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The development of the Dutch version of the Fremantle Back Awareness Questionnaire

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Statement of Institutional Review Board approval of the study protocol

The study conformed to the principles of the Declaration of Helsinki (1964) and was approved by the Ethics Committee of the University Hospitals Leuven.

ABSTRACT

Background: Disturbed body perception may play a role in the aetiology of chronic low back pain (LBP). The Fremantle Back Awareness Questionnaire (FreBAQ) is currently the only self-report questionnaire to assess back-specific body perception in individuals with LBP.

Objectives: To perform a cross-cultural adaptation of the FreBAQ into Dutch.

Design: Psychometric study.

Methods: A Dutch version of the FreBAQ was generated through forward-backward translation, and was completed by 73 patients with LBP and 73 controls to assess discriminant validity. Structural validity was assessed by principal component analysis. Internal consistency was assessed by the Cronbach's alpha coefficient. Construct validity was assessed by examining the relationship with clinical measures (Numerical Rating Scale pain, Oswestry Disability Index (ODI), Tampa Scale for Kinesiophobia). Test-retest reliability was assessed in a subgroup (n= 48 with LBP and 48 controls) using intraclass correlation coefficients (ICC), standard error of measurement (SEM) and minimal detectable change (MDC 95%)

Results: The Dutch FreBAQ showed one component with eigenvalue >2. Cronbach's alpha values were respectively 0.82 and 0.73 for the LBP and control group. ICC values were respectively 0.69 and 0.70 for the LBP and control group. In the LBP group, the SEM was 3.9 and the MDC (95%) was 10.8. The LBP group (ODI 22±21%) scored significantly higher on the Dutch FreBAQ than the control group (ODI 0%) (11±7 vs. 3±9, $p< 0.001$). Within the LBP group, higher Dutch FreBAQ scores correlated significantly with higher ODI scores (rho= 0.30, p= 0.010), although not with pain (rho= 0.10, p= 0.419) or kinesiophobia (r= 0.14, p= 0.226).

Conclusions: The Dutch version of the FreBAQ can be considered as unidimensional and showed adequate internal consistency, sufficient test-retest reliability and adequate discriminant and construct validity in individuals with and without LBP. It can improve our understanding on back-specific perception in the Dutch-speaking population with LBP.

Keywords: back pain; proprioception; body perception; cross-cultural adaptation

INTRODUCTION

Low back pain (LBP) affects most people at some point in their life (Airaksinen et al., 2006), and is associated with considerable socio-economic burden (Hoy et al., 2014). In Belgium, LBP accounts for a mean yearly cost of €922 per patient for the social security system (Nielens et al., 2006), and 29% of the total number of sick leave days are attributable to LBP (van Zundert and van Kleef, 2005). Therefore, the identification of underlying mechanisms and causes of LBP is currently described as a research priority in this field (Costa et al., 2013).

Pain is associated with disruptions of awareness and perception of the painful body part (Moseley, 2005), This may include alterations in the perceived size/shape, location, movement, or ownership of a body part such that the perception of the body is significantly different from reality (Boesch et al., 2016). Disturbed body perception may play a role in the chronic LBP experience (Lotze and Moseley, 2007; Wand et al., 2011). Researchers have consistently observed cortical reorganisation (Flor et al., 1997; Tsao et al., 2008; Tsao et al., 2011; Schabrun et al., 2015; Hotz-Boendermaker et al., 2016), morphological changes (Schmidt-Wilcke et al., 2006; Baliki et al., 2011; Baliki et al., 2012; Kong et al., 2013; Mao et al., 2013; Ung et al., 2014) and biochemical changes (Sharma et al., 2012) in brain areas thought to subserve body perception. Furthermore, individuals with chronic LBP perceive their back as fragile and vulnerable (Bunzli et al., 2015; Darlow et al., 2015), feel a sense of exclusion, alienation, and rejection of the back (Afrell et al., 2007; Crowe et al., 2009) and represent the back differently when asked to draw how the back feels to them (Nishigami et al., 2015).

Psychophysical findings consistent with disruption of the mechanisms that underpin body perception (Tsay et al., 2015) appear to be features of chronic LBP. Patients with chronic LBP have reduced lumbar tactile acuity, in terms of enlarged two-point discrimination thresholds (Catley et al., 2014), problems localising tactile inputs to the back (Wand et al., 2013), poor trunk motor imagery performance (Bray and Moseley, 2011; Bowering et al., 2014) and impaired perception of the sensorimotor aspects of visually displayed movements (de Lussanet et al., 2012; de Lussanet et al., 2013). It was shown that patients with LBP have lower lumbosacral proprioceptive acuity (Brumagne et al., 2000), and show blunted responses to

lumbosacral proprioceptive stimulus (Brumagne et al., 2008; Janssens et al., 2016). To compensate for this decreased lumbosacral proprioceptive acuity, individuals with LBP favour reliance on ankle proprioceptive signals during postural control, irrespective of the postural demands (Claeys et al., 2011). Interestingly, this impaired proprioceptive use during postural control in individuals with LBP correlated with decreased structural organisation of the superior cerebellar peduncle (Pijnenburg et al., 2014). This suggests that disorganized white matter plays a possible role in body perception deficits in the LBP population.

