumbar extension. Several studies however, did find a relationship between fear of movement and activities such as lifting [36], range of motion [37, 38] and walking velocity [39]. These varied findings may be influenced by the diverse type of tests utilised to quantify physical capacity. The low association between SMT and TSK may be because the subjects did not perceive movement tests as especially threatening. The extent to which kinesiophobia is related to actual quality of movement may also be dependent on the ability of the TSK to assess fear for that specific test, in this case the SMT. In addition to fear of movement there may have been other psychological factors, which were closely related to altered posture, movement and respiration.

5 Limitations

The main limitation of this study was the relatively low number of participants, particularly males. A larger sample would make it possible to perform analysis on subgroups of participants, i.e. divided by sex. The generalizability of the data to the general population may be limited as the patients were recruited from specialists care.

6 Conclusions

A marked difference in the SMT scores was observed between the NSCLBP patients and controls particularly with regard to movement pattern. In this respect, the SMT domains of movement might potentially be a valuable examination tool in assessment and treatment of NSCLBP patients.

6.1 Implications

Further, longitudinal studies should investigate whether poor movement and respiration patterns are important factors in NSCLBP, e.g. as predictors and/or mediators of therapeutic effects.

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