The Fremantle Back Awareness Questionnaire (FreBAQ) is currently the only self-report questionnaire assessing back-specific body perception in individuals with LBP (Wand et al., 2014). The questionnaire consists of nine items (e.g., “My back feels as though it is not part of the rest of my body.”) for which the participant rates the degree of agreement from 0 (never) to 4 (always). The items evaluate neglect-like symptoms (item 1-3), reduced proprioceptive acuity (item 4-5) and perceived trunk shape and size (item 6-9). The psychometric properties of the English (Wand et al., 2014; Wand et al., 2016) and Japanese versions (Nishigami et al., 2017) of the questionnaire have been found to be acceptable and there is consistent evidence of a significant relationship between FreBAQ scores and clinical status in a variety of lumbopelvic pain populations (Wand et al., 2014; Beales et al., 2016; Wand et al., 2016; Nishigami et al., 2017; Wand et al., 2017). A Dutch version of the FreBAQ is currently lacking, but would be useful to evaluate the Dutch-speaking LBP population, mainly located in Belgium and The Netherlands. Therefore, the aim of this study was to develop a Dutch version of the FreBAQ, and to evaluate its face validity, structural validity, internal consistency, reliability, discriminant and construct validity in a sample of individuals with and without LBP.

MATERIALS AND METHODS

Participants

Participants (n= 73) who sought care for LBP as their primary complaint, were recruited as consecutive cases by a physician from the Department of Physical Medicine and Rehabilitation, University Hospital of Leuven (UZ Leuven) in Belgium. Subsequently, healthy matched controls (n= 73) were recruited via online and offline advertisements, relatives, colleagues and friends. Control subjects were included if they scored zero on the Oswestry Disability Index, version 2 (adapted Dutch version) (ODI-2), meaning that they were not at all disabled due to LBP (van Hooff et al., 2015). The two groups were matched for age (+/- 2 years), BMI (+/- 2 kilogram/metre^2), and gender. Inclusion criteria for both groups were being aged between 20 and 80 years old, and being Dutch-speaking. Exclusion criteria were having an acute episode of LBP (< 6 weeks), LBP with a non-musculoskeletal origin (e.g., tumour), neurological disease, impaired cognition, a history of vestibular disorders, and current pregnancy.

All participants gave their written informed consent. The study conformed to the principles of the Declaration of Helsinki (1964) and was approved by the local Ethics Committee of Biomedical Sciences of KU Leuven S53588 (ML7729).

Cross-cultural adaptation process

The process of cross-cultural adaptation of the questionnaire consisted of five steps and was based on the guidelines of Beaton et al. (Beaton et al., 2000).

Step 1: Forward translation

The original English version of the FreBAQ was translated into Dutch by four independent translators, of which three experts and one non-expert in the field. The three experts have scientific (PhD) as well as clinical background in rehabilitation and physiotherapy. More specifically, their expertise is related to spinal problems, proprioception and postural control. The non-expert has no expertise in rehabilitation sciences or physiotherapy, but has a background in biomedical sciences (PhD), more specifically related

to nursing research methodology, epidemiology and healthcare services research. All translators were Dutch native speakers.

Step 2: Synthesis

After discussion through both face-to-face meetings and follow-up by e-mail, the four translators reached a consensus on a Dutch version of the questionnaire.

Step 3: Backward translation

Two English-speaking non-experts in the field independently performed a backward translation into English. Both translators were Dutch native speakers with an educational background in Germanic language studies (English-Dutch), a C2 level of English (i.e., proficiency level) according to the Common European Framework of Reference for Languages (CEFR), and a professional background in journalism. An English consensus version was produced.

Step 4: Expert committee review

The consensus version of the back-translation was reviewed by the developer of the original English version of the FreBAQ (BMW). Together with the three experts, discrepancies with the original version were discussed. After this expert committee review (Epstein et al., 2015), consensus was reached on a pre-final version of the Dutch FreBAQ. One Dutch-speaking translator was from The Netherlands, whereas the other three Dutch-speaking translators and two English speakers originated from Flanders (Belgium).

Step 5: Pretesting

In a pretest phase, face validity of the questionnaire was assessed in 22 individuals with LBP (Terwee et al., 2007). Face validity can be defined as ‘the extent to which a test is subjectively viewed as covering the concept it purports to measure. It refers to the transparency or relevance of a test as it appears to test participants.’ (Holden, 2010). Acceptability of time exposure to fill out the questionnaire was scored by

'yes' versus 'no'. Comprehensibility of the questionnaire was scored by 'yes' versus 'no', and from zero ('absolutely not comprehensible') to ten ('completely comprehensible'). When scoring 'no' on comprehensibility, the participants were asked to point out which items were not comprehensible, and to describe the reason in their own words. Finally, the purpose of the questionnaire to assess back-specific body perception was explained to the participants, after which the participants were asked to judge the completeness of the questionnaire by 'yes' versus 'no'. Based on the results of the pretesting phase, no additional changes were made to the pre-final version of the Dutch FreBAQ. Face validity was judged as being acceptable when not more than half of the participants scored negatively on these three items.

Structural validity, internal consistency and reliability

The 147 participants were asked to complete the newly developed Dutch FreBAQ (See **Appendix 1**) in the presence of an investigator in a quiet room of the hospital centre, in order to assess structural validity and internal consistency. One week later, the participants were provided with a second copy of the questionnaire to be completed and sent back, in order to evaluate test-retest reliability of the questionnaire. Twenty-five individuals with LBP did not return the second copy of the questionnaire. Therefore, test-retest reliability was assessed in a subgroup of the participants (48 individuals with LBP and 48 healthy age-, gender- and BMI-matched controls) in terms of intraclass correlation coefficients (ICC), standard error of measurement (SEM) and minimal detectable change (MDC 95%). According to Shoukri et al. (2004), a sample size of 46 participants is judged as sufficient to investigate reliability in terms of ICC.

*****Please refer to Appendix 1 near here*****

Discriminant and construct validity

To assess discriminant and construct validity of the Dutch FreBAQ, the following clinical outcome measures were assessed in 73 individuals with LBP and 73 healthy controls: demographics, severity of LBP, LBP-related disability and kinesiophobia. Weight, height, age and gender were registered for each participant. Severity of LBP was scored by the Numerical Rating Scale (NRS) from zero ('no pain') to ten

('worst pain imaginable') (Jensen et al., 1986), and LBP-related disability was evaluated using the Oswestry Disability Index, version 2 (adapted Dutch version) (ODI-2) (van Hooff et al., 2015). Scores on the ODI-2 relate to five levels of disability: 0-19% (minimal disability), 20-40% (moderate disability), 41-60% (severe disability), 61-80% (crippling) and 81-100% (bedridden). The Tampa Scale for Kinesiophobia (TSK), which ranges from 17 ('low') to 68 ('high'), was completed to identify fear of (re)injury following movements or activities in the participants with LBP (Kori et al., 1990). An adapted version of the TSK (TSK-G), developed for administration among the general population, was used to evaluate kinesiophobia in the healthy controls (Houben et al., 2005).

Statistical analysis

Statistical analysis was performed by the Statistical Package for Social Sciences (SPSS) version 24 (IBM Corporation, New York, USA). The level of significance was set at $P< 0.05$. Shapiro-Wilk tests verified whether the data were normally distributed. For the normally distributed variables (height, weight, BMI, and TSK), a Paired-samples t-test explored differences between the sample with LBP and the sample without LBP. A Wilcoxon Signed Rank test investigated group differences for the non-normally distributed data (age, ODI-2, NRS, and Dutch FreBAQ). Differences in gender were tested with the McNemar test. As an assumption to assess internal consistency, test-retest reliability, discriminant and construct validity, structural validity (dimensionality) was assessed first through principal component analysis (PCA) (Smith, 2000). The PCA correlation matrix was visually inspected to identify the presence of secondary dimensions. Components with an eigenvalue greater than 2 were reviewed to ascertain whether a second dimension was present (Raîche, 2005). In addition, large positive correlations between a specific item and this component (defined as $r> 0.5$) were considered indicative of local dependence where the response to one item relies on the response to the other (Tennant and Conaghan, 2007). If the questionnaire was considered unidimensional, internal consistency, test-retest reliability, discriminant and construct validity were subsequently evaluated. To assess internal consistency of the Dutch FreBAQ, Cronbach's alpha coefficient was calculated. A value of at least 0.7 indicates adequate inter-relatedness of items (Terwee et al., 2007). To assess test-retest reliability of the Dutch FreBAQ, ICC(2,1) *absolute agreement* were

calculated. ICC(2,1) *absolute agreement* accounts for systematic differences between measurements and is calculated with the following equation:

$$\mathrm{ICC}(2,1) = \frac{\mathrm{MSsubjects} - \mathrm{MSerror}}{\mathrm{MSsubjects} + (\mathrm{k}-1)\mathrm{MSerror} + (\mathrm{k}(\mathrm{MSmeasurements} - \mathrm{MSerror}))/\mathrm{n}}$$

In this equation, MS = mean square, n = number of subjects and k = number of measurements. The minimum threshold for sufficient reliability is considered as ICC = 0.7 (Terwee et al., 2007; Chiarotto et al., 2016; Prinsen et al., 2016). Moreover, the SEM and MDC 95% were calculated. A MDC of at least 20% of the scale range is considered as acceptable (Chiarotto et al., 2016). To assess the construct validity of the Dutch FreBAQ, Pearson's R (for TSK) and Spearman's rho (for ODI and NRS) correlation coefficients were calculated between the Dutch FreBAQ scores and the clinical outcomes. Principally, we hypothesized a positive correlation between the Dutch FreBAQ and ODI (rho> 0.30), followed by positive correlations between the Dutch FreBAQ and NRS (rho> 0.20) and TSK (r> 0.20). The magnitude and direction of these hypothesized correlations were based on the previously reported correlations between these (or similar) clinical outcomes and the English (Wand et al.; 2014; Wand et al., 2016) and Japanese versions of the FreBAQ (Nishigami et al., 2017). To additionally assess construct validity of the Dutch FreBAQ within the LBP sample, the patients were subclassified into a group of patients having moderate or severe disability (based on ODI ≥ 20%) versus minimal disability (based on ODI < 20%) (Fairbank et al., 1980).

RESULTS

Forward-backward translation process

During the forward translation process, the following points were discussed. Initially, four different translations were suggested for 'things' in the first sentence 'Here are some things which other patients have told us about how their back feels to them.', which were '*dingen', 'stellingen', 'beschrijvingen'* and *'uitspraken'*. Consensus was reached to use the term *'uitspraken'* because the fact that other patients have told these things is especially stressed in this word and not/less in the others. Further, the word 'occasionally' in the definition of score 2 was translated in *'soms', 'occasioneel'* or *'incidenteel'*. Consensus was reached to use the term *'soms'* because this word requires a lower level of cognition then the others. Finally, while translating the description of item 5, one expert highlighted potential misinterpreting the word 'exactly' in terms of referring to 'not exactly sure' versus 'not sure about the exact position'. Consensus was reached to interpret is as 'not exactly sure', so it was translated into Dutch with this in mind. During the backward translation process, consensus was reached on translation of the following words: 'back pain' was chosen over 'backaches', 'occasionally' was chosen over 'sometimes' (score 2), both suggestions 'often' and 'regularly' were used to define score 3, and 'out of my control' was chosen over 'without me having control over it' describing item 3. Consequently, the consensus version of the backward translation was discussed between the initial developer of the English FreBAQ and the three experts on the following points. The word *'moment'* in 'at the moment you experience back pain' might be interpreted in English as 'at the instant your back pain comes on – what it is like at that moment rather than in general when experiencing pain'. Therefore, *'op dat moment'* was replaced by *'wanneer'* in the Dutch version to focus more on experiencing pain in general instead of at one specific moment. Furthermore, the initial developer checked whether it was clear enough in the Dutch version that the 9 items were statements 'that came from other people with back pain'. Because of the choice of the word *'uitspraken'* in Dutch, it was judged that this was stressed sufficiently in the Dutch version (see supra). In addition, the wording 'out of my control' (item 3) was found to sound more dramatic than 'without my control' in the initial version. The wording in Dutch *'zonder dat ik hier controle over heb'* was however

judged as not that dramatic and was therefore kept. Furthermore, the sequence of the wording of item 5 was adapted so that it was consistent with the English version. Finally, the word 'crooked' was judged as sounding more severe and having a connotation of being bent, rather than 'lopsided' in the initial English version. However, an appropriate Dutch translation was not found and therefore only the word *'asymmetrisch'* (asymmetrical) was used in the final Dutch version for item 9.

Face validity (practicability)

The time to complete the Dutch FreBAQ was rated as acceptable by all 22 participants (100%). The comprehensibility was rated as acceptable by 17 participants (77%), with a mean score of 7.1 ± 2.1/10. Item 6 ("*Ik kan de exacte aflijning van mijn rug niet waarnemen*.") and 9 ("*Mijn rug voelt asymmetrisch aan.")* were mainly rated as the least comprehensible. Item 6 was found as the least comprehensible by 11 participants (50%). Only two participants provided a reason: the item was found to be 'ambiguous' and 'difficult to imagine'. Item 9 was found as the least comprehensible by 7 participants (32%). Only one participant gave a reason, which was related to the fact that the item was 'difficult to imagine and requires high cognition'. Although these two items were rated as the least comprehensible, it was decided not to make any changes to the questionnaire because of a lack of sufficient response on the question why these items were found to be less comprehensible. Completeness of the questionnaire was rated as acceptable by 18 participants (82%).

Structural validity (dimensionality)

Visual inspection of the item-to-item correlation matrix suggested that items 4, 5 and 6 could constitute a second dimension. This judgement was based on the fact that these items showed the highest item-to-item correlations ($r > 0.65$) (item 4 and 5: $r = 0.81$; item 4 and 6: $r = 0.65$; item 5 and 6: $r = 0.65$). However, only one component was found with an eigenvalue > 2, more specifically with eigenvalue 3.82, which suggests that the scale is unidimensional. One other component with an eigenvalue > 1 was found and the remaining seven components had an eigenvalue < 1. The ratio between the first and second component (3.82/1.65) was 2.32, which suggests unidimensionality as the ratio is lower than 4 (Reeve et

al. 2007; Prinsen et al., 2016). Moreover, strong positive correlations (r> 0.50) between the component and all items were found (item 1: r= 0.76; item 2: r= 0.64, item 3: r= 0.64; item 4: r= 0.74, item 5: r= 0.69, item 6: r= 0.69; item 8: r= 0.67; item 9: r= 0.62) except for item 7 (r= 0.34).

Internal consistency

Table 1 displays the demographics and clinical outcomes of the LBP and control group.

*****Please insert Table 1 near here*****

Cronbach's alpha values were respectively 0.82 and 0.73 for the LBP group (n= 73) and the control group (n= 73), thereby indicating adequate internal consistency of all items of the Dutch FreBAQ. Table 2 (LBP group) and Table 3 (control group) show the Cronbach's alpha values when one of the nine items was deleted, as well as the inter-item correlations and the total-item correlations. In the LBP group, internal consistency of the questionnaire was not significantly affected by deletion of any item and correlations above 0.5 were found between each item and the total score, except for item 9 (r= 0.25). However, in the control group, removal of either item 4, 5, or 6 resulted in a reduced internal consistency (i.e., Cronbach's alpha < 0.7) of the Dutch FreBAQ, and low correlations were found between the other items and the total score (r< 0.3).

*****Please insert Table 2 near here*****

*****Please insert Table 3 near here*****

Test-retest reliability

The ICC (95% confidence intervals (95%CI)) of the Dutch FreBAQ was 0.69 (0.51-0.82) in the LBP group, referring to a sufficient test-retest reliability. In the matched control group, the ICC (95%CI) of the Dutch FreBAQ was 0.70 (0.53-0.83). The ICC (95%CI) of the total group was 0.77 (0.70-0.84). In the LBP group, the calculated SEM of the Dutch FreBAQ was 3.9, and the MDC (95%) was 10.8 (30% of scale range), referring to a non-sufficient measurement error.

Discriminant and construct validity

Table 1 shows that the LBP group scored significantly higher on the Dutch FreBAQ compared to the healthy control group (p= 0.001). The LBP group also scored significantly higher on the TSK compared to the healthy control group (p= 0.001). Within the LBP group, higher Dutch FreBAQ scores correlated significantly with higher ODI scores (rho= 0.30, p= 0.010), although not with NRS pain scores (rho= 0.10, p= 0.419) or TSK scores (r= 0.14, p= 0.226). Individuals with LBP with ODI scores equal to or above 20% (n= 43) scored significantly higher on the Dutch FreBAQ compared to those with ODI scores lower than 20% (n= 30) (mean±SD: 13±8 vs. 8±6; p= 0.005). These two subgroups based on ODI did not significantly differ in terms of demographic variables, though differences were noted for pain intensity (median±IQR: 6±4 vs. 3±3; p= 0.001) and TSK (median±IQR: 39±8 vs. 34±9 p= 0.011).

DISCUSSION

This study aimed to perform a cross-cultural adaptation of the FreBAQ into Dutch. First, the original English version of the FreBAQ was translated into Dutch. The results indicated acceptable levels of face validity (practicability) for the Dutch version, although one should take into account relatively lower comprehensibility of items 6 and 9. The Dutch FreBAQ can be considered as unidimensional and showed acceptable internal consistency, although attention must be payed to potential independence of specific items when using the questionnaire in a pain-free population. Test-retest reliability of the Dutch FreBAQ based on ICC was found to be sufficient, and the SEM and MDC are in line with the original English version. However, the MDC was rather high and therefore it received a negative rating on measurement error. Finally, individuals with LBP showed significantly higher scores on the Dutch FreBAQ compared to healthy controls, suggesting an adequate discriminant validity of the Dutch FreBAQ. This adequate discriminant validity was especially found in terms of LBP-related disability, since higher Dutch FreBAQ scores in the LBP group correlated significantly with higher ODI scores as hypothesized. However, no correlations were found with NRS pain scores or TSK scores, in contrast to the initial hypothesis.

Specific items of the Dutch FreBAQ were found less or not comprehensible by some of the participants. Further questioning revealed that these participants thought that the wording of these particular items required a high level of cognition. However, we cannot rule out that the reduced comprehensibility might be attributed to a reduced perceptual awareness of the back in these patients. Based on these findings, we believe that the Dutch FreBAQ is especially suited to assess individuals with long-term or recurring episodes of disturbed perceptual back awareness, and is less suited for individuals who have a lower level of cognition. On the other hand, the low comprehensibility of some items might also be explained by the fact that the forward translation of the Dutch FreBAQ did not include a person without a biomedical background, as suggested in guidance for cross-cultural adaptation (Beaton et al., 2000). Therefore, we recommend future studies to include a translator without any biomedical background in the forward translation process in order to better assess face and content validity of this questionnaire, with specific

focus on its comprehensibility. More specifically, if the same item is not clearly formulated for several patients in future studies, its removal should be considered.

Factor analysis judged the Dutch FreBAQ as unidimensional as its items measure a single construct. Subsequently, the psychometric properties of the Dutch FreBAQ could be evaluated. It showed acceptable internal consistency both in the LBP group and in the control group. However, in the control group, removal of item 4 (*"Ik weet niet hoe mijn rug beweegt tijdens dagdagelijkse activiteiten."*), 5 (*"Ik weet niet zeker in welke houding mijn rug zich bevindt tijdens dagdagelijkse activiteiten."),* or 6 ("*Ik kan de exacte aflijning van mijn rug niet waarnemen*.") would result in Cronbach's alpha values lower than 0.7. Moreover, in the control group, low correlations between the other items (items 1-3 and 7-9) and the total score were found, suggesting that these items might measure another construct when using in a population without LBP. This might be obvious because the questionnaire is especially developed for individuals 'with' LBP (for which the internal consistency was found to be sufficient) and not for those without. As item 4, 5 and 6 are specifically related to lumbar proprioceptive acuity, we recommend further studies to further reveal potential independence of this feature, for example by use of local muscle vibration (Brumagne et al., 2000; Brumagne et al., 2008; Claeys et al., 2011; Claeys et al., 2015). Also, we recommend future studies to perform a confirmatory factor analysis as there are only few language versions of the FreBAQ available at this point (English and Japanese).

In the studied LBP sample, disturbed body perception was associated with LBP-related disability (ODI-2) but not with severity of LBP (NRS pain). Changes in how the individual perceives the back might therefore affect LBP complaints during functional activities rather than at rest. The perception of 'fitness' of the back to be able to perform activities of daily life might be reduced, affecting their disability (de Moraes Vieira et al., 2014) and thus affecting ODI scores rather than pain intensity scores. However, this is not in agreement with two English-speaking LBP samples in which the FreBAQ scores were associated with both disability and pain (Wand et al., 2014; Wand et al., 2016). This might be explained by the higher pain and disability scores seen in the two English-speaking samples.

In addition, the disturbed body perception in the studied LBP sample was not associated with changes in kinesiophobia (TSK). This is in agreement with Wand et al. (2014) who also did not find an association between scores on the English FreBAQ and TSK scores. However, there was a relationship between FreBAQ scores and scores on the physical activity subscale of the Fear Avoidance Beliefs Questionnaire (Wand et al., 2016) as well as with pain catastrophizing (Wand et al., 2014; Wand et al., 2016) and psychological distress (measured by the Depression Anxiety Stress Scales) (Wand et al., 2016). While accumulating evidence supports that psychological factors might contribute to changes in self-reported perception of the back, it is largely unclear what the contribution of changes in sensory and motor precision might be. Therefore, we suggest future studies to investigate the role of disturbed lumbosacral proprioceptive acuity in self-reported perception of the back.

Some limitations must be addressed. To evaluate test-retest reliability, participants first completed the questionnaire at the hospital and were then asked to complete the questionnaire again one week later at home. However, only the questionnaires of those participants who completed the questionnaire for the second time (i.e., the responders versus the non-responders) were taken into account to evaluate test-retest reliability, which could have led to a selection bias of participants. Moreover, a potential bias linked to variation in testing environment must be taken into account. On the other hand, it is known that a one-week interval minimises the risk that participants remember how they responded during the first assessment time point, which strengthens the study outcome (Deyo et al., 1991). Test-retest reliability and measurement error (i.e., SEM and MDC) estimates may have been biased due to variation in clinical status between the two test moments, because of the lack of clinical outcome measures at the second time point. Also, the fact that the questionnaire was filled out in the near presence of an investigator during at least one visit, contributes to the fact that all items of the Dutch FreBAQ were filled out by every participant. Therefore, one cannot conclude that specific items were harder to endorse based on misfits, in contrast to the study of Wand et al. (Wand et al., 2016). The absence of misfit can be explained by the fact that the investigator double-checked the completeness before handing in.

The development of the Dutch FreBAQ may be useful in further understanding the underlying mechanisms of nonspecific LBP. In particular, it is still largely unclear if a causal relationship exists

between back-specific perception deficits and LBP. Some researchers suggest that body perception deficits may be a maladaptive response to pain. For example, avoiding LBP-provocative movements and postures because of fear of pain and (re)injury might lead to (sub)cortical changes and consequently to a disturbed self-perception of the back (Wand et al., 2016). However, the opposite may also be true. Reduced back awareness might lead to LBP, or may at least influence the pain experience. Efficient and adaptive movement requires an intact perception of the body (parts) and its position in space. Disrupted body perception may thus compromise movement quality, which in turn can lead to abnormal spinal tissue loading, excessive nociceptive input and resultant movement-related pain (O'Sullivan, 2005). Related to this, suboptimal proprioceptive use during postural control has been shown to increase the risk of developing or maintaining LBP within two years (Claeys et al., 2015). Such suboptimal proprioceptive use may lead to excessive movements beyond the range of mechanical stability, thereby risking mechanical injury (Cholewicki and McGill, 1996) or it may lead to maladaptive spinal loading through hyperactivity (i.e., stiffening, co-contraction) or hypo-activity (i.e., hanging end of range in spinal joints) of trunk muscles (van Dieën et al., 2003). It is also possible that sensitivity to nociceptive input might be enhanced by changes in body perception. A number of studies have shown that distorting the perception of a body part by visual manipulation increases the sensitivity to experimental pain (Osumi et al., 2014a; Osumi et al., 2014b; Martini et al., 2015) and the clinical disruption of perceptual awareness might have a similar outcome in patients. Non-nociceptive contributions to the pain experience may also be important. For example, it has been hypothesized that changes in cortical body representation may give rise to pain due to a mismatch between predicted and actual responses of a motor action (Harris, 1999). Thus, there is still conflicting evidence whether disturbed self-perception of the back is a cause or consequence of LBP – or both. Therefore, we believe that the Dutch FreBAQ is a non-invasive, low-cost and safe manner of evaluating back-specific perception, which is useful to serve as an additional predictive clinical tool and thus might improve our understanding on the LBP experience.

CONCLUSION

Acceptable levels of face validity (practicability) were found for the Dutch version of the FreBAQ, although attention must be payed to the comprehensibility of specific items. The Dutch FreBAQ can be considered as unidimensional and showed acceptable internal consistency. Test-retest reliability of the Dutch version of the FreBAQ was found to be sufficient. Individuals with LBP showed significantly higher scores on the Dutch FreBAQ compared to pain-free controls. Further research on the concurrent validity of the Dutch version of the FreBAQ may further unravel the underlying mechanisms of LBP in the Dutch-speaking population. For example, concurrent validity of the FreBAQ with postural and cortical responses to back muscle vibration (to evaluate lumbosacral proprioceptive acuity) is currently under investigation.

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TABLES WITH CAPTIONS

Table 1 Characteristics of the groups with and without low back pain.

	LBP group (n= 73)	**Control group (n= 73)**	**p-value**
Gender	49 F / 24 M	49 F / 24 M	1.000
Age (years)	47±24*	47±25*	0.691
Height (centimetre)	171±8	170±9	0.429
Weight (kilogram)	72±13	71±13	0.457
BMI (kilogram/metre^2)	25±3	25±4	0.992
ODI-2 (%)	22±21*	0	**N/A**
NRS pain	4±4*	0	**N/A**
TSK	37±7	32±7	**0.001**
Dutch FreBAQ	11±7	3±9*	**0.001**

Data are presented as mean±standard deviation (normal distribution) or median±interquartile range* (no normal distribution); BMI: Body Mass Index; ODI-2: Oswestry Disability Index version 2 (0-100); NRS: Numerical Rating Scale (0-10); TSK: Tampa Scale for Kinesiophobia (17-68); FreBAQ: Fremantle Back-Awareness Questionnaire (0-36); N/A: not applicable

Table 2 Internal consistency of the Dutch Fremantle Back-Awareness Questionnaire in individuals with low back pain.

LBP group	**Cronbach's alpha if item deleted**	**Item-total correlation**	**Inter-item correlation matrix**								
			Item 1	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**Item 8**	**Item 9**
Item 1	0.79	0.65		0.43	0.62	0.41	0.32	0.35	0.36	0.43	0.47
Item 2	0.80	0.51	0.43		0.46	0.32	0.30	0.28	0.10	0.40	0.40
Item 3	0.80	0.51	0.62	0.46		0.31	0.26	0.27	0.22	0.34	0.21
Item 4	0.79	0.60	0.41	0.32	0.31		0.81	0.65	-0.01	0.32	0.24
Item 5	0.80	0.56	0.32	0.30	0.26	0.81		0.65	0.03	0.22	0.22
Item 6	0.80	0.55	0.35	0.28	0.27	0.65	0.65		0.01	0.33	0.27
Item 7	0.83	0.25	0.36	0.10	0.22	-0.01	0.03	0.01		0.43	0.29
Item 8	0.79	0.59	0.43	0.40	0.34	0.32	0.22	0.33	0.43		0.55
Item 9	0.80	0.51	0.47	0.40	0.21	0.24	0.22	0.27	0.29	0.55	

Table 3 Internal consistency of the Dutch Fremantle Back-Awareness Questionnaire in individuals without low back pain.

Control group	**Cronbach's alpha if item deleted**	**Item-total correlation**	**Inter-item correlation matrix**								
			Item 1	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**Item 8**	**Item 9**
Item 1	0.74	0.16		0.01	0.05	0.15	0.14	0.24	0.05	-0.11	-0.04
Item 2	0.73	0.19	0.01		0.21	0.18	0.17	0.14	0.09	0.06	0.05
Item 3	0.73	0.18	0.05	0.21		0.18	0.14	0.16	0.27	-0.06	-0.01
Item 4	0.58[a]	0.85	0.15	0.18	0.18		0.94	0.83	0.02	0.15	0.04
Item 5	0.58 [a]	0.85	0.14	0.17	0.14	0.94		0.82	0.01	0.15	0.08
Item 6	0.61 [a]	0.77	0.24	0.14	0.16	0.83	0.82		-0.06	0.04	0.01
Item 7	0.73	0.13	0.05	0.09	0.27	0.02	0.01	-0.06		0.37	0.48
Item 8	0.73	0.21	-0.11	0.06	-0.06	0.15	0.15	0.01	0.37		0.63
Item 9	0.74	0.11	-0.04	0.05	-0.01	0.04	0.08	0.01	0.48	0.63	

[a]cronbach's alpha value not reaching 0.70

APPENDIX 1: Dutch version of the Fremantle Back Awareness Questionnaire (Dutch FreBAQ)

Hieronder volgen enkele uitspraken van patiënten met lage rugpijn over hoe hun rug aanvoelt. Gelieve op onderstaande schaal aan te duiden in welke mate uw rug op de omschreven manier aanvoelt **wanneer u last heeft van rugpijn.**

0 = **Mijn rug voelt nooit zo aan**

1 = **Mijn rug voelt zelden zo aan**

2 = **Mijn rug voelt af en toe of soms zo aan**

3 = **Mijn rug voelt vaak of regelmatig zo aan**

4 = **Mijn rug voelt altijd of meestal zo aan**

	Nooit	**Zelden**	**Soms**	**Vaak**	**Altijd**
1. Het voelt aan alsof mijn rug geen onderdeel uitmaakt van de rest van mijn lichaam.	0	1	2	3	4
2. Ik moet al mijn aandacht op mijn rug richten om mijn rug te laten bewegen zoals ik wil.	0	1	2	3	4
3. Het voelt aan alsof mijn rug soms onvrijwillig beweegt, zonder dat ik hier controle over heb.	0	1	2	3	4
4. Ik weet **niet** hoe mijn rug beweegt tijdens dagdagelijkse activiteiten.	0	1	2	3	4
5. Ik weet **niet** zeker in welke houding mijn rug zich bevindt tijdens dagdagelijkse activiteiten.	0	1	2	3	4
6. Ik kan de exacte aflijning van mijn rug **niet** waarnemen.	0	1	2	3	4
7. Mijn rug voelt vergroot (gezwollen) aan.	0	1	2	3	4
8. Mijn rug voelt gekrompen aan.	0	1	2	3	4
9. Mijn rug voelt asymmetrisch aan.	0	1	2	3	